IBM Tivoli Storage Manager Implementation Guide

Includes worksheets, scripts, and macros to make your job easier

See features for new and advanced users

Use this hands-on guide for planning and setup

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Note: Before using this information and the product it supports, read the information in “Notices” on page xxiii.

Fourth Edition (June 2006)

This edition applies to IBM Tivoli Storage Manager Version 5.3.2
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Preface

This IBM® Redbook describes how to integrate, install, configure, and operate the very latest IBM Tivoli® Storage Manager in heterogeneous environments.

You will learn how to implement and operate IBM Tivoli Storage Manager. You should have already a conceptual understanding of IBM Tivoli Storage Manager. We will show you how to set up and implement the software, covering basic and advanced topics for Windows®, AIX®, and Linux® based operating system platforms.

We demonstrate how to handle all of the important tasks necessary to protect your business: planning, client and server installation, operations, performance considerations, SAN environments, NDMP, and much more.

This practical guide is intended for these audiences: system administrators, new to IBM Tivoli Storage Manager, who are asked to commence a basic IBM Tivoli Storage Manager implementation for the very first time, as well as administrators who want to learn more about the basic and advanced components and their implementation. This book is also a very valuable resource if you are planning to become a certified IBM Tivoli Storage Manager consultant.

A companion redbook, IBM Tivoli Storage Management Concepts, SG24-4877, is available. It covers concepts, architecture, and systems management features of IBM Tivoli Storage Manager and shows complementary products available. That redbook would be a useful general introduction for people who have had no previous exposure to IBM Tivoli Storage Manager.

The team that wrote this redbook

This redbook was produced by a team of specialists from around the world working at the International Technical Support Organization, San Jose Center.

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Thanks to the following people for their contributions to this project:

Jason Basler and Ashish Agarwal developed and provided the chapter “Server-free data movement”.

Jennifer Davis developed and provided the sections “Using SysBack™ for bare machine recovery” and “Integrating SysBack for System Backup and Recovery with Tivoli Storage Manager”.

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Landzettel, Armando Lemos da Silva Filho, Rod MacLeod, Andy Pattinson, Patrick Randall, Holger Speh, Phil Thomas, and Roland Tretau.

Thanks to the following people for their invaluable contributions to this project:

Emma Jacobs, Deanna Polm, Sangam Racherla, <editor name>
International Technical Support Organization, San Jose Center

Betsy Colby, Mike Dile, Diana Duan, Rob Elder, Del Hoobler, Tricia Jiang, Holly King, Randy Larson, Len Ling, Zong Ling, Steven John Mann, Urs Moser, Charles Nichols, Kathy Pang, Brian Pendergrass, Rosa Plaza, Deanna Shaw, Jim Smith, John Viksne, Chris Zaremba
IBM Tivoli Storage Manager Development and Marketing, IBM US

Monika Doshi, Nicholas Wilhelm-Olsen, Chris Lueth
Network Appliance, Inc.

Figure 0-1   The team: Eduardo, Martin, Peter, Charlotte, and Norbert
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Part 1

Introduction

The objective of this redbook is to provide material describing how to implement and operate IBM Tivoli Storage Manager Version 5.3.2. We assume a basic knowledge of IBM Tivoli Storage Manager, which you can gain by reading the companion redbook, IBM Tivoli Storage Management Concepts, SG24-4877.

This redbook is not designed to be a follow-along implementation guide that will install, configure, and implement IBM Tivoli Storage Manager in your environment. Rather, the book is designed to provide you with step-by-step instructions and examples that you can follow when you design and implement your solution in your specific environment with your business policies and needs.

A successful implementation of IBM Tivoli Storage Manager benefits enormously from planning prior to attempting to set up the environment. The planning for what equipment is needed — such as hardware platform, size of processor, network connectively, and tape library — should all have been done before trying to make IBM Tivoli Storage Manager work in an environment which may not be suitable.
Implementation checklists

In this chapter we offer an overview of the IBM Tivoli Storage Manager environment described in our redbook, as well as implementation checklists for planning, installing, and operating that environment.

Our environment provides an integrated solution that incorporates client and server options, basic performance recommendations, and operational processes. In our experience, this environment has been shown to satisfy the most common customer requirements while also forming a sound basis for extension.

The checklists provide step-by-step processes to plan and implement an IBM Tivoli Storage Manager environment. Although geared towards our redbook environment, the checklists can be used for any implementation. There are separate checklists for planning the environment, server implementation, client implementation, and daily operations.

We have provided planning sheets, option files, and administrative macros to help plan and implement your IBM Tivoli Storage Manager environment. Appendix A, “Planning and sizing worksheets” on page 727 and Appendix B, “Redbook support material — macros and scripts” on page 733 provide copies of those materials.
1.1 The big picture

Any Tivoli Storage Manager solution consists of a number of pieces that are crafted to satisfy a particular set of requirements. These solution pieces include definitions for data storage management, policy management, user management, and operational management.

The difficulty is in determining how to craft each of these pieces to complete the solution jigsaw puzzle. This is complicated by the vast number of options and variations that are possible with Tivoli Storage Manager.

This redbook is not designed to be a follow-along implementation guide that will actually install, configure, and implement Tivoli Storage Manager in your environment. Rather, the book is designed to provide you with step-by-step instructions and examples that you can follow when you design and implement your solution in your specific environment with your business policies and needs.

We have developed a functional Tivoli Storage Manager environment which has been shown to satisfy a number of key customer requirements. Those key requirements are:

- Multiple backup copies of files to be kept
- Second copy of backup data to be kept offsite
- Restore time to be minimized
- High level of automation

Our environment also incorporates basic performance tuning recommendations and operational procedures for onsite-offsite tape movement. It forms a sound platform for future development.

Figure 1-1 shows the data storage management perspective of our Tivoli Storage Manager environment. The figure shows the flow of data to and from the onsite storage pools and offsite copy pools. Some key features of this environment are:

- Separate storage pools for client directory information and client data
- Client data written to a disk storage pool, then migrated to tape storage pool
- Duplicate copies of onsite data created for offsite storage
- Mirrored Tivoli Storage Manager database and recovery log
The two primary disk storage pools hold client directory information (DISKDIRS) and client data (DISKDATA). The remaining storage pool (TAPEDATA) is on tape and holds only client data. A copy of the client data is stored in one offsite storage pool (OFFDATA), and a copy of the client directory data is stored in another storage pool (OFFDIRS).

1.1.1 Our redbook support material

We provide worksheets, option files, and administrative macros to help plan and implement your Tivoli Storage Manager environment.

The worksheets are used during the planning phase of a Tivoli Storage Manager implementation, which we use and discuss in Chapter 2, “Implementation planning” on page 15.
The option files provided are examples for customizing your Tivoli Storage Manager server and clients. If you want to use them in your implementation, you need to modify the example files to fit into your environment, and replace the existing options files with these.

The administrative macros are used to reduce some steps in your Tivoli Storage Manager implementation. Again, you need to modify some of the macros to meet specific requirements in your Tivoli Storage Manager environment.

The redbook support material is available in softcopy on the Internet from the redbooks Web server. Point your Web browser to:

ftp://www.redbooks.ibm.com/redbooks/SG245416

Alternatively, you can get to the same Web page at:


Select Additional Materials and click the suggested link.

We provide two files. Each file contains all the support material in compressed format. The UNIX platform file is named sg245416.tar, and the Windows platform file is named sg245416.zip.

Table 1-1 lists the contents of the support material from those files.

<table>
<thead>
<tr>
<th>File name</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>dsmopt.aix</td>
<td>Client user options file for AIX</td>
</tr>
<tr>
<td>dsmopt.nw</td>
<td>Client options file for NetWare</td>
</tr>
<tr>
<td>dsmopt.win</td>
<td>Client options file for Windows</td>
</tr>
<tr>
<td>dsmserv.aix</td>
<td>Server options file for AIX</td>
</tr>
<tr>
<td>dsmserv.mvs</td>
<td>Server options file for MVS™</td>
</tr>
<tr>
<td>dsmserv.win</td>
<td>Server options file for Windows NT/2000</td>
</tr>
<tr>
<td>dsmsys.aix</td>
<td>Client system options file for AIX</td>
</tr>
<tr>
<td>mac.admins</td>
<td>Administrative macro to define administrators</td>
</tr>
<tr>
<td>mac.optionsets</td>
<td>Administrative macro to define client option sets</td>
</tr>
<tr>
<td>mac.schedules</td>
<td>Administrative macro to define administrative and client schedules</td>
</tr>
<tr>
<td>mac.scripts</td>
<td>Administrative macro to define server scripts</td>
</tr>
</tbody>
</table>
We recommend that you download the support material files into a separate directory on a system from which you can run an administrative command client. In our experience, the implementation works best when you choose a UNIX or Windows platform for that system.

### 1.2 Planning checklist

Proper planning for your Tivoli Storage Manager environment is critical to the success of the implementation. This cannot be stressed enough. Plan first, verify the plan, then execute the plan.

The tasks contained in the Tivoli Storage Manager planning checklist are shown in Table 1-2. You should complete all these tasks before implementing the Tivoli Storage Manager environment.

<table>
<thead>
<tr>
<th>File name</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>mac.stgcreate</td>
<td>Administrative macro to create storage pools</td>
</tr>
<tr>
<td>mac.stgdelete</td>
<td>Administrative macro to delete default storage pools</td>
</tr>
<tr>
<td>mac.policy</td>
<td>Administrative macro to define policy domains, policy sets, management</td>
</tr>
<tr>
<td></td>
<td>classes, and copy groups.</td>
</tr>
<tr>
<td>planning.123</td>
<td>Planning spreadsheets (Lotus® 123 format)</td>
</tr>
<tr>
<td>plan_sampledata.123</td>
<td>Planning spreadsheets (Lotus 123 format) with some sample data</td>
</tr>
<tr>
<td>planning.xls</td>
<td>Planning spreadsheets (Microsoft® Excel® format)</td>
</tr>
<tr>
<td>plan_sampledata.xls</td>
<td>Planning spreadsheets (Microsoft Excel format) with some sample data</td>
</tr>
<tr>
<td>readme.1st</td>
<td>Contents of support materials</td>
</tr>
</tbody>
</table>

We recommend that you download the support material files into a separate directory on a system from which you can run an administrative command client. In our experience, the implementation works best when you choose a UNIX or Windows platform for that system.

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<table>
<thead>
<tr>
<th>Tasks</th>
<th>Refer to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Download redbook support materials</td>
<td>Table 1-1, “Redbook support material” on page 6</td>
</tr>
<tr>
<td>Complete client requirements worksheet</td>
<td>2.2, “Client environment data” on page 16</td>
</tr>
<tr>
<td>Complete data retention worksheet</td>
<td>2.3, “Data retention requirements” on page 25</td>
</tr>
</tbody>
</table>
1.2.1 Server implementation checklist

The server checklist identifies those tasks you must complete to set up the redbook Tivoli Storage Manager server environment. The tasks contained in the checklist are shown in Table 1-3. These tasks are performed by either the system administrator or Tivoli Storage Manager administrator.

The checklist consists of a series of tasks which must be performed sequentially. Each task in the table has a reference to another section in this redbook. The referred section contains the specific details on how to complete that task. For some tasks, we additionally refer to the macro file we provide, as described in 1.1.1, “Our redbook support material” on page 5.

Table 1-3 Server implementation checklist

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Refer to:</th>
<th>Macro</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choose server platform</td>
<td>2.4, “Server architecture considerations” on page 29</td>
<td></td>
</tr>
<tr>
<td>Size Tivoli Storage Manager server</td>
<td>2.5, “System size” on page 32</td>
<td></td>
</tr>
<tr>
<td>Determine network load</td>
<td>Table 2-8 on page 36</td>
<td></td>
</tr>
<tr>
<td>Complete Tivoli Storage Manager database worksheet</td>
<td>Table 2-9 on page 42</td>
<td></td>
</tr>
<tr>
<td>Complete Tivoli Storage Manager recovery log worksheet</td>
<td>Table 2-10 on page 43</td>
<td></td>
</tr>
<tr>
<td>Complete Tivoli Storage Manager storage pool worksheet</td>
<td>Table 2-11 on page 46</td>
<td></td>
</tr>
<tr>
<td>Complete Tivoli Storage Manager disk worksheet</td>
<td>Table 2-13 on page 48</td>
<td></td>
</tr>
<tr>
<td>Determine tape library</td>
<td>2.9.2, “Tape libraries” on page 50</td>
<td></td>
</tr>
<tr>
<td>Determine number of tape drives</td>
<td>Table 2-15 on page 50</td>
<td></td>
</tr>
<tr>
<td>Determine number of tape volumes</td>
<td>2.10.1, “Onsite volumes” on page 52 and 2.10.2, “Offsite volumes” on page 54</td>
<td></td>
</tr>
<tr>
<td>Complete administrator worksheet</td>
<td>Table 2-16 on page 57</td>
<td></td>
</tr>
<tr>
<td>Tasks</td>
<td>Refer to:</td>
<td>Macro</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Update server options file</td>
<td>3.7.1, “Options file” on page 88</td>
<td></td>
</tr>
<tr>
<td>Create database volumes</td>
<td>5.1, “Database” on page 178</td>
<td></td>
</tr>
<tr>
<td>Create recovery log volumes</td>
<td>5.2, “Recovery log” on page 182</td>
<td></td>
</tr>
<tr>
<td>Mirror database</td>
<td>5.6.1, “Database mirroring” on page 195</td>
<td></td>
</tr>
<tr>
<td>Mirror recovery log</td>
<td>5.6.2, “Recovery log mirroring” on page 196</td>
<td></td>
</tr>
<tr>
<td>Remove default database volumes</td>
<td>5.7.1, “Removing the default database volume” on page 197</td>
<td></td>
</tr>
<tr>
<td>Remove default recovery log volumes</td>
<td>5.7.2, “Removing the default recovery log volume” on page 199</td>
<td></td>
</tr>
<tr>
<td>Set up server licensing</td>
<td>9.2, “Registering licensed features” on page 293</td>
<td></td>
</tr>
<tr>
<td>Define tape libraries</td>
<td>6.2.1, “Defining a library” on page 210</td>
<td></td>
</tr>
<tr>
<td>Define a library path</td>
<td>6.2.4, “Defining a path to a drive in a library” on page 214</td>
<td></td>
</tr>
<tr>
<td>Define tape drives</td>
<td>6.2.3, “Defining a drive in a library” on page 213</td>
<td></td>
</tr>
<tr>
<td>Define tape path</td>
<td>6.2.4, “Defining a path to a drive in a library” on page 214</td>
<td></td>
</tr>
<tr>
<td>Tasks</td>
<td>Refer to:</td>
<td>Macro</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Define device classes</td>
<td>6.2.5, “Defining a device class for a library” on page 216</td>
<td></td>
</tr>
<tr>
<td>Change server run-time settings</td>
<td>3.7, “Customization” on page 88</td>
<td></td>
</tr>
<tr>
<td>Define storage pools</td>
<td>6.3, “Storage pools” on page 219</td>
<td>stgcreate</td>
</tr>
<tr>
<td>Define storage pool volumes</td>
<td>6.4, “Storage pool volumes” on page 227</td>
<td></td>
</tr>
<tr>
<td>Remove default storage pools</td>
<td>6.3.5, “Deleting the default storage pools” on page 226</td>
<td>stgdelete</td>
</tr>
<tr>
<td>Define policy domains</td>
<td>7.1.1, “Defining policy domains” on page 259</td>
<td>policy</td>
</tr>
<tr>
<td>Define policy sets</td>
<td>7.1.2, “Defining policy sets” on page 260</td>
<td>policy</td>
</tr>
<tr>
<td>Define management classes</td>
<td>7.1.3, “Defining management classes” on page 260</td>
<td>policy</td>
</tr>
<tr>
<td>Define backup copy groups</td>
<td>7.1.4, “Defining backup copy groups” on page 262</td>
<td>policy</td>
</tr>
<tr>
<td>Define archive copy groups</td>
<td>7.1.5, “Defining the archive copy group” on page 264</td>
<td>policy</td>
</tr>
<tr>
<td>Activate new policy</td>
<td>7.3.2, “Activating the recommended policy sets” on page 267</td>
<td></td>
</tr>
<tr>
<td>Remove default policy management definitions</td>
<td>7.3.3, “Deleting the STANDARD policy domain” on page 267</td>
<td></td>
</tr>
<tr>
<td>Define administrator IDs</td>
<td>8.1, “Management” on page 272</td>
<td>admins</td>
</tr>
<tr>
<td>Define administrative schedules</td>
<td>12.2, “Administrative schedules” on page 362</td>
<td>schedules</td>
</tr>
<tr>
<td>Define client schedules</td>
<td>12.3, “Client schedules” on page 374</td>
<td>schedules</td>
</tr>
</tbody>
</table>
1.2.2 **Client implementation checklist**

The client implementation checklist consists of two parts that identify those tasks you must complete to set up the redbook Tivoli Storage Manager client environment. The tasks contained in the checklists are shown in Table 1-4 and Table 1-5 on page 12.

Each checklist consists of a series of tasks which must be performed sequentially. Each task in the table has a reference to another section in this redbook. The referred section contains the specific details on how to complete that task.

The first checklist consists of tasks performed at the Tivoli Storage Manager server. These tasks are performed by the Tivoli Storage Manager administrator.

*Table 1-4  Client implementation checklist: server tasks*

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Refer to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create client option sets</td>
<td>8.3, &quot;Client option sets” on page 286</td>
</tr>
<tr>
<td>Register client node</td>
<td>“Registering a client node” on page 280</td>
</tr>
<tr>
<td>Associate client nodes with schedules</td>
<td>12.3.3, “Associating a client with a schedule” on page 378</td>
</tr>
<tr>
<td>Associate client nodes with client option set</td>
<td>8.3.5, “Associating a client node with a client option set” on page 288</td>
</tr>
<tr>
<td>Grant authority for Web client access</td>
<td>“Web client” on page 173</td>
</tr>
<tr>
<td>Define event logging</td>
<td>13.3, “Event monitoring” on page 390</td>
</tr>
</tbody>
</table>

The second checklist consists of tasks performed at the Tivoli Storage Manager client. These tasks are performed by the administrator of that client system.
1.2.3 Operations checklist

The operations checklist consists of those tasks you should complete on a daily basis. The tasks contained in the checklist are shown in Table 1-6. Each task in the table has a reference to another section in this redbook. The referred section contains the specific details on how to complete that task. This checklist does not include the tasks we recommend scheduling on a daily basis. See Chapter 13, “Routine tasks” on page 381 for more information on scheduled operations.

Table 1-6  Daily operations checklist

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Refer to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check completion of client and administrative events</td>
<td>13.6.2, “Client-server activity” on page 406</td>
</tr>
<tr>
<td>Bring free offsite volumes back to onsite</td>
<td>13.7.5, “Off-site tape management to on-site” on page 423</td>
</tr>
<tr>
<td>Send copy tapes to offsite location</td>
<td>13.7.3, “On-site and off-site tape management” on page 414</td>
</tr>
</tbody>
</table>
1.3 Summary

In conclusion, we have discussed and given you access to many checklists, and now it's time to move into the actual planning details, architectural considerations, environments, and our recommendations.
Implementation planning

A successful implementation of IBM Tivoli Storage Manager benefits enormously from planning prior to attempting to set up the environment. We have just discussed the checklists you can use, and now we will head into the planning stage. Choice of equipment, such as hardware platform, size of processor, network connectivity and tape library, should all have been done prior to trying to make IBM Tivoli Storage Manager work in an environment that may not be suitable.
2.1 Planning

Understanding your customers, your environment, your business, your needs, and your requirements are key to success, in storage management as well as business in general. Tivoli Storage Manager can help with your storage management needs and requirements. You will need three things to achieve success:

► Realistic goals and objectives
► Understanding
► Planning

In this chapter, as well as in the redbook, *IBM Tivoli Storage Management Concepts*, SG24-4877, we present a number of planning worksheets that lead you through gathering the client requirements and the data retention requirements in an orderly way. We assume you are somewhat familiar with IBM Tivoli Storage Management Concepts and terms.

We provide planning sheets, option files, server scripts, and administrative macros to help plan and implement your Tivoli Storage Manager environment. Blank worksheets are provided in Appendix A, “Planning and sizing worksheets” on page 727. Appendix B, “Redbook support material — macros and scripts” on page 733 contains information about how to download those support materials and what those materials provide.

2.2 Client environment data

Tivoli Storage Manager exists to provide services to clients, so it makes sense to begin by gathering data about the client environment. A Tivoli Storage Manager client is the machine from which Tivoli Storage Manager backs up or archives data. It could be various types of workstation, laptop computer, file server, database, or application server. Even though you may know the machine as a server, to Tivoli Storage Manager it is considered a client. The Tivoli Storage Manager server refers to the machine where the Tivoli Storage Manager server code runs. The Tivoli Storage Manager server stores and manages all the data backed up from clients.

**Note:** For UNIX and Windows clients, Tivoli Storage Manager offers an extra level of protection called Logical Volume Backup. We will be using the term Image Backup and Logical Volume Backup interchangeably throughout the book to refer to this feature.
At this point, it is very important that you consider your backup and restore requirements, so that you can match the Tivoli Storage Manager features to your needs. Since statistics show that the majority of user restore requests are for single files or other small amounts of data, the Tivoli Storage Manager file-level backup is the foundation of any recover strategy. However, there are additional methods to cover your data restore requirements more completely.

Tivoli Storage Manager provides the following backup methods:

- **File-level backup**: Good for small and ad-hoc file or directory restores, but may not be the optimal solution for large-volume restores.

- **Logical volume backup**: Good for large full restores, but only available on UNIX and not for single file restores.

- **Backup sets**: Good for remote and/or portable restores.

Figure 2-1 shows some possible generic scenarios. Of course, you can combine those in different ways to fit your own requirements.

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**Integrated backup/restore scenarios**

1. Progressive incremental backup and archive function
   - File-level granularity of restore

2. Logical volume backup (UNIX)
   - Restore of raw devices and full logical volumes

3. Progressive incremental + periodical image backup
   - Fast restore in case of disaster recovery scenario
   - Unique command to restore at the point in time

Backup sets
- Portable, Lan-free restore

---

**Figure 2-1  Tivoli Storage Manager backup/restore scenarios**

Due to the nature and complexity of customer environments and requirements, our planning description will give the building blocks for your own environment definition. The tables and calculations take into account the backup, archive,
image and backup set requirements that should be suitable for a real-life situation. In any case, you must evaluate if all such requirements are really important in your case and decide whether or not to implement them.

Complete Table 2-1 using a column for data from each client being considered for this Tivoli Storage Manager implementation. Analyzing client data helps you make decisions about the Tivoli Storage Manager server environment. The information collected in the table is used for node definitions and for calculating database, recovery log, and storage pool sizes.

This table is presented in a portrait orientation in the book due to space considerations. If you have a large number of nodes or use a spreadsheet version, you may find the table more workable by transposing it to a landscape orientation.

<table>
<thead>
<tr>
<th></th>
<th><strong>Client Type 1</strong></th>
<th><strong>Client Type 2</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Client Type</strong></td>
<td><strong>Workstation</strong></td>
<td><strong>Database server</strong></td>
</tr>
<tr>
<td><strong>Number of similar clients</strong></td>
<td>20</td>
<td>4</td>
</tr>
<tr>
<td><strong>ClientName</strong></td>
<td>WORKSTN1..20</td>
<td>DBSERV1..4</td>
</tr>
<tr>
<td><strong>Contact Information</strong></td>
<td>John at x1645</td>
<td>Nick at x3761</td>
</tr>
<tr>
<td></td>
<td>Remote Users</td>
<td>UNIX and AIX</td>
</tr>
<tr>
<td><strong>Operating system</strong></td>
<td>Windows XP</td>
<td>UNIX Servers</td>
</tr>
<tr>
<td><strong>Total storage available (GB)</strong></td>
<td>80</td>
<td>150</td>
</tr>
<tr>
<td><strong>Total storage used (GB)</strong></td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td><strong>Total data changed per backup (GB)</strong></td>
<td>6 = 10%</td>
<td>100 = 100%</td>
</tr>
<tr>
<td><strong>Number of files or total GB to be backed up</strong></td>
<td>3,000 * 20 = 60,000</td>
<td>2,000 * 4 = 8,000</td>
</tr>
<tr>
<td><strong>Number of backup versions to be kept</strong></td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td><strong>Data compression</strong></td>
<td>.5</td>
<td>.66</td>
</tr>
<tr>
<td><strong>Backup window times</strong></td>
<td>17:00 - 23:00</td>
<td>22:00 - 04:00</td>
</tr>
<tr>
<td><strong>Number of hours to complete backups</strong></td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total recovery time frame per server</strong></td>
<td>48 hours</td>
<td>8 hours</td>
</tr>
<tr>
<td><strong>Tivoli Storage Manager restore time</strong></td>
<td>24 hours</td>
<td>4 hours</td>
</tr>
<tr>
<td><strong>Average GB copied per archive</strong></td>
<td>10 * 20 = 200</td>
<td>4 * 20 = 80</td>
</tr>
</tbody>
</table>
### Client name
Enter the name Tivoli Storage Manager will use for each client. Each name must be unique. We recommend using the hostname for the Tivoli Storage Manager client name, so various groups such as Help Desk personnel or end users can easily correlate the client node to the Tivoli Storage Manager name without having to look in a translation table.

By allowing the Tivoli Storage Manager client name to default to the machine name on Windows clients, you can roll out a standard Tivoli Storage Manager options file to numerous clients automatically without having to modify the options file for each client.

### Contact information
Enter information identifying the contact person or group responsible for this client. This should be the person who knows the data structure and applications which run on these servers.

### Operating system
Identify the operating system and level the client is using. Any clients using operating systems not supported by Tivoli Storage Manager will have to be handled separately.

<table>
<thead>
<tr>
<th></th>
<th>Client Type1 Workstation</th>
<th>Client Type 2 Database server</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of files archived</td>
<td>4,000 * 20 = 80,000</td>
<td>3,000 * 4 = 12,000</td>
</tr>
<tr>
<td>Number of Archives kept</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Archive frequency</td>
<td>Monthly</td>
<td>Monthly</td>
</tr>
<tr>
<td>Archive window times</td>
<td>Monthly</td>
<td>Month end</td>
</tr>
<tr>
<td>Archive number of hours</td>
<td>24 hours</td>
<td>24 hours</td>
</tr>
<tr>
<td>Number of image backups</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>Image backup frequency</td>
<td>N/A</td>
<td>Monthly</td>
</tr>
<tr>
<td>Number of backup sets</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Backup set frequency</td>
<td>Monthly</td>
<td>Bi-monthly</td>
</tr>
<tr>
<td>Policy domain</td>
<td>Workstation</td>
<td>UNIX</td>
</tr>
<tr>
<td>Client option set</td>
<td>Windows</td>
<td>AIX</td>
</tr>
</tbody>
</table>
**Total storage available**
Calculate the total amount of usable disk storage in GB available on the client. This number is the amount of disk storage seen by the client file system and does not contain the actual amount installed and used by a RAID or mirroring implementation.

**Total storage used**
Calculate the total amount of disk storage in GB currently in use or expected to be used on the client. If this number is unknown, use the Total storage available from above.

**GB changed per backup**
Calculate the amount of storage, data, or files changed between backup cycles. This value indicates how long the client will be busy backing up, and how robust a network is required to complete all the backups each backup cycle. It is used to estimate disk and tape storage requirements on the Tivoli Storage Manager server. Table 2-2 presents some typical percentages of data changed for various sizes and types of data.

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Percentage of data changed (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large, busy file server</td>
<td>10</td>
</tr>
<tr>
<td>Smaller, less busy file server</td>
<td>5</td>
</tr>
<tr>
<td>Workstation</td>
<td>1</td>
</tr>
<tr>
<td>Database using utilities or Tivoli Storage Manager for Databases</td>
<td>10-20</td>
</tr>
<tr>
<td>Database not using utilities or Tivoli Storage Manager for Databases</td>
<td>100</td>
</tr>
</tbody>
</table>

If your data change percentage is known, then enter that number in the worksheet. Otherwise, use Table 2-2 to estimate a rate, keeping in mind that your numbers may vary. A high estimate is better than one that is too low.

**Number of files backed up**
Calculate the total number of files to be backed up for each client. It is used to estimate disk and tape storage requirements on the Tivoli Storage Manager server.
If the number of files is unknown, two values are possible. Enter either an estimate of the number of files in this field, or enter 10% of the Total Storage Used field, in GB.

**Number of backup versions to be kept**

Determine the number of changed copies that you want to keep of a file that exists on the client when the backup task runs. How many different versions of that file do you want to be able to restore? For example, if backup runs every night and a file changes every day, and you want to be able to restore any version up to one week ago, then you would choose 7 as the number of backups to keep. Remember that the more versions you choose to keep, the more database and storage pool space you will need to configure.

**Data compression**

Estimate a data compression rate. To do that, you must first decide whether to use data compression on the client.

Tivoli Storage Manager allows a client to compress data before sending it to the Tivoli Storage Manager server. To decide whether to use Tivoli Storage Manager compression, take into account the speed of your network, the speed of the client CPU, and whether the Tivoli Storage Manager server storage devices are capable of compression. Table 2-3 provides some criteria for selecting data compression.

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Compression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dial-up connection</td>
<td>Yes</td>
</tr>
<tr>
<td>Your network is approaching capacity</td>
<td>Yes</td>
</tr>
<tr>
<td>High-speed data network</td>
<td>No</td>
</tr>
<tr>
<td>Slower CPUs in clients</td>
<td>No</td>
</tr>
<tr>
<td>Faster CPUs in clients</td>
<td>Yes</td>
</tr>
<tr>
<td>No hardware compression on tape devices</td>
<td>Yes</td>
</tr>
<tr>
<td>Small capacity or slow response storage devices</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Compression takes time, so you need to decide whether the compression is helping or hurting the total elapsed time of your operation. In general, very high speed networks do not benefit as much from compression because network bandwidth is usually not saturated. Conversely, older client CPU models may run slowly because the CPU cannot compress data fast enough to keep the network connection busy.
Many sites have various combinations of these configurations, such as slow networks, slow CPUs and small/slow devices. In this case, make a judgement call about using Tivoli Storage Manager compression. Performing tests may show you the most efficient mode for your environment.

Data compresses to varying degrees depending on the content of the files. Data composed of text, or many repeated characters like blanks, compresses well. Data that is already compressed, and data consisting of random characters like executables does not compress well, and may actually grow.

If you decide to use compression, enter your data reduction rate. Use Table 2-4 to estimate the data reduction if your actual ratio is unknown, but the best advice is to make some tests on your actual data.

If you decide not to use compression, or are unsure whether to use compression, enter one (no compression) in the Data Compression field.

If you do not use client compression and your tape device has a hardware compression capability, then the data will still end up compressed when it reaches a tape volume. If you do use client compression, then you should disable any hardware compression capability on your tape devices, since data in general cannot be “doubly compressed”.

### Table 2-4 Typical data compression ratios

<table>
<thead>
<tr>
<th></th>
<th>Compression ratio</th>
<th>Data reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Database data</td>
<td>3:1 - 4:1</td>
<td>0.66 - 0.75</td>
</tr>
<tr>
<td>Print and file server data</td>
<td>2:1</td>
<td>0.5</td>
</tr>
<tr>
<td>Executables, compressed data, encrypted data</td>
<td>1:1</td>
<td>1</td>
</tr>
</tbody>
</table>

**Backup window times**

Enter the times of the day between which Tivoli Storage Manager must start and complete its backup cycle. This window depends on when end-user client usage drops off, by availability requirements, and by network capacity usage time frames.

**Backup number of hours**

Calculate the number of hours in the backup window.

**Required recovery time frame**

Identify the time frame in hours, which you have agreed to with the customer, to recover a client completely. This is the time from when the data is lost, to the time
the data is usable again. It includes the time to fix or replace the machine and the
time to restore the data.

Recovery time frames are vitally important, as this is the whole reason you are
backing up.

This field documents your service level agreement with the customer.

**Tivoli Storage Manager restore time frame**
Calculate the time frame, in hours, allotted to Tivoli Storage Manager to restore
(possibly all) the data to the client. This number is used to size factors affecting
the restore process such as network throughput and the number of tape drives
required.

To calculate the Tivoli Storage Manager Restore Time Frame, subtract from the
Required Restore Time Frame, above, the maximum time required to prepare the
client machine for a restore. In reality, this number will vary, depending upon the
complexity of the restore. In the worst case (a disaster), the time to prepare the
machine may include contacting support, fixing or replacing the machine,
installing an operating system, installing the Tivoli Storage Manager client code,
and connecting to the network. In the best case (to simply recover deleted data),
the time to prepare the machine may be the same as the Required Restore Time
Frame.

A full Tivoli Storage Manager restore typically takes significantly more time than a
full Tivoli Storage Manager backup. We have observed restore times of 110% or
more over a full file-level backup.

**GB copied per archive**
Calculate or estimate the amount of data to be archived during each archive
session. Archives target specific data files. Typically, you do not archive whole
systems.

**Number of files archived**
Calculate or estimate the number of files archived in each archive session. You
can calculate this number by using an operating system utility to verify the size of
a directory tree or an entire filesystem.

**Number of archives kept**
Identify how many archives will be kept. For example, if an archive is performed
monthly, you may want to keep 12 copies of that archive. Note that this number is
basically influenced by the retention period for that archive, since archives, unlike
backups, do not have versions which expire.
**Archive frequency**
Determine how often you want to perform an archive function. Archives are typically run less frequently than incremental backups. Time frames such as monthly or yearly are common.

**Archive window times**
Enter the times between which Tivoli Storage Manager must start and complete its archive cycle for this client. This window is influenced by when end-user client usage drops off, by availability requirements, by network capacity usage time frames, or by when the data becomes available for archive.

Archive time frames may be less time sensitive than incremental backups if they are going against copies of data or against data already processed. Often it is not possible to automatically schedule this archive function using Tivoli Storage Manager schedules, due to the dependency on other events external to Tivoli Storage Manager.

This number may be a specific time frame, such as between 23:00 and 04:00, or a more general time frame, such as after month-end processing finishes.

**Archive number of hours**
Identify the number of hours available to complete the archive function.

**Number of image backups**
Identify the number of eligible system images that you want to back up. For a workstation that doesn’t change very frequently, a good number could be six to twelve per machine.

**Image backup frequency**
Identify how often you want to perform image backups. A good standard will be on a monthly basis for less critical and static machines, with more frequent backups for more critical and dynamic machines.

**Number of backup sets**
Determine the number of backup sets that you want to create. This number must be balanced against your full recovery time and the change rate for data. Consider a more frequent backup set for large file systems.

**Backup set frequency**
Determine how often you will need to generate a backup set. Although a backup set is made of client data, it is a server initiated process which will require some scratch tapes in the automated library or some guidelines for the operations team to run.
**Policy domain**

Leave this field blank. During the planning phase, this is unknown. We use this field later in “Server implementation checklist” to contain the policy domain chosen for this client. For example, if you are implementing our redbook configuration, the policy domains would be SERVER or WORKSTN.

For more information on policy domains, see Chapter 7, “Data storage policies” on page 257.

**Client option set**

Leave this field blank. During the planning phase, this is unknown. We use this field later in “Client implementation checklist” to contain the client option set chosen for this client. For example, if you are implementing our redbook configuration, the client options set names would be AIX or WINDOWS or NETWARE.

For more information on client option sets, see 8.3, “Client option sets” on page 286.

### 2.3 Data retention requirements

In this section we identify the requirements for managing the data received from the clients. Categorize your data into a small number of groups with similar requirements. This table provides information to create copy groups under Management Classes in Tivoli Storage Manager, to calculate storage pool sizes, and to calculate the number of tapes required to hold the data.

Complete a column in Table 2-5 for each different group. We show two example groups.

<table>
<thead>
<tr>
<th>Table 2-5   Storage policy requirement worksheet</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group name</strong></td>
</tr>
<tr>
<td>Workstn</td>
</tr>
<tr>
<td>Number of backup versions</td>
</tr>
<tr>
<td>Backup file retention period</td>
</tr>
<tr>
<td>Number of deleted versions</td>
</tr>
<tr>
<td>Last deleted file version retention period</td>
</tr>
<tr>
<td>Archive retention period</td>
</tr>
<tr>
<td>Offsite copies</td>
</tr>
</tbody>
</table>
Group name
Choose a descriptive name for each different categorized group of data. In our example, the Workstn group is used for files from a workstation, while the Server group is used for all data from a large file server.

Number of backup versions
Determine the number of changed copies that you want to keep of a file that exists on the client when the backup task runs. How many different versions of that file do you want to be able to restore? For example, if backup runs every night and a file changes every day, and you want to be able to restore any version up to one week ago, then you would choose 7 as the number of backups to keep.

You will use the field Number of Backup Versions as a basis to group your data storage requirements into management classes.

Backup file retention period
Determine the number of days you want to keep a backup version of a file (other than the current version). There are two options: keep the backup version for a set number of days; or specify NOLIMIT, which implies that you want Tivoli Storage Manager to retain all backup versions, other than the most recent version, indefinitely (the most recent active version is already stored indefinitely by default).

Number of deleted versions
Determine how many versions of a file to keep after the file has been deleted from the original file system. This parameter comes into force during the first backup cycle after the file has been deleted. For example, assume you are keeping seven versions of a file as specified above, and you have set this parameter to one. When the next backup cycle runs after the file has been deleted off the client, Tivoli Storage Manager will flag the six oldest backup versions of the file for deletion and just keep the most current backup version.

Last deleted file version retention period
Determine the number of days you want to keep the last backup version of a file after it has been deleted from the client. There are two options: keep the last

<table>
<thead>
<tr>
<th></th>
<th>Example 1</th>
<th>Example 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onsite collocation</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Offsite collocation</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Image backup retention</td>
<td>30 days</td>
<td>30 days</td>
</tr>
<tr>
<td>Backup set retention</td>
<td>180 days</td>
<td>60 days</td>
</tr>
</tbody>
</table>

Example 1  Example 2
backup version for a set number of days; or NOLIMIT, which implies that you want to keep the backup version indefinitely.

For example, if you are keeping one version of a deleted file, and you set this parameter to 60, then 60 days after this file is noticed by Tivoli Storage Manager as being deleted from the client file system, the one remaining backup version will be deleted from Tivoli Storage Manager.

**Archive retention period**
Determine how long you want to keep a file that is archived. Many sites set up a limited number of data groups with standard archive retention periods, such as seven days, 31 days, 180 days, 365 days, or seven years. Nonstandard requests for archive retention periods are slotted into the next larger retention period group. This reduces management complexity at the expense of keeping some data longer than actually required. If every nonstandard request is honored, the number of groups quickly becomes unmanageable. On the other hand, you can use the backup set feature to retain all nonstandard backup requirements, or even just use backup sets instead of archive.

**Offsite copies**
Determine if you want to send a copy of the data offsite. Copying data to a removable device like tape allows the data to be taken offsite. An offsite copy along with other procedures provides recoverability in the event that the Tivoli Storage Manager server becomes unusable, or that data on the Tivoli Storage Manager server becomes corrupted.

Enter Yes to use offsite copies or No to not use offsite copies.

**Onsite collocation**
Determine if you want to use onsite collocation.

Tivoli Storage Manager uses collocation to dedicate as few tapes as required to hold all of one client’s files. Collocation reduces elapsed time for multiple file restores and full client restores at the expense of using more tapes, potentially increasing backup times and increasing Tivoli Storage Manager management time for migration and for storage pool copies.

Collocating by client allows as many clients to be restored simultaneously as you have tape drives. If you have stringent restore requirements and sufficient tape drives, then collocation makes good sense.

Table 2-6 highlights some factors affecting whether to use collocation.
Tivoli Storage Manager implementations that are small (small number of clients managing a small amount of data) do not see much benefit from collocation, due to the small number of tapes required for any restore. Large Tivoli Storage Manager implementations often collocate both onsite and offsite files due to the amount of data required for the restore of a client.

Tape drive capacity is a consideration for collocation. To use the minimum number of tapes, each tape must be used to its maximum capacity. Smaller capacity tapes will tend to fill completely even with small clients. In this case, collocation may be useful. With large capacity tape devices and collocation, a small client may not be able to fill a tape. With a large number of clients, significant numbers of tape volumes may be required.

**Offsite collocation**
Determine if you want to use offsite collocation.

**Image backup retention**
Determine how long you want to keep an image backup. Consider your restore time frame and balance the criticality of a full filespace restore, compared with single or a small number of files. Image backups can be very useful for quick restore of large file systems. However, this process will take longer, depending on how many changes there have been to the file system since the last image backup. A rule of thumb would be to keep at least one weekly image for small servers and a monthly image for bigger servers (or more frequently if change rates in the file system are high).

**Backup set retention**
A backup set execution creates a copy of the client node's previously backed up active files and stores them on sequential media. This has an impact on the

---

**Table 2-6  Factors affecting collocation**

<table>
<thead>
<tr>
<th></th>
<th>Onsite collocation</th>
<th>Offsite collocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short restore window</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Less than 10 Clients, each 10 GB storage</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>More than 50 clients, each 10 GB storage</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>More than 50 clients, each 100 GB or more</td>
<td>Yes</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Limited disk or tape resources</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Workstations</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Database, print, and file servers</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
number of tapes that you may need, specially if you want to retain those backup sets for long periods of time or even if you want to have one copy onsite and one for offsite purposes.

Determine how long you want to keep the backup sets. Use a small retention if your data changes frequently and you do not need to keep it for long periods. You can use a longer retention for special cases or for legal requirements.

2.4 Server architecture considerations

Having gathered information on the total client environment, you can now make decisions about the architecture of the Tivoli Storage Manager server environment. This section deals with issues related to the Tivoli Storage Manager server.

Server platform

A Tivoli Storage Manager server runs on several platforms. How do you choose one platform over another? With only minor differences, a Tivoli Storage Manager server provides the same functionality on every platform. The major differences between Tivoli Storage Manager server platforms relate to capacity, cost, installation, operation, supported devices, and installed user base. Each of these factors is explained below. Table 2-7 summarizes these considerations in choosing a Tivoli Storage Manager server platform - note these are indicative only and designed for comparative purposes.

In many cases, the choice of server platform will be dictated by enterprise policy or preference - and will be primarily related to the platforms already in use, and with skilled administrators available.

<table>
<thead>
<tr>
<th></th>
<th>Windows System</th>
<th>UNIX</th>
<th>iSeries™</th>
<th>zSeries®</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installed user base</td>
<td>+++</td>
<td>AIX +++</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Linux- ++; HP-UX, Sun™ Solaris™</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost</td>
<td>+</td>
<td>UNIX ++/+++</td>
<td>++/+++</td>
<td>+++</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Linux +</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacity</td>
<td>+</td>
<td>+++/+++</td>
<td>++/+++</td>
<td>+++</td>
</tr>
</tbody>
</table>
Installed user base
The number of Tivoli Storage Manager servers installed for a particular platform is a consideration. At the time of writing, there are more Tivoli Storage Manager servers installed in Windows and AIX platforms, compared with the other choices.

Cost
Cost is a very dynamic area to discuss in a static manual, so we shall only generalize! Check for special promotions and other discounts before committing to acquiring a particular platform configuration.

Cost is further subdivided into platform costs and Tivoli Storage Manager software license costs. Platform costs include the cost to acquire all the hardware and software to run the platform exclusive of the Tivoli Storage Manager software license. It ranges from low for Windows system to high for zSeries. The high cost of installing a new zSeries system usually precludes it from being selected to run a Tivoli Storage Manager server exclusively. However, if this platform is already in use, it can be an economical choice, particularly if there is considerable in-house expertise on this platform available.

Tivoli Storage Manager license costs vary somewhat, with Windows costs being the lowest, followed by Linux, AIX, HP-UX, Sun Solaris, and iSeries costs. All of these are one-time charges to purchase the product. zSeries licenses are available for a one-time charge or as a monthly license fee. You may want to calculate the break-even point.

Tivoli Storage Manager server costs include a license for only one client by default. To manage more clients, more client licenses must be purchased. The actual client code is free to download. Under the current pricing model, Tivoli Storage Manager is sold as a per processor fee for either a server or client license. Check with your Sales Representative for more information on pricing and license regulations.

Capacity
The Tivoli Storage Manager server can essentially manage a basically unlimited number of clients and an unlimited amount of data (within restrictions of the

<table>
<thead>
<tr>
<th>Platform installation</th>
<th>Windows System</th>
<th>UNIX</th>
<th>iSeries™</th>
<th>zSeries®</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple</td>
<td>Simple</td>
<td>Medium</td>
<td>Complex</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operation</th>
<th>Windows System</th>
<th>UNIX</th>
<th>iSeries™</th>
<th>zSeries®</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple</td>
<td>Simple</td>
<td>Medium</td>
<td>Medium</td>
<td>Complex</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supported devices</th>
<th>Windows System</th>
<th>UNIX</th>
<th>iSeries™</th>
<th>zSeries®</th>
</tr>
</thead>
<tbody>
<tr>
<td>Many</td>
<td>Many</td>
<td>Limited</td>
<td>Limited</td>
<td></td>
</tr>
</tbody>
</table>
maximum Tivoli Storage Manager server database size). With that said, the Tivoli selected Storage Manager server platform does limit the maximum configuration size. Various hardware platforms have different capacities in regard to the CPU power they can deliver to Tivoli Storage Manager, the number of devices which can be attached, and the maximum throughput.

Choose your platform with growth in mind. Moving from a small platform to a larger platform of the same server type, such as from a small AIX box to a larger AIX box, is relatively simple. Starting at the top end of a server type and moving to another server type, such as from Windows to AIX, involves export and import operations. Although the procedure is straightforward, it can be time-consuming and labor-intensive.

Platform installation
Installation consists of the platform installation and the Tivoli Storage Manager server code installation. Platform installation consists of hardware installation and configuration, and of operating system installation and configuration. Installation of each platform requires specialized knowledge that will not be covered here.

The Tivoli Storage Manager server code installation varies by platform in the specifics, but generally follows a similar procedure. Installation on Windows can be easier due to the Windows wizards that have been provided. Installation of the Tivoli Storage Manager server on other platforms is not difficult for an administrator familiar with the platform.

Operation
Operation of a platform varies from reasonably simple on Windows, to complex on zSeries, with the UNIX and iSeries platforms somewhere in the middle. The availability of tools to assist in managing the operation of the various platforms is nearly opposite, in that the zSeries environment has a rich, powerful assortment of tools, while Windows is lacking in this regard.

Operation of Tivoli Storage Manager itself varies only in the way some operating system-specific Tivoli Storage Manager commands are issued on each platform. It is important to look at the skills available among your staff for a particular operating system platform. If there are more people familiar with a particular platform, then it will be easier to maintain Tivoli Storage Manager in this environment.

Supported devices
There are a wide variety of supported devices on the Windows and UNIX platforms, including disk drives, tape drives, optical drives and automated tape libraries. zSeries and iSeries are more limited in their choice of devices, but these devices generally have tremendous capacity.
Be careful if choosing a “smaller” platform that you will have the ability to attach the required amount of devices as the environment grows. On larger platforms this concern is usually reduced.

2.5 System size

Choosing the correct platform CPU size and memory requirements is an inexact art. As you would expect, the risk of configuring insufficient resources increases with the size of the Tivoli Storage Manager implementation. Small Tivoli Storage Manager implementations are at less risk of choosing an incorrect platform size, and the incremental cost to scale up or down is small. Many sites start small and grow into larger systems. However, this is of little help if you are starting large.

The Tivoli Storage Manager server is CPU-, I/O-, and memory-intensive. CPU is a function of the number of files to manage and how your platform processes I/O. A large number of small files is more CPU-intensive than a small number of large files. As the number of files and the amount of data to be moved increases, each backup, migration, storage pool copy, and expiration process will use more CPU to maintain the database entries. Tivoli Storage Manager takes advantage of multiple processors.

In our experience, zSeries platforms seem to be more CPU-intensive than UNIX platforms. zSeries sites should be aware that Tivoli Storage Manager can use significant amounts of CPU. We have seen Tivoli Storage Manager among the top five users of CPU on such systems.

I/O is the major part of Tivoli Storage Manager processing - in fact, Tivoli Storage Manager does very little else. Backups and restores, database updates and retrievals, and storage pool management (reclamation, migration, copying) are all I/O intensive. The I/O subsystem needs to be robust enough to handle this load. As the number of files and the amount of data climb, the need for a larger, faster I/O subsystem increases. Separate controllers or adapters for disk and tape devices become essential as the load increases.

Memory is used to cache database entries, among other things. As the number of files being managed increases (and thus the database size increases), the amount of memory that Tivoli Storage Manager requires increases. zSeries users note that Tivoli Storage Manager likes to keep a large part of its address space in real storage. Since memory is relatively cheap, and you will never regret having too much memory, we recommend starting with a minimum of 1 GB and increasing from there.
2.6 Multiple Tivoli Storage Manager servers

When first setting up a Tivoli Storage Manager environment, we recommend implementing a single server. Once experience has been gained, and the implementation has grown enough to be reaching the capacity of the current server model family, a second server may be considered. We recommend upgrading your current server hardware to its next larger model before considering a second server, because this will keep the management overhead smaller. Tivoli Storage Manager can handle very large amounts of data or clients in one implementation. Currently, we have seen implementations with Tivoli Storage Manager internal server databases of 80 GB and larger (admittedly on very powerful, large platforms).

2.6.1 Reasons to consider multiple servers

Multiple Tivoli Storage Manager servers can be configured to provide some redundancy and disaster recoverability in the event of a Tivoli Storage Manager server outage. For example, a company with two well-connected sites A and B, may decide to install a Tivoli Storage Manager system in each site. The system in site A would back up the client data from site B and vice versa. The loss of site A would mean that the Tivoli Storage Manager system in site B (which holds the backup data for site A) could immediately start restoring the client systems onto replacement equipment. The server at site A (which was lost) could be recovered to the server at site B.

The Virtual Volumes and Enterprise Administration capabilities of Tivoli Storage Manager make managing multiple servers easier by centralizing some administration functions and allowing changes to be replicated on some or all systems.

For very large or critical clients such as a large, enterprise-wide business intelligence complex, a dedicated Tivoli Storage Manager server (either on the same system or a different one) might be the best solution.

In installations where network connectivity is slow or expensive, placing a Tivoli Storage Manager server close to the client(s) usually makes sense. For example, for a business that has multiple file servers in each of a number of cities interconnected by a slow network, it may be appropriate to install a Tivoli Storage Manager server in each city.

2.6.2 Disadvantages of multiple servers

Multiple servers increase costs. Two small server CPUs may be more expensive than one larger CPU of the same power. Where one automated tape library may
be enough, multiple servers may require multiple automated libraries. Every Tivoli Storage Manager server requires a Tivoli Storage Manager server license.

Management of a multiple server environment is more complex, costly, and time consuming than a single environment. Installation and maintenance procedures have to be repeated on each server. Confusion about where data is stored, in the event of a restore, may result. Some of these disadvantages can be reduced by using the Enterprise Administration feature.

2.7 Network

The network connection plays an integral part in providing service to the customer. If the other components of the solution have been correctly sized, it will often turn out that the network is the performance bottleneck. The network typically consists of a combination of network interface cards, hubs, routers, gateways, wire, and software. Tivoli Storage Manager server software, Tivoli Storage Manager client software, the server platform, and the client platform all have at least minimal monitoring or management capabilities. Often small networks may have no more than this (that is, no additional network management hardware or software), with limited or no network administration expertise. This makes the network a weak link in the overall management of the implementation.

Network design, implementation, and operation is beyond the scope of this book. However, we cover some basic recommendations.

2.7.1 Network considerations

The network speed to back up clients should be enough to transport common data and backup data. Generally, the backup should be done during nonworking hours. We call this period the backup window. While it is possible to split client backups to minimize network bandwidth, it makes the backup administration more difficult.

Workload calculations

An important consideration for designing the overall Tivoli Storage Manager solution is the total amount of data that the Tivoli Storage Manager server will need to support for backup or restore over a particular time frame.

A normal approach to estimate the network bandwidth needed is to consider all client information backed up in the same backup window using the following procedure:
- Calculate the amount of data a Tivoli Storage Manager server will have to accommodate during its nightly backup window and ensure that the hardware can reasonably accommodate the data.

- Calculate the amount of data that will be restored from a disaster recovery Tivoli Storage Manager server and ensure that the hardware will meet DR recovery SLAs.

We can calculate the workload for a Tivoli Storage Manager server in a theoretical environment. As an example, the environment has the following systems that we must back up:

**20 workstations**
- Each workstation has 60 GB of file data
  - Incremental forever backup with a change of approximately 10%
  - 6-hour backup window

**4 database servers**
- Each server has 100 GB of database data
  - Full backups with a change of 100%
  - 6-hour backup window

So doing the calculation for backup workload, each night we will need to back up:

\[(60 \times 20 \times 0.10) + (100 \times 4 \times 1) = 520 \text{GB}\]

And dividing that by the time allowed for the backup:

\[
\frac{520 \text{GB}}{6 \text{Hr}} \approx 86.6\frac{\text{GB}}{\text{Hr}}
\]

So the network interfaces, drives, Tivoli Storage Manager server, and all other infrastructure must to handle this amount of data in order to meet SLAs for this environment. Note that this type of calculation does not only apply to backups. It can and should be done for disaster recovery restores and single system restores.

**LAN/WAN transports**

The performance of your network backup solution will be no better than the performance of your network. You must consider expected and real performance of your network when you are designing a Tivoli Storage Manager solution.

As an example, calculate theoretical network throughput using Fast Ethernet and a 40% efficiency:
Assume 40%-80% of total theoretical throughput for a TCP/IP adapter or protocol.

Be careful of the CPU usage and real throughput of faster TCP/IP protocols (such as would). They often do not even perform close to the 80% rule.

Measure LAN throughput outside of Tivoli Storage Manager with simple protocols such as FTP. This will provide a true picture of how a network is performing.

\[
\frac{100\text{Mb}}{s} \times \frac{1B}{8b} \times \frac{1\text{GB}}{1024\text{MB}} \times \frac{60\text{s}}{1\text{min}} \times \frac{60\text{min}}{1\text{Hr}} \times 0.4 \approx \frac{18\text{GB}}{\text{Hr}}
\]

Using this type of calculation, you can calculate the anticipated throughput for any network transport. Table 2-8 on page 36 shows the most common throughputs.

<table>
<thead>
<tr>
<th>Technology</th>
<th>MB/s</th>
<th>Assume Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast Ethernet</td>
<td>100 MB/s</td>
<td>18 GB/hr @ 40% efficiency</td>
</tr>
<tr>
<td>Gigabit Ethernet</td>
<td>1000 MB/s</td>
<td>180 GB/hr @ 40% efficiency</td>
</tr>
<tr>
<td>T1</td>
<td>1.54 Mb/s</td>
<td>0.5 GB/hr @ 80% efficiency</td>
</tr>
<tr>
<td>T3</td>
<td>45 Mb/s</td>
<td>16 GB/hr @ 80% efficiency</td>
</tr>
</tbody>
</table>

Using this table, your own calculations, and any real testing you may have done, you can validate the amount of data you need to move to backup and restore (backup and restore workload) against your SLAs and your network transports. Obviously, if the network will not meet your SLAs, either the SLAs must be relaxed or the network must be improved.

**LAN-Free data movement (SAN backup and restore)**

Tivoli Storage Manager for Storage Area Networks allows for Tivoli Storage Manager backups and restores to be sent over the SAN instead of the LAN, as shown in Figure 2-2 on page 37.

When planning for LAN-free, remember that file metadata must still be sent over the LAN. This metadata can add overhead to a LAN-free backup. Even though the data is streaming over the SAN to the tape or disk, the metadata still goes to the Tivoli Storage Manager server using whatever LAN protocol and speed are
being used. As you might imagine, as the amount of metadata grows, the LAN-free backup speed will approach the speed of LAN-based backup.

Experience has shown that systems with large files (greater than 10 MB, on average) and large amounts of data (greater than 50 GB) are good candidates for LAN-free backup, while systems with numerous small files (average size in KB) often perform better using traditional LAN-based backups. Examples of the former include databases, mail systems, and ERP systems; examples of the latter are traditional file and print type servers.

**Figure 2-2  LAN-free data movement.**

### 2.7.2 Communication protocol

Most network protocols such as TCP/IP and NETBIOS are supported by Tivoli Storage Manager. TCP/IP is the most common communication method and the easiest to set up. Certain functions, such as server prompted mode and the Web clients, require TCP/IP.

### 2.7.3 Network name resolution

The Tivoli Storage Manager server machine requires a name that clients use to reference the Tivoli Storage Manager server. If TCP/IP is used, create a Domain
Name Server (DNS) entry for Tivoli Storage Manager itself, as well as a DNS entry for the machine's hostname(s). For example, create DNS name TSMSRV1 and use it in the client option files. If Tivoli Storage Manager needs to be moved to another machine, only the DNS entry needs to be changed, instead of editing the Tivoli Storage Manager options file for each client. However, using DNS may impact backup availability if for some reason the DNS service is down (the DNS name will not get resolved unless availability has been built into the DNS setup).

### 2.8 Disk considerations and sizing

Tivoli Storage Manager requires disk to operate - to hold the database, logs, and usually the primary storage pools. In this section we talk about how to choose a disk subsystem, and how to size the required amount of disk storage capacity.

#### 2.8.1 The disk subsystem

In general, choose the fastest disk subsystem that you can afford. Slow disks may not be a hindrance for a small implementation, but as the site grows, disk access becomes a large percentage of the overall elapsed time to complete a task. Choose a scalable disk subsystem because the vast majority of Tivoli Storage Manager implementations grow substantially. Multiple I/O paths and hot-swappable components should also be considered, both for performance and availability.

#### 2.8.2 Tivoli Storage Manager database

The Tivoli Storage Manager database is critical to the operation of the entire Tivoli Storage Manager environment. Systems with poorly designed Tivoli Storage Manager databases tend to run very poorly and rarely meet expectations. When planning a Tivoli Storage Manager environment, you should plan enough instances of Tivoli Storage Manager to keep the size of each Tivoli Storage Manager database reasonable.

The database size depends on how many files are managed with Tivoli Storage Manager, and whether the files are in a primary storage pool or a copy storage pool.

The database holds two types of data:

- Entries for backups - this sizing calculates how much of the database holds backup entries.
- Entries for archives - this sizing calculates how much of the database holds archive entries.
The database also holds items such as entries for policy settings, client definitions, image backups, server scripts, and the volume history, but typically, these are insignificant in sizing the database.

Use backup or archive sizing, or both, depending on what functions your server will perform. If both backup and archive are used, then add the calculated database sizes together to arrive at the total database size.

If you are planning to use backup sets, remember that these are not tracked in the Tivoli Storage Manager database, so they do not impact our calculation. They do affect the tape library size if the media used is retained online. Image backups are entered in the database, although only one entry for each backup is required. The database space requirements for image backup entries will therefore be small compared to the backups and archives, and we will not include this in our calculation.

Our calculations assume that each backed up or archived file version uses 600 bytes of space in the server database. If offsite copies are used as well, this takes an extra 200 bytes of space. Where we did not know the number of files to be kept, but only the total storage, we estimated 5% of the total server storage requirement for onsite copies and 1% for offsite.

Do not let the Tivoli Storage Manager database get too large. A good general rule is 120 GB or so, but there is no “magic” number. When expiration, database restores, and other Tivoli Storage Manager admin processes take too long and client restores become too slow, it is too big.

We recommend using Tivoli Storage Manager internal software mirroring, it is the fastest and most reliable. Spread Tivoli Storage Manager volumes over as many physical disks as possible and use smaller database volume sizes (for example, 4-8 GB), as they will improve Tivoli Storage Manager and database performance.

### 2.8.3 Database performance

Database performance is a critical factor in design and operation of a Tivoli Storage Manager solution. In this area, there are certain typical performance recommendations for any database, and some that are peculiar to the Tivoli Storage Manager database.

As with any database, the faster the disk used for the database the better. Spreading the database over as many physical disks as possible allows for better performance because multiple disk heads can be seeking, reading, and writing simultaneously.

Counter to conventional thinking, however, several design ideas are peculiar to Tivoli Storage Manager. First, our lab measurements and customer experiences
have shown Tivoli Storage Manager internal software database mirroring to be a very efficient means of providing database redundancy—often more so than “lesser” hardware redundancy.

And finally, due to locking and threading information in the Tivoli Storage Manager server code, smaller logical database volumes tend to perform better than the larger ones. This is primarily due to Tivoli Storage Manager server code locking and threading considerations.

### 2.8.4 Database size

To estimate the Tivoli Storage Manager database size for backup data, use the data collected in Table 2-1 on page 18 and Table 2-5 on page 25.

The calculation is based upon the actual number of file versions backed up. If this is not known, you can estimate 5% of amount of data backed up for the primary storage pool and 1% for copy pools.

1. Sum the field Number of Files Backed Up for all clients.
2. Multiply this number by the Number of Versions Kept, giving a total number of files backed up.
3. Multiply this number by 600 bytes, to give bytes used in the database for all known files backed up.
4. If copy storage pools are used (and we strongly recommend this), multiply the total number of files backed up and calculated in Step 2 above by 200 bytes, giving the bytes for known copy storage pool files.
5. Add bytes for known copy storage pool files to estimated bytes for copy storage pool files to give total bytes for copy storage pool files.
6. Add the total bytes for backed up files to the total bytes for copy storage pool files to give the total bytes calculated for the database.
7. Calculate 135% of total bytes calculated for the database to give the database size. This is for overhead and for growth.

For example, using the sample data in Table 2-1 on page 18 and Table 2-5 on page 25, calculate the sample database size as follows:

1. 60,000 (3,000 files per workstation * 20 clients) + 8,000 (2,000 files per server) = 68,000
2. 60,000 * 2 + 8,000 * 7 = 176,000 files
3. 176,000 * 600 = 105.6 MB
4. 176,000 * 200 = 35.2 MB
5. 105.6 MB +35.2 MB = 140.8 MB
6. 140.8 MB * 1.35 = 190 MB database size for backup files
2.8.5 Archive sizing

To estimate the Tivoli Storage Manager database size for archive data, use the data collected in Table 2-1 on page 18 and Table 2-5 on page 25.

The calculation is based upon the number of files archived:

1. Sum the field Number of Files Archived for all clients.
2. Multiply the Number of files archived by the Number of archives kept times the yearly retention ratio (that is, desired monthly retention/12 months), giving a total number of files archived.
3. Multiply this number by 600 bytes to give total bytes for archived files.
4. If copy storage pools are used (and we strongly recommend this), then multiply the total number of files archived and calculated in Step 2 above by 200 bytes, giving the total bytes for copy storage pool files.
5. Add the total bytes for archived files to the total bytes for copy storage pool files to give the total bytes calculated for the database.
6. Calculate 135% of total bytes calculated for the database to give the database size for archives. This is for overhead and for growth.

For example, using the sample data in Table 2-1 on page 18 and Table 2-5 on page 25 calculate the sample database size for archive as follows:

1. 80,000 + 12,000 = 92,000 files
2. 92,000 * 12 * (12/12) = 1,104,000 files archived
3. 1,104,000 * 600 = 662.4 MB
4. 1,104,000 * 200 = 220.8 MB
5. 662.4 MB + 220.8 MB = 883.2MB
6. 883.2 MB * 1.35 = 1192.32 MB database size for archive data

2.8.6 Identify database volumes

The total required database size including both backup and archive requirements will be 190 + 1192.32 = 1382.4MB.

We recommend using the Tivoli Storage Manager mirroring function for the database instead of a hardware or operating system mirroring, because Tivoli Storage Manager has additional functions to handle error conditions that may affect the mirrored copy.

If you are using Tivoli Storage Manager mirroring, you need to plan for the mirror copy by doubling the amount of disk for the database.

Various file systems have different maximum capacities, so the database may have to be split across numerous volumes to make up your database size. To
ensure no single point of failure when mirroring the database, each volume in a mirrored set should be placed on a separate drive and even controller.

**Note:** By summing up backup and archive database sizes, you will have a full, consolidated database for the calculated time frame. You can start with a smaller configuration initially but leave enough spare disk space for growth. You should round up database volume sizes to multiples of 4 MB plus 1 MB for overhead.

Complete Table 2-9 with the database file names and the volume names for your primary database and copy database. This table includes the space for the backup and archive requirements.

**Table 2-9  Database worksheet - backup and archive requirements**

<table>
<thead>
<tr>
<th>Database volume</th>
<th>Filename (Primary)</th>
<th>Size MB</th>
<th>Filename (Copy)</th>
<th>Size MB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vol1</td>
<td>/tsm/database/primary/file01</td>
<td>693</td>
<td>/tsm/database/copy/file01</td>
<td>693</td>
</tr>
<tr>
<td>Vol2</td>
<td>/tsm/database/primary/file02</td>
<td>693</td>
<td>/tsm/database/copy/file02</td>
<td>693</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>1386</strong></td>
<td><strong>Total</strong></td>
<td><strong>1386</strong></td>
</tr>
</tbody>
</table>

**2.8.7 Tivoli Storage Manager recovery log**

The size of the recovery log depends on the amount of data changed between Tivoli Storage Manager database backups. The larger the amount of data, the larger the recovery log needs to be. Either a full or an incremental Tivoli Storage Manager database backup (in roll-forward mode) resets the recovery log back to empty. If the recovery log fills up completely, Tivoli Storage Manager stops and you have to manually increase the size of the recovery log. This may take some time but can usually be avoided with adequate precautions (for example, by monitoring and planning for growth).

To estimate the size of the recovery log, multiply the database size by the percentage of data that changes each backup cycle. Double this number to allow for two backup cycles to occur without a database backup. This gives a starting point for the recovery log.

For example, if the database size is 1386 MB, and 5% of the data changes every backup cycle, then the estimated size for the recovery log would be 1386 MB x 0.05 x 2 = 138.6 MB (141 MB for better allocation, if using a single volume).

As with the database, we recommend using the Tivoli Storage Manager mirroring function for the recovery log instead of hardware or operating system mirroring.
If you are using Tivoli Storage Manager mirroring, you need to plan for the mirror copy by doubling the amount of disk for the recovery log.

Various file systems have different maximum capacities, so the recovery log may have to be split across numerous volumes to make up your total recovery log size. To ensure no single point of failure when mirroring the recovery log, each volume in a mirrored set should be placed on a separate drive and even controller.

Complete Table 2-10 with the recovery log file names for your primary and copy recovery log.

---

**Table 2-10  Recovery log worksheet**

<table>
<thead>
<tr>
<th>Log Volume</th>
<th>Filename (Primary)</th>
<th>Size (MB)</th>
<th>Filename (Copy)</th>
<th>Size (MB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vol1</td>
<td>/tsm/log/primary/file01</td>
<td>141</td>
<td>/tsm/log/copy/file01</td>
<td>141</td>
</tr>
<tr>
<td>Total</td>
<td>Total</td>
<td>141</td>
<td>Total</td>
<td>141</td>
</tr>
</tbody>
</table>

---

**2.8.8 Primary disk storage pool**

The traditional Tivoli Storage Manager design uses disks as a cache for nightly backups. Data is migrated daily from disk to a less expensive medium such as tape.

A best practice it to have enough disk storage pool space to store one night’s incremental file system backup, and send large file backups directly to tape (for example, Database Files) to optimize the overall I/O. Consider using the cache=yes parameter on disk storage pools - this means files remain on disk until space is needed for further backups. This can significantly improve restore performance for recently backed-up files.

As the cost of per megabyte of disk decreases, more and more disk is being used in Tivoli Storage Manager designs. Some use no tape at all - so that all backed up data is saved to disk. In this case, file-type device class should be used, not a disk-type (even if a disk-type is the initial destination). Disk-type pools become fragmented if data is retained for extended periods of time, unlike file-type classes which can be defragmented.

Tivoli Storage Manager supports a “tapeless” configuration through the use of disk storage pools or a device class of type file. When deciding whether to use only disk for backup/archive storage, consider the following caveats:
Do a realistic analysis of the total amount of storage needed your data retention policies, total data, and growth expectations. Evaluate the cost of tape versus disk for storing all data.

Invest in a disk technology that can permanently store the data. If the device can fail (and all devices can, whether RAID, mirrored, or whatever), consider using a copy storage pool for data redundancy.

Carefully consider the cost and technical feasibility of getting the data off-site for disaster recovery purposes. Tape cartridges are portable. If using disk only, off-site copies have to be moved over a network transport.

In our scenario, when a client node backs up, archives, or migrates data (during HSM function), all data is stored in one primary storage pool. You could also use separate storage pools for a backup, archive, and HSM data for improved controls and manageability of production data.

To size the disk storage pool, calculate how much will be backed up during one cycle and add on a proportion of the amount of archive data transferred to the server. This amount (plus a contingency for growth) is the recommended size for the storage pool.

If you are also using space management (HSM) features, the rate of data migration to the server is hard to predict, so you need to get experience of your particular environment to make an accurate sizing.

Primary storage pools (usually disk devices) can be made larger or smaller than the recommended size, depending on the resources available. A larger pool size allows for more than one backup cycle of data to remain on disk, thus improving restore times. It also allows for spare capacity for an unexpectedly large amount of backup data to prevent server migration from running during backup. A smaller primary storage pool uses less disk, but runs the risk that the pool will fill up during back up. This is not functionally a problem, since the backup and migration to the next storage pool can execute concurrently, however performance will degrade.

We recommend using a primary disk storage pool of at least the recommended size to reduce interference from migration while backup is running.

### 2.8.9 Disk storage pool size

To estimate a primary storage pool size if running backup cycles only, do the following:

1. Using Table 2-1 on page 18, multiply the GB changed per backup by (1 - the Data compression rate) to give the total bytes transferred for each client.
2. Sum the total bytes transferred for all clients to give the total bytes transferred per backup cycle.

3. Add 15% to total bytes transferred per backup cycle to give the storage pool size. This allows for variability in the size and number of files per backup.

For example, using the sample figures in Table 2-1 on page 18, the GB changed per backup are 6 * 20 (120 GB) and 4 * 100 (400 GB) while the Data compression figures are 0.5 and 0.66 respectively.

1. Multiplying 120 by (1 - 0.5) gives 60, and multiplying 400 by (1 - 0.66) gives 136.

2. Summing 60 and 136 gives 196 GB.

3. Adding 15% gives a storage pool size of 225.4 GB - we will round to 226 GB.

2.8.10 Archive disk sizing

In most environments, archive disk sizing is less critical than for backup. This is because backup operations tend to run much more frequently (usually nightly) and to a stricter time frame. Archives may run less frequently, and on weekends when the overall workload is lighter. Since in these circumstances, the impact of running concurrent archive and storage pool migration might not be so critical, it is not normally necessary to use the full archive size in calculating storage pool requirements. Another factor to be considered for sites which are doing frequent archiving of large amounts of data, where the storage pool and processing impact are great, is the possibility of substituting backup set operations for archive. The advantage of this is that generating a backup set requires the Tivoli Storage Manager server only — the client is not involved in any way since the backup set is created using data which has already been sent to the server in normal backup operations.

To additionally increase the storage pool to hold archive data as well, follow these steps:

1. Using Table 2-1 on page 18 and the field GB copied per archive, group all machines that require simultaneous archive operations during one common time frame (for example, every month). Select the biggest group, giving peak archive size.

2. Take 10% of peak archive size, giving archive storage size.

For example, using the sample figures in Table 2-1 on page 18:

1. Assuming a monthly/month end time frame as our baseline, we have the workstations (200 GB) and database servers (80 GB), which equals 280 GB.

2. Taking 10% from all archive storage required during the time frame, 280 GB * 0.10 = 28 GB for archive disk storage.
### 2.8.11 Image disk sizing

If you are planning to use image backups, you would consider sizing the disk storage pool to hold the filespaces you want to back up. This is because image backups are single objects and therefore, the server will require that size for storing data (or at least part of it, assuming compression is enabled).

For example, assuming that the client filespaces eligible for image backup are `/oralog` (200 MB), `/finsys` (1.5 GB), `/oradata` (1 GB) and `/findata` (1 GB), then the disk image requirements should be at least 3.7 GB to hold those filespaces in disk without having to use tape immediately. This is especially true if you are running parallel backup operations (that is, executing multiple concurrent backup image commands). Alternatively, since the disk storage requirements are so high for this operation, you could consider sending these backups straight to tape, provided that you have enough tape drives and/or backup window to co-exist with normal backup and archive operations as well.

**Note:** You must sum up all disk storage requirements (backup, archive, image) to have your final disk storage size. You can of course, start with smaller numbers and evaluate future growth.

We recommend that the disk storage pools be allocated on fault tolerant hardware devices such as RAID 5 devices. If you are using hardware or operating system mirroring, you need to plan for the mirror copy by doubling the amount of disk for the primary storage pool.

Various file systems have different maximum capacities, so the primary storage pool may have to be split across numerous volumes to make up your total primary storage pool size. We recommend that the disk storage pools be placed on their own disk devices and controller separate from the database and the recovery log, if possible.

Complete Table 2-11 with the primary storage pool file names and volume names for your primary storage pool. We are considering backup and archive requirements only - which was 226 + 28 GB = a total of 254 GB. If using 20GB size for disk storage pool volumes, we would need at least 13 volumes.

#### Table 2-11 Primary storage pool worksheet

<table>
<thead>
<tr>
<th>Filename</th>
<th>Size (GB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>/tsm/stgpool/file01</td>
<td>20</td>
</tr>
<tr>
<td>/tsm/stgpool/file02</td>
<td>20</td>
</tr>
<tr>
<td>/tsm/stgpool/file03</td>
<td>20</td>
</tr>
</tbody>
</table>
2.8.12 Device configuration table and volume history file

The device configuration table and the volume history table also require disk space, but typically, they are very small. The device configuration table contains entries for defined device classes and definitions for drives and libraries. Every volume that is used by Tivoli Storage Manager is tracked in the volume history database, including the volume identifier for the database backups. The volume history information is periodically copied out to a volume history file that you can specify with the VOLUMEHISTORY option in the dsmserv.opt file.

We recommend defining at least two copies of both the device configuration table and the volume history file, in case one becomes unusable due to a hardware or software failure. It is also highly recommended that you back up the device configuration file and the volume history file every time you back up your Tivoli Storage Manager database. These files will be invaluable in the event you need to recover your Tivoli Storage Manager server.

Complete Table 2-12 with the device configuration and volume history filenames and sizes.

**Table 2-12 Device configuration and volume history worksheets**

<table>
<thead>
<tr>
<th>Name</th>
<th>Size (MB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>/tsm/files/primary/devconfig1.out</td>
<td>0.5</td>
</tr>
<tr>
<td>/tsm/files/copy/devconfig2.out</td>
<td>0.5</td>
</tr>
<tr>
<td>/tsm/files/primary/volhist1.out</td>
<td>0.5</td>
</tr>
<tr>
<td>/tsm/files/copy/volhist2.out</td>
<td>0.5</td>
</tr>
<tr>
<td>**Total</td>
<td><strong>2</strong></td>
</tr>
</tbody>
</table>

2.8.13 Total disk

Total disk refers only to the numbers discussed here. If you are using mirroring or some other version of RAID, you need to take that into consideration separately.
The disk required to run the server platform operating system efficiently also has not been considered.

IBM Tivoli Storage Manager code requirements for disk vary depending on the server platform and release level. We use an estimate of 200 MB as the time of writing. Table 2-13 summarizes the disk requirements for the Tivoli Storage Manager server as we have planned it.

Table 2-13  Total IBM Tivoli Storage Manager disk required worksheet

<table>
<thead>
<tr>
<th>Segment</th>
<th>Size (GB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM Tivoli Storage Manager code (dependent on platform)</td>
<td>.2</td>
</tr>
<tr>
<td>IBM Tivoli Storage Manager database</td>
<td>2.772</td>
</tr>
<tr>
<td>IBM Tivoli Storage Manager recovery log</td>
<td>.282</td>
</tr>
<tr>
<td>Primary storage pools</td>
<td>254</td>
</tr>
<tr>
<td>Device configuration table and volume history table</td>
<td>.002</td>
</tr>
<tr>
<td>Other (RAID, Operating system)</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>258</strong></td>
</tr>
</tbody>
</table>

2.9  Tape drives and sizing

In this section, we discuss the calculations for estimating the size of a tape library to support a Tivoli Storage Manager solution. Similar calculations can be used to determine the total disk storage needed to support an environment.

Most Tivoli Storage Manager designs incorporate tape and tape drives as the ultimate long-term storage locations for backups and archives. Therefore, it is important to understand the performance characteristics of tape drives and tapes when designing a Tivoli Storage Manager solution.

When using tape storage pools, a Tivoli Storage Manager server should have access to no less than two drives. For architecture calculation purposes, assume only 80% of maximum, uncompressed throughput for a tape drive. Be prepared to do restores while other administrative operations are happening on the system or when drives are broken.

Carefully consider card and bus throughput when attaching tape drives to systems. Most protocol/tape combinations can accommodate two or three tape drives per card. When using Fibre Channel/SAN attached tape drives and disks, do not mix disk and tape traffic on the same HBA.
When planning for tape drive throughput and tape capacity, it is best to be conservative. Although drives can perform close to and better than their compressed rating, typically their performance is far less than this in reality. We use 80% of native uncompressed throughput ratings and 150% of native capacity ratings for theoretical calculations of drive throughput and tape capacity.

Table 2-14 on page 49 summarizes those calculations for some popular tape drives:

<table>
<thead>
<tr>
<th>Tape drive</th>
<th>Native speed (MB/s)</th>
<th>Native capacity (GB)</th>
<th>Assumed speed (GB/HR)</th>
<th>Assumed capacity (GB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM LTO Gen 2</td>
<td>35</td>
<td>200</td>
<td>98</td>
<td>300</td>
</tr>
<tr>
<td>IBM LTO Gen 3</td>
<td>80</td>
<td>400</td>
<td>224</td>
<td>600</td>
</tr>
<tr>
<td>IBM 3590-E1A</td>
<td>14</td>
<td>40</td>
<td>39</td>
<td>60</td>
</tr>
<tr>
<td>IBM 3590-H1A</td>
<td>14</td>
<td>60</td>
<td>39</td>
<td>90</td>
</tr>
<tr>
<td>IBM 3592</td>
<td>40</td>
<td>300</td>
<td>112</td>
<td>450</td>
</tr>
<tr>
<td>STK T9840C</td>
<td>30</td>
<td>40</td>
<td>84</td>
<td>60</td>
</tr>
<tr>
<td>STK T9940C</td>
<td>30</td>
<td>200</td>
<td>84</td>
<td>300</td>
</tr>
<tr>
<td>Sony AIT-3</td>
<td>12</td>
<td>100</td>
<td>33</td>
<td>150</td>
</tr>
</tbody>
</table>

Whether you use the table above or your own calculations, it is critical when designing a Tivoli Storage Manager solution to measure the backup and potential restore workload against the speed of your tape solution. In our earlier example, for instance, we calculated that we needed to move 86.6 GB/HR to meet SLAs. So based on the theoretical numbers above, a solution that is capable of that data movement would take three LTO Gen 1 tape drives.

In addition to calculating backup workload, an architect must also consider administrative processes and potential restores when deciding how many tape drives a system needs. Each day, off-site copies of tapes must be made and reclamation must occur. A potential restore of a large system could also require multiple drives to meet SLAs.

A detailed discussion of specific I/O protocol speeds is beyond the scope of this book. However, you should understand the speeds of the drive you choose and recommendations for system connectivity. As a general rule, most hardware vendors recommend no more than two to three tape drives per interface card and, if using Fibre Channel, that tape traffic be separated from disk traffic.
The information in Table 2-15 on page 50, will be used when sizing tape libraries and then when defining them to Tivoli Storage Manager.

### Table 2-15  Tape drive configuration worksheet

<table>
<thead>
<tr>
<th>Option</th>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Library model</strong></td>
<td>IBM System Storage™ TS3310 Tape Library</td>
</tr>
<tr>
<td><strong>Number of drives</strong></td>
<td>2</td>
</tr>
<tr>
<td><strong>Drive model</strong></td>
<td>3580</td>
</tr>
<tr>
<td><strong>Number of onsite tape volumes</strong></td>
<td>19</td>
</tr>
<tr>
<td><strong>Number of onsite tape volumes</strong></td>
<td>29</td>
</tr>
<tr>
<td><strong>Number of database volumes</strong></td>
<td>6</td>
</tr>
<tr>
<td><strong>Number of scratch tapes</strong></td>
<td>9</td>
</tr>
<tr>
<td><strong>Number of backup set tape volumes</strong></td>
<td>5</td>
</tr>
<tr>
<td><strong>Total tape volumes required</strong></td>
<td>68</td>
</tr>
<tr>
<td><strong>Assume 10% growth in first year</strong></td>
<td>75</td>
</tr>
</tbody>
</table>

### 2.9.1 Tape devices

Tape drives come in all sizes, including, but not limited to: DLT, SDLT, LTO, 3590, and other device types. Each type of drive has a different data capacity, performance, cost, and reliability characteristics. Although data capacity and cost per megabyte stored are important, reliability is much more important. Having saved money buying tapes is small consolation when you are unable to restore your customer billing database due to a tape error.

In general, tape drives where the tape touches the read/write heads, such as 4mm and 8mm, tend to be less reliable (and slower) than tape drives where the tape does not touch the read/write heads, such as 3580 and 3590. If you do implement drives that touch the read/write heads, plan to replace the tapes at regular intervals.

### 2.9.2 Tape libraries

Tivoli Storage Manager was designed with automation in mind, specifically for automated tape libraries. The best and easiest way to run a Tivoli Storage Manager library is to keep all on-site data in the library so that tapes can be
mounted automatically when needed for restores, backups, reclamation, and other Tivoli Storage Manager administration processes.

2.9.3 Number of tape drives

In attempting to reduce costs, some Tivoli Storage Manager customers might consider purchasing only one or at most two tape drives. Although the Tivoli Storage Manager could be configured with only one drive (or with a library containing one drive), we do not consider this to be a production level solution and do not recommend it. A single drive solution cannot make additional data copies (for disaster recovery purposes) or perform space reclamation without considerable manual effort and additional disk resources. Any Tivoli Storage Manager server for production use should have a library with two or more tape drives. Here are some business reasons for selecting a multiple drive solution:

- To avoid a single point of failure
- To avoid interruptions to automated backup processing (reclamation, backup stgpool, migration contention)
- To avoid limiting your scalability (few environments are static or shrink with regards to the amount of managed data)
- To avoid building additional complexity into the design and implementation, which will drive the cost of implementation higher
- Because the price point for libraries and tape drives have fallen significantly in the recent past

Two-drive systems allow for quicker reclamation and pool copies and reduced drive outages, but restores coming from tape may be delayed due to other competing tape activity. Systems with three or more tape drives can handle restores from tape occurring while tape reclamation or other tape processing is in progress.

As for the number of tape drives, a critical consideration is how quickly you need to restore one or more clients. More tape drives allow you to restore more clients in a given time. Collocation allows as many clients to be restored simultaneously as you have tape drives. If you have stringent restore requirements, collocation and multiple tape drives make sense. You could also consider features like backup sets and logical volume backups for highly time dependent servers to improve their restore window.

To calculate the rate of a restore operation, divide the amount of storage to be restored by the sustained data rate of the tape drive (not the instantaneous, or burst, rate) quoted by the manufacturer. If this number does not allow you to meet your service levels, collocation, more tape drives, faster tape drives, a new service level, or another backup strategy may be required.
We recommend a minimum of a library with a barcode reader and at least two tape drives for all production-level Tivoli Storage Manager solutions.

2.10 Tape volumes

Tape volumes are used to store onsite copies of data, offsite copies of data and database backups. Additional tape volumes are required because all tape volumes are not filled to capacity. Some volumes are required to stock a scratch pool so that mounts for unused tape volumes can be satisfied. If you are considering backup sets and image backups, you may need to add some more tapes to your scratch pool.

2.10.1 Onsite volumes

You must consider how many tapes you will need to hold your backup, archive and image data in a specified time frame. Each of those have different expiration requirements, and therefore, the calculation may not be linear. In any case, keep in mind that it is best to assume a middle case / worst case scenario, so that you do not run out of tapes.

Backup tapes

To calculate the number of onsite tape volumes required for backup operations, carry out the following calculations:

- If this is a sequential storage pool (tape device), multiply the primary storage pool size by the Number of backup versions from Table 2-5 on page 25 to give versions pool size.
- Add the sum of all Total storage used fields for each client from Table 2-1 on page 18 to the versions pool size, giving tape pool size.
- Divide the tape pool size by the device capacity to find the number of tape cartridges required.
- Add 50% to cater to tapes that are in Filling status to give the total cartridges required for onsite tapes.
- If using collocation, normally there should be at least as many tape cartridges as there are clients. Consider tape native capacity as a rounding factor.

We do not use the compressed capacity of the tape here because we factored the client compression rate into the calculation of the storage pool size. If data is compressed at the client, it will not receive any benefit from hardware compression done by the tape drive.
Backup tape calculation

- If the primary storage pool is 254 GB, and the number of versions kept is 7, then multiplying 1.04 * 7 gives a 1778 GB versions pool size.
- If the all the clients are using 1200 and 400 GB, then 1200 + 400 + 1778 equals 3378 GB.
- If the tape device has a capacity of 400 GB, then dividing 1938 by 400 gives 9 cartridges required to store all the data.
- 5 * 1.5 gives 14 total cartridges required for onsite tapes.
- If we use collocation for the database servers, since there 4 database servers and 20 file servers, we have enough tape volumes.

Archive tapes

- Using Table 2-1 on page 18, multiply the GB copied per archive by (1 - the Data compression rate) giving transferred archive data.
- For each client, multiply transferred archive data by Number of archives kept in a year times the yearly retention ratio (that is, desired monthly retention/12 months), and sum up giving total archive data.
- Divide total archive data by native tape capacity, giving the total number of tapes required.

Archive tape calculation

- The clients in our table have 200 GB and 80 GB of archive data. The compression ratios are 0.5 and 0.66. This equals 200 *(0.5) and 80 * (0.34) which equals 100 and 27.2 GB.
- The number of archives kept are 12 and 12. The yearly retention ratios are 12/12 and 12/12. This equals 100*12*1 + 27.2*12*1 = 1526.4 GB.
- If the tape device has a capacity of 400 GB, then dividing 1526.4 GB by 400 gives 4 cartridges required to store all archive data.

Image backup tapes

Image requirements are calculated on total allocated file system space. For the sake of simplicity, we are not considering any compression rating (you can use the compression ratio for the client on the sum of file systems), and therefore the number is already overestimated without any need for extra tapes:

- Consider all client filespaces eligible for image backup. Sum them all, giving transferred image size per client.
- Using Table 2-1 on page 18, Multiply the Number of image backups by transferred image size per client times yearly retention ratio (that is, desired monthly retention/12 months), and sum them all giving total image size.
Divide total image size by native tape capacity, giving the total number of tapes required.

**Image backup tape calculation**

- In our example, we assume that the sum of all of Client 3 eligible filespaces for logical volume backup would be $10 \, \text{GB} \times 4 = 40\, \text{GB}$.
- The retention ratio is $1/12$. Assuming previous calculation, this gives $12 \times 40 \times 0.16 = 76.8 \, \text{GB}$.
- If the tape device has a capacity of 400 GB, then the image backup data needs only one tape to store it all (assuming no compression).

Therefore, the total onsite tape requirements for this example would be:

$$14+4+1 = 19 \, \text{tapes}.$$

### 2.10.2 Offsite volumes

You will probably have more tapes in your offsite pool than onsite, because of less frequent reclamation and partially filled tapes.

To estimate the number of tape cartridges required for offsite copies, use the number of onsite tape volumes calculated in the previous section. As a rough guide, add 50% to estimate the number of tapes required. In our example, this comes to 29 offsite tapes. Keep in mind that collocation may be set on for either, both, or none of onsite and offsite tape pools, which will also affect tape volume requirements.

### 2.10.3 Database tape volumes

Each database backup requires at least one tape volume. We recommend backing up the database every day and keeping backups for at least five days.

**To calculate the database tape volumes required:**

- Divide the database size calculated in, 2.8.4, “Database size” on page 40 by the tape device capacity and round up to the nearest whole number to give the number of tape volumes required for one database backup.
- Multiply this number by six (five copies plus the copy just being made) to give the total number of tape volumes required for database backups.

For example, if the database size is 1386 MB, and the device capacity is 400 GB, each database backup will fit on one tape volume. Therefore

$$1 \, \text{tape} \times 6 \, \text{versions} = 6 \, \text{tape volumes}.$$
Scratch volumes
A scratch (or empty) volume is required every time Tivoli Storage Manager wants to write to an unused tape.

To estimate the number of scratch volumes required:

- Total the number of tape volumes required for onsite tapes, offsite tapes and database backup tapes.
- Calculate 15% of this number to allocate for scratch tape volumes.

We have a total of 49 onsite, offsite and scratch tapes. 15% of this is 9 tapes.

Backup set volumes
It is worth calculating backup set tape space requirements separately from regular file-based processing due to the nature of backup sets. Note that although the backup set is a server initiated procedure, our calculations are based on previous file-backup operations. Note that this step may not be necessary, since you may create backup sets onto disk and copy them onto media such as CD or use another tape format which is common to both the server and the client. For this calculation we are assuming the backup set consists of the entire client system’s file, however you may only use a subset of its filesystems.

To estimate the number of backup set volumes required:

- Using Table 2-1 on page 18, multiply the Total storage used by (1 - the Data compression rate) to give the total gigabytes for each client. Round up to the next multiple of the native tape capacity, since backup sets, like server database backups, cannot stack onto tapes.
- Multiply number of backup sets by the total gigabytes for that client to give the client backup set size.
- Multiply client backup set size by the yearly retention ratio (that is, desired monthly retention/12 months) for that client. Sum all client backup set sizes to give the total backup set requirement.
- Divide the total backup set requirement by the device capacity to find the number of tape cartridges required.

Backup set calculation

- Multiplying 1200 by (1 - 0.5) gives 600, and multiplying 400 by (1 - 0.66) gives 136. Assuming native tape capacity of 400 GB, this rounds up to 800 and 400 GB respectively.
- From previous calculations, client backup set sizes are 6 * 800 (4800 GB) and 6 * 400 (2400 GB).
Assuming retention periods of 4/12 and 2/12, this gives 4800*0.33 + 2400*0.16 = 2000 GB as backup set space requirement.

If the tape device has a capacity of 400 GB, then dividing 2000 by 400 gives 5 cartridges required to store all backup set data during the specified time frame.

Adding up all these numbers as stored in Table 2-15 on page 50 gives a total of 68 tape volumes required, growing to 75 in the first year, assuming a 10% growth rate. You then need to consider this number against the library configurations available for your chosen technology. The IBM System Storage TS3310 with expansion unit has space for 128 cartridges so this leaves some capacity for future growth. It should be noted that Tivoli Storage Manager setups rarely if ever shrink!

### 2.10.4 z/OS tape management

On all platforms except for iSeries and z/OS®, OS/390® (or MVS), Tivoli Storage Manager provides its own tape management functions. For z/OS, it uses the functions provided within the operating system or other tape library management systems.

Tivoli Storage Manager uses data set names to identify various types of Tivoli Storage Manager data sets. The data set name prefix is set by the device class parameter PREFIX. Each device class can have a different data set name prefix. The data set name suffix is fixed by Tivoli Storage Manager for various data types. The suffix.DBB indicates a database backup data set. The suffix.BFS indicates an onsite or offsite data copy.

Most tape library management systems on z/OS use the data set name to identify tapes to be taken offsite. Since Tivoli Storage Manager uses the data set name PREFIX.BFS for both onsite and offsite copies, the tape management system has no way to identify tapes that must be moved offsite.

To choose another data set name for offsite copies, create another device class for the offsite copies and choose a different prefix. Set the tape library management system to trigger on this different PREFIX.BFS data set name and offsite copies will be identified automatically.

Tivoli Storage Manager allows an external data manager (EDM) to control tapes. To inform the EDM when a tape goes into a scratch status, you can use the DFSMSHsm™ ARCTVEXT parameter. Include the DELETIONEXIT ARCTVEXT parameter in the Tivoli Storage Manager server options file. For more information, see *IBM Tivoli Storage Manager for MVS and OS/390 Administrator's Guide*, GC35-0377.
If your tape management system uses program names to identify External Data Managers, the Tivoli Storage Manager program name is ANRSERV.

### 2.11 Administrator IDs

Identify who will be the Tivoli Storage Manager administrator(s) in your organization.

A Tivoli Storage Manager administrator controls Tivoli Storage Manager resources. There can be numerous administrators with varying levels of authority over the Tivoli Storage Manager server itself. Also, an administrator can use the Web backup-archive client to perform backup, restore, archive, and retrieve operations on the behalf of other users using a Web browser. Help desk personnel can use this to perform these client tasks for their end users without having to logon to the client machine.

If your Tivoli Storage Manager installation is large or widely dispersed, you should delegate some authority to administrators based on policy domains or storage pools. Therefore, a workstation administrator could look after setting data retention criteria for workstation data only (assuming the correct policy domains were set up). A UNIX administrator could be given Tivoli Storage Manager authority over UNIX data retention criteria only.

Since Tivoli Storage Manager logs all commands issued by administrators and it has no limit on the number of administrators, do not share administrator IDs. Sharing administrator IDs reduces the accountability of each ID, and therefore of all the people sharing the ID. Conversely, numerous administrator IDs may give too many people too much authority.

Table 2-16 suggests several administrator IDs you may want to implement.

**Table 2-16  Administrator IDs worksheet**

<table>
<thead>
<tr>
<th>Functions</th>
<th>Administrator ID</th>
<th>Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Server console</td>
<td>SERVER_CONSOLE</td>
<td>System</td>
</tr>
<tr>
<td>System administrator</td>
<td>sysadmin</td>
<td>System</td>
</tr>
<tr>
<td>System support</td>
<td>support</td>
<td>System</td>
</tr>
<tr>
<td>System reporter</td>
<td>reporter</td>
<td>none</td>
</tr>
<tr>
<td>Client administrator</td>
<td>helpdesk</td>
<td>Node</td>
</tr>
</tbody>
</table>

We recommend you delete the default installed administrator, admin, to prevent the possibility of this ID being misused. Many sites leave this ID with its default
password, creating a big security hole for any malicious person with basic Tivoli Storage Manager knowledge!

2.12 License considerations

This section describes the tasks involved when licensing a Tivoli Storage Manager system, including registering, saving and auditing.

The base IBM Tivoli Storage Manager feature includes the following support:

- An unlimited number of administrative clients.
- Enterprise Administration, which includes: command routing, enterprise configuration, and enterprise logging (server-to-server).
- Server-to-server Virtual Volume capabilities (does not include database and storage pool backup).
- Network Enabler (network connections for clients).
- AFS/DFS™ Support, (the S/390® platform includes the S/390 UNIX client as part of Managed System for SAN).
- Smaller tape libraries

Tivoli Storage Manager Extended Edition also includes the disaster recovery manager, space management, NDMP backup, server-free backup LAN-free backup, and use of any size tape library.

2.12.1 Registering licensed features

You must register a new license if you want to add support for any of the following features that are not already in your existing license agreement. Tivoli Storage Manager uses a license file and the REGISTER LICENSE command to complete this task. Licenses are stored in enrollment certificate files, which contain licensing information for the server product. When registered, the licenses are stored in a nodelock file within the current directory.

To register a license, use the REGISTER LICENSE command as well as the license file associated with the license. See Table 9-1 on page 292 and Table 9-2 on page 297 for a list of valid license files for the different versions of Tivoli Storage Manager.

Saving your licenses

Save the CD-ROM or directory containing your enrollment certificate files. You may you need to register your licenses again for any of the following reasons:
Chapter 2. Implementation planning

- The server is corrupted.
- The server is moved to a different machine.
- The nodelock file is destroyed or corrupted. Tivoli Storage Manager stores license information in the nodelock file, which is located in the directory from which the server is started.

Monitoring licenses
When license terms change (for example, a new license is specified for the server), the server conducts an audit to determine if the current server configuration conforms to the license terms. The server also periodically audits compliance with license terms. The results of an audit are used to check and enforce license terms. If 30 days have elapsed since the previous license audit, the administrator cannot cancel the audit.

If a Tivoli Storage Manager system exceeds the terms of its license agreement, one of the following occurs:

- The server issues a warning message indicating that it is not in compliance with the licensing terms.
- If you are running in Try Buy mode, operations fail because the server is not licensed for specific features.

You must contact your Tivoli Storage Manager account representative or authorized reseller to modify your agreement. An administrator can monitor license compliance by:

Auditing licenses
Use the AUDIT LICENSES command to compare the current configuration with the current licenses.

Displaying license information
Use the QUERY LICENSE command to display details of your current licenses and determine licensing compliance.

Scheduling automatic license audits
Use the SET LICENSEAUDITPERIOD command to specify the number of days between automatic audits.
2.13 Other considerations

There are numerous other topics to be considered when planning a Tivoli Storage Manager installation. Many of these topics are outside the scope of this book, but we are mentioning them here for completeness.

- **Staffing:** Staffing requirements need to be addressed. The various functions such as operations, technical support, administration, and help desk may all be performed by one person in a small site. Larger sites may find a more specialized approach useful. To provide backup coverage, two people per function is always a good idea.

- **Lead time:** Some tasks such as installing a tape exit in zOS may have considerable lead times before the change can be made. We have highlighted some of these, but check with your technical support group and your change management group for their guidelines.

- **Monitoring:** You may want to consider monitoring your Tivoli Storage Manager server system using a product such as Tivoli Enterprise™. We have highlighted some suggestions for this, but there are many more items that you may want to monitor. Monitoring also includes monitoring the health of the IBM Tivoli Storage Manager software. Numerous queries are useful for displaying information about the IBM Tivoli Storage Manager system and its workings. We have included some basic possibilities.

- **Chargeback:** Some Tivoli Storage Manager installations charge for their services. This is possible using the accounting records and site specific programs. Some items you may want to consider charging for include bytes stored, CPU time per client, or tapes used.

- **Code refreshes:** New client code typically has been released every three months. With installations greater than about 50 clients, keeping up with these refreshes of client code requires special consideration. Set up a procedure for tracking which clients are running which release of Tivoli Storage Manager code. Design your client installs to be as generic and as similar as possible. If an automated software install process is available, consult with the process owners regarding the best practices to use in setting up Tivoli Storage Manager clients.

- **Export/Import:** It is possible to export a client definition and all of its related data from one Tivoli Storage Manager server and import it into another Tivoli Storage Manager server. This facility is useful for moving clients from one server platform to another server on the same or different platform. With a large number of clients, or clients with a large amount of data, the export and import can take a significant amount of time, in the order of 24 to 48 hours. In these cases, planning and coordination needs to be done as to when the exporting server ceases backups and the importing server starts backups.
Server scripts: These are very useful for issuing Tivoli Storage Manager commands repeatedly, or with some rudimentary logic around it.

SQL queries: These are powerful queries you can run against the Tivoli Storage Manager database to extract information.

Problem determination: Diagnosing and resolving problems are tasks you will have to do on a regular basis. In general, once you have determined you have a problem, install the latest level of Tivoli Storage Manager client and Tivoli Storage Manager server code and try to recreate the problem. If it still exists, you should engage formal software support procedures. Alternatively, you may search or post your problem to the Tivoli Storage Manager listserv list to see if someone else has experienced the problem or who may be able to offer some suggestions.

Disaster recovery: We recommend planning and testing for disaster recovery be done on a regular basis. Disaster Recovery Manager (DRM) assists in gathering, maintaining and recommending information and planning pertinent to disaster recovery.

2.14 Summary

Now that we have discussed planning and checklists in the initial chapters — as well as the need to read and understand the redbook, IBM Tivoli Storage Management Concepts, SG24-4877 — we can get started on the actual installation phase.
In this part of the book we discuss the installation of the server and client code that will be used to implement IBM Tivoli Storage Manager. We provide implementation checklists and describe the various planning considerations you will need to take into account to get the best results.
Server installation

In this chapter, we explain the steps relating to the implementation of an IBM Tivoli Storage Manager server. We cover the topics of code installation and options file customization.

We are assuming that, before you enter into this installation, you have completed the planning worksheets, and have read and understood the *IBM Tivoli Storage Management Concepts*, SG24-4877. If not, please stop and take the time to do so now.

You will gain a better understanding and be more successful if you take the time to plan and design your total solution before you begin installation.
3.1 Software installation

We are assuming you have read and understood the redbook, *IBM Tivoli Storage Management Concepts*, SG24-4877, as well as the previous chapters. You should also use the instructions in the associated *Quick Start* manual for your chosen Tivoli Storage Manager server platform to install the Tivoli Storage Manager code. The *Quick Start* manual is shipped with the install media. The latest version of this manual is also available from the Tivoli Storage Manager Web site in either HTML or PDF format. We recommend that you download the manual to ensure that you are working with the latest information. The URL for Tivoli Storage Manager publications is:


**Note:** We highly recommend that you read the readme.1st file to see the changes in the Tivoli Storage Manager version you are about to install, the hardware and software prerequisites, and any additional installation steps that might be needed.

3.2 Latest software updates

Tivoli Storage Manager server and client code fixes and enhancements are released on a regular basis. The fixes are available from IBM via the Internet or CD-ROM. Downloading from the Internet is preferable if your connection supports it. Many fixes can be quite large, as they are full or near-full code replacements. If you are unable to download from the Internet, you can order the fixes through your usual IBM service channel.

The Tivoli Storage Manager support home page has links to the latest Tivoli Storage Manager server fixes, Tivoli Data Protection for application fixes, Tivoli Storage Manager client code, and important download information. It also contains important FLASHES of late breaking product news which may affect your implementation. You may subscribe to updates via RSS, or regularly visit the Web site:


This link will take you to the ftp server:

ftp://service.boulder.ibm.com/storage/tivoli-storage-management/maintenance/

If you have downloaded many fixes you may find it more convenient to go directly to the ftp site and navigate through the directories to quickly find the latest fixes.
The individual fix directories in general include these files - the names and content of these files may vary slightly across platforms:

- **README.ftp**
  
  This file contains the download and install instructions.

- **README.1st**
  
  This file contains important information that is not yet available in manuals. This includes information such as description of code fixes, enhancements, limitations, and additions or corrections to the hardcopy publications.

- **Code image(s)**
  
  These files contain the actual code fixes. You should download and unpack these files exactly as instructed in the README.ftp file.

If the fix is unavailable for download, or your environment is not suitable for downloading large files, you can use the fix number to order the code on CD-ROM from IBM support.

We recommend that you keep a copy of the latest server, agent, and client fix files on a suitable file server (which could be the Tivoli Storage Manager server itself), at your site. This allows easier distribution and code installation, especially for clients.

**Attention:** If you using IBM tape devices, such as 3580, 3592 and associated libraries, you do not need to install the Tivoli Storage Manager device driver, since these device drivers use the IBM tape driver. The IBM tape device drivers are available in the ftp site:
ftp://ftp.software.ibm.com/storage/dev/drvr. However, if you also install the Tivoli Storage Manager device driver, you will be able to use some useful utilities on the IBM tape devices.

At the time of the writing, a number of important server fixes are available to support library sharing and LAN-free environments. If you are using or planning to use these environments, it is strongly recommended to install server levels 5.2.7.1/5.3.2.3 or higher.
3.3 AIX server installation

Here we show how to perform a fresh install of the Tivoli Storage Manager server code on AIX on a pSeries® server with AIX V5.3 64-bit installed.

You must be logged in as root to install the Tivoli Storage Manager server code.

1. Insert the Tivoli Storage Manager server for AIX installation CD in the CD-ROM drive. From the operating system prompt, enter `smitty installp`. Choose **Install and Update from ALL Available Software** as shown in Example 3-1.

**Example 3-1  Tivoli Storage Manager installation: smitty installp**

```
Install and Update Software

Move cursor to desired item and press Enter.

Install Software
Update Installed Software to Latest Level (Update All)
Install Software Bundle
Update Software by Fix (APAR)
Install and Update from ALL Available Software
```

2. Select the INPUT device where the installation packages are located. This is system dependent - usually this will be the CD-ROM (e.g.: /dev/cd0) or a directory. We used the CD-ROM as our input device.

3. Select the filesets to install. Place the cursor in the **Software to install** option and enter **F4** to display the list of available filesets. The Tivoli Storage Manager AIX server is supported on 32- and 64-bit platforms. For the supported filesets to select during installation or to upgrade from previous versions, see *Tivoli Storage Manager AIX Installation Guide*, GC32-1597.

**Note:** You cannot install both the 32-bit (tivoli.tsm.server.rte) and 64-bit (tivoli.tsm.server.aix5.rte64) server filesets on the same machine. Use the AIX `bootinfo -y` command to determine if your system is 32 or 64 bit.

We selected the following 64-bit filesets:

- tivoli.tsm.devices.aix5.rte  Device Support - AIX 5.x, 32 and 64-bit
- tivoli.tsm.server.com  Server samples and diagnostic utilities
- tivoli.tsm.server.aix5.rte64  Server runtime - AIX 5.x, 64-bit
- tivoli.tsm.msg.en_US.server  Message Library and help
- tivoli.tsm.msg.en_US.devices  SMIT menu catalogs
- tivoli.tsm.license.aix5.rte64  License enablement module - 64-bit kernel
Chapter 3. Server installation

- tivoli.tsm.license.cert License certificates
- tivoli.tsm.server.webcon Administration Center

4. Perform a preview install to make sure there is sufficient disk space and that all prerequisite filesets have been selected. With **Preview only** and **Preview new LICENSE agreements** options set to **Yes**, press **ENTER**.

**Note:** To install the server on AIX V5.2 or later, you must accept the license agreement. You can view the license agreement by selecting **Yes** on the **Preview new LICENSE agreement** option in smit.

5. If there is sufficient disk space and all prerequisite filesets have been selected, perform the actual install. With **Preview install** option set to **No** and **Accept new LICENSE agreement** set to **Yes press ENTER**. Example 3-2 shows the screen with all the selections we made for installation.

**Example 3-2  Install and Update from all available software**

Install and Update from ALL Available Software

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

* INPUT device / directory for software /dev/cd0
* SOFTWARE to install [tivoli.tsm.devices.ai> +
  PREVIEW only? (install operation will NOT occur) no +
  COMMIT software updates? yes +
  SAVE replaced files? no +
  AUTOMATICALLY install requisite software? yes +
  EXTEND file systems if space needed? yes +
  OVERWRITE same or newer versions? no +
  VERIFY install and check file sizes? no +
  DETAILED output? no +
  Process multiple volumes? yes +
  ACCEPT new license agreements? yes +
  Preview new LICENSE agreements? no +

**Example 3-3  Installation success**

**COMMAND STATUS**

Command: OK stdout: yes stderr: no
Before command completion, additional instructions may appear below.

```
[TOP]
geninstall -I "a -cgNqwXY -J" -Z -d /usr/sys/inst.images -f File 2>&1
```

File:
- `I:tivoli.tsm.license.aix5.rte64 5.3.2.0`
- `I:tivoli.tsm.license.cert 5.3.2.0`
- `I:tivoli.tsm.msg.en_US.devices 5.3.2.0`
- `I:tivoli.tsm.msg.en_US.server 5.3.2.0`
- `I:tivoli.tsm.server.aix5.rte64 5.3.2.0`
- `I:tivoli.tsm.server.com 5.3.2.0`
- `I:tivoli.tsm.webcon 5.3.2.0`

[MORE...235]

The report shows the list of filesets you have chosen to install and the status of the installation.

The Tivoli Storage Manager server process will automatically be started after a successful installation.

### 3.4 Linux server installations

This section shows the installation steps for Linux servers. We installed the server on a Red Hat Linux distribution.

For more information on Tivoli Storage Manager Server for Linux, please see the Information Center:


#### 3.4.1 Installation packages

The installation packages are in “rpm” format, and include:

- `TIVsm-license-5.3.2-0.i386.rpm`
- `TIVsm-server-5.3.2-0.i386.rpm`
- `TIVsm-tsmscsi-5.3.2-0.i386.rpm`
3.4.2 Installation commands

Go to the directory where the TIVsm-server package was uncompressed and unpacked (or the mount point for CD-ROM). Execute the server installation script, `install_server`, as shown in Example 3-4.

Select the language for installation (2 for English in our example). The license agreement displays.

Example 3-4   Install_server: license acceptance

[root@palau:/tsm5320server]# ./install_server
Preparing License Agreement
Software Licensing Agreement
1. Czech
2. English
3. French
4. German
5. Italian
6. Polish
7. Portuguese
8. Spanish
9. Turkish

Please enter the number that corresponds to the language you prefer.

2
Software Licensing Agreement
Press Enter to display the license agreement on your screen. Please read the agreement carefully before installing the Program. After reading the agreement, you will be given the opportunity to accept it or decline it. If you choose to decline the agreement, installation will not be completed and you will not be able to use the Program.

International Program License Agreement

Part 1 - General Terms

BY DOWNLOADING, INSTALLING, COPYING, ACCESSING, OR USING THE PROGRAM YOU AGREE TO THE TERMS OF THIS AGREEMENT. IF YOU ARE ACCEPTING THESE TERMS ON BEHALF OF ANOTHER PERSON OR A COMPANY OR OTHER LEGAL ENTITY, YOU REPRESENT AND WARRANT THAT YOU HAVE FULL AUTHORITY TO BIND THAT PERSON, COMPANY, OR LEGAL ENTITY TO THESE TERMS. IF YOU DO NOT AGREE TO THESE TERMS,
Accept the license, by entering 1. Now select which package to install. We selected **B BASIC INSTALL**, as shown in Example 3-5. This installs the server and license packages.

**Example 3-5  Install_server: basic installation**

License Agreement Accepted
Ready to install RPM packages for i686.

Please select a package to install or "Q" to quit.
1  TIVsm-license-5.3.2-0
2  TIVsm-server-5.3.2-0
3  TIVsm-tsmiscsi-5.3.2-0
4  TIVsm-cmdlinehelp.de_DE-5.3.0-0
5  TIVsm-cmdlinehelp.de_DE.utf8-5.3.0-0
6  TIVsm-cmdlinehelp.en_US.utf8-5.3.0-0
7  TIVsm-cmdlinehelp.es_ES-5.3.0-0
8  TIVsm-cmdlinehelp.es_ES.utf8-5.3.0-0
9  TIVsm-cmdlinehelp.fr_FR-5.3.0-0
10 TIVsm-cmdlinehelp.fr_FR.utf8-5.3.0-0
11 TIVsm-cmdlinehelp.it_IT-5.3.0-0
12 TIVsm-cmdlinehelp.it_IT.utf8-5.3.0-0
13 TIVsm-cmdlinehelp.ja_JP-5.3.0-0
14 TIVsm-cmdlinehelp.ja_JP.utf8-5.3.0-0
15 TIVsm-cmdlinehelp.ko_KR-5.3.0-0
16 TIVsm-cmdlinehelp.ko_KR.utf8-5.3.0-0
17 TIVsm-cmdlinehelp.pt_BR-5.3.0-0
18 TIVsm-cmdlinehelp.pt_BR.utf8-5.3.0-0
19 TIVsm-cmdlinehelp.zh_CN-5.3.0-0
20 TIVsm-cmdlinehelp.zh_CN.gb18030-5.3.0-0
21 TIVsm-cmdlinehelp.zh_CN.utf8-5.3.0-0
22 TIVsm-cmdlinehelp.zh_TW-5.3.0-0
23 TIVsm-cmdlinehelp.zh_TW.euctw-5.3.0-0
24 TIVsm-cmdlinehelp.zh_TW.utf8-5.3.0-0
B  BASIC INSTALL
Q  QUIT
The basic install includes the following packages:
TIVsm-server-5.3.2-0
TIVsm-license-5.3.2-0

Should I continue with the basic install? (Y/N)
y
Installing TIVsm-server-5.3.2-0.
Preparing...                                      [100%]
1:TIVsm-server                                      [100%]

Upgrading TSM server database...

********************************************************************
IMPORTANT: Read the contents of file /README
for extensions and corrections to printed
product documentation.
********************************************************************
Installing TIVsm-license-5.3.2-0.
Preparing...                                      [100%]
1:TIVsm-license                                   [100%]

After the installation is complete, you are again prompted for the package
selection. This time, select 3 for the device driver package. Once the device
driver installation is completed, select Q and press Enter.

Alternate installation: rpm package installer. You can also use the rpm package
installer for your installation. The following is the command syntax used for this
install, listed in the order of installation:
rpm -ivh TIVsm-license-5.3.2-0.i386.rpm
rpm -ivh TIVsm-server-5.3.2-0.i386.rpm
rpm -ivh TIVsm-temscluscsi-5.3.2-0.i386.rpm

3.4.3 Post-installation steps

After the installation, the server does not start automatically. We need to
customize the server options file, /opt/tivoli/tsm/server/bin/dsmserv.opt. As
shown in Example 3-6, the default dsmserv.opt file created at installation only
defines a minimum of possible server options and is not sufficient to start the
server.

Example 3-6  Default dsmserv.opt file after installation

[root@palau:/opt/tivoli/tsm/server/bin]# more dsmserv.opt
*** IBM TSM Server options file
*** Refer to dsmserv.opt.smp for other options
Example 3-7 shows our edited server options file.

**Example 3-7  Edited dsmserv.opt**

```
[root@palau:/opt/tivoli/tsm/server/bin]# more dsmserv.opt
*** IBM TSM Server options file
*** Refer to dsmserv.opt.smp for other options
COMMMETHOD TCPIP
TCPPORT 1500
TCPADMINPORT 1501
DEVCONFIG devcnfg.out
EXPINTERVAL 0
```

After this, we started the server with the `dsmserv` command from the server executable directory, `/opt/tivoli/tsm/server/bin`, as shown in Example 3-8.

**Example 3-8  Initial Linux Tivoli Storage Manager server startup**

```
[root@palau:/opt/tivoli/tsm/server/bin]# ./dsmserv
```

Tivoli Storage Manager for Linux/i386
Version 5, Release 3, Level 2.0

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restricted by GSA ADP Schedule Contract with IBM Corporation.

ANR7800I DSMSERV generated at 03:39:28 on Sep 27 2005.
ANR7801I Subsystem process ID is 15131.
ANR0900I Processing options file dsmserv.opt.
ANR4726I The ICC support module has been loaded.
ANR0990I Server restart-recovery in progress.
ANR0200I Recovery log assigned capacity is 8 megabytes.
ANR0201I Database assigned capacity is 36 megabytes.
ANR0306I Recovery log volume mount in progress.
ANR0353I Recovery log analysis pass in progress.
ANR0354I Recovery log redo pass in progress.
ANR0355I Recovery log undo pass in progress.
ANR0352I Transaction recovery complete.
ANR1635I The server machine GUID, 9e.6f.a1.d2.ee.c7.d9.11.a5.b8.00.02.55.21.0e.79, has initialized.
ANR2100I Activity log process has started.
ANR4726I The NAS-NDMP support module has been loaded.
Next we set up the server addresses to allow for server to server communication, as shown in Example 3-9 and a unique servername to allow for administration through the Administration Center.

**Example 3-9  Setting the server high/low level address and servername**

```bash
TSM:SERVER1> set serverlladdress 1500
ANR2017I Administrator SERVER_CONSOLE issued command: SET SERVERLLADDRESS 1500
ANR2133I Server lladdress set to 1500.
TSM:SERVER1> set serverhladdress 9.43.86.83
ANR2017I Administrator SERVER_CONSOLE issued command: SET SERVERHLADDRESS 9.43.86.83
ANR2132I Server hladdress set to 9.43.86.83
TSM:SERVER1> set servername PALAU_SERVER1
ANR2017I Administrator SERVER_CONSOLE issued command: SET SERVERNAME PALAU_SERVER1
ANR2094I Server name set to PALAU_SERVER1.
TSM:PALAU_SERVER1>
```

At this point the server is ready to be further customized, depending on what you require (more storage pools, tape drives, clients, server to server configuration). See the following chapters for more details.

### 3.4.4 Uninstalling the server

If you need to uninstall the server, use rpm to uninstall the modules.

```bash
rpm -e TIVsm-license-5.3.2-0.i386.rpm
rpm -e TIVsm-server-5.3.2-0.i386.rpm
rpm -e TIVsm-tsmcs-5.3.2-0.i386.rpm
```

Depending on the customization you did to your server, after the uninstall completes, there may be still files in the server directory `/opt/tivoli/tsm/server/bin`, e.g. sample, database, log and storage pool files that got created during server installation. If you no longer are using the Tivoli Storage Manager server, you can delete them manually and remove the server directory.
3.5 Windows 2000/2003 server installation

Next, we show how to install the Tivoli Storage Manager server on a Windows 2000 or 2003 platform. The server in the lab has the latest service pack installed:

3.5.1 Tivoli Storage Manager server package installation

1. We are installing the downloadable package available to registered users from the Passport Advantage® Web site. Alternatively you might install from a CD. Before the installation begins, you are prompted for a location to store the temporary installation files - the default is C:\TSM_Images\TSMSRV5320_WIN. Once the package is extracted, click the Install Products option. An installation menu, as shown in Figure 3-1, is displayed.

![IBM Tivoli Storage Manager Server
Version 5.3.2.0](image)

Install Products

Recommended Installation Sequence:

- **TSM Server**
- **TSM Server Licenses**
- **TSM Language Packs**
- **TSM Device Driver**

Additional Installation:

---

Figure 3-1   Windows Tivoli Storage Manager server installation menu

2. Choose the TSM Server installation package first. The InstallShield Wizard will guide you through the installation of the package. Click Next on the wizard welcome window.
3. The license agreement confirmation is displayed next, please read the license agreement carefully. To accept the license agreement select “I accept the terms in the license agreement” and click Next.

4. Enter customer information and choose access rights to the Tivoli Storage Manager server application. We entered the following:
   – User name: Senegal
   – Organization: ITSO
   – Install this application for anyone who uses this computer.

Click Next.

5. The next window defines the setup type. You may choose Custom installation to select specific components only. However, we recommend that you choose Complete installation to make sure that all Tivoli Storage Manager server components and prerequisites are installed. If you do not want to install the server to the default install path “C:\Program Files\Tivoli\TSM” you can change the installation path on the custom setup page. Select Complete and click Next.

6. Now you can review your inputs to the installation wizard. If you are satisfied with your choices, click Install to begin the installation. The installation may take several minutes depending on the hardware used.

7. When the installation is complete, the InstallShield Wizard completion window will be displayed. Click Finish to return to the installation menu as shown in Figure 3-1 on page 76.

### 3.5.2 Tivoli Storage Manager License package installation

1. After the server has been installed, choose TSM Server Licenses from the installation menu, Figure 3-1 on page 76.

2. The InstallShield Wizard for IBM Tivoli Storage Manager License initiates. Click Next on the wizard welcome window.

3. Enter customer information and choose access rights to the Tivoli Storage Manager server application. We entered the following:
   – User name: Senegal
   – Organization: ITSO
   – Install this application for anyone who uses this computer.

Click Next.
4. Define the setup type. You may choose Custom installation to select specific components only or change the installation path of the package. We recommend you choose Complete installation to make sure that all Tivoli Storage Manager server license components and its prerequisites are installed. Select Complete and click Next.

5. Now you can review your inputs to the installation wizard. If satisfied with your choices, click Install to begin the installation.

6. When the server license installation is complete, the InstallShield Wizard completion window is shown. Click Finish to go back to the installation menu as shown with Figure 3-1 on page 76. Choose TSM Device Driver next for installation.

3.5.3 Tivoli Storage Manager Device Driver package installation

1. Choose TSM Device Driver from the installation menu, Figure 3-1 on page 76.

2. **Tip:** You should disable the Windows Removable Storage Manager (RSM™) component so that it will not conflict with Tivoli Storage Manager. To disable RSM, select RSM from the Windows services applet and change its startup type to disabled.

3. The InstallShield Wizard initiates. Click Next on the wizard welcome window.

4. Enter customer information and choose access rights to the Tivoli Storage Manager server application. We entered the following:
   - User name: Senegal
   - Organization: ITSO
   - Install this application for anyone who uses this computer.

   Click Next.
5. Define the setup type. You may choose **Custom** installation to select specific components only or change the installation path of the package. We recommend you choose **Complete** installation to make sure that all Tivoli Storage Manager device driver components and prerequisites are installed. Select **Complete** and click **Next**.

6. Now you can review your inputs to the installation wizard. If satisfied with your choices, click **Install** to begin the installation.

7. When the device driver installation is complete, the InstallShield Wizard completion window will be displayed. Click **Finish** to go back to the installation menu as shown in Figure 3-1 on page 76.

After the device driver installation, you will be prompted to reboot your system as shown in Figure 3-2. You should reboot before continuing.

![IBM Tivoli Storage Manager Device Driver 5.3.2.0 Install...](image)

*Figure 3-2  Windows reboot system after installation*

If you want to install a different language pack or the backup-archive client code on the same machine, you may do so by choosing those options in the install menu.

### 3.5.4 Windows 2000/2003 configuration wizards

The Tivoli Storage Manager server utilities are available through the Tivoli Storage Manger program group. These provide access to various configuration wizards, an administrative interface, a server console, Web sites, and other useful utilities. In particular, the initial configuration wizards provide a structured way to implement a Tivoli Storage Manager environment. Each of the configuration wizards is also available independently within the Server Utilities.
The wizards provide a good front end to some steps in Tivoli Storage Manager configuration. They are specially useful in the areas of licensing, services configuration, device configuration, volume formatting and media preparation. The configuration wizards are easier to use than the equivalent administrative interfaces, particularly for a new user, as they hide the details of the command interface and provide good help. However, you still need some Tivoli Storage Manager knowledge to create a good working environment.

The wizards and server utilities do not cover all aspects of an implementation and are not suited to bulk entry of definitions (large server configuration). This task is better handled through the use of administrative macros or scripts. Our recommendation is to use the wizards with care.

Figure 3-3 shows the main screen for the server configuration wizard.

Information: The configuration wizards are not discussed in this book. Documentation is provided on the use of these wizards in the section, “Performing the Initial Configuration”, of IBM Tivoli Storage Manager for Windows Quick Start, GC32-0784.
3.6 Integrated Solution Console and Administration Center

Tivoli Storage Manager V5.3 or later servers are administered through a new administrative GUI interface, the Administration Center. This replaces the old administrative web interface. The Administration Center is a Web-based interface used to centrally configure and manage Tivoli Storage Manager servers. The Administration Center is the only Web interface you can use to administer V 5.3 or later servers - the old administrative Web interface cannot be used for these.

You install the Administration Center as an IBM Integrated Solutions Console (ISC) component. The Integrated Solutions Console (ISC) allows you to install components provided by multiple IBM applications, and access them from a single interface.

The Tivoli Storage Manager server itself can require a large amount of memory, network bandwidth, and processor resources. In many cases, the server performs best when other applications are not installed on the same system. If your system meets the combined requirements for the server and the Administration Center (for example, it has at least 2 GB of physical memory), you can use it to install both applications on a single machine. However, if you plan to use the Administration Center to manage an environment with a large number of servers or administrators, consider installing the Administration Center on a separate system.

You can install the ISC on any supported platform, the installation is independent from the platform your Tivoli Storage Manager server is running on.

Figure 3-4 shows an example screenshot of the Administration Center health monitor, monitoring 5 servers: ATLANTIC, DIOMEDE, LOCHNESS_SERVER1, PALAU and WISLA.

**Note:** When you install or upgrade the server to Tivoli Storage Manager V5.3, you must give your servers unique names. If all of your servers have the default name, SERVER1, you will only be able to add one of them to the Administration Center. You will then have to set the server names of the other servers.
3.6.1 ISC and Administration Center installation

The ISC and the Administration Center are supported on AIX, Windows, Sun Solaris, and Linux. For detailed information on the system requirements and platform specific installation instructions check the Tivoli Storage Manager server installation guide for your operating system. As a brief introduction we will describe the installation steps on a Windows system here.

1. Go to the directory where you have unpacked the ISC and Administration Center code to. Start the installation with `setupISC.exe`. The InstallShield Wizard for IBM Integrated Solutions Console as shown in Figure 3-5 appears. Click Next.
2. The next screen shows detailed installation system requirements. This information is also available in the README file in the installation directory. Make sure that your system meets the requirements and click **Next**.

3. Review the license information. If you accept, select *I accept the terms of the license agreement* and click **Next**.

4. You are prompted to provide a Integrated Solutions Console user ID, password and password verification. We decided to keep the default ID, *iscadmin*. Once you have completed the input fields click **Next**.

5. Now you are prompted for the directory location to install the IBM Integrated Solutions Console. If you want to install to another directory, provide your input here, you can browse through your system for an alternate installation path. We kept the default of C:\Program Files\IBM\ISC601. Click **Next**.

6. Specify the ports to be used by the ISC. As a best practice, use secure ports to access the Administration Center. To do so, you must configure the ISC to use *Secured Sockets Layer (SSL)*. You can find detailed instructions in the Administrator’s Guide Appendix for your system. We kept the defaults:
   - Web administration port (HTTP): 8421
   - Secure Web administration port (HTTPS): 8422

Click **Next**. You will be asked to review and confirm your settings as shown in Figure 3-6.
7. To start the installation, click Next. The installation progress will be displayed as in Figure 3-7.
8. After the ISC installation is complete, a success screen is displayed. Click **Next**, then click **Finish**. You can now install the Administration Center which is provided as a separate package.

9. Change to the directory where you have extracted the Administration Center code to and start `setupAC.exe`. The InstallShield Wizard for Tivoli Storage Administration Center is displayed as shown in Figure 3-8. Click **Next**.
Figure 3-8 InstallShield wizard for Administration Center

10. Review the license information. If you accept, select *I accept the terms of the license agreement* and click **Next**.

11. To deploy the Administration Center component to the ISC, the Administration Center needs to know the values for the ISC installation path, ISC port used and the ISC administrator user ID. Review the information and if it is correct select *The information is correct on the review screen* and click **Next**.

12. For installation of the Administration Center you now need to enter the Integrated Solutions Console password. Use the one you defined in step 4 on page 83 and click **Next**.

13. The Administration Center can display information in languages other than English. You can enable language support in this step of the installation. If this support is enabled, the Administration Center attempts to display the same language as the Web browser used to access it. If the Web browser uses a different language than the Tivoli Storage Manager server, some information will be displayed in the language used by the server. To change the default language used by the Web browser, see the browser documentation. If you do not require a language other than English make no selection and click **Next**.

The installation configuration settings will be displayed for confirmation as shown in Figure 3-9.
14. Review the information and if it is correct click Next. The installation will start and the installation progress is displayed. Once the installation is completed a success screen like Figure 3-10 is shown. Click Next to finish the installation. You now can access the console through your Web browser under http://<machinename>:8421. We give more information on the Administration Center in 10.1.2, “Administration Center interface” on page 301.

**Note:** The Administration Center assumes that the host system is using a static IP address instead of a dynamically assigned IP address. A static IP address is necessary because the Administration Center server must be listed on your domain name servers, which map the host name to the physical address of the system.
3.7 Customization

The Tivoli Storage Manager server has a number of options and settings which control its operation. You specify the options in the server options, as well as some individual settings.

3.7.1 Options file

Tivoli Storage Manager has a server options file with a set of default options to start the server. You can modify the server options file using a text editor. On some platforms, Tivoli Storage Manager provides a server options file editor to perform this function. The supplied default server options file contains information on what options and option values can be specified. You can display the current server options via the query options command.

We provide recommended options files for the various server platforms, because the layout of the supplied options file is not immediately intuitive. See B.2, “Server options files” on page 744, which contains our server option files. The file options are presented in a more logical sequence than those provided during the install. We assume that TCP/IP is the network protocol.
Table 3-1 shows the default location of the Tivoli Storage Manager server options file by server platform. We recommend saving a backup copy of the existing options file before updating it.

**Table 3-1 Server options file location**

<table>
<thead>
<tr>
<th>Platform</th>
<th>File Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIX</td>
<td>/usr/tivoli/tsm/server/bin/dsmserv.opt</td>
</tr>
<tr>
<td>Linux</td>
<td>/opt/tivoli/tsm/server/bin/dsmserv.opt</td>
</tr>
<tr>
<td>HP/UX</td>
<td>/opt/tivoli/tsm/server/bin/dsmserv.opt</td>
</tr>
<tr>
<td>MVS</td>
<td>As specified by DDname OPTIONS</td>
</tr>
<tr>
<td>Solaris</td>
<td>/opt/tivoli/tsm/server/bin/dsmserv.opt</td>
</tr>
<tr>
<td>Windows 2000/2003</td>
<td>C:\Program Files\Tivoli\tsm\server\dsmserv.opt</td>
</tr>
</tbody>
</table>

Although the number of server options is very large, there are only a small number that need to be changed for each server. These options fall into the following categories:

- Communication
- Server storage
- Client server
- Site-dependent options
- Database and recovery log
- Data transfer
- Message
- Event logging
- Security and licensing
- Miscellaneous

Make sure to set the following options before continuing any configuration on your Tivoli Storage Manager server:

- COMMmethod
- TCPport
- VOLUMEHistory
- DEVCONFig
- TCAPADMINPORT

**Note:** At server initialization, the server reads the server options file. If you update a server option by editing the file, you must stop and restart the server to activate the updated server options.
For more information about the different server options, see *IBM Tivoli Storage Manager Quick Start Manual* and *Administrator's Reference Manual* for your platform.

### 3.7.2 Settings

Tivoli Storage Manager provides default server run-time settings. These settings are stored in the Tivoli Storage Manager database and persist across server restarts. You specify the server settings via the administrative interface. You can display the current server settings via the `query status` command.

The default values for the server settings are generally acceptable. There are a few settings for which we recommend values other than the defaults. The settings are changed via the `set` command and fall into the following categories:

- Security related settings
- Our recommended settings

#### Security related settings

Table 3-2 shows the various default security related settings for the server. We recommend that you select values for these settings which reflect the security policy at your site.

<table>
<thead>
<tr>
<th>Setting and Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUTHENTICATION ON</td>
<td>Whether administrators and client nodes must use a password to access the server</td>
</tr>
<tr>
<td>INVALIDPWLIMIT 0</td>
<td>Maximum number of failed logon attempts before a node or administrator is locked</td>
</tr>
<tr>
<td>MINPWLENGTH 0</td>
<td>Minimum length of a password</td>
</tr>
<tr>
<td>PASSEXP 90</td>
<td>Password expiration period</td>
</tr>
</tbody>
</table>

For example, consider the security policy at a company which specifies that all passwords must be changed every 90 days and must be a minimum of six characters in length. If three invalid passwords are entered in response to a password prompt, that user must have the system access revoked.

Example 3-10 shows how this policy is implemented through administrative commands:

**Example 3-10 Setting security related commands on the server**

```bash
  tsm: TSM> set authentication on
  ANR2095I Authentication parameter set to ON.
```
tsm: TSM> set invalidpwlimit 3
ANR2175I Invalid password limit set to 3 attempts.
tsmtm: TSM> set minpwlengt 6
ANR2138I Minimum password length set to 6.
tsmtm: TSM> set passexp 90
ANR2092I Password expiration period set to 90 days.

Recommended server settings
We recommend changing some of the default server settings.

The accounting server setting determines whether an accounting record is created every time a client node session ends. The default is not to create these records. We recommend that accounting be switched on to collect these records. For zOS systems, this information is recorded in the Systems Management Facility (SMF). For other systems, this information is written to a file which contains text records that can be viewed directly or can be imported into a spreadsheet program.

All Tivoli Storage Manager server activity is recorded in an activity log. This log is located in the Tivoli Storage Manager database and contains text messages. The log is pruned automatically every night at midnight. The default retention period for the log is only one day. This does not provide an adequate amount of information for production systems. We recommend that you specify a value of between seven and 14 days.

The administrative commands to collect accounting information and keep server activity log records for 10 days, are shown in Example 3-11. We are using the command-line interface (CLI) to enter these commands - see 10.2.3, “Command line interface” on page 308 for information on how to invoke this.

Example 3-11  Set accounting on

```
tsm: TSM> set accounting on
ANR2091I Accounting parameter set to ON.
```

```
tsm: TSM> set actlogretention 10
ANR2090I Activity log retention period set to 10 days.
```

3.8 Summary
Now you have your Tivoli Storage Manager server installed. It is time to move on to installing the clients and testing your initial backup configuration. The following chapter talks specifically about configuring clients.
Backup-archive client installation

Now that you have your server installed, in this chapter we cover the steps you must perform to install and configure the backup-archive client. We also show you how to configure the backup-archive client to work either as a foreground program or as a background process, so that you can automate the backup processes using the scheduler facility. See 2.2, “Client environment data” on page 16 for planning considerations.
4.1 **Backup-archive client code**

There are three types of Tivoli Storage Manager client. Here we describe some of their characteristics.

4.1.1 **Backup-archive client**

The first type is the native *backup-archive client*. This client code is installed on every Tivoli Storage Manager client node and provides the local interface to back up and restore operations on that node. The client code includes a command line interface (CLI) and a graphical user interface (GUI), either Java-based or native, depending on the platform. On most platforms both CLI and GUI are provided, but there are some exceptions - see 4.6, “Client interfaces” on page 159 for details of platform support. With these interfaces you can by default back up and restore files from that client node.

4.1.2 **Web client**

The second type is the *Web client*, which provides a remote interface to back up and restore operations on a Tivoli Storage Manager client node. This client is particularly suitable for help desk operations. The help desk administrator can perform restores on behalf of the end users as required without having to be physically present at that client, and only needs an Internet browser installed on their systems. The client who is receiving the remote operations needs to install the backup/archive client code, including the Web client component. Figure 4-1 shows the difference between a traditional restore using the native backup-archive client and using the Web client.
The Web backup-archive client main window is shown in Figure 4-2. Its functions are described in the following sections.
The Web client has components which must be installed and configured on any client node which will be remotely accessed. For example, in Figure 4-1 on page 95, Hermione’s system needs the Web client components of the backup-archive client set up, so that the help desk staff can perform backup and restore operations for her using the browser.

The Web client is installed with the backup-archive client package. The Web client consists of two processes on the client workstation: the client acceptor and the remote client agent.

The client acceptor is an HTTP daemon that serves the Web client Java applet to the Web browser. The executable name is DSMCAD. On UNIX and Linux clients, it should be run as a daemon. For Windows 2000, XP, or 2003, it is installed and run as a service called *TSM Client Acceptor*. 
The remote client agent performs the client functions initiated with the Web client interface. The name of the executable is DSMAGENT. The agent does not have to be running all the time. The acceptor daemon starts the agent when client functions are initiated through the Web client interface.

4.1.3 API client

The third type is the application program interface (API) client. This client allows other applications from IBM and other vendors to access programmatically, the Tivoli Storage Manager services. For more information on the API client, see IBM Tivoli Storage Manager Using the Application Program Interface, GC32-0793.

4.2 Code installation

In this section we cover backup-archive client code installation on AIX, Linux, and Windows operating system platforms. The procedure for installation is generally the same across all platforms; however there are some minor differences. For more information on installation and configuration of the backup-archive client, refer to the latest version of IBM Tivoli Storage Manager Backup-Archive Clients Installation and User’s Guide for your specific platform.

Backup-archive client code

The backup-archive client is installed on each machine that you need to protect with backups. After installing the client code and customizing how it should interact with the Tivoli Storage Manager server, you have a working machine ready to send and receive data. Figure 4-3 shows our lab setup for installing and configuring the Tivoli Storage Manager client code.
Tivoli Storage Manager client code fixes and enhancements are released regularly. We strongly recommend obtaining the latest code level before starting any installation. You should also check for any recent FLASHES of late breaking product news which may affect your implementation. You may subscribe to updates via RSS, or regularly visit the Web site: The Tivoli Storage Manager support Web site is at:


### 4.2.1 AIX backup-archive client

This section shows how to install the Tivoli Storage Manager backup-archive client code on a pSeries running AIX V5.3 with 64-bit kernel.

**Note:** With IBM Tivoli Storage Manager V5.3, there is no longer a separate 64-bit AIX client package. The same V5.3 client can be used on either 32-bit or 64-bit machines. Also note, that the root user must install the clients filesets.

Here are the steps:
1. Insert either the Tivoli Storage Manager client for AIX installation CD in the CD-ROM drive or store a downloaded installation package on your file system. As root, enter `smitty installp` from the shell prompt.

2. Choose **Install and Update from ALL Available Software** as shown in Example 4-1.

   **Example 4-1   Installation from ALL available Software**

   ![Installation from ALL available Software](image)

   Install and Update Software

   Move cursor to desired item and press Enter.

   - Install Software
   - Update Installed Software to Latest Level (Update All)
   - Install Software Bundle
   - Update Software by Fix (APAR)
   - **Install and Update from ALL Available Software**

3. Select the device to be used for installation. Example 4-2 shows the available sources for the installation package. We selected the CD-ROM.

   **Example 4-2   Select source for installation**

   ![Select source for installation](image)

   Install and Update from ALL Available Software

   Type or select a value for the entry field.
   Press Enter AFTER making all desired changes.

   * INPUT device / directory for software  

   ![Input device directory for software](image)

   ![Input device directory for software](image)
4. Select the filesets to install as shown in Example 4-3. Place the cursor in the **Software to install** option and press F4 to display the list of available filesets.

**Example 4-3  Select software filesets**

Install and Update from ALL Available Software

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

<table>
<thead>
<tr>
<th>[Entry Fields]</th>
</tr>
</thead>
<tbody>
<tr>
<td>* INPUT device / directory for software</td>
</tr>
<tr>
<td>* SOFTWARE to install</td>
</tr>
<tr>
<td>PREVIEW only? (install operation will NOT occur)</td>
</tr>
<tr>
<td>COMMIT software updates?</td>
</tr>
<tr>
<td>SAVE replaced files?</td>
</tr>
<tr>
<td>AUTOMATICALLY install requisite software?</td>
</tr>
<tr>
<td>EXTEND file systems if space needed?</td>
</tr>
<tr>
<td>OVERWRITE same or newer versions?</td>
</tr>
<tr>
<td>VERIFY install and check file sizes?</td>
</tr>
<tr>
<td>DETAILED output?</td>
</tr>
<tr>
<td>Process multiple volumes?</td>
</tr>
<tr>
<td>ACCEPT new license agreements?</td>
</tr>
<tr>
<td>Preview new LICENSE agreements?</td>
</tr>
</tbody>
</table>

---

We installed the following filesets:

tivoli.tsm.client.ba.jfs2

tivoli.tsm.client.api.jfs2

tivoli.tsm.books.en_US.client.htm

The tivoli.tsm.client.ba.jfs2 fileset contains the following packages:

tivoli.tsm.client.ba.jfs2.base

tivoli.tsm.client.ba.jfs2.common

tivoli.tsm.client.ba.jfs2.image

tivoli.tsm.client.ba.jfs2.nas

tivoli.tsm.client.ba.jfs2.web

5. Perform a preview install to ensure there is sufficient disk space and that all prerequisite filesets have been selected. Example 4-4 shows the Preview only and Preview new LICENSE agreements options set to Yes.

**Example 4-4  Smitty screen - preview only installation**

Install and Update from ALL Available Software

Type or select values in entry fields.
Press Enter AFTER making all desired changes.
[Entry Fields]
* INPUT device / directory for software               /dev/cd0
* SOFTWARE to install                                [+ 5.3.2.0  TSM BOOKS > +
  PREVIEW only? (install operation will NOT occur)    yes +
  COMMIT software updates?                           yes +
  SAVE replaced files?                                no +
  AUTOMATICALLY install requisite software?           yes +
  EXTEND file systems if space needed?                yes +
  OVERWRITE same or newer versions?                  no +
  VERIFY install and check file sizes?                no +
  DETAILED output?                                   no +
  Process multiple volumes?                          yes +
  ACCEPT new license agreements?                     yes +
  Preview new LICENSE agreements?                    no +

**Note:** To install the backup-archive client on AIX V5.1 or later, you must accept the license agreement. You can view the license agreement by selecting **Yes** on the **Preview new LICENSE agreement** option in **smit**.

6. If there is sufficient disk space and preview did not indicate any missing requisite filesets, perform the actual install. Example 4-5 shows the **Preview install** option set to **No** and **Accept new LICENSE agreements** set to **Yes**.

**Example 4-5   Smitty screen - preview of installation**

Install and Update from ALL Available Software

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

[Entry Fields]
* INPUT device / directory for software               /dev/cd0
* SOFTWARE to install                                [+ 5.3.2.0  TSM BOOKS > +
  PREVIEW only? (install operation will NOT occur)    no +
  COMMIT software updates?                           yes +
  SAVE replaced files?                                no +
  AUTOMATICALLY install requisite software?           yes +
  EXTEND file systems if space needed?                yes +
  OVERWRITE same or newer versions?                  no +
  VERIFY install and check file sizes?                no +
  DETAILED output?                                   no +
  Process multiple volumes?                          yes +
  ACCEPT new license agreements?                     yes +
  Preview new LICENSE agreements?                    no +
7. Example 4-6 shows the final output after installation - including the list of
filesets which were installed and the status of the installation.

**Example 4-6  Smitty screen - installation complete**

<table>
<thead>
<tr>
<th>Name</th>
<th>Level</th>
<th>Part</th>
<th>Event</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>tivoli.tsm.client.api.jfs2</td>
<td>5.3.2.0</td>
<td>USR</td>
<td>APPLY</td>
<td>SUCCESS</td>
</tr>
<tr>
<td>tivoli.tsm.books.en_US.clie</td>
<td>5.3.2.0</td>
<td>USR</td>
<td>APPLY</td>
<td>SUCCESS</td>
</tr>
<tr>
<td>tivoli.tsm.client.ba.jfs2.c</td>
<td>5.3.2.0</td>
<td>USR</td>
<td>APPLY</td>
<td>SUCCESS</td>
</tr>
<tr>
<td>tivoli.tsm.client.ba.jfs2.w</td>
<td>5.3.2.0</td>
<td>USR</td>
<td>APPLY</td>
<td>SUCCESS</td>
</tr>
<tr>
<td>tivoli.tsm.client.ba.jfs2.n</td>
<td>5.3.2.0</td>
<td>USR</td>
<td>APPLY</td>
<td>SUCCESS</td>
</tr>
<tr>
<td>tivoli.tsm.client.ba.jfs2.i</td>
<td>5.3.2.0</td>
<td>USR</td>
<td>APPLY</td>
<td>SUCCESS</td>
</tr>
<tr>
<td>tivoli.tsm.client.ba.jfs2.b</td>
<td>5.3.2.0</td>
<td>USR</td>
<td>APPLY</td>
<td>SUCCESS</td>
</tr>
</tbody>
</table>

**Note:** The Tivoli Storage Manager Client for JFS2 is not compatible with the
Tivoli Storage Manager client for JFS or GPFS. Therefore, if you select to
install a combination of filesets from JFS and JFS2 filesets, the installation
would fail. The Tivoli Storage Manager Client for JFS2 client allows you to
backup and restore files from a JFS or GPFS file system. However, migration
and recall for Space Managed client (HSM) is possible only from a JFS2 file
system.

### 4.2.2 Linux backup-archive client

We installed the client code on SuSE and Redhat Linux distributions. The
installation packages are in “rpm” format.

Store the compressed installation package on the machine where you want to
install the backup-archive client and do the following:

1. Decompress the zip file and unpack the tar file, as in Example 4-7. The
   command output was actually longer, as there were a number of localization
   files which we deleted for clarity.

**Example 4-7  Unpacking Linux client installation packages**

```bash
wisla:/tmp/tsm_client # gzip -dc TSMLinuxCliV5.3.2.tar.gz | tar -xvf -
```
2. You need to install two rpm packages - TIVsm-API.i386.rpm and TIVsm-BA.i386.rpm, using the `rpm` utility, shown in Example 4-8. The API package must be installed before the BA package as it contains libraries the BA package depends on.

   **Example 4-8 Installing Linux client packages**

   ```
   wisla:/tmp/tsm_client/linux86 # rpm -ivh TIVsm-API.i386.rpm
   Preparing...                                      [100%]
   package TIVsm-API-5.3.2-0 is already installed
   wisla:/tmp/tsm_client # rpm -e TIVsm-API
   wisla:/tmp/tsm_client # rpm -ivh TIVsm-API.i386.rpm
   Preparing...                                      [100%]
   1:TIVsm-API                                       [100%]
   Postinstall of the API
   TSM Linux API installation complete.
   Be sure to set up the configuration files!
   ```

   ```
   wisla:/tmp/tsm_client/linux86 # rpm -ivh TIVsm-BA.i386.rpm
   Preparing...                                      [100%]
   1:TIVsm-BA                                        [100%]
   Postinstall of the Backup Archive client
   TSM Linux client installation complete.
   Be sure to set up the system configuration file before starting the client!
   ```

3. After successful installation, you can display the installed filesets using the `rpm query` command, as shown in Example 4-9.

   **Example 4-9 Querying for installed client packages on Linux**

   ```
   wisla:/tmp/tsm_client/linux86 # rpm -qa | grep -i TIV
   TIVsm-BA-5.3.2-0
   TIVsm-API-5.3.2-0
   ```
For more information on UNIX and Linux installation and prerequisites, see *IBM Tivoli Storage Manager for Unix and Linux Backup-Archive Clients Installation and User's Guide*, GC32-0789

4.2.3 Windows backup-archive client

We installed the backup-archive client code on Diomede, running Windows 2003 Server. The same installation package is used for other supported Windows platforms, such as Windows XP, or Windows 2000.

There are two ways to install the backup-archive client on Windows - the standard Installshield wizard or with the command line. The latter is known as a silent, or unattended client installation. By placing a customized version of the `msiexec` command (which invokes the Microsoft Software Installer) in a script or batch file, you can easily perform installations on multiple Windows machines.

Installshield method

1. Insert the installation CD and when the autorun displays the main installation window, click **Install Products** item to begin. Figure 4-4 shows the available backup-archive client installation packages.

![IBM Tivoli Storage Manager Client
Version 5.3.2.0](image)

**Install Products**

- **TSM Backup-archive Client - x32**
- **TSM Backup-archive Client - IA64**
- **TSM Backup-archive Client - x64**
- **TSM Language Packs - x32**
- **TSM Language Packs - IA64**
- **TSM Language Packs - x64**
- Additional Installation:
  - **TSM ODBC Client**

*Figure 4-4  Backup-archive client installation packages*
Click the appropriate product for your operating system platform. Our machine runs the 32-bit version of Windows 2003 on an x86-based processor, so we choose to install TSM Backup-archive Client - x32.

2. Selecting the language environment for the installation process, in our case English. The Installshield wizard then starts the installation process. Click Next and you are given an option to specify the destination folder, where the client code is to be installed. In Figure 4-5 on page 105, we chose to install the code in the default installation path, which is the recommended destination.

![IBM Tivoli Storage Manager Client - InstallShield Wizard](Image)

**Figure 4-5  Client code destination**

3. Choose the type of installation - in Figure 4-6 we chose a typical installation. You may choose Custom installation to select additional components and features, such as Open Files support, Image backup support, and more. However, when these features are not required, our recommendation is to choose Typical installation to make sure that all Tivoli Storage Manager basic client components and prerequisites are installed. Also, a Typical installation without the additional components mentioned above does not require a reboot after the client installation. You may install them later, when required.
4. You are now ready to begin the Tivoli Storage Manager client installation. Here, you have the option to go back and review your inputs to the installation wizard. If satisfied with your choices, click **Install** to begin the installation.

5. When the installation is done, the window shown in Figure 4-7 will be displayed. Click **Finish** to end the installation.
Chapter 4. Backup-archive client installation

Figure 4-7  Completion of client installation

This concludes the interactive installation of the Windows backup-archive client.

**Silent installation**

Example 4-10 on page 108 shows a sample command to silently install the backup-archive command line client, GUI client, Web client, API and HTML help files. You may need to customize this example to run correctly on your system. While the command is physically spread across multiple lines on this page, it is one single command. You can modify the example to also install a Tivoli Storage Manager Backup-Archive Client Language Pack.

Under certain conditions, a system reboot might be necessary for the installation to complete successfully. You may specify options *RebootYesNo* and *REBOOT* to suppress this. These options causes the installation program to not reboot the system if circumstances would otherwise cause the reboot to occur. While this option is convenient, it should be used with caution because suppressing the reboot might cause the program to behave unpredictably. The most common reason that a reboot is required is if the installation is an upgrade to an existing Tivoli Storage Manager client, and the installation is performed while the client programs are running. Therefore, we recommend that you shut down all Tivoli Storage Manager client programs and services before performing the installation.
Example 4-10 Backup-archive sample client silent installation

c:/>msiexec /i "C:\WindowsClient5.3.2\tsmcli\x32\client\Disk1\IBM Tivoli Storage Manager Client.msi" RebootYesNo="No" REBOOT="Suppress" ALLUSERS=1 INSTALLDIR="c:\program files\tivoli\ tsm" ADDLOCAL="BackupArchiveGUI,BackupArchiveWeb,ApiRuntime,Readmes" TRANSFORMS=1033.mst /qn /l*v "c:\log.txt"
c:/>

The installation process creates a Tivoli Storage Manager folder in the programs folder of the Windows Start menu. You may review the logfile the details on installation procedure.

4.3 Customization

The following sections describe the various settings for the backup-archive client and the Web backup-archive client.

4.3.1 Backup-archive client customization

This section discusses how to customize the client installation:

- Setting environment variables
- Defining client options files
- Defining include-exclude lists

For a more detailed explanation, see the Backup-Archive Client Installation and User's Guide for each platform.

To customize the client, you can either manually edit the files described below, or use the client configuration wizard available on most platforms, as described in 4.3.3, “Using the client configuration wizard” on page 115.

Environment variables

These are the variables to update and set in your client environment:

- **PATH**: This is the default search path that the operating system uses to locate executable files. Set this to include the fully qualified path of the Tivoli Storage Manager client directory, where executables such as dsmc or dsm reside.

- **DSM_CONFIG**: Specifies the location of the client options file dsm.opt. Set this environment variable to the fully qualified path and filename of the client options file.

- **DSM_DIR**: Specifies the location of all other client files. Set this environment variable to the directory where the client message file dsc*.txt, the executable
file dsmc and the resource files are located. On UNIX/Linux clients, this
directory also contains the dsm.sys option file.

- **DSM_LOG**: Points to the directory where you want the dsmerror.log,
dsmwebcl.log, and dsmsched.log files to reside. The error log file,
dsmerror.log contains information about any processing errors. The Web log
file, dsmwebcl.log is for errors that occur when the client is accessed through
the Web interface. The schedule log, dsmsched.log contains the output of
scheduled commands.

**Note**: DSM_LOG environment variable changes have been made in the Tivoli
Storage Manager V5.3 client and later to prevent a security or data integrity
problem. Logs are no longer created in the installation directory. In addition, if
the client cannot open a required log for writing, the client process will
terminate - the Tivoli Storage Manager command line client, the web client
acceptor and agent will NOT run without a writable dsmerror.log.

- **LANG**: On AIX, HP-UX, Solaris, Linux, and Windows platforms, the
backup-archive client automatically detects the language of the system locale
and displays in that language. To change the locale on UNIX/Linux, use the
LANG environment variable. For example, if LANG is set to Czech, the
backup-archive is displayed in Czech, provided that the Czech client
language pack is installed. If Tivoli Storage Manager cannot load the Czech
message catalog, it will default to the English (United States) language pack.
On Windows platforms, use the LANGUAGE client option to change the
national language in which the client displays the messages.

**Options file**
Tivoli Storage Manager includes options that control processing for user
sessions. For example, you can use options to tell Tivoli Storage Manager which
communication method to use, or what format to use for dates, whether to use
client compression, and more.

We provide recommended options files for the various client platforms, as the
layout of the supplied options file is not immediately intuitive.

The backup-archive client has at least one configuration file, which is divided into
the following parts:

- Communication options
- Operational options
- Site-dependent options
- Include-exclude options
Some of the configuration steps on the client side may need complementary configuration on the Tivoli Storage Manager server side.

On all non-UNIX platforms, all options reside in the client options file, dsm.opt (Preferences file for Macintosh) which resides by default in the Tivoli Storage Manager client installation directory.

On UNIX (including Linux), the root user can set options in three different files:

- **Client system options file (dsm.sys):** Contains options required to establish communication with a Tivoli Storage Manager server, and options that authorize users on the client node to use Tivoli Storage Manager services. It can also contain options that affect backup and archive processing, and options that affect scheduled services.

- **Client user options file (dsm.opt):** Contains options that determine which Tivoli Storage Manager server is used, and that specify the formats for date, time, and numbers. Can also contain options affecting backup, archive, restore, and retrieve processing. Users can also create their own personalized client user options file if they want to use different options. Options from a client user options file can be over-ridden by using appropriate Tivoli Storage Manager commands.

- **Include-exclude options file:** Specifies file and directory patterns to be included and/or excluded from backup services. It also contains statements to associate specific files with different management classes. This file can be called any legal filename and be located in any directory, provided that its full pathname is referenced in the dsm.sys file.

Because there are many different options and setting possible in these files, we provide recommended client options files for various client platforms in B.3, “Client options files” on page 750. We assume that TCP/IP is the network protocol. Most options may also be centrally set using client option sets on the Tivoli Storage Manager server - see 8.3, “Client option sets” on page 286 for more information on this.

**Communication options**

Each Tivoli Storage Manager client needs some basic communication settings to send or receive data. You can choose any protocol that is supported by Tivoli Storage Manager, provided that both client and server are properly configured for them. Depending on the type of Tivoli Storage Manager server, you may need help from the system administrator to put all the necessary communication definitions in place. The server may have multiple communication protocols configured. If that is the case, you may choose any of those to start communicating with the Tivoli Storage Manager server.

Here is a list of communication options you need to set:
- **COMMMETHOD**: Specifies the communication method used for client-server communication. The Tivoli Storage Manager server options file (dsmseriv.opt) must have specified the same communication method with a valid port address, so that the server can accept client requests. Examples of various communications methods available are TCP/IP, HTTP (for web client), shared memory or named pipe. The vast majority of Tivoli Storage Manager configurations use TCP/IP for regular backup-archive operations.

- **TCPSERVERADDRESS**: Specifies the TCP/IP address or hostname of a Tivoli Storage Manager server. If using the hostname, make sure that it is resolvable on the client machine, otherwise, you will not be able to connect to the Tivoli Storage Manager server. If you use name resolution, you will depend on the DNS to be up and running. If you believe that name resolution may not be always available during your backup windows, consider using the IP address instead. Although it gives you less flexibility, it will work despite any name resolution service problem.

- **TCPPORT**: Specifies a TCP/IP port address for a Tivoli Storage Manager server. The default value is 1500.

- **TCPCLIENTPORT**: Specifies a different TCP/IP port number for the server to contact than the one that was used to make the first server contact. This option is used with server-prompted scheduling, and only while the scheduler is running. The default value is 1501.

- **TCPWINDOWSIZE**: Specifies the size, in kilobytes, of the TCP/IP sliding window for the client node. This setting is highly operating-system specific. You must only use the allowed values for your TCP/IP implementation.

- **TCPBUFFSIZE**: Specifies the size, in kilobytes, of the Tivoli Storage Manager internal TCP/IP communication buffer. This setting is highly operating-system specific. You must only use the allowed values for your TCP/IP implementation.

- **NODENAME**: Indicates the client node name - to over-ride the default value of the hostname.

- **HTTPPORT**: Specifies a TCP/IP port where the Tivoli Storage Manager Client Acceptor (Web client) will listen for potential connections from remote users. By default, if the Web client is configured, it listens on port 1581.

- **WEBPORTS**: Enables the use of the Web client outside a firewall by specifying the TCP/IP port numbers used by the Tivoli Storage Manager Client Acceptor service and Web Client Agent service for communications with the Web client.
**When using firewalls:** Use of firewalls requires additional configuration setting and in considerations when using Tivoli Storage Manager. To allow clients to communicate with a server across a firewall, the ports specified in these options must be open in the firewall:

- **TCPPORT**
- **HTTPPORT**
- **WEBPORTS**

However, if the client scheduler is running in server-prompted mode, it is not necessary to open any ports on the firewall. You can set the option `SESSIONINITIATION` to `serveronly` in the client options file and then the client will not attempt to contact the server. The `SESSIONINITIATION` option only affects the behavior of the client scheduler when running in prompted mode.

**Operational options**

Here are some examples of client options for backup, restore, and scheduling services.

- **PASSWORDACCESS:** Specifies whether you want your Tivoli Storage Manager client node password to be automatically provided by the client whenever the client initiates a session to the server or you want to be prompted to enter it. We highly recommend setting PASSWORDACCESS to GENERATE, as this provides a secure way for exchanging passwords and generating a new one whenever the old client node password expires.

- **REPLACE:** Specifies default behavior for when Tivoli Storage Manager restores files that already exist on the client node. This option applies to the `restore` and `retrieve` commands only.

- **SUBDIR:** Specifies whether you want Tivoli Storage Manager to include subdirectories of named directories during the client operations. This option applies, e.g., to `selective`, `restore`, `archive`, and `retrieve`.

- **TAPEPROMPT:** Specifies whether to wait for a tape to mount if it is required for an interactive backup, archive, restore, retrieve operation, or to prompt the user for a choice. The TAPEPROMPT setting has no impact on scheduled operations.

- **SCHEDMODE:** Specifies whether to use client-polling mode (the client node periodically asks the Tivoli Storage Manager server for scheduled work), or server-prompted mode (the server contacts the client node when it is time to start a scheduled operation). All communication methods can use client-polling mode, but only TCP/IP can use server-prompted mode. More information about scheduling operations is in 12.3, “Client schedules” on page 374.
► **CLUSTERNODE:** Specifies that the client participates in a clustered environment (e.g. HACMP™, MSCS, VERITAS Cluster Service, Novell Cluster Service).

► **COMPRESSION:** If set to yes, the client compresses objects before sending them to the Tivoli Storage Manager server.

► **DIRMC:** Specifies the management class for directories to bind to. If you do not specify this option to associate a management class with directories, the management class in the active policy set of your policy domain with the longest retention period will be used for directories. We recommend that you select a management class for individual directories that retains directories at least as long as it retains the files associated with them.

### Site dependent options

If your locale is not US English, then we recommend that you adjust the date, number, and time format options and also the language option in your client options file to support your requirements. Respective client options are *DATEFORMAT, NUMBERFORMAT* and *TIMEFORMAT*.

### Include-exclude options

The include-exclude options are written into the client user options file dsm.opt on non-UNIX platforms. On UNIX/Linux, include-exclude options are either written into the client system options file (dsm.sys) or in a separate file, called the include-exclude file. If you use a separate include-exclude file, rather than including the statements directly, use the option INCLEXCL in the client system options file dsm.sys to indicate the name and location of the include-exclude file:

```
INCLEXCL /tsm/server1/inclexcl.file
```

Having determined where to put the include-exclude options, here is how to specify them. The two statements INCLUDE and EXCLUDE are used.

The INCLUDE option specifies files to include for backup services. Also use this option to assign a management class either to specific files or to all files to which you have not already assigned a specific management class, and for which you do not want Tivoli Storage Manager to use the default management class.

The EXCLUDE option excludes files from backup or archive services. When you back up files, any files you exclude are not considered for backup. For example, we recommend excluding the Tivoli Storage Manager installation directory.

Further, a combination of exclude and include rules may be used to enforce compression or encryption on certain subsets of files.

Include-exclude options are checked from the bottom up to the top of the list until a match is found. If so, the processing stops and checks whether the option is
INCLUDE or EXCLUDE. If the option is INCLUDE, the file is backed up, using the assigned management class. If the option is EXCLUDE, the file is not backed up. Any file which does not match any of the rules is automatically included for backup and is bound to the default management class.

Tip: If your workstation is memory constrained, specify the option, MEMORYEFFICIENTBACKUP Yes in your client options file. Specifying Yes reduces memory consumption but increases backup time.

You can also use the RESOURCEUTILIZATION option to increase the number of parallel sessions initiated to the Tivoli Storage Manager server. By default, a client uses two sessions: one session to query the server and one to send file data. For example, a RESOURCEUTILIZATION 10 setting permits up to eight sessions with the server, which may result in faster backup as multiple filespaces are backed up in parallel.

### 4.3.2 Web backup-archive client

These client options are important when using the Web client:

**PASSWORDACCESS**

The PASSWORDACCESS option must be set to generate and the password itself must be generated by first running a backup-archive client session. The remote client agent establishes connection to Tivoli Storage Manager in the same manner as the backup-archive GUI and command line clients. It requires the generated client password to authenticate a client session when the Web client is used.

**HTTPPORT**

The acceptor daemon listens on a TCP/IP port for incoming connections from an administrator’s Web browser. By default it listens on port 1581. This default port can be overridden with the HTTPPORT client option.

**REVOKEREMOTEACCESS**

The REVOKEREMOTEACCESS option has two possible values: none, which is the default, and access. If the option is set to none, any administrator userid with either client access or client owner authority can perform client operations. If the option is set to access, administrator userids with only client access authority cannot perform remote client operations. A pop-up message displayed in the Web browser indicates that the administrator userid being used has insufficient authority. Administrators with client owner or higher authorities can still perform client functions. Table 4-1 on page 95 summarizes the Web client options.

Tip: If your workstation is memory constrained, specify the option, MEMORYEFFICIENTBACKUP Yes in your client options file. Specifying Yes reduces memory consumption but increases backup time.

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WEBPORTS
The WEBPORTS option is used in firewall environments and was explained in “Communication options” on page 110.

Table 4-1 Web client options

<table>
<thead>
<tr>
<th>Option</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PASSWORDACCESS</td>
<td>GENERATE</td>
</tr>
<tr>
<td>HTTPPORT</td>
<td>1581</td>
</tr>
<tr>
<td>REVOKEREMOTEACCESS</td>
<td>NONE</td>
</tr>
<tr>
<td>WEBPORTS</td>
<td>CADPort and AgentPort, defaults are 0</td>
</tr>
</tbody>
</table>

4.3.3 Using the client configuration wizard

The next sections describe how to use the backup-archive client configuration wizard on UNIX/Linux and Windows platforms.

When the GUI client starts, it checks to see whether a client user options file exists. If the client user options file does not exist (which is typically the case when the client is first installed), the setup wizard automatically starts to guide you through the configuration process. You can re-launch the setup wizard at any time to modify your client configuration files.

The wizard creates the options files, with the specified values - so it is an alternative to setting all the options we have presented in the previous sections.

Note: If you are using the setup wizard in the Java GUI, on UNIX or Linux platforms, a new dsm.opt and dsm.sys is created, overwriting the existing dsm.opt and dsm.sys file. The Java GUI should only be used for initial setup if a previous dsm.opt or dsm.sys file does not exist, otherwise, existing dsm.opt or dsm.sys files will be overwritten.

This does not apply to the native Windows and Macintosh clients.

4.4 Using the UNIX/Linux configuration wizard

The configuration wizard figures taken and procedures described below were performed on an AIX system; however the techniques and options are similar on all other platforms where the Java GUI is available.

The configuration wizard is used to create, update, or delete the client options files.
In this section, we show you how to create a new client options file using the client configuration wizard in the backup-archive client Java GUI.

**Important:** Before configuring the client, the Tivoli Storage Manager administrator must have defined the client to the Tivoli Storage Manager server, using the `register node` command. The administrator will supply you with the defined node name and password to use in the configuration. See 8.2.3, “Working with client nodes” on page 280 for more information on defining clients at the server.

1. Open the Java GUI, with the command `dsmj`. Since this is the first time we run the client, and the options file is not configured yet, the client wizard starts immediately, as shown in Figure 4-8. We choose **Create a new options file** and click **Next**.

![Figure 4-8 Java GUI client configuration wizard](image)

2. In the next screen (Figure 4-9) enter the Tivoli Storage Manager server name. On UNIX clients, you may create multiple server definitions in your central option file (dsm.sys) each with different settings. Each set of definitions uses a different stanza in the dsm.opt file and is identified by a *stanza* name,
corresponding to the Tivoli Storage Manager server name. We enter the server name TSM_ATLANTIC - do not use IP address or host name here.

**Figure 4-9  Server name definition**

3. Next specify the communication method between the client and the server. In our lab, we installed the client on the same machine as the server, so could use either of two methods - TCP/IP and Shared Memory (available only if client resides on the same machine as server code). We chose TCP/IP, as in Figure 4-10, since this is the most common method across all client types.

**Figure 4-10  Client/Server communication method screen**
4. When using the TCP/IP communication method, we need to provide the address of the server and the TCP/IP port the server instance listens on, as in Figure 4-11. You may use either TCP/IP address or hostname. In our case, the server is installed on the same machine as the client, ATLANTIC, and since we do not want to depend on name resolution services, we provide the dotted IP address. Our server listens on the default port number, 1500.

![Figure 4-11 Setting up communication parameters](image)

5. Enter the client node name which will be used to authenticate with the server defined in this stanza. You need to ask your Tivoli Storage Manager administrator what node name they used to register your client to the server. Often this is the same as the hostname, but it may not be. In Figure 4-12, we used the hostname, ATLANTIC as the node name.
6. In the final screen, Figure 4-13, you are prompted to apply the settings configured in the previous screens. To review or change any options, click Back. When satisfied, complete the configuration wizard clicking Finish.

7. The backup-archive client then automatically starts - with the login screen. You need to enter in your password, as shown in Figure 4-14. You need to ask your Tivoli Storage Manager administrator for the password which was
specified for your client node when it was registered at the Tivoli Storage Manager server. You can now run basic backup operations.

![IBM Tivoli Storage Manager](image)

**Figure 4-14  UNIX Tivoli Storage Manager client login**

**Note:** Before a Tivoli Storage Manager client can login to the Tivoli Storage Manager server, it must be first defined to the Tivoli Storage Manager server using the **register node** command.

### 4.4.1 Setting up journalling on AIX

With the client V5.3.3 you can use the journalling service to run journal-based backups on AIX nodes.

To enable journal-based backup, install and configure the Tivoli Storage Manager journal daemon. This daemon can be configured by editing the journal daemon configuration sample file, tsmjbbd.ini.smp, and saving it as tsmjbbd.ini. Both files should be in the default install directory.

The journal configuration file (tsmjbbd.ini) needs as a minimum a list of the file systems to monitor. These two lines are sufficient:

```
[JournaledFileSystemSettings]
JournaledFileSystems=/home
```

We recommend also entering a JournalDir setting and a JournalExcludeList for the database files, as shown in Example 4-11 on page 121. An errorlog setting will also explicitly name the errorlog file. Once the configuration file is created, the journal daemon can be started using the script file /usr/tivoli/tsm/client/ba/bin/rc.tsmjbb.
Example 4-11  Journal configuration settings tsmjbbd.ini

[JournalSettings]
Errorlog=/tsm/journal/jbberror.log
Journaldir=/tsm/journal/

[JournalExcludeList]
; Note that this list contains the journal database files.
*.jdb.jbbdb
*.jdbInc.jbbdb

[JournaledFileSystemSettings]
JournaledFileSystems=/home /xyz

The journal will write initialization information to the file specified by the errorlog option. When you are satisfied the journal is working correctly, you should run the script file /usr/tivoli/tsm/client/ba/bin/jbbinit. This puts the following entry in /etc/inittab so that the journal daemon starts when the machine boots.

tsmjbb:2:wait:/usr/tivoli/tsm/client/ba/bin/rc.tsmjbb > /dev/console 2>&1

4.5 Using Windows configuration wizards

The Windows backup-archive client configuration wizard allows you to configure the client options file, Web client, client scheduler, journal engine, online image support, and open file support. The following sections show how to configure all of these using the wizards.

4.5.1 Configuring the backup-archive client

Although Windows clients uses a native GUI backup-archive client as opposed to the Java GUI on UNIX and Linux, the wizard configuration process for the Windows backup-archive client is almost identical.

Important: Before configuring the client, the Tivoli Storage Manager administrator must have defined the client to the Tivoli Storage Manager server, using the register node command. The administrator will supply you with the defined node name and password to use in the configuration. See 8.2.3, “Working with client nodes” on page 280 for more information on defining clients to the server.
1. Start the native GUI: either from Start → Programs → Tivoli Storage Manager → Backup-Archive GUI or with the `dsm` command at the command line.

On startup, the client checks whether a client options file exists as specified in the DSM_CONFIG environment variable. If not, it immediately starts a setup wizard to configure the client options file, see Figure 4-15. Click Next.

![Figure 4-15 Client Configuration Wizard startup window](image)

2. In the next screen, Figure 4-16, you have the option to create, update, or import an options file. We select **Create a new options file**.
Figure 4-16  Windows create options file

3. Enter a node name to be used by the client. You need to contact your Tivoli Storage Manager administrator to find out what node name they have used to register your client to the server. In Figure 4-17, we used the hostname, DIOMEDE.
4. Select the communication method - we chose TCP/IP as in Figure 4-18.
5. Enter the Tivoli Storage Manager server IP address or resolvable hostname, and the TCP/IP port number. Figure 4-19 shows our values - using the default TCP/IP port of 1500.
6. Figure 4-20 shows a recommended Include/Exclude file list. These files are in most cases not needed for system recovery, so the client configuration wizard gives you the option to directly exclude here, while allowing other files to be backed up or archived.
7. Next you can specify file suffixes to be excluded, regardless of their physical location in the file system. Your choices here depend on your particular environment. You might exclude audio or video files, such as .avi, or .mp3, for example. On the other hand, excluding executables (.exe) or dynamic library files (.dll) might have a negative impact on the recovery procedures. In our example, Figure 4-21 on page 128, we exclude video files, with an .avi suffix.
In Figure 4-22 on page 129, you can specify which file systems and system objects, collectively referred to as *domains*, you want to include during incremental and image backup processing. Choose the respective operation form the drop-down menu - either choose all local file systems and system objects by checking the option **Backup all local file systems** or explicitly select a subset of those. Usually, you want to incrementally backup all file systems, so we recommend the **Backup all local file systems** option unless you really do want to exclude certain file systems from backup. Doing this ensures that if you add a new partition or disk, it will be automatically included in incremental backup operations.
Figure 4-22  Specifying domains for incremental and image backups

9. Figure 4-23 shows the end of the wizard. To apply the settings you have selected, click **Finish**. You can also modify your selections by going back.
10. The client GUI automatically starts - you are prompted to enter the client node ID and password as shown in Figure 4-24. You need to ask your Tivoli Storage Manager administrator for the password which was specified for your client node when it was registered at the Tivoli Storage Manager server. You can now run basic backup operations.

Figure 4-23 Completion of client configuration wizard

Figure 4-24 Windows Tivoli Storage Manager client login
4.5.2 Configuring the Web Client

To run the configuration tasks, launch the configuration wizard from the backup-archive client main screen. Select **Utilities → Setup Wizard** from the client GUI, shown in Figure 4-59 on page 163.

1. We are setting up the Web Client, so select **Help me configure the TSM Web Client** as shown in Figure 4-25.

![Figure 4-25 Configuring the Web Client selection](image)

2. We want to install a new Web Client, so select this option as in Figure 4-26.
3. As shown in Figure 4-27, we select the name of the Web Service “Client Acceptor” process, which you will see running and also will be seen later in the Windows services list. We accept the default name.
4. Enter the path and filename of the options file, as in Figure 4-28. We have chosen the default location, which is the client installation directory, in subdirectory baclient.
Figure 4-28  Choose the path and filename of the options file

5. In Figure 4-29, specify the port that the Web Client Acceptor will listen on. This will be the port you reference when connecting with your browser. We choose the default, 1581.
6. It should display your client node name - enter in the client password, as shown in Figure 4-30. We recommend checking the **Contact the TSM server to validate password** box, so that the client will authenticate with the Tivoli Storage Manager server to validate the password that you specified.
7. In the **Service login options** panel, select the Windows account which will start and run the Web Client service. Also you can select whether to start the service automatically or manually, as shown in Figure 4-31.
8. Next, choose a name for the remote client agent, as in Figure 4-32. This will be the name of the service which displays in the Windows services applet. Note this service only runs when requested by the Web Client, therefore you do not specify startup options here. We accepted the default name.
9. Determine if you want to revoke access to this Web Client for administrators with access privilege, which is shown in Figure 4-33. Note that this will not restrict the administrators who are granted client owner privilege. We leave it with default option, which is no restriction to other administrators.

Figure 4-32 Select the name of the client agent
Figure 4-33   Choose whether to allow remote access to the Web Client

10. In Figure 4-34, choose whether to start the Web Client services after this wizard completes.
Figure 4-34  Choose whether to start the service after the wizard completes.

11. Figure 4-35 is the completion screen for the wizard. Click Finish to commit the changes or Back to review your selections.
4.5.3 Configuring the client scheduler

This section shows how to use the Windows wizard to configure the client scheduler, which will communicate with the Tivoli Storage Manager server to perform scheduled events, such as incremental backups. Unlike with the Web Client, there are situations where you might operate more than one scheduler service at a time. This technique is used when you want your data to be backed up by different node names. For example, if you are running a database server in MSCS cluster environment, you will have one scheduler service backing up operating system files on local disks using a local node name and another
scheduler service, running under a cluster-wide node name, backing up database files on shared disks. If this is the case, you would run this wizard multiple times, to configure each scheduler service.

1. Launch the wizard as before, (Figure 4-25 on page 131) but this time select **Help me configure the TSM Client Scheduler**.

2. As this is our first scheduler service, we only have the option to install a new scheduler service, as shown in Figure 4-37

![Figure 4-37 Installing a new client TSM Scheduler Wizard selection](image)

3. Enter a name for the scheduler service, as in Figure 4-38. You can choose to install it on the local machine or on a remote machine. Optionally, you may specify for the Web Client Acceptor Daemon (CAD) to operate the scheduler service. This is useful if running in memory-constrained environments, as the CAD consumes less memory than the traditional client scheduler service.
Figure 4-38 Choosing the name and location of the client scheduler

4. In Figure 4-39, enter the option file. For our first scheduler instance, this is the standard client options file. If running multiple scheduler clients, then each needs its own client options file.
5. Enter the client node name and password, Figure 4-40. As before in step 6 on page 135, you can choose to immediately authenticate to the Tivoli Storage Manager server.
6. Choose which Windows account to run the service, and the startup options, as in Figure 4-41.
7. Enter a directory and name for the schedule and error log files. We accepted the default locations, as shown in Figure 4-42. We also selected to log events to the Windows Event Log.

The schedule log contains the results of scheduled operations, and can be either verbose or summary information, depending on the options set in the dsm.opt file. The error log will contain any errors created by the scheduler, communication sessions with the server, and general backup failures.
8. In Figure 4-43, choose whether to start the scheduler service after this wizard completes.
Figure 4-43  Startup choice once the wizard has completed

9. Figure 4-44 is the completion screen for the wizard. Click **Finish** to commit the changes or **Back** to review your selections.
4.5.4 Configuring the journal engine

The journal engine component observes and keeps track of changes in files in local file systems. During incremental backups this information is used to select files for backup - which improves performance compared with the standard technique of scanning the file system for changes. This section shows how to configure this feature with the wizard.

1. Start the wizard from the backup-archive client and select Help me configure the TSM Journal Engine from the screen shown in Figure 4-25 on page 131.
2. In Figure 4-46, choose **Install a new Journal Engine**. This panel also has options to update and remove the Journal Engine if it already exists.

![Figure 4-46 Installing a new Journal Engine](image)

3. In Figure 4-47, select which file systems you want to journal. You can select individual file systems, or check to **Journal all local file systems**.
Figure 4-47  Choose the file systems which are to be journaled

4. In Figure 4-48, specify where to put the journal database. You can have one single journal database for all the journaled file systems, or have the journal files spread across the respective file systems. If running the journal engine in a clustered environments, you would want separately stored databases on the shared cluster disks, so that they are available in the event of a failover.
5. In the next screen, Figure 4-49, you specify which particular changes in the file systems are to be monitored by journal engine. By default, creating new objects, changing the content of the existing ones, and changing access control attributes and other NTFS security changes are monitored. We use these defaults, since there is usually no need to monitor changes such as file size (will be caught by last modification time) and last access time (does not necessarily mean that an object is being changed).
6. You can limit the maximum size of the journal database. We recommend not doing this, as shown in Figure 4-50.

Figure 4-49  Journal engine notification filters
7. Define the service login options. As with the other services, we recommend running as the System account, as shown in Figure 4-51.
8. In Figure 4-52, we select to start the service immediately.
Figure 4-52  Startup service after the wizard completes

9. Figure 4-53 is the completion screen for the wizard. Click **Finish** to commit the changes or **Back** to review your selections.
4.5.5 Configuring online image support

In this section we describe how to configure Online Image Support.

1. Start the wizard from the backup-archive client and select **Help me configure ‘Online’ Image Support** from the screen shown in Figure 4-25 on page 131.

2. Select **Install the Logical Volume Snapshot Agent**, as in Figure 4-55.
3. There are no options to select - the agent simply installs. Click Next on the completion window. You are prompted to reboot the system, Figure 4-56.

4.5.6 Configuring Open File Support

As with the previous configuration, Open File Support is very short and simple. Open File backup is now supported on all supported Windows platforms, such as Windows 2000, XP and the recently added Windows 2003.

1. Start the wizard from the backup-archive client: and select Help me configure Open File Support from the screen shown in Figure 4-25 on page 131.
2. As shown in Figure 4-57, select **Install the Logical Volume Snapshot Agent** for open file support.

   ![Figure 4-57 Installation of the Logical Volume Snapshot Agent panel](image)

3. There are no options to select - the agent simply installs. Click **Next** on the completion window. Figure 4-58 shows the agent has successfully installed.

   ![Figure 4-58 Successfully completed panel](image)

**4.6 Client interfaces**

Tivoli Storage Manager client interfaces are used to perform client tasks on the Tivoli Storage Manager server. In this section we describe how to start, use, and stop the command line interface (CLI) and the GUI. Figure 4-2 lists all available backup-archive client interfaces by platform.
<table>
<thead>
<tr>
<th>Platform</th>
<th>Command Line client</th>
<th>Native GUI</th>
<th>Java GUI</th>
<th>Web client</th>
<th>API client</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple Macintosh</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hewlett-Packard HP/UX PA-RISC</td>
<td>x</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Hewlett-Packard HP/UX Itanium®</td>
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<td></td>
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<td>x</td>
</tr>
<tr>
<td>IBM AIX 5L™</td>
<td>x</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Linux for x86</td>
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<td></td>
<td>x</td>
<td>x</td>
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<tr>
<td>Linux for pSeries</td>
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<tr>
<td>Microsoft Windows 2003 Standard, Enterprise, Datacenter</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Novell NetWare</td>
<td>x</td>
<td></td>
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<td>Sun Solaris</td>
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<tr>
<td>OS/400®</td>
<td></td>
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<td>z/OS</td>
<td>x</td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>
There are some minor differences between the backup-archive client code on different platforms. For example, the Windows client has specific options to handle the Windows registry information, which are not found in any other platform. Despite those specific options, all commands are the same except for the filesystem specification for each platform (in UNIX/Linux this uses the format /usr/tivoli, and in Windows, D:\newdir). Although the examples in this section are based on UNIX, we also give examples of Windows commands.

4.6.1 Command line

The command line interface (CLI) is a character mode interface, and therefore is well suited for those users who are generally familiar with these types of interfaces - e.g. UNIX or Windows shells. It is also useful if you cannot access the GUI for some reason, or for creating scripts to automate a backup process. The CLI can be used for backup, restore, archive, or retrieve operations and to start the Tivoli Storage Manager scheduler.

Starting a session
To start the command line interface, enter dsmc at the operating system prompt, as shown in Example 4-12.

Example 4-12 Backup-archive client command line interface

root@Atlantic /: dsmc
IBM Tivoli Storage Manager
Command Line Backup/Archive Client Interface
  Client Version 5, Release 3, Level 2.0
  Client date/time: 02/20/06 10:54:16
  (c) Copyright by IBM Corporation and other(s) 1990, 2005. All Rights Reserved.
  Node Name: ATLANTIC
  Please enter your user id <ATLANTIC>:
  Please enter password for user id “ATLANTIC”:

  Session established with server ATLANTIC: AIX-RS/6000
    Server Version 5, Release 3, Level 2.2
    Data compression forced off by the server
    Server date/time: 02/20/06 10:54:16 Last access: 02/20/06 10:54:04
    tsm>

You can see the prompt tsm> where you can type backup-archive client commands. When issuing the first command, you may be prompted for your password before the command is executed. This occurs if you are not using automatic password handling. If you set up your client to use automatic password handling, by setting the PASSWORDACCESS option to GENERATE, the command you issue will be executed directly.
Once a command is executed, you always return back to the `tsm>` prompt. This interactive method is also called *loop* mode.

Another way to start a client session is the so-called *batch* mode. You simply type `dsmc` together with the actual command parameter that you want to execute. In this mode, the backup-archive client processes the command and returns to the operating system prompt. This is the recommended way to use the `dsmc` command when creating scripts for automation. You can create each `dsmc` command in turn (as well as any other operating system command you want to include in the script) and save them in a batch file for processing later.

**Help for the CLI**

Example 4-13 shows the Help utility available from the `tsm>` command prompt. Type `help` and then select a number from the list.

*Example 4-13  Backup-archive client help options*

```
  tsm> help
To search the IBM Tivoli Storage Manager technical support Web site to find
technical solutions and answers to frequently asked questions, refer to
http://www.ibm.com/software/sysmgmt/products/support/IBMTivoliStorageManager.ht
ml.
The following help topics are available.
Enter the number of the desired help topic or 'q' to quit,
'd' to scroll down, 'u' to scroll up.

  0 - Summary of Changes
  1 - Using Commands
  2 - Select from the commands listed below:
      3 - ARCHIVE
      4 - BACKUP GROUP
      5 - BACKUP IMAGE
      6 - BACKUP NAS
      7 - BACKUP WAS
      8 - CANCEL PROCESS
      9 - CANCEL RESTORE
     10 - DELETE ACCESS
     11 - DELETE ARCHIVE
     12 - DELETE BACKUP
```

**Stopping a session**

If the Tivoli Storage Manager backup-archive client is running in loop mode and
resting at the `tsm>` prompt, enter `quit` to end the session as shown in
Example 4-14. This terminates the connection with the Tivoli Storage Manager
server and returns to the calling program, which is normally the operating system
prompt.
4.6.2 GUI

Most end-users find the GUI more attractive and intuitive than the command line. You can use it for all Tivoli Storage Manager client operations except for scheduled operations.

Starting a session
To start the GUI, enter `dsm` at the operating system prompt. The GUI is almost the same on Windows and UNIX/Linux.

Figure 4-59 shows the main screen of the client GUI on Windows.

![Windows GUI client interface](image)
Figure 4-60 shows the main screen of the Java™-based client GUI on UNIX and Linux:

![Java-based backup-archive client GUI interface](image)

**Figure 4-60 Java-based backup-archive client GUI interface**

Depending on the features of your UNIX machine, for example, if it has the Common Desktop Environment (CDE) installed, you can add an option in the workplace screen so that it is easier to start Tivoli Storage Manager.

**Stopping a session**

To stop a GUI session, select **File → Exit** from the pull-down menu in the main window.

### 4.7 Client scheduler

A Tivoli Storage Manager administrator can create schedules for clients so that they perform defined tasks automatically on a regular basis. For example, you can define schedules to automatically run an incremental file backup at the end of each day, or to archive a particular directory tree every Friday.

This procedure, known as central scheduling, is a cooperative effort between the server and the client node. You associate clients with one or more schedules that are part of the policy domain maintained in the Tivoli Storage Manager database.
You use the central scheduler on the server, and you start the client scheduler process on the workstation. Once you start the client scheduler, further intervention is not necessary.

**Note:** The schedule start time is based on the server clock, not the client clock. This makes it easier for you to manage schedule start times for clients in different time zones.

With regard to scheduling, you may also want to:

- Display information about available schedules.
- Display information about work that the schedule has completed.
- Modify scheduling options in the client options file.

**Note:** Make sure that you have the Tivoli Storage Manager administrative command-line client installed and that the client-server communication is working correctly before you attempt to start the client scheduler service.

You cannot start the client scheduler from the Tivoli Storage Manager GUI.

### 4.7.1 Starting the client scheduler

You can start the Tivoli Storage Manager client scheduler either manually or with each system start. If you change the client options files while the client scheduler is running, it must be stopped and re-started to pick these up.

However if you chose to have the scheduler managed by the Client Acceptor Daemon (CAD), in step 3 on page 142, this is not required. CAD reads the client options file whenever an operation, such as scheduled incremental backup, is performed, therefore it can pick up options file changes dynamically.

**Manual start**

**Note:** The client scheduler can only be started by a Tivoli Storage Manager-authorized user. This is a user who has administrative authority for the Tivoli Storage Manager client on a workstation. This user changes passwords, performs open registrations, and deletes filespaces.

You can manually startup the Tivoli Storage Manager scheduler if it was accidentally stopped, if you want to re-start it to pick up a changed client option, or if you want to force it to run immediately, e.g. while testing a new function.

To start the client scheduler on your client node and connect to the server scheduler, enter the `dsmc schedule` command from the operating system prompt.
as shown in Example 4-15. You will be prompted to type in the password unless you have set the PASSWORDACCESS GENERATE option in the client option file (dsm.opt). The scheduling requirement is one of the strongest reasons for recommending the PASSWORDACCESS GENERATE option. If you don’t specify this you will always be prompted for a password unless you include it in a script file or use the PASSWORD client option in the option file. Either possibility is undesirable - there is probably no-one around to enter the password and entering it in a script or in the option file in plain text exposes a security risk.

Since a schedule has been defined for this client, the output shows the details, and specifies when it will execute. The scheduler will remain "quiet" until contacted by the server to start the operation.

Example 4-15  Manually starting the client scheduler

```
root@brazil > dsmc sched
IBM Tivoli Storage Manager
Command Line backup-archive Client Interface-Version 5, Release 2, Level 0.0 h4
(c) Copyright by IBM Corporation and other(s) 1990, 2003. All Rights Reserved.

Querying server for next scheduled event.
Node Name: AIXCLIENT
Session established with server TSMSERVER: Windows
   Server Version 5, Release 2, Level 0.0
   Server date/time: 04/11/03   15:00:59  Last access: 04/11/03   15:00:40

Next operation scheduled:
---------------------------------------------------------------------
Schedule Name:         INCR_BKUP
Action:                Incremental
Objects:               
Options:               
Server Window Start:   09:00:00 on 04/12/03
---------------------------------------------------------------------
Waiting to be contacted by the server.
```

When you start the client scheduler, it runs continuously until you close the window, therefore ending the process, or log off your system.

**UNIX/Linux**

To run the schedule command in background and to keep the client scheduler running even if you log off your UNIX system, enter the command shown in Example 4-16 from the UNIX shell:

```
Example 4-16  Running the client scheduler in the background - UNIX

root@ / > nohup dsmc schedule 2> /dev/null &
```
Windows

We showed how to configure the client scheduler using the wizard in 4.5.3, “Configuring the client scheduler” on page 141.

As shown in Figure 4-61, we can see a running scheduler service, called TSM Client Scheduler in the Windows service list. It is set to startup automatically.

![Image of computer management showing running scheduler service](image)

*Figure 4-61  Client Scheduler service is running on a machine*

The Tivoli Storage Manager Windows client also provide a utility, dsmcutil, that may be used as a substitute for the client configuration wizard. It does exactly the same as the wizard, in just one command (although with a couple of necessary parameters) on the operating system command line.

This is particularly useful in enterprise environments where running the client configuration wizard for each single service on each machine would be a time-consuming process. Instead, dsmcutil can be run in a script to configure the scheduler and other services on multiple client machines at once.

Example 4-17 shows how to manually install the client scheduler named “TSM Central Scheduler” on node DIOMEDE on Windows 2003 machine.

*Example 4-17  installation and configuration of Scheduler service using Dsmcutil*

```
C:\Program Files\Tivoli\TSM\baclient>dsmcutil install scheduler /name:”TSM Central Scheduler” /node:DIOMEDE /password:diomede /autostart:yes
```

TSM Windows NT Client Service Configuration Utility
Command Line Interface - Version 5, Release 3, Level 2.0
(C) Copyright IBM Corporation, 1990, 2005, All Rights Reserved.
Last Updated Sep 17 2005
TSM Api Verison 5.3.2

Command: Install TSM Client Service
Machine: DIOMEDE(Local Machine)
Installing TSM Client Service:

Machine : DIOMEDE
Service Name : TSM Central Scheduler
Client Directory : C:\Program Files\Tivoli\TSM\baclient
Automatic Start : yes
Logon Account : LocalSystem

The service was successfully installed.

Creating Registry Keys ...
Updated registry value 'ImagePath' .
Updated registry value 'EventMessageFile' .
Updated registry value 'TypesSupported' .
Updated registry value 'TSM Central Scheduler' .
Updated registry value 'ADSMClientKey' .
Updated registry value 'OptionsFile' .
Updated registry value 'EventLogging' .
Updated registry value 'ClientNodeName' .

Generating registry password ...
Authenticating TSM password for node DIOMEDE ...

Connecting to TSM Server via client options file
'C:\Program Files\Tivoli\TSM\baclient\dsm.opt' ...
Password authentication successful.
The registry password for TSM node DIOMEDE has been updated.
Starting the 'TSM Central Scheduler' service ...
The service was successfully started.
C:\Program Files\Tivoli\TSM\baclient>

The dsmcutil utility can also be used to install the other services - Web client, journal engine etc., as well as query and update service settings. For more information on the use and syntax of dsmcutil, see IBM Tivoli Storage Manager Backup-Archive Clients installation and User's Guide, GC32-0788

Example 4-18 shows a dsmcutil query execution:

Example 4-18  Dsmcutil query scheduler service status

C:\Program Files\Tivoli\TSM\baclient>dsmcutil
query /name:"TSM Central Scheduler"

TSM Windows NT Client Service Configuration Utility
Command Line Interface - Version 5, Release 3, Level 2.0
(C) Copyright IBM Corporation, 1990, 2005, All Rights Reserved.
Last Updated Sep 17 2005
TSM Api Verison 5.3.2
Command: Query TSM Client Service Parameters
Machine: DIOMEDE (Local Machine)

Connecting to service 'TSM Central Scheduler' ...
Service Configuration/Status:
Service Name : TSM Central Scheduler
Image Path   : "C:\Program Files\Tivoli\TSM\baclient\dsmcsvc.exe"
Logon Account: LocalSystem
Start Type   : Auto
Current Status: Started

TSM Client Service Registry Settings:
Client Service Type = Client Scheduler Service
Options file      = C:\Program Files\Tivoli\TSM\baclient\dsm.opt
Event Logging     = YES
TSM Client Node   = DIOMEDE
Comm Protocol     = (value not currently set)
Server            = (value not currently set)
Server Port       = (value not currently set)
Schedule Log      = (value not currently set)
Error Log         = (value not currently set)
Cluster Enabled   = (value not currently set)
Cluster Name      = (value not currently set)
C:\Program Files\Tivoli\TSM\baclient>

Automatic start
We recommend the scheduler service to be automatically started when operating system boots. This is to ensure that the server can contact the client to execute regular schedules, especially if you have an enterprise policy to have Tivoli Storage Manager machines backed up at some point in the day.

If you rely on manual startup, this can be easily forgotten if the owner of the client system has to reboot it for some reason, resulting in a missed backup schedule.

UNIX/Linux
If you want to start the client scheduler when the system reboots, set the PASSWORDACCESS option parameter to GENERATE in your client system options file, and include the following command in the /etc/inittab (for AIX) file:

tsm:2345:once:/usr/bin/dsmc schedule >/dev/console 2>&1 #Start Scheduler

The scheduler starts the next time the system is rebooted. On other UNIX variants enter a similar command in the startup files.
Windows
We showed how to set up the scheduler service for automatic start in 4.5.3, “Configuring the client scheduler” on page 141. You can also do this using dsmcutil.

You can also change settings using the Services applet like any other operating system or application service. Figure 4-62 shows how to do this.

![Figure 4-62   Changing startup behavior of the client scheduler service in Windows](image)

4.7.2 Stopping the scheduler
To terminate a running client scheduler in foreground mode, you can cancel the operation by pressing CTRL-C in the session window. If the scheduler is running silently, you can ask the Tivoli Storage Manager administrator to issue the `cancel session` command. The administrator may need to cancel all multi-threaded sessions for the client. If the scheduler is executing a restore process, the Tivoli Storage Manager administrator needs to cancel the restartable restore by issuing the `cancel restore` command.
On Windows platforms, you can also terminate the client scheduler by stopping its service in the Services applet, or calling the `dsmcutil` stop command, as shown in Example 4-19 on page 171.

**Example 4-19  Stopping client scheduler service using dsmcutil stop command**

```bash
C:\Program Files\Tivoli\TSM\baclient>dsmcutil stop /name:"TSM Central Scheduler"

TSM Windows NT Client Service Configuration Utility
Command Line Interface - Version 5, Release 3, Level 2.0
(C) Copyright IBM Corporation, 1990, 2005, All Rights Reserved.
Last Updated Sep 17 2005
TSM Apiv5.3.2

Command: Stop TSM Client Service
Machine: DIOMEDE(Local Machine)

Stopping the 'TSM Central Scheduler' service ....
The service was successfully stopped.
C:\Program Files\Tivoli\TSM\baclient>
```

### 4.8  Web client usage

The Tivoli Storage Manager Web backup-archive client is a Java-based interface that enables authorized users to perform remote operations on a backup-archive client system.

#### 4.8.1  Remote client GUI

The Web client is a Java applet that provides a remote client GUI for Tivoli Storage Manager backup-archive clients. Authorized users can access the Web client remotely using a Web browser. The graphic is the initial client hub window displayed in the Web browser when the Web client is accessed.

The Web client can be used from any workstation running a Web browser with Java support, such as Microsoft Internet Explorer or Mozilla Firefox.

#### 4.8.2  Client functions

The Web client supports all of the backup-archive client functions. It can be used to perform all file-based functions such as backup, restore, archive, and retrieve operations. For both UNIX and Windows clients, the Web interface also supports
Logical Volume operations. The Windows Web client can also back up and restore system objects.

For file-based restore operations, both active and inactive files can be restored, and the point-in-time restore function is supported. You may search for specific files in the backup, restore, archive, or retrieve window, by filtering file names or filtering the directory tree. You can restore a backup set without a server connection.

The Web client is another client interface - and is used only to perform backup-archive client operations. If used from a Web browser on a remote workstation, with a user ID with client access privilege, no local access to backup or archive data is provided on that remote workstation. Data cannot be restored or retrieved locally; it can only be restored to or retrieved to the client workstation that owns the data. A Web browser can also be used locally on the client workstation to invoke the Web client as an alternative interface to the backup-archive client command line interface or GUI.

Using the Web client via the browser means that you actually do not have to have any Tivoli Storage Manager code on the Web browser workstation, yet you can perform backup, restore, archive or retrieve operations on behalf of the actual client.

### 4.8.3 Access authorization

Use of the Web client interface is authenticated whenever backup, restore, archive, or retrieve Web client functions are performed. Authentication of the Web client interface is separate, and independent, from authentication between the client node and the server.

An administrator userID is required to use the Web client. This administrator userid, and associated password, is used to authenticate that the user has sufficient authority to perform remote client functions. Two administrative authorities are provided to enable this authentication:

- Client owner
- Client access

These authorities can be used to enable usage of the Web client interface for backup-archive client owners and helpdesk personnel. A user ID with client access privilege can only restore data back to its original system. A user ID with client owner privilege can restore data to another system if required.
4.8.4 Starting the Web client

The Web client consists of two processes on the client workstation: the client acceptor and remote client agent.

**Client acceptor**
The Client Acceptor Daemon (CAD) is an HTTP daemon that serves the Web client Java applet to the Web browser. The name of the executable is `dsmcad`.

On UNIX/Linux clients, it should be run as a daemon. To have the Web client automatically available when the system is started, edit the `/etc/inittab` file on AIX (or use the equivalent startup file on other UNIX variants) and add the following entry:

```
  dsmcad:2345:once:/usr/tivoli/tsm/client/ba/bin/dsmcad >/dev/console 2>&1
  #Start the TSM WEB agent
```

On Windows platforms use the `dsmcutil` utility or the GUI wizard to install the client acceptor and remote agent services. Make sure that the startup options for both services are set to automatic.

**Remote client agent**
The remote client agent performs the client functions initiated with the Web client interface. The name of the executable is `dsmagent`. The agent does not run all the time - the acceptor daemon starts the agent when client functions are initiated through the Web client interface.

**Web client**
To access the Web backup-archive client, start your Web browser. In the Location or Address field, enter the URL:

```
http://<machinename>:1581
```

Where `<machinename>` is the hostname or TCP/IP address of the Tivoli Storage Manager client machine which you want to connect to, and 1581 is the TCP/IP port number set by the HTTPPORT option.

Figure 4-63 shows the main Web client screen.
When you try to connect to a client by using the Web client interface, Tivoli Storage Manager validates the administrator ID given. You are then granted access to the Web client interface, the client is connected to the Tivoli Storage Manager and the main window displays. Figure 4-64 shows a login dialog box for a Web client session.

4.8.5 Stopping the remote agent services

In general, there is no need to stop the remote agent services manually.
On Windows platforms, if you wish to disable administrators from accessing the Web client, you can prevent the service from starting by disabling it. To do that, change the service setting to disabled or use `dsmcutil` equivalent command. In Example 4-20 we change the startup behavior of the scheduler service and subsequently stop the service operation.

Example 4-20  Disabling Web Client from starting upon system reboot using dsmcutil

```
C:\Program Files\Tivoli\TSM\baclient> dsmcutil update
   /name:"TSM Remote Client Agent" /autostart:no
```

TSM Windows NT Client Service Configuration Utility
Command Line Interface - Version 5, Release 3, Level 2.0
(C) Copyright IBM Corporation, 1990, 2005, All Rights Reserved.
Last Updated Sep 17 2005
TSM Api Verison 5.3.2

Command: Update TSM Client Service Parameters
Machine: DIOMEDE(Local Machine)

Opening Registry Keys ...
Located service 'TSM Remote Client Agent'.
Updated registry value 'Start'.

```
C:\Program Files\Tivoli\TSM\baclient> dsmcutil stop
   /name:"TSM Remote Client Agent"
```

TSM Windows NT Client Service Configuration Utility
Command Line Interface - Version 5, Release 3, Level 2.0
(C) Copyright IBM Corporation, 1990, 2005, All Rights Reserved.
Last Updated Sep 17 2005
TSM Api Verison 5.3.2

Command: Stop TSM Client Service
Machine: DIOMEDE(Local Machine)

Stopping the 'TSM Remote Client Agent' service ....
The service was successfully stopped.
```
C:\Program Files\Tivoli\TSM\baclient>
```

In a UNIX environment, you can stop the `dsmcad` process by using the `kill` command as shown in Example 4-21.

Example 4-21  Stopping the remote agent service - on Unix and Linux platforms

```
root@Atlantic /: ps -ef | grep dsmcad
   root 200792      1  0 11:49:12      -  0:00 dsmcad
   root 221318 184822  0 11:49:13  pts/5  0:00 grep dsmcad
```
4.9 Summary

You now have your server and clients installed and basic backup and restore functions tested and working. Next we will proceed with further configuration and customizing of the environment to suit your specific requirements.
Database and recovery log

By now you should have completed the installation of your IBM Tivoli Storage Manager server and clients, and done some basic functional testing. You are ready to move on to further customization. In this chapter we cover the steps to set up and change your database and recovery log settings to a recommended configuration.

The Tivoli Storage Manager database contains all the information needed for server operations, and information about client data that has been backed up, archived, and space-managed. The database and the recovery log are closely related. The recovery log caches database transactions, allowing you to replay the transactions in the event of the database requiring restoration.

The information in this chapter assumes that you have read the redbook, IBM Tivoli Storage Management Concepts, SG24-4877, and have planned your database and recovery log sizes. See 2.8, “Disk considerations and sizing” on page 38 for planning considerations. If you have not planned the values that your installation requires to run Tivoli Storage Manager, please do so before continuing.

Use the information you gathered from the planning chapter when you issue your own commands. Because the database and recovery log configurations are highly dependent on site-specific values, we cannot predict all possible combinations. Instead, we provide a sequence of example commands that you can use to best configure the database and recovery log for your environment.
5.1 Database

The database is a critical Tivoli Storage Manager component - it must be configured for availability good performance.

5.1.1 Database design considerations

Before you start, there are a few important differences to consider, depending on which platform you will be using.

Platform specific information: Some minor changes are required in UNIX/Linux and Windows because of the different filespace naming conventions of those platforms. The examples in this section are from Windows and AIX systems. Use the correct directory separator for your platform when entering file and path names. For other platforms, see the IBM Tivoli Storage Manager Administrator's Reference for that server.

Tivoli Storage Manager has a single database made up of one or more volumes. A database volume is a physical file located on one of the server's file systems. In other words, the database is a logical entity made up of physical files.

Database volume numbers, sizes, and locations affect database performance. The following points should be considered:

- All database volumes must reside on random access media, that is, disk drives.
- If there is more than one database volume, more than one process can access the database simultaneously.
- If there is more than one database volume, the data is distributed across all available volumes and writes to the database volumes are performed in a “round robin” fashion. Suppose the database has three volumes, vol01, vol02 and vol03. A sequence of four writes would go: 1 to vol01, 2 to vol02, 3 to vol03 and 4 to vol01. Writing in a round robin fashion, distributes the load and makes the most of available resources.
- Create database volumes the same size if possible.
- Database segments are 4MB in size, so a volume must be a multiple of 4MB. One recommendation is to make your database volume sizes a multiple of the power of 2. That is, 128MB, 256MB, 512MB, 1024MB, 2048MB and so on.
- Tivoli Storage Manager requires 1MB of space (known as the restart area) at the start of the volume. Take this overhead into account when calculating disk usage.
If you have a number of physical disks (or logical LUNs) allocated for use with Tivoli Storage Manager, try to position the database volumes on different file systems, to leverage performance provided by the hardware.

If using mirroring for database and recovery log volumes, and do not have enough disks to locate all primary and mirror volumes separately:

- Place primary database volumes on the same physical disk(s) as the mirror recovery log volumes.
- Place primary recovery log volumes on the same physical disk(s) as the mirror database volumes.

The current maximum size for the database is 530GB.

As an example, say your planning shows that you need an 8GB database. One way to configure an 8GB database would be to create 8 x 1024MB volumes. Add 1MB each for the restart area and you have a database size of 8200MB.

**Note:** If you forget to include the 1MB for the restart area, or the format size is not a multiple of 4MB, the `define dbvolume` command will ensure that the size is rounded to a multiple of 4MB and add 1MB. See Example 5-1 on page 181.

Figure 5-1 shows a database consisting of four volumes (vol01.dsm through vol04.dsm). The volumes could exist on the same disk, or be spread across any number of actual disk drives or LUNs. Although the volumes are separate files from an operating system point of view, Tivoli Storage Manager regards the database as a single logical entity.
5.1.2 Defining database volumes

There are two ways to allocate a new database volume. The most common and easiest to use is the `define dbvolume` command (or equivalent Administration Center GUI function). The `FORMATSIZE` option allows you to specify the size for the volume.

The second method is to first use the external `DSMFMT` utility (from a shell or command window) to allocate the volume file. Then, use the `define dbvolume` command to define the database volume to Tivoli Storage Manager (without specifying the `FORMATSIZE` option). For more information about the `DSMFMT` utility, see the Administrator’s Reference for your server platform.

Whichever method you choose to define the volume, you must extend the database once the volume is defined. The `extend db` command allows the database to use the newly defined volume.

Example 5-1 on page 181 shows how to define a new database volume on a Windows server™. The volume is called `C:\TSMDATA\DBP\DBV_01.DSM` and is 1GB in size.
Example 5-1  Defining a database volume

tsm: LOCHNESS_SERVER1>define dbvolume c:\tsmdata\dbp\dbv_01.dsm formatsize=1024 wait=yes
ANR0984I Process 36 for DEFINE DBVOLUME started in the FOREGROUND at 14:46:43.
ANR2240I Database volume C:\TSMDATA\DBP\DBV_01.DSM defined.
ANR0986I Process 36 for DEFINE DBVOLUME running in the FOREGROUND processed 1 items for a total of 1,074,790,400 bytes with a completion state of SUCCESS at 14:46:43.

 ANR0984I Process 36 for DEFINE DBVOLUME started in the FOREGROUND at 14:46:43.
 ANR2240I Database volume C:\TSMDATA\DBP\DBV_01.DSM defined.
 ANR0986I Process 36 for DEFINE DBVOLUME running in the FOREGROUND processed 1 items for a total of 1,074,790,400 bytes with a completion state of SUCCESS at 14:46:43.

 tsm: LOCHNESS_SERVER1>query db

Available Assigned Maximum Page Total Used Pct Max.
Space Capacity Extension Reduction Size Usable Pages Util Pct
--------- -------- --------- ------- ------- ------- ----- ---- ---- ----
2,024 1,000 1,024 996 4,096 256,000 1,202 0.5 0.5

 tsm: LOCHNESS_SERVER1>query dbvol

Volume Name Copy Volume Name Copy Volume Name Copy
(Copy 1) Status (Copy 2) Status (Copy 3) Status
---------------- ------ ---------------- ------ --------------- ------
C:\TSMDATA\SERV- Sync'd  Undef- Undef-
ER1\DB1.DSM ined ined
C:\TSMDATA\DBP\- Sync'd  Undef- Undef-
DBV_01.DSM  ined ined

The output shows the volume has been created. The query db command shows the available space. Note that the available space is not the amount of space currently in use by the database. It is the total amount of space available in database volumes. The assigned capacity is the amount of space currently in use by the database.

Note also that even though we specified a format size of 1024MB, the actual size allocated was 1025MB (1025*1024*1024 = 1,074,790,400). As mentioned above, the define process adds the extra 1MB for the restart area.

UNIX users: Database volume file names are case-sensitive.

Figure 5-2 shows the second phase - extending the database.

Example 5-2  Extending the database

tsm: LOCHNESS_SERVER1>query db
After the assigned capacity is extended, the output from `query db` changes accordingly. As we have extended the database to use all the defined database volumes, the maximum extension column shows 0 bytes.

### 5.2 Recovery log

The recovery log performs two functions, depending on its mode setting. Firstly, the recovery log stores database transactions that have not yet been committed to the database. Any operation that updates the Tivoli Storage Manager database is first written to the recovery log. Secondly, if the recovery log mode is rollforward, the transaction is cached in the recovery log after it has been committed. Caching of transactions allows you to replay the transactions at a later point in time to enhance database recovery, if needed. See 5.3, “Setting the log mode” on page 186 for more information.

As with its database, Tivoli Storage Manager considers the recovery log as one logical object, made up of a number of physical files, or volumes.

### 5.2.1 Recovery log design considerations

Recovery log volume numbers, sizes and locations affect performance of the recovery log. The following points should be considered:

- All recovery log volumes must be on random access media, i.e., disk drives.
- If there is more than one recovery log volume, more than one process can access the recovery log simultaneously.
If there is more than one recovery log volume, the data is distributed across all available volumes and writes to the log volumes are performed in a “round robin” fashion. Suppose the recovery log has three volumes, log01, log02 and log03. A sequence of four writes would go: 1 to log01, 2 to log02, 3 to log03 and 4 to log01. Writing in a round robin fashion distributes the load and makes the most of available resources.

Create recovery log volumes the same size if possible.

Recovery log segments are 4MB in size, so a volume must be a multiple of 4MB. One recommendation is to make recovery log volume sizes a multiple of the power of 2. That is, 128MB, 256MB, 512MB and so on.

Tivoli Storage Manager requires 1MB of space (known as the restart area) at the start of the volume.

If you have a number of physical disks (or logical LUNs) allocated for use with Tivoli Storage Manager, try to position the recovery log volumes on different file systems, to leverage performance provided by the hardware.

If using mirroring for database and recovery log volumes, and do not have enough disks to locate all primary and mirror volumes separately:

- Place primary database volumes on the same physical disk(s) as the mirror recovery log volumes.
- Place primary recovery log volumes on the same physical disk(s) as the mirror database volumes.

The total maximum size for the recovery log is 13 GB. That is, the sum of the sizes of all recovery log volumes must be 13 GB or less.

As an example, say your planning shows that you need 4GB of recovery log space. One way to configure this would be to create 8 x 512MB volumes. Add 1MB each for the restart area and you have a recovery log size of 4104MB.

Figure 5-2 on page 184 shows a recovery log consisting of three volumes (log01.dsm through log03.dsm). The volumes could exist on the same disk, or be spread across any number of actual disk drives.
5.2.2 Defining recovery log volumes

There are two ways to allocate a new recovery log volume. The most common and easiest method to use is the administrative `define logvolume` command (or equivalent Administration Center GUI function) specifying the `FORMATSIZE` option.

The second method is to use the `DSMFMT` utility command (from a shell or command window) to allocate the volume file. Then, use the `define logvolume` command to define the recovery log volume to Tivoli Storage Manager (without specifying the `FORMATSIZE` option). For further information about the `DSMFMT` utility, see the Administrator's Reference for your server platform.

Example 5-3 shows how to allocate a new recovery log volume on a Windows server. The volume is called D:\TSMDATA\RLP\LOG_01.DSM and is 512MB in size.

**Example 5-3  Defining a recovery log volume**

```
tsm: LOCHNESS_SERVER1>define logvol D:\tsmdata\rlp\log_01.dsm formatsize=512 wait=yes
ANRO984I Process 72 for DEFINE LOGVOLUME started in the FOREGROUND at 16:04:30.
```
ANR2260I Recovery log volume D:\TSMDATA\RLP\LOG_01.DSM defined.
ANR0986I Process 72 for DEFINE LOGVOLUME running in the FOREGROUND processed 1 items for a total of 537,919,488 bytes with a completion state of SUCCESS at 16:04:30.

tsm: LOCHNESS_SERVER1>**query log**

<table>
<thead>
<tr>
<th>Available</th>
<th>Assigned</th>
<th>Maximum</th>
<th>Maximum</th>
<th>Page</th>
<th>Total</th>
<th>Used</th>
<th>Pct</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space</td>
<td>Capacity</td>
<td>Extension</td>
<td>Reduction</td>
<td>Size</td>
<td>Usable</td>
<td>Pages</td>
<td>Util</td>
<td>Pct</td>
</tr>
<tr>
<td>(MB)</td>
<td>(MB)</td>
<td>(MB)</td>
<td>(MB)</td>
<td>(bytes)</td>
<td>(bytes)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>--------</td>
<td>---------</td>
<td>---------</td>
<td>--------</td>
<td>--------</td>
<td>------</td>
<td>-----</td>
<td>------</td>
</tr>
<tr>
<td>1,012</td>
<td>500</td>
<td>512</td>
<td>492</td>
<td>4,096</td>
<td>127,488</td>
<td>359</td>
<td>0.3</td>
<td>0.7</td>
</tr>
</tbody>
</table>

**tsm: LOCHNESS_SERVER1>query logvol**

<table>
<thead>
<tr>
<th>Volume Name</th>
<th>Copy</th>
<th>Status</th>
<th>Volume Name</th>
<th>Copy</th>
<th>Status</th>
<th>Volume Name</th>
<th>Copy</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Copy 1)</td>
<td></td>
<td></td>
<td>(Copy 2)</td>
<td></td>
<td></td>
<td>(Copy 3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C:\TSMDATA\SERV-ER1\LOG1.DSM</td>
<td>Sync'd</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D:\TSMDATA\RLP\LOG_01.DSM</td>
<td>Sync'd</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The output shows the volume has been created. The **query log** command shows the available space. Note that the available space is *not* the amount of space currently in use by the recovery log. It is the total amount of space available in recovery log volumes. The *assigned* capacity is the amount of space currently in use by the recovery log.

Even though we specified a format size of 512MB, the actual size allocated was 513MB (513*1024*1024 = 537,919,488). As mentioned previously, the define process adds the extra 1MB for the restart area.

**UNIX users:** Recovery volume file names are case-sensitive.

As with the database, you must extend the recovery log once you have defined a new volume. Example 5-4 shows how to extend the recovery log using the **extend log** command.

**Example 5-4  Extending the recovery log**

tsm: LOCHNESS_SERVER1>**extend log 512 wait=yes**

ANR0984I Process 74 for EXTEND LOG started in the FOREGROUND at 16:21:18.
ANR0307I Recovery log extend in progress; 4 megabytes of 512 formatted.
ANR0307I Recovery log extend in progress; 8 megabytes of 512 formatted.
ANR0307I Recovery log extend in progress; 12 megabytes of 512 formatted.
ANR0307I Recovery log extend in progress; 16 megabytes of 512 formatted.

ANR0307I Recovery log extend in progress; 504 megabytes of 512 formatted.
ANR0307I Recovery log extend in progress; 508 megabytes of 512 formatted.
ANR0307I Recovery log extend in progress; 512 megabytes of 512 formatted.

ANR2268I Recovery log assigned capacity has been extended.
ANR0988I Process 74 for EXTEND LOG running in the FOREGROUND processed 536,870,912 bytes with a completion state of SUCCESS at 16:21:29.

```
1,012 1,012  0 1,008 4,096 258,560  153 0.1 0.2
```

Notice that a **ANR0307I** message is printed for every 4 megabytes of the log volume that is formatted. After the assigned capacity is extended, the output from `query log` changes accordingly. As we have extended the log to use all the defined volumes, the maximum extension column shows 0 bytes.

### 5.3 Setting the log mode

Use the `set logmode` command to set the mode for saving recovery log records. The log mode determines how Tivoli Storage Manager saves records in the recovery log and controls the kind of database recovery you can use. The two log modes are **NORMAL** and **ROLLFORWARD**.

- **NORMAL**: In normal mode, Tivoli Storage Manager saves only those transactions needed to restore the database to the point of the last database backup. Tivoli Storage Manager deletes any unnecessary transactions from the recovery log. Changes made to the database since the last backup cannot be recovered if the database is lost. Database backups can only be used to perform point-in-time recovery (that is, to the time of the last database backup). In NORMAL log mode, you need less space for the recovery log, since Tivoli Storage Manager deletes transactions once they have been committed to the database.

- **ROLLFORWARD**: In rollforward mode, Tivoli Storage Manager caches all transactions changes made to the database since the last time it was backed up. Tivoli Storage Manager deletes cached transactions only after a successful database backup. The cached transactions can be used to restore
the database to its most current state (roll-forward recovery) after loading the most current database backup series. A database backup series created in ROLLFORWARD mode can be used for either point-in-time recovery or roll-forward recovery. We recommend ROLLFORWARD mode for the superior recoverability it brings to the server database. Note that in ROLLFORWARD mode, more recovery log space is required.

When you change the log mode to ROLLFORWARD, if the database backup trigger is set, a database backup will immediately run.

To configure the log for ROLLFORWARD mode, issue the `set logmode` command as shown in Example 5-5. The command takes effect immediately - you do not need to restart the server.

```
Example 5-5   Set logmode to rollforward

    tsm: LOCHNESS_SERVER1> set logmode rollforward

    ANR2294I Log mode set to ROLLFORWARD.
```

To check that the command was successful, use the `query status` command and note the Log Mode field.

```
Example 5-6   Check status for log mode

    tsm: LOCHNESS_SERVER1> query status

    Server Name: LOCHNESS_SERVER1
    Server host name or IP address: 9.43.86.84

    Retry Period: 5 Minute(s)
    Scheduling Modes: Any
    Log Mode: RollForward
    Database Backup Trigger: Not Defined
    BufPoolSize: 261,120 K

```

**Note:** If you are changing the recovery log to rollforward mode, the recovery log size must be increased. To estimate the new value, reset the cumulative log consumption statistic using the administrative command `reset logconsumption`. Monitor the cumulative consumption over a number of days. Divide the cumulative consumption by the number of days since you reset the value, to get an average value. A safe size for the log pool is around 30-40% larger than this figure.
5.4 Defining the database backup trigger

The database backup trigger determines when to backup the Tivoli Storage Manager database, based on the recovery log utilization. When the recovery log is in rollforward mode, the potential for it to fill up is much greater than in normal mode. If the recovery log fills up, it is possible that the server can stall or even halt unexpectedly. By defining a database backup trigger, when the recovery log usage reaches the defined percentage, the server database is automatically backed up. The backup operation clears the cached transactions, clearing the recovery log.

Use the `define dbbackuptrigger` command to define settings for the database backup trigger, such as the percentage of the assigned capacity and device class to be used for automatic database backups. You can also define the number of incremental database backups that can be run before a full backup must run. These settings are used only when the recovery log mode is ROLLFORWARD.

The actual percentage to choose depends on the planning considerations in Chapter 2, “Implementation planning” on page 15. We recommend using 75 percent as a starting point and use the default number of incrementals (six). Monitor your environment’s activity to make sure that you do not trigger database backups too frequently, as this creates unnecessary load on the server and increases tape mount activity. If database backups are triggering too frequently, consider increasing the recovery log size.

Example 5-7 shows how to set the limit of 75% and run up to six incremental database backups before a full database backup.

Example 5-7  Setting the database backup trigger

```bash
    tsm: LOCHNESS_SERVER1> define dbbackuptrigger devclass=lto2-dc logfullpct=75 numincremental=6 incrdevclass=lto2-dc
    ANR2282I Database backup trigger defined and enabled.
    tsm: LOCHNESS_SERVER1> query process
    Process Number   Process Description Status
    --------        ---------------  ----------------
    76              Database Backup Full backup: 0 pages of 1500 backed up.
                     Current output volume: LTO888
    tsm: LOCHNESS_SERVER1> query dbbackuptrigger

    Full  Incremental  Log Full  Incrementals  Minimum  Minimum
    Device Device  Percentage Between Backup  Log
    Class  Class
    Fulls  Interval  Percentage
```
Notice that once we defined the database backup trigger, a database backup was immediately started. To verify that the `define dbbackuptrigger` command was successful, issue the `query dbbackuptrigger` command.

**Tip:** The combination of the dbbackuptrigger and rollforward mode may require some tuning attention. As with most automated processes, regular operational monitoring is required.

### 5.5 Setting the expansion trigger

Tivoli Storage Manager lets you fully automate the process of increasing the database and recovery log, whenever necessary. For example, suppose you have a 4 GB database and a 2 GB recovery log. You want to increase the size of the database by 25% when it is 85% utilized, but not to more than 8 GB. You also want to increase the recovery log by 30% when it is 75% utilized, but not to more than 4 GB.

**Note:** Setting a space trigger does not mean that the percentage used in the database and recovery log will always be less than the value specified with the `FULLPCT` parameter. Tivoli Storage Manager checks utilization when database and recovery log activity results in a “commit”. Deleting database volumes and reducing the database does not cause the trigger to activate. Therefore, the utilization percentage can exceed the set value before new volumes are online.

**zOS tip:** Database expansion triggering is not fully supported in Tivoli Storage Manager for zOS. On this platform, the `define spacetrigger` command does not cause new volumes to be created. It causes the database and recovery log to be extended if space is available. Event logging allows messages to display the amount of new space that is needed to satisfy the space trigger utilization parameter. You can use these messages to initiate automatic expansion or to complete an allocation job (refer to ANRFMT1 and ANRFMT, sample jobs that are located in the ASAMPLIB library).
5.5.1 Database space trigger

To define a new space trigger for the database, so that new volumes will be automatically created, (Tivoli Storage Manager generates the volume names), issue the `define spacetrigger db` command as in Example 5-8. The `expansionprefix` parameter specifies the directory where the volumes will be created.

Example 5-8   Defining and querying the database spacetrigger

```plaintext
define spacetrigger db fullpct=85 spaceexpansion=25 expansionprefix=c:\tsmdatadbprefix maximumsize=8192
ANR2274I Data Base Space trigger defined and enabled.

query spacetrigger db
```

Use `query spacetrigger db` to show the current settings.

The maximum size we want the database to grow to is 8GB, as specified in the `MAXIMUMSIZE` parameter. The system limit for the database is 530000MB (530GB). Set `MAXIMUMSIZE` to zero, or omit the parameter to disable checking for maximum size. If you need to change the trigger definition later, use the `update spacetrigger` command.

Whenever the system detects that the database needs extra space, it triggers the expansion, and writes messages to the activity log, as shown in the `query actlog` command in Example 5-9.

Example 5-9   Activity log messages from database expansion

```plaintext
query actlog

02/16/06 13:44:27 ANR4414I Data Base Space expansion Is Needed, 4 Megabytes needed.
02/16/06 13:44:27 ANR4412I Data Base and Recovery Log Space expansion triggered.
02/16/06 13:44:28 ANR2240I Database volume C:\TSMDATADBprefixDBD0200888.DBF defined.
```
5.5.2 Recovery log space trigger

To define a new space trigger for the recovery log to automatically create new volumes, (Tivoli Storage Manager generates the volume names), use the `define spacetrigger log` command as in Example 5-10. The `expansionprefix` parameter specifies the directory where the volumes will be created.

**Example 5-10  Defining and querying the recovery log spacetrigger**

```
tsm: LOCHNESS_SERVER1> define spacetrigger log fullpct=75 spaceexpansion=30 expansionprefix=d:\tsmdata\rlp\ maximumsize=4096
ANR2279I Recovery Log Space trigger defined and enabled.
```

```
tsm: LOCHNESS_SERVER1> query spacetrigger log
LOG Full  LOG Space LOG Expansion LOG Maximum Mirror Mirror
Percentage Expansion prefix Size (Mega- Prefix 1 Prefix 2
Percentage bytes)  ------- ---------- --------------- ----------- -------- --------
------- -------- --------- --------------- --------------  -------- --------
75 35 d:\tsmdata\rlp\ 4,096
```

You can specify a `MAXIMUMSIZE` from 9 MB through 13000 MB (13GB) for the recovery log. Set `MAXIMUMSIZE` to zero, or omit the parameter to disable checking for maximum size. If you need to change the trigger definition later, use the `update spacetrigger` command.

Whenever the system detects that the recovery log needs extra space, it triggers the expansion, and writes messages in the activity log, as shown in the `query actlog` command in Example 5-11.

**Example 5-11  Activity log messages from recovery log expansion**

```
tsm: LOCHNESS_SERVER1> query actlog
...
02/16/06 18:06:48 ANR4413I Recovery Log Space expansion Is Needed, 4 Megabytes needed.
02/16/06 18:06:48 ANR4412I Data Base and Recovery Log Space expansion triggered.
02/16/06 18:06:50 ANR2260I Recovery log volume D:\TSMDATA\RLP\L8675309.LOG defined.
```
5.6 Mirroring

When you first install Tivoli Storage Manager and initialize your server, the database and recovery log volumes are not mirrored. However, we strongly recommend that you create mirrors for the database and recovery log volumes.

Mirroring of database and recovery log volumes provides an extra level of recoverability, should a system fail during a write operation. If a partial write to a non-mirrored volume occurs, transaction recovery operations cannot complete when the server is restarted. The database will need to be restored from its most recent backup. With mirrored volumes, the chance that at least one of the mirror writes was successful is much higher. If a partial write is detected, a mirror volume can be used to construct valid images of the missing pages. For this reason we recommend that you use the Tivoli Storage Manager provided mirroring function at a minimum, rather than just operating system software or disk hardware mirroring.

Although you can mirror either the database or the recovery log, we recommend that you mirror both. Mirroring both database and log provides better availability and recoverability.

In Figure 5-3 on page 193, the Tivoli Storage Manager database volumes are mirrored to two different disks, so if one fails, the server can still function. The recovery log volumes are also duplicated. Note that Tivoli Storage Manager still has one database object and one recovery log object, regardless of whether mirroring is implemented.
You can use two-way or three-way mirroring. With two-way, there are two copies of each database or recovery log volume; with three-way, there are three copies of each database or recovery log volume. Figure 5-3 shows two-way mirroring.

![Database and recovery log mirroring](image)

All database volume copies are equal - as are all recovery log volume copies. There is no concept of a master and secondary mirror copy. The server can continue operating in the event of a failure of any single volume.

Tivoli Storage Manager copy volumes must have at least the same capacity as the original volumes. If your database consists of eight volumes of 1GB each, you will need eight more 1GB allocated volumes to completely mirror the database. If you create volumes larger than necessary, Tivoli Storage Manager gives a warning message (ANR2253W for database and ANR2273W for the log), but still allows you to use the allocated volume. The extra capacity will be wasted. We recommend creating all copies of each volume at the same size. You should mirror all or none of the volumes - there is no point in only mirroring some of them.

Use separate disks for each of the volumes in a mirrored set, so that you do not lose data if one disk fails. Although you can technically place primary and mirror
copies on the same disk, this is also a waste of space and will probably even decrease performance because of disk head contention.

When using two-way mirroring, we recommend using four disks for the database and recovery log volumes to keep each set of volumes on a separate disk. If you can, go one step further and ensure that the disks are on separate controllers. In a SAN environment, your disks will probably be virtualized, and running separate controllers for each LUN is not likely.

Table 5-1 shows an example of database and recovery log directories for UNIX/Linux and Windows, respectively. The UNIX file systems are assumed to be built on separate disks.

Table 5-1  Database and recovery log volume placement on four disks

<table>
<thead>
<tr>
<th>Type of Volume</th>
<th>UNIX file system mount points</th>
<th>Windows location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Database volumes</td>
<td>/tsm/database/primary</td>
<td>D: \TSMDATA\DBP</td>
</tr>
<tr>
<td>Mirrored database volumes</td>
<td>/tsm/database/mirror</td>
<td>E: \TSMDATA\DBM</td>
</tr>
<tr>
<td>Log volumes</td>
<td>/tsm/log/primary</td>
<td>F: \TSMDATA\RLP</td>
</tr>
<tr>
<td>Mirrored log volumes</td>
<td>/tsm/log/mirror</td>
<td>G: \TSMDATA\RLM</td>
</tr>
</tbody>
</table>

If four separate disks for your database and recovery log volumes are not possible, we recommend a minimum of two separate disks. In this way, you can place primary database and mirror log volumes on one disk, and primary log and mirror database volumes on the other. Table 5-2 shows how the volume placement would work. We assume for the UNIX examples, that /tsm/primary and /tsm/mirror are file systems created on separate disks.

Table 5-2  Database and recovery log volume placement on two disks

<table>
<thead>
<tr>
<th>Type of Volume</th>
<th>UNIX directories</th>
<th>Windows location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Database volumes</td>
<td>/tsm/primary/database</td>
<td>D: \TSMDATA\DBP</td>
</tr>
<tr>
<td>Mirrored database volumes</td>
<td>/tsm/mirror/database</td>
<td>E: \TSMDATA\DBM</td>
</tr>
<tr>
<td>Log volumes</td>
<td>/tsm/mirror/log</td>
<td>E: \TSMDATA\RLP</td>
</tr>
<tr>
<td>Mirrored log volumes</td>
<td>/tsm/primary/log</td>
<td>D: \TSMDATA\RLM</td>
</tr>
</tbody>
</table>
5.6.1 Database mirroring

To mirror the database, use the `define dbcopy` administrative command, or the `DSMFMT` utility for each volume that you want to mirror. Example 5-12 shows how to create a mirror volume of the volume created in Example 5-1 on page 181 using `define dbcopy`.

Example 5-12  Defining and querying database volume mirrors

```bash
Example 5-12  Defining and querying database volume mirrors

```
As soon as the copy volume is created, a background process synchronizes the data in the primary volume to the mirror. The output of `query dbvol` now shows the two mirror volumes and the status of each copy. The status should always be “Sync'd”.

We can see there is still the previous database volume present, C:\TSMDATA\SERVER1\DB1.DSM which is not mirrored. We will deal with this in 5.7.1, “Removing the default database volume” on page 197.

### 5.6.2 Recovery log mirroring

To mirror the recovery log, use the `define logcopy` administrative command, or use the `DSMFMT` utility for each log volume you want to mirror. Example 5-13 shows how to create a mirror volume of the volume created in Example 5-3 on page 184 using `define logcopy`.

**Example 5-13  Defining and querying recovery log volume mirrors**

```
tsm: LOCHNESS_SERVER1> define logcopy d:\tsmdata\rlp\log_01.dsm
c:\tsmdata\rlm\lgm_01.dsm formatsize=512 wait=yes
ANR0984I Process 83 for DEFINE LOGCOPY started in the FOREGROUND at 16:36:27.
ANR2262I Recovery log volume copy C:\TSMDATA\RLM\LG/_01.DSM defined; synchronization process started (process ID 84).
ANR0986I Process 83 for DEFINE LOGCOPY running in the FOREGROUND processed 1 items for a total of 537,919,488 bytes with a completion state of SUCCESS at 16:36:27.
```

```
tsm: LOCHNESS_SERVER1> query process

<table>
<thead>
<tr>
<th>Process</th>
<th>Process Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>84</td>
<td>Recovery Log Copy</td>
<td>Volume C:\TSMDATA\RLM\LG/_01.DSM - 256 Synchronization megabytes of 512</td>
</tr>
</tbody>
</table>
```

```
tsm: LOCHNESS_SERVER1> query logvol

<table>
<thead>
<tr>
<th>Volume Name (Copy 1)</th>
<th>Copy Status</th>
<th>Volume Name (Copy 2)</th>
<th>Copy Status</th>
<th>Volume Name (Copy 3)</th>
<th>Copy Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>C:\TSMDATA\SERVER1\LOG1.DSM</td>
<td>Sync'd</td>
<td></td>
<td>Undef-</td>
<td></td>
<td>Undef-</td>
</tr>
<tr>
<td>D:\TSMDATA\RLP\LOG_01.DSM</td>
<td>Sync'd</td>
<td>C:\TSMDATA\RLM\LG/_01.DSM</td>
<td>Sync'd</td>
<td></td>
<td>Undef-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```
As with the database volume mirror, after the log copy volume is created, a background process synchronizes the data in the primary volume to the mirror. The output of `query logvol` now shows the two mirror volumes and the status of each copy. The status should always be “Sync’d”.

We can see there is still the previous database volume present, \texttt{C:\TSMDATA\SERVER1\LOG1.DSM} which is not mirrored. We will deal with this in 5.7.2, “Removing the default recovery log volume” on page 199.

## 5.7 Removing default volumes

During installation on UNIX/Linux platforms, default database and recovery log volumes are created, usually in the server installation directory (`/usr/tivoli/tsm/server/bin` on AIX, for example). On Windows, the install process does not create any database or log volumes. You initialize the server with a wizard that allows you to specify where your first database and log volumes are located.

We recommend removing the initial default database and recovery log volumes. Removing them gives you complete control over the new database and recovery log distribution. If your Tivoli Storage Manager server is running on a Windows platform, and you wish to remove the first database and log volumes that you created in favour of better placement, you can also follow the examples.

### 5.7.1 Removing the default database volume

To remove a database volume, you must first have enough free space existing in the database to reduce its size by the amount of the volume’s size. The Tivoli Storage Manager server will automatically move any active pages in the volume that you are removing to other volumes. The `query db` command in the “Maximum Reduction (MB)” column shows the amount by which the database can be reduced. You must first define a new volume and extend the database if the number in that column is smaller than the size of the volume you wish to delete.

Use the `reduce db` command to reduce the database size. Once the database is reduced in size, the desired volume can be deleted. Example 5-14 shows the procedure.

**Example 5-14  Reducing database size**

```
tsm: ATLANTIC>query db
Available Assigned Maximum Maximum Page Total Used Pct Max.
Space Capacity Extension Reduction Size Usable Pages Util Pct
(MB) (MB) (MB) (MB) (MB) (bytes) Pages Util
--------- -------- --------- -------- ------- ---- ---- ----
tsm: ATLANTIC>reduce db
```

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We see we have plenty of space for reduction, as the default database volume is only 16MB in size. We have one other mirrored volume of 1GB, so there is enough space to reduce the size or the database. The second query db shows that the maximum extension is now 16MB, since the default volume has not yet been deleted.

Use the query dbvvolume command to see the full name of the file. You can now delete the default database volume using the delete dbvolume command, as shown in Example 5-15.

Example 5-15  Deleting a database volume

1,040 1,040 0 1,032 4,096 266,240 1,996 0.7 0.8
Even though the volume no longer appears in the `query dbvol` output, the file itself is not deleted by the process. You should now physically remove the file from the file system.

### 5.7.2 Removing the default recovery log volume

The procedure for removing the default recovery log volume is very similar to that for removing the default database volume. You must first have enough free space existing in the recovery log to reduce its size by the amount of the volume's size. The Tivoli Storage Manager server will move any active pages in the volume that you are removing to other volumes. Use the `reduce log` command, as shown in Example 5-16.

**Example 5-16  Reducing the recovery log size**

```
  tsm: ATLANTIC> q log
  Available Assigned Maximum Maximum Page Total Used Pct Max.
     Space Capacity Extension Reduction Size Usable Pages     ------ ------- ------- ---- ----
            (MB) (MB) (MB) (MB) (bytes) (MB) (bytes) Pct Pct
  --------- -------- -------- --------- ------ ------- ------ ---- ----
  520       520       0        512     4,096    132,608  317   0.2  0.2

  tsm: ATLANTIC> reduce log 8
  ANR2270I Recovery log assigned capacity has been reduced.

  tsm: ATLANTIC> q log
  Available Assigned Maximum Maximum Page Total Used Pct Max.
     Space Capacity Extension Reduction Size Usable Pages     ------ ------- ------- ---- ----
            (MB) (MB) (MB) (MB) (bytes) (MB) (bytes) Pct Pct
  --------- -------- -------- --------- ------ ------- ------ ---- ----
  520       512       8        504     4,096    132,560  321   0.2  0.2
```

We see that there is enough space to reduce the log by 8MB, the size of the default recovery log volume. To delete the volume, use the `delete logvol` command, as shown in Example 5-17.

**Example 5-17  Deleting a recovery log volume**

```
  tsm: ATLANTIC> q logvol
  Volume Name Copy Volume Name Copy Volume Name Copy
     (Copy 1) Status (Copy 2) Status (Copy 3) Status
  ---------------- ------ ---------------- ------ --------------- ------
```

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Even though the volume no longer appears in the `query logvol` output, the file itself is not deleted by the process. You should now physically remove the file from the file system.

### 5.8 Database backup

The Tivoli Storage Manager database is the heart of Tivoli Storage Manager - it tracks the location of all your backed up objects. Without it, your backups are just a bunch of ones and zeros. It is vitally important to run regular Tivoli Storage Manager database backups.

If the database becomes damaged or lost, you can restore it by running the Tivoli Storage Manager server in database restore mode: `DSMSERV RESTORE DB`. You will require the latest database backup media.

If you are following the steps in this chapter, the `DBBACKUPTRIGGER` will already start database backups as needed. However, it is also recommended to run a `FULL` database backup on a regular basis, at the least, daily. If you make a number of database configuration changes, such as we did earlier in this chapter, you should run a backup immediately afterwards. You should not rely solely on the `DBBACKUPTRIGGER` to produce your regular backups. The `DBBACKUPTRIGGER` is a safeguard to stop your recovery log from filling up. You will also see how to back up the database at least once every night as a scheduled operation in Chapter 12, “Scheduling” on page 359.
Use the `backup db` command to back up a Tivoli Storage Manager database to sequential access storage volumes. You can use `backup db` to run one of the following types of backup:

- **Full backup (TYPE=FULL)**: Backs up the entire Tivoli Storage Manager database. Example 5-18 shows how to perform a full backup operation.

- **Incremental backup (TYPE=INCREMENTAL)**: Backs up only those database pages that have been added or changed since the last time the database was backed up.

- **DBSnapshot (TYPE=DBSNAPSHOT)**: Specifies that you want to run a full snapshot database backup. The entire contents of the database are copied and a new snapshot database backup is created without interrupting the existing full and incremental backup series for the database. Example 5-19 shows how to perform a snapshot backup operation.

**Example 5-18  Creating a full database backup**

```sh
$ tsm: ATLANTIC> backup db type=full devclass=lto2-dc wait=yes

ANR0984I Process 14 for DATABASE BACKUP started in the FOREGROUND at 11:33:54.
ANR2280I Full database backup started as process 14.
ANR4554I Backed up 960 of 2001 database pages.
ANR4554I Backed up 1920 of 2001 database pages.
ANR4550I Full database backup (process 14) complete, 2001 pages copied.
ANR0985I Process 14 for DATABASE BACKUP running in the FOREGROUND completed with completion state SUCCESS at 11:34:30.
```

**Example 5-19  Creating a database snapshot**

```sh
$ tsm: ATLANTIC> backup db type=dbsnapshot devclass=lto2-dc wait=yes

ANR2287I Snapshot database backup started as process 15.
ANR4554I Backed up 960 of 2002 database pages.
ANR4554I Backed up 1920 of 2002 database pages.
ANR4550I Full database backup (process 15) complete, 2002 pages copied.
ANR0985I Process 15 for DATABASE BACKUP running in the FOREGROUND completed with completion state SUCCESS at 11:40:08.
```

The output from the two examples is very similar because the snapshot was run immediately after the full backup.
This section details a number of extra commands which relate to the Tivoli Storage Manager Database.

**DELETE VOLHIST TYPE=DBBACKUP**

If you are using the Disaster Recovery Manager (DRM), your database backups will be managed and expired automatically. You do not need to delete volume history. However, if you are not using DRM, you need to manually delete database backup volume history after a period of time.

A common problem reported by new Tivoli Storage Administrators is running out of tapes. It turns out that many tapes have been used by old server database backups, and they have never been expired. The problem can be compounded by the fact that each database backup requires its own tape — it is not possible to “stack” multiple backups onto a single tape.

You should think of this as a security feature. Database backups are extremely important - you do not want to be in the situation where the last seven days of database backups are contained on one tape which, at the crucial moment when a restore is required, turns out to be unreadable. That is why you have to use a new tape each time you back up the database, regardless of whether it is a full or incremental backup.

**Tip:** The devclass parameter may have a different value for your installation. You can run the `query devclass format=detailed` command to check the available device classes and query library to check the corresponding libraries available for use. You can run the `backup db` command at any time, without having to stop the server.

**Tip:** We recommend sending the most up-to-date Tivoli Storage Manager database backup offsite, to form a recovery position for your Tivoli Storage Manager environment.

Although our redbook material uses the **FULL + Incremental** features to handle Tivoli Storage Manager database backups, you should consider also running a **DBSNAPSHOT** as well. Keep the **FULL + Incremental** database backups onsite for faster recovery. The **DBSNAPSHOT** backup, being an out-of-band backup and not dependent on any incremental backups, should be taken offsite with any other offsite tapes.

### 5.9 Additional commands

This section details a number of extra commands which relate to the Tivoli Storage Manager Database.
Use the `delete volhistory` command to remove the references to old database backups from the Tivoli Storage Manager database. Depending on the options chosen, `delete volhistory` can delete sequential volumes used for database backups, storage pools, or other purposes.

When records containing volume history information about volumes that are not in storage pools (volume types `DBSNAPSHOT`, `BACKUPFULL`, `BACKUPINCR`, and `EXPORT`) are deleted, the volumes return to scratch status if they were acquired by Tivoli Storage Manager as scratch volumes. For scratch volumes with device type `FILE`, the files are deleted.

When records containing volume history information about volumes in storage pools are deleted, the volumes themselves are not affected and remain in the Tivoli Storage Manager database. In 12.2.2, “Defining the volume history schedules” on page 367, we describe setting up a schedule to take care of volume history deletion automatically.

**Tip:** Do not run the `delete volhist` command to delete obsolete database backups if you are using DRM - DRM handles the expiry itself.

**ESTIMATE DBREORGSTATS**

Occasionally, if your database grows to be quite large, and has been in use for a long period of time, it may benefit from a reorganization. Although database dump and reload is beyond the scope of this redbook, a command introduced with Tivoli Storage Manager V5.3 might assist you in determining whether your database needs attention.

The `ESTimate DBREorgstats` command examines the database and determines whether the database would benefit from a re-organization. Example 5-20 shows how to run the command.

Example 5-20  Estimating database reorganization statistics

```
$ tsm: LOCHNESS_SERVER1>estimate dbreorgstats wait=yes
ANR0984I Process 87 for ESTIMATE DBREORG started in the FOREGROUND at 12:09:21.
ANR1782W ESTIMATE DBREORG process 87 started - server performance may be degraded while this process is running.
ANR1784I A database reorganization would reduce the database utilization by an estimated 0 MB.
ANR0987I Process 87 for ESTIMATE DBREORG running in the FOREGROUND processed 940 items with a completion state of SUCCESS at 12:09:21.
ANR0381I Buffer pool statistics were successfully reset.
```
The output shows that reorganization would result in a zero megabyte reduction, so we do not need to perform a dump and reload at this stage. Note the message regarding performance degradation (ANR1782W). Ensure that you do not run the command during periods of peak usage. Note also that the buffer pool statistics were reset at the completion of the command.

5.10 Summary

You have now finished configuring your database and recovery log volumes to suit your environment. The next step is to do the same for storage pool volumes, and configure your storage devices.
Data storage

In the previous chapters we created planning material and performed installations, followed by database and recovery log customization. This chapter deals with storage configuration and customization. We assume that you have read and understood the redbook, *IBM Tivoli Storage Management Concepts*, SG24-4877.

In the following sections, we discuss how IBM Tivoli Storage Manager manages data storage pools, how you can define them, query them for status, and make changes based on operational requirements.
6.1 Example environment

The examples presented in this chapter are based on an environment shown in Figure 6-1. The example environment contains four primary storage pools and two copy pools. Client data backups go to the disk-based storage pool DISKDATA, and are then migrated to the sequential storage pool, TAPEDATA. OFFDATA is set up as a copy pool for taking data offsite. Client directory structures, which are much smaller in size, are directed to the sequential file storage pool DISKDIRS. They are then backed up to the copy pool, OFFDIRS.

In 1.1.1, “Our redbook support material” on page 5, we show how to load a predefined macro into Tivoli Storage Manager. The macro, `mac.stgcreate`, which we provide to create the storage pools in our redbook environment, is shown in B.1.6, “Create storage pools” on page 742.
Primary storage pools
In our example solution, we set up four primary storage pools: TAPEDATA, DISKDATA, DISKDIRS, and NONE. Storage pool TAPEDATA must be set up before storage pool DISKDATA, because DISKDATA refers to TAPEDATA as its next storage pool.

The examples in this chapter set up the following storage pools:

1. A primary storage pool named TAPEDATA, with device class LTO2-DC. The pool has collocation by node, and reclamation turned off (set to 100 percent).
2. A primary storage pool named DISKDATA, with a device class of DISK. It has an upper threshold of 70% that must be reached for migration to start, and a lower threshold of 30% that is reached or surpassed before migration stops. The pool to which data migrated goes is called TAPEDATA. The disk pool does not cache migrated data.
3. A primary storage pool named DISKDIRS, with a device class of FILE. It has migration turned off and no next storage pool, keeping the client directory structure permanently on disk. The pool has collocation by node, ensuring that clients directories will be stored in separate volumes. Note that only directories from clients where the directories have extended attributes will be stored in the storage pool. Windows and NetWare clients have extended file attributes. On UNIX clients, the directory entries are stored directly in the Tivoli Storage Manager database. The reason for having a separate storage pool for directories is so that we can guarantee the directories will be stored on disk, and not require tape mounts when files are restored. If you do not use the DIRMC client option to specify where directories are stored, they will be sent to whichever storage pool is pointed to by the management class with the longest retention period - which might end up being a tape storage pool.
4. A dummy storage pool named NONE that is simply a definition. No data will be stored in this storage pool, and there are no volumes assigned to it. It is simply used as a migration destination to prevent warnings when activating a policy set. See 7.1.3, “Defining management classes” on page 260 for further explanation.

Copy storage pools
The example solution has two copy storage pools:

1. OFFDATA for making copies of TAPEDATA to take offsite. OFFDATA is not collocated, and has reclamation set to 100 percent to avoid reclamation process from starting until our scheduled reclamation. Reuse delay is set to five days.
2. OFFDIRS, for making copies of DISKDIRS to take offsite. OFFDIRS is not collocated and also has its reclamation threshold set to 100 percent. Reuse delay is set to five days.
6.2 Devices

Before defining a new device to the Tivoli Storage Manager server, the device must first be configured under the operating system. We need the device name that the operating system understands when configuring the device to Tivoli Storage Manager.

Tivoli Storage Manager divides physical devices into two broad categories: Random access devices and sequential access devices.

- **Random access devices**: magnetic disk devices. Tivoli Storage Manager uses disk devices for two main purposes:
  - To store the database and recovery log.
  - To store data from client nodes. The client data is stored in disk storage pools.

There are two types of disk-based storage pool:

- Those with random access volumes using a DISK device class.
- Those with sequential volumes using a FILE device class.

Magnetic disk devices do not need defining to Tivoli Storage Manager; they can be referred to directly using a standard drive and path reference - e.g. C:\TSMDATA\STG\DISK_1.DSM for Windows, or /tsm/stg/disk_01.dsm for UNIX/Linux. The device type of DISK is predefined in Tivoli Storage Manager and cannot be altered.

- **Sequential access devices**: tape drives, optical devices and write once read many (WORM) devices. Medium changers such as tape libraries are also included.

Drives and libraries must first be defined under the operating system. You then define the library and drives to Tivoli Storage Manager before defining storage pools that use the devices.

**Device drivers**

IBM supplies device drivers for each of its library and tape devices, for each operating system the device is supported on. If you will be using another vendor’s device, you may require operating system device drivers for the device from the vendor. The following points should be noted:

- On Windows 2000 and 2003, you may need to use the Tivoli Storage Manager Device Driver.
  - However, if you are using IBM devices, such as the 3582, 3310/3576 or 3584 libraries with LTO drives, you should install the IBM-supplied device drivers for Windows. You do not need to install the Tivoli Storage Manager Device Driver.
If you have devices from another vendor that are supported by Tivoli Storage Manager, you should install the Tivoli Storage Manager Device Driver.

You should also disable the Windows Removable Storage (RSM) service, as it may interfere with Tivoli Storage Manager.

Check the Windows device manager to ensure that the library appears under “Medium Changers”, and the tape drives appear under “Tape Drives”. All devices should be “working properly”.

For AIX, IBM libraries and drives such as the 3582, 3310/3576 or 3584, require the IBM Atape.driver package to be installed. Some IBM libraries, such as the 3494 also require the IBM at1dd package. If you have a non-IBM device supported by Tivoli Storage Manager, you must install the tivoli.tsm.devices package.

For Linux platforms, IBM libraries and drives require the IBM ibmtape and ibmatl packages for the particular Linux you are using. Non-IBM devices supported by Tivoli Storage Manager require the appropriate device driver package installed from the Tivoli Storage Manager distribution for the particular Linux you are using.

To use a sequential device with Tivoli Storage Manager, a number of components must be configured. The components can be thought of in two classes, physical and logical, and must be configured in the following order:

**Physical:**
- a. The library (SCSI (automated) or MANUAL)
- b. The library path (that is, the link from the server to the library's operating system device)
- c. Tape drives within the library
- d. Drive paths (one for each drive)

**Logical:**
- a. **Device class**: Here you create a class for the library, and associate it with the device type and the library name. The device type is from a Tivoli Storage Manager-supported list, and common to all Tivoli Storage Manager server platforms, for example LTO, 4MM, DLT.
- b. **Storage pool**: specifies the device class to use for storing data. Storage pools have various attributes based on the device type. Many storage pools can use the same device class.
- c. **Volumes**: objects belonging to a particular storage pool. For sequential access devices, volumes are usually tape cartridges or magneto-optical discs. Volumes can be assigned to a scratch pool where they are used as needed, or assigned as private to a particular storage pool.
As mentioned above, when configuring sequential access devices for use, there is an order that must be followed. If you try to create a Tivoli Storage Manager object that has a parameter referring to another item, that item must already exist.

Table 6-1 details the steps required in order to configure each device and storage pool you wish to set up. It also shows the reference sections in this chapter for completing the tasks.

**Note:** The examples in this section deal with an automated library (SCSI). Automated libraries are the most common libraries in use.

<table>
<thead>
<tr>
<th>Order of Definition</th>
<th>Component Class</th>
<th>Component</th>
<th>To Define the Type of Device Below, Follow Each Component Section</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Auto Library</td>
</tr>
<tr>
<td>1</td>
<td>Physical</td>
<td>Library</td>
<td>6.2.1</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Library Path</td>
<td>6.2.2</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Drive</td>
<td>6.2.3</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Drive Path</td>
<td>6.2.4</td>
</tr>
<tr>
<td>5</td>
<td>Logical</td>
<td>Device Class</td>
<td>6.2.5</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Storage Pool</td>
<td>6.3.1</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>Volume</td>
<td>6.4.2</td>
</tr>
</tbody>
</table>

### 6.2.1 Defining a library

There are two parts to configuring a library: defining the library, and defining a path to it. To define the library, you simply need the name you will call it, the type (SCSI, MANUAL, 349X and so on), whether or not you will share it with another Tivoli Storage Manager server, and whether you wish unlabeled tapes to be automatically labelled for use. Example 6-1 shows an example of the `define library` command.

**Example 6-1** Defining an automated SCSI library

```
tsm: ATLANTIC>define library 3582lib libtype=scsi shared=yes autolabel=yes
ANR8400I Library 3582LIB defined.
```
6.2.2 Defining a path to a library

A path to a device is a link between the Tivoli Storage Manager server and the operating system name for the device. Automated libraries have a medium changer (also known as a robot) that performs movement operations on tapes inside the library. The medium changer has an associated operating system device name. You will need to find the operating system device names for each device before you define them to Tivoli Storage Manager.

Windows 2000/2003: Open the Tivoli Storage Management Console. In the left-hand pane, expand Tivoli Storage Manager, your server name, TSM Device Driver, Reports, Device Information. The device is under the “TSM Name” column in the right-hand pane, for example lb0.1.0.2

AIX users: Run the following AIX command to find the device name, for example, /dev/smc0:

```
root@Atlantic /: lsvg -Cc tape
rmt0 Available 1Z-08-01 IBM 3580 Ultrium Tape Drive (FCP)
smc0  Available 1Z-08-01 IBM 3582 Library Medium Changer (FCP)
```
Before defining the path, the library must already be defined, as in 6.2.1, “Defining a library” on page 210. Paths also have a source and a destination. The source is the name of the server or datamover from which you are defining the path. The destination is the name of the library or drive to which you are defining the path. Example 6-2 shows an example of the define path command when used to define a path from a server to a library:

Example 6-2  Defining a path to an automated library

tsmt: ATLANTIC>define path ATLANTIC 3582LIB srctype=server autodetect=yes desttype=library device=/dev/smc0 online=yes
ANR1720I A path from ATLANTIC to 3582LIB has been defined.

tsmt: ATLANTIC>q path f=d

Source Name: ATLANTIC
Source Type: SERVER
Destination Name: 3582LIB
Destination Type: LIBRARY
Library:
  Node Name:
    Device: /dev/smc0
External Manager:
  LUN:
  Initiator: 0
  Directory:
    On-Line: Yes
Last Update by (administrator): ADMIN
  Last Update Date/Time: 02/22/2006 12:32:27

tsmt: ATLANTIC>q library f=d

Library Name: 3582LIB
Library Type: SCSI
  ACS Id:
  Private Category:
  Scratch Category:
  WORM Scratch Category:
External Manager:
  Shared: Yes
  LanFree:
  ObeyMountRetention:
Primary Library Manager:
  WWN: 500308C140067006
  Serial Number: 0000013108231000
  AutoLabel: Yes
  Reset Drives: Yes
Last Update by (administrator): ADMIN
  Last Update Date/Time: 02/22/2006 12:32:41
With the path successfully created, the `query library` command now provides us with some more information - we can see the SAN World-Wide Name (WWN) and the library’s serial number.

### 6.2.3 Defining a drive in a library

Libraries with multiple drives must have each drive defined to Tivoli Storage Manager. Each drive and each cartridge location in a library has what is known as an **element address**. The element address is used by the device driver when it sends a media movement command, for example “move tape in element 4096 to tape drive at element 256”. Element information must be supplied when you define the drive, along with the serial number and optionally, the WWN for SAN-attached drives. Use the `define drive` command to define each drive.

#### Element information

Element numbers can be discovered automatically when you specify the `ELEMENT=AUTODetect` option. However, the element number is not detected until you run the `define path` command. The element address is also printed in the manual that came with the library. Windows also has a wizard that can display the element number.

#### Serial number

The serial number of the drive can also be discovered automatically by specifying the `SERial=AUTODetect` option. Again, the element number is not detected until you run the `define path` command. Windows also has a wizard that can display the drive serial number.

#### WWN

The WWN can also be supplied if you wish. Typically, however, the WWN is detected when the `define path` command polls the drive to obtain other information.

#### Defining the drive

Example 6-3 shows the commands to define drives named DR00 and DR01 in the library named 3582LIB that we created earlier.

**Example 6-3  Defining drives in an automated library**

```
tsm: ATLANTIC>define drive 3582lib dr00 serial=autod online=yes element=autod cleanfreq=asneeded
ANR8404I Drive DR00 defined in library 3582LIB.
```
tsm: ATLANTIC> define drive 3582lib dr01 serial=autod online=yes element=autod cleanfreq=asneeded
ANR8404I Drive DRO1 defined in library 3582LIB.

tsm: ATLANTIC> q dr f=d

Library Name: 3582LIB
Drive Name: DR00
Device Type: UNKNOWN
On-Line: Yes
Read Formats:
Write Formats:
Element:
Drive State: UNKNOWN
Volume Name:
Allocated to:
WWN:
Serial Number:
Last Update by (administrator): ADMIN
Last Update Date/Time: 02/22/2006 12:58:40
Cleaning Frequency (Gigabytes/ASNEEDED/NONE): ASNEEDED

Notice that the element, serial number, WWN and read and write format fields are not yet populated.

6.2.4 Defining a path to a drive in a library

As for the library, you use the define path command. However, you specify some different options when defining a path to a drive. Example 6-4 shows the syntax of define path for drives.

Example 6-4  Defining drive paths

tsm: ATLANTIC> define path ATLANTIC DR00 srctype=server desttype=drive library=3582lib device=/dev/rmt0 online=yes
ANR1720I A path from ATLANTIC to 3582LIB DR00 has been defined.

tsm: ATLANTIC> define path ATLANTIC DR01 srctype=server desttype=drive library=3582lib device=/dev/rmt1 online=yes
ANR1720I A path from ATLANTIC to 3582LIB DR01 has been defined.

tsm: ATLANTIC> q drive f=d

Library Name: 3582LIB
Drive Name: DR00
Device Type: LTO
On-Line: Yes
When the paths are defined, the drive information is obtained. You can see in the example that the element number, serial number, WWN and supported format fields are now populated. The Drive State field remains unknown at this stage as we have not read from, nor written to, either of the drives.

The path information for the drives can also be displayed using query path as shown in Example 6-5.

Example 6-5  Querying drive path information

```bash
  tsm: ATLANTIC> q path * * srct=server destt=drive libr=3582lib f=d
```

Source Name: ATLANTIC
Source Type: SERVER
Destination Name: DR00
Destination Type: DRIVE
Library: 3582LIB
Node Name:
  Device: /dev/rmt0
External Manager:
6.2.5 Defining a device class for a library

A device class is the link between a storage pool and a particular device upon which you wish to store data.

In order to create a storage pool to use our library and tape drives, we must define a device class for the library (and its drives). A library can be defined in many device classes, and a device class can be used by many storage pools.

To define a device class, use the `define devclass` command. This command has many different options depending on the type of devices you are using. You should read the online help (`help define devclass`) before defining your device classes.

Some of the important options are:

- **FORMAT**: defines the format in which the device reads and writes.

- **MOUNTRetention**: specifies the amount of time a tape will remain mounted in a drive after it becomes idle. The default of 60 minutes is generally too long for most environments. If your environment requires frequent tape mounts, set a low value (5 or 10 minutes).
> **MOUNTWait**: specifies the length of time the server will wait for a tape to become available in the library (that is, either mounted in a drive for a manual library, or checked in to an automated library).

Example 6-6 shows defining a device class for use with an IBM 3582 LTO2 library.

**Example 6-6  Defining an LTO device class**

```bash
tsm: ATLANTIC> define devclass LTO2-DC library=3582LIB devtype=lto format=ultrium2c estcapacity=400G mountretention=10 mountwait=20 mountlimit=drives
ANR2203I Device class LTO2-DC defined.

tsm: ATLANTIC> q devc lto2-dc f=d

Device Class Name: LTO2-DC
Device Access Strategy: Sequential
Storage Pool Count: 0
  Device Type: LTO
    Format: ULTRIUM2C
Est/Max Capacity (MB): 409,600.0
  Mount Limit: DRIVES
  Mount Wait (min): 20
  Mount Retention (min): 10
Label Prefix: ADSM
  Library: 3582LIB
  Directory:
  Server Name:
  Retry Period:
  Retry Interval:
  Shared:
High-level Address:
  Minimum Capacity:
    WORM: No
  Scaled Capacity:
Last Update by (administrator): ADMIN
  Last Update Date/Time: 02/22/2006 14:48:51
```

The `query devclass` command shows the attributes of device classes.

You can, if you wish, define other device classes that use the same library. It is entirely up to how you want to configure you environment. For example, you could define another device class to be used exclusively for creating offsite tapes.

If you are using a separate library or a z/OS server platform, you need to define a separate device class.
The command shown in Example 6-7, defines a device class named LTO2-OFFSITE for library 3582LIB.

Example 6-7  Defining an extra device class for the same library

```bash
   tsm: ATLANTIC>define devclass LTO2-OFFSITE library=3582LIB devtype=lto format=ultrium2c estcapacity=400G mountretention=10 mountwait=20 mountlimit=drives
   ANR2203I Device class LTO2-OFFSITE defined.
```

### 6.2.6 Defining a sequential file device class

Device classes that use a type of FILE allow a random access (disk) device to simulate a sequential device. The most common uses for sequential file storage pools are:

- If your library has a single drive and you want to perform reclamation on volumes in storage pools using this library. When you specify the reclamation pool for the storage pools, it must be a primary sequential storage pool. To use a disk for reclamation you must create a sequential file storage pool.

- Creating database backups for keeping on-site and online.

To configure a sequential storage pool, you must first define a device class of device type FILE. When defining the device class, you need to specify which directory to use and what the maximum size of each volume can be. Volumes in a sequential file storage pool are, of course, files. You can specify how big each of these files can become before the Tivoli Storage Manager server closes one and creates another.

As for other device classes, use the `define devclass` command, specifying the `DEVType=FILE` option. Example 6-8 defines a device class named SEQF-DC with a maximum capacity of 256MB. We also create a sequential file device class for use with directory metadata (from the directory management class).
Example 6-8  Defining a sequential file device class

```
 DEFINE DEVCSEQF-DC DEVTYPE=FILE MOUNTLIMIT=25 MAXCAPACITY=256M DIRECTORY=/TSM/STG/SEQF
ANR2203I Device class SEQF-DC defined.
```

```
tsm: ATLANTIC>devseqf-dc f=d

Device Class Name: SEQF-DC
Device Access Strategy: Sequential
Storage Pool Count: 0
Device Type: FILE
Format: DRIVE
Est/Max Capacity (MB): 256.0
Mount Limit: 25
Mount Wait (min):
Mount Retention (min):
Label Prefix:
Library:
Directory: /tsm/stg/seqf
Server Name:
Retry Period:
Retry Interval:
Shared:
High-level Address:
Minimum Capacity:
WORM: No
Scaled Capacity:
Last Update by (administrator): ADMIN
Last Update Date/Time: 02/22/2006 15:50:07
```

```
tsm: ATLANTIC>devdirm-dc f=d

Device Class Name: DIRM-DC
Device Access Strategy: Sequential
Storage Pool Count: 0
Device Type: FILE
Format: DRIVE
Est/Max Capacity (MB): 64.0
Mount Limit: 50
Mount Wait (min):
Mount Retention (min):
Label Prefix:
Library:
Directory: /tsm/stg/dirm
Server Name:
Retry Period:
Retry Interval:
Shared:
High-level Address:
Minimum Capacity:
WORM: No
Scaled Capacity:
Last Update by (administrator): ADMIN
Last Update Date/Time: 02/22/2006 15:50:07
```

6.3 Storage pools

Storage pools are the logical entities in which Tivoli Storage Manager stores client data. Up to now, we have configured the devices that our storage pools will use for physically storing the data. Now we will create the pools.

Tivoli Storage Manager has two types of storage pools:

- Primary storage pools
- Copy storage pools
A primary storage pool can use random access storage (DISK device class) or sequential access storage (tape, optical, or file device classes). A copy storage pool can use only sequential access storage.

You can define your storage pools in any order. However, it is easier to first create the pools that will be pointed to by others.

6.3.1 Defining a sequential access tape storage pool

You define a primary tape storage pool using the `define stgpool` command with your defined device class (LTO2-DC in our case. Some important options are:

- `MAXSCRatch`: number of scratch tapes that the storage pool can use before it reports that it is full. For automatic libraries, set `MAXSCRatch` to a large number, say 1,000,000, to avoid the server stopping when the storage pool is “full”. For manual libraries with a small capacity, set `MAXSCRatch` to a more realistic number.

- `REClaim`: percentage of empty space on a tape volume that will cause the server to try to consolidate the remaining data to another volume. Set `REClaim` to 100 to disable reclamation. This requires scheduled reclamation for the storage pool.

- `COLlocate`: specifies whether the server tries to keep data from a client, group of clients or client filespaces on as few tapes as possible (known as collocation). Collocation reduces the number of tapes required to perform restore operations, but will increase the number of tapes required to store client data.

- `RECLAIMSTGpool`: if your library has only one drive, you will need another primary sequential storage pool to permit reclamation.

Example 6-9 defines a primary sequential tape pool.

Example 6-9   Defining a primary sequential tape pool

```sh
tsm: ATLANTIC>define stgpool tapedata LTO2-DC description="Primary tape pool"
        reclaim=100 maxscratch=1000000 colllocate=node
ANR2200I Storage pool TAPEDATA defined (device class LTO2-DC).
```

```
tsm: ATLANTIC>q stgp
Storage Device Estimated Pct Pct High Low Next Storage
Pool Name Class Name Capacity Util Migr Mig Mig Mig Pool
----------  ---------- --------- ---- ----- ---- --- -----------
TAPEDATA   LTO2-DC   0.0 M  0.0 90 70
```

ANR2200I Storage pool TAPEDATA defined (device class LTO2-DC).
6.3.2 Defining a random access disk storage pool

You define a primary disk storage pool using the `define stgpool` command with the predefined device class of DISK. Some of the options you should consider are:

- **NEXTstgpool**: defines the next storage pool in the hierarchy. `NEXTstgpool` is where migrated data is sent, or files exceeding `MAXSize` (see below).

- **MAXSize**: the maximum size a file can be to be stored in the storage pool. Any file over this size is written to the next storage pool. If `NEXTstgpool` is not defined, the store operation for the file fails.

- **HIGHmig**: the threshold at which migration starts. When the storage pool reaches this percentage of its capacity, a migration process will begin to move the data to the `NEXTstgpool`.

- **LOWmig**: when migration stops. When migration is running, if the utilization of the pool falls to or below this value, migration stops.

- **CACHE**: specifies whether a copy of a migrated file is cached in the pool after migration to the next pool. Caching files can improve restore performance, but may cause other processes to suffer. For example, if a disk pool is full of cached files, when a client backs up new data into that pool, the server must find suitable cached files to remove and provide free space for the new data.

Example 6-10 defines a storage pool named DISKDATA with a high migration threshold of 80% and a low migration threshold of 30%. We also create the dummy pool NONE. Both use the predefined device class of DISK.

**Example 6-10  Defining a random access DISK storage pool**

```plaintext
Example 6-10  Defining a random access DISK storage pool

```
Note that the estimated capacity and utilization figures are zero at this point as we have not assigned any volumes or stored any data as yet.

### 6.3.3 Defining a sequential access file storage pool

You define a primary tape storage pool using the `define stgpool` command with your defined device class (LT02-DC). Some of the options you should consider are:

- **MAXSCRatch**: number of scratch volumes that the storage pool can use before it reports that it is full. For sequential file storage pools, set `MAXSCRatch` to a large number, say 1,000,000, to avoid the server stopping when the storage pool is “full”. Sequential file storage pools create and delete volumes as required, however, when a volume is created, the number of scratch volumes used is incremented.

- **COLlocate**: specifies whether the server tries to keep data from a client, group of clients or client filespaces on as few tapes as possible (known as Collocation). Collocation reduces the number of volumes required to perform restore operations, but will increase the number of volumes required to store client data.

Example 6-11 shows the definition of two sequential access storage pools.

---

**Example 6-11  Defining sequential file storage pools**

```plaintext
{tsm: ATLANTIC> define stgpool DISKFILE seqf-dc description="Sequential file storage pool" collocate=node maxscratch=1000000
ANR2200I Storage pool DISKFILE defined (device class SEQF-DC).

{tsm: ATLANTIC> define stgpool DISKDIRS dirm-dc description="Sequential file storage pool for directory metadata" collocate=node maxscratch=1000000
ANR2200I Storage pool DISKDIRS defined (device class DIRM-DC).

{tsm: ATLANTIC> q stgp
Storage Pool Name  Device Class Name  Estimated Capacity  Pct Util  Pct Migr  High Mig Pct  Low Mig Pct  Next Storage Pool
----------  ----------  ---------  ------  ----  -----  ------  ----  ------
DISKDATA  DISK  0.0 M  0.0  0.0  80 30  TAPEDATA
DISKDIRS  DIRM-DC  0.0 M  0.0  0.0  90 70
DISKFILE  SEQF-DC  0.0 M  0.0  0.0  90 70
NONE  DISK  0.0 M  0.0  0.0  90 70
TAPEDATA  LT02-DC  0.0 M  0.0  0.0  90 70

---
```
Operation of a sequential access FILE storage pool

A sequential access storage pool with a FILE device class acts somewhat differently compared to a storage pool mapped to a physical tape or optical device. When disk is used, the server opens a file only when one is required. The storage pool shows an estimated capacity of zero megabytes until data has been sent to it. Following a client backup operation, we see the estimated capacity increase. The estimated capacity is calculated as the product of the maximum volume size (`MAXCAP`, 64MB) and the maximum number of scratch volumes allowed (`MAXSCR`, 1,000,000). For `DISKDIRS`, the estimated capacity is 64,000GB (64TB).

The server creates and names volumes as they are needed; volumes do not have to be defined in sequential file storage pools.

The first volume created in the `DISKDIRS` pool is named `00000001b.BFS`.

Example 6-12  Sequential FILE storage pool volumes

```plaintext
Volume Name     Storage Pool Name    Device Class Name    Estimated Capacity    Pct Util    Volume Status
---------------  ---------------------  -------------------  -------------------  ----------  -------------
/tsm/stg/dirm/0000001B-   DISKDIRS    DIRM-DC             64.0               100.0      Full
.BFS            /tsm/stg/dirm/0000002A- DISKDIRS    DIRM-DC             64.0               0.0        Filling
.BFS
```

From AIX shell prompt:

```plaintext
root@Atlantic /:
root@Atlantic /tsm/stg/dirm:
ls -l
total 132608
-rw------  1 root     system     67108864 Feb 23 15:52 00000001b.bfs
-rw------  1 root     system     786432  Feb 23 15:52 00000002a.bfs
```

Single drive reclamation using disk for reclaim storage pool

To perform reclamation with a single tape drive, specifying the `RECLAIMSTGpool` parameter when creating the tape storage pool. `RECLAIMSTGpool` points to another primary sequential storage pool that can be used as the holding area for the data being consolidated. The “holding area” storage pool then refers to the original pool being reclaimed as its `NEXTstgpool`.

Example 6-13 updates the existing storage pool `TAPEDATA` to use `DISKFILE` as its reclamation storage pool. We then update `DISKFILE` to change its next storage pool to `TAPEDATA`. 
Example 6-13  Updating storage pools

```
tsm: ATLANTIC> update stgpool tapedata reclaimstgpool=diskfile
ANR2202I Storage pool TAPEDATA updated.

tsm: ATLANTIC> q stg tapedata f=d

        Storage Pool Name: TAPEDATA
        Storage Pool Type: Primary
        Device Class Name: LTO2-DC
        Estimated Capacity: 0.0 M
        Space Trigger Util:
            Pct Util: 0.0
            Pct Migr: 0.0
            Pct Logical: 0.0
            High Mig Pct: 90
            Low Mig Pct: 70
        Migration Delay: 0
        Migration Continue: Yes
        Migration Processes: 1
        Reclamation Processes: 1
        Next Storage Pool:
        Reclaim Storage Pool: DISKFILE
        Maximum Size Threshold: No Limit
            Access: Read/Write
            Description: Primary tape pool
        Overflow Location:
        Cache Migrated Files?:
            Collocate?: Node
        Reclamation Threshold: 100
        Offsite Reclamation Limit:
        Maximum Scratch Volumes Allowed: 1,000,000
        Number of Scratch Volumes Used: 0
        Delay Period for Volume Reuse: 0 Day(s)
        Migration in Progress?: No
        Amount Migrated (MB): 0.00
        Elapsed Migration Time (seconds): 0
        Reclamation in Progress?: No
        Last Update by (administrator): ADMIN
            Last Update Date/Time: 02/23/2006 09:35:08
        Storage Pool Data Format: Native
        Copy Storage Pool(s):
            Continue Copy on Error?:
                CRC Data: No
        Reclamation Type: Threshold

        tsm: ATLANTIC> update stg diskfile nextstgpool=tapedata
        ANR2202I Storage pool DISKFILE updated.
```
6.3.4 Defining a copy storage pool

A copy storage pool is used to create copies (backups) of primary storage pools.

In our example solution, we have two copy storage pools: OFFDIRS and OFFDATA.

Reuse delay

The example copy pools have a reuse delay of five days. The reuse delay must expire before empty offsite tape volumes are moved back to the scratch pool. The delay allows for a period of time in which the offsite tapes, even though "empty", may be required for a restore. For example, if your most current offsite backups were destroyed in transit (a car accident involving the courier, perhaps), you may need to restore from a database backup made four days ago. The four-day-old database backup will still reference now-empty tapes, but consider them as having data. The reuse delay allows you to use these tapes even though they are currently considered empty. The reuse delay is especially helpful during a long company shutdown, such as at the end of the year, where the offsite data must remain intact in case a disaster occurs at your main site. You should set the reuse delay equal to the expiry period of your database backups. For example, if you are using DRM and your `DRMDBBackupexpiredays` is set to 6, or you run `delete volhistory type=dbbackup todate=today-6`, you should set `REUsedelay` on the copy storage pools to 6 as well.

The commands given in Example 6-14 set up the following storage pools:

1. A copy storage pool named OFFDIRS, with device class LTO2-DC.
   Reclamation is switched off and the reuse delay is set for five days.

2. A copy storage pool named OFFDATA, with device class LTO2-DC.
   Reclamation is switched off and the reuse delay is set for five days.

When defining copy storage pools, the same options as for defining a sequential pools apply, except you must specify `Pooltype=Copy`, and reclamation is by default set at 100 percent.
Example 6-14  Defining copy storage pools

```plaintext
tsm: ATLANTIC>define stgpool OFFDIRS lto2-dc pooltype=copy description="Copy storage pool for directories" maxscratch=1000000 reusedelay=5
ANR2200I Storage pool OFFDIRS defined (device class LTO2-DC).

tsm: ATLANTIC>define stgpool OFFDATA lto2-dc pooltype=copy description="Copy storage pool for data" maxscratch=1000000 reusedelay=5
ANR2200I Storage pool OFFDATA defined (device class LTO2-DC).

tsm: ATLANTIC>q stg pooltype=copy
```

<table>
<thead>
<tr>
<th>Storage Pool Name</th>
<th>Device Class Name</th>
<th>Estimated Capacity</th>
<th>Pct Util</th>
<th>Pct Migr</th>
<th>High Mig Pct</th>
<th>Low Mig Pct</th>
<th>Next Storage Pool</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFFDATA</td>
<td>LTO2-DC</td>
<td>0.0 M</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OFFDIRS</td>
<td>LTO2-DC</td>
<td>0.0 M</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.3.5 Deleting the default storage pools

Now that you have created your storage pools as planned, you can delete the default storage pools to tidy up your installation. The `delete stgpool` command removes a storage pool, as shown in Example 6-15.

Example 6-15  Deleting the default storage pools

```plaintext
tsm: ATLANTIC>del stgpool archivepool
ANR2201I Storage pool ARCHIVEPOOL deleted.

tsm: ATLANTIC>del stgpool backuppool
ANR2201I Storage pool BACKUPPOOL deleted.

tsm: ATLANTIC>del stgpool spacemgpool
ANR2201I Storage pool SPACEMGPOOL deleted.
```

In 1.1.1, “Our redbook support material” on page 5, we show how to load a predefined macro into Tivoli Storage Manager. The macro `mac.stgdelete`, which we provide to delete the default storage pools, is shown in B.1.7, “Delete default storage pools” on page 743. The macro deletes the four default storage pools automatically set up by the Windows installation, including an additional storage pool named DISKPOOL. Note that a Tivoli Storage Manager installation on a UNIX platform does not create DISKPOOL. You must remove the line deleting DISKPOOL before running the macro.
6.4 Storage pool volumes

Now that our storage pools are defined, we must perform one final task for each of them. Storage pools must contain volumes to be able to store data. For disk storage pools, volumes are simply files (usually large) located on the server’s file systems. For tape storage pools (both primary and copy), volumes are physical tape cartridges. In order to write to, or read from, the tapes, they must be mountable, that is, present in a library. Tape volumes are still regarded as part of a storage pool even though they might no longer be inside a tape library (that is, not-mountable or offsite).

This section provides examples of assigning volumes to storage pools. You can add or remove volumes to and from storage pools without interrupting server operations. For example, if you install a new disk drive for a disk pool, the Tivoli Storage Manager administrator can move the storage pool data from the old pool to the new pool without shutting down the server. Or, if you have to add space to a storage pool, you can easily define new volumes and expand the size of the storage pool without disrupting service.

6.4.1 Defining random access disk volumes

Disk volumes can be defined to a Tivoli Storage Manager storage pool in two ways. Described here is the more efficient one-step process using the `define volume` command with the `FORMATSIZE` option. The other method has two steps - prepare the disk volume using the `dsmfmt` utility, and then define the volume to the storage pool using the `define volume` command.

By now you will have decided on your disk storage pool volume numbers and sizes. Remember that it is better to have a number of smaller volumes than a single large volume in your disk storage pools. Although they take up the same amount of space, having more smaller volumes is more efficient. With a single volume in the pool, only a single server thread can write to it at any given time. With more volumes, more server threads can write to them simultaneously. Multiple volumes, can be spread over more physical disks, enhancing performance. And with more volumes, you can easily remove some from one pool and assign to another if your requirements change during processing (temporarily or permanently).

Example 6-16 shows the commands to define and query volumes.

Example 6-16   Defining volumes to the DISKDATA storage pool

```bash
  tsm: ATLANTIC>define volume diskdata /tsm/stg/diskdata/ddvol_01.dsm
  formatsize=2048 wait=no
```
ANS8003I Process number 16 started.

**tsm: ATLANTIC>** define volume diskdata /tsm/stg/diskdata/ddvol_02.dsm
formatsize=2048 wait=no
ANS8003I Process number 17 started.

**tsm: ATLANTIC>** define volume diskdata /tsm/stg/diskdata/ddvol_03.dsm
formatsize=2048 wait=no
...

**tsm: ATLANTIC>** define volume diskdata /tsm/stg/diskdata/ddvol_04.dsm
formatsize=2048 wait=no
...

**tsm: ATLANTIC>** define volume diskdata /tsm/stg/diskdata/ddvol_05.dsm
formatsize=2048 wait=no
...

**tsm: ATLANTIC>** define volume diskdata /tsm/stg/diskdata/ddvol_06.dsm
formatsize=2048 wait=nos
ANR0984I Process 21 for DEFINE VOLUME started in the FOREGROUND at 11:33:53.
ANR2206I Volume /tsm/stg/diskdata/ddvol_06.dsm defined in storage pool DISKDATA (device class DISK).
ANR0986I Process 21 for DEFINE VOLUME running in the FOREGROUND processed 1 items for a total of 2,147,483,648 bytes with a completion state of SUCCESS at 11:37:19.

**tsm: ATLANTIC>** q vol stg=diskdata

```
<table>
<thead>
<tr>
<th>Volume Name</th>
<th>Storage Pool Name</th>
<th>Device Class Name</th>
<th>Estimated Capacity</th>
<th>Pct Util</th>
<th>Volume Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>/tsm/stg/diskdata-</td>
<td>DISKDATA</td>
<td>DISK</td>
<td>2,048.0</td>
<td>0.0</td>
<td>On-Line</td>
</tr>
<tr>
<td>/ddvol_01.dsm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/tsm/stg/diskdata-</td>
<td>DISKDATA</td>
<td>DISK</td>
<td>2,048.0</td>
<td>0.0</td>
<td>On-Line</td>
</tr>
<tr>
<td>/ddvol_02.dsm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/tsm/stg/diskdata-</td>
<td>DISKDATA</td>
<td>DISK</td>
<td>2,048.0</td>
<td>0.0</td>
<td>On-Line</td>
</tr>
<tr>
<td>/ddvol_03.dsm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/tsm/stg/diskdata-</td>
<td>DISKDATA</td>
<td>DISK</td>
<td>2,048.0</td>
<td>0.0</td>
<td>On-Line</td>
</tr>
<tr>
<td>/ddvol_04.dsm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/tsm/stg/diskdata-</td>
<td>DISKDATA</td>
<td>DISK</td>
<td>2,048.0</td>
<td>0.0</td>
<td>On-Line</td>
</tr>
<tr>
<td>/ddvol_05.dsm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/tsm/stg/diskdata-</td>
<td>DISKDATA</td>
<td>DISK</td>
<td>2,048.0</td>
<td>0.0</td>
<td>On-Line</td>
</tr>
<tr>
<td>/ddvol_06.dsm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

**tsm: ATLANTIC>** q stg diskdata

```
<table>
<thead>
<tr>
<th>Storage Pool Name</th>
<th>Device Class Name</th>
<th>Estimated Capacity</th>
<th>Pct Util</th>
<th>Pct High</th>
<th>Pct Low</th>
<th>Next Storage Pool Pct Pct</th>
</tr>
</thead>
</table>
```

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The example starts five `define volume processes` in the background (some status messages have been removed to save space) and one in the foreground. Once all six are created, use `query volume` to display them. Notice that the storage pool statistics show an estimated capacity of 12GB. You can also view the files at an operating system level, as shown in Example 6-17.

**Example 6-17  Listing the volumes from the operating system**

```
root@Atlantic /: cd /tsm/stg/diskdata
root@Atlantic /tsm/stg/diskdata: ls -la
```

```
total 25166232
  drwxr-xr-x   2 root     system          256 Feb 23 11:33 .
  drwxr-xr-x   6 root     system         4096 Feb 23 11:32 ..
----------   1 root     system   2147483648 Feb 23 11:36 ddvol_01.dsm
----------   1 root     system   2147483648 Feb 23 11:36 ddvol_02.dsm
----------   1 root     system   2147483648 Feb 23 11:37 ddvol_03.dsm
----------   1 root     system   2147483648 Feb 23 11:37 ddvol_04.dsm
----------   1 root     system   2147483648 Feb 23 11:37 ddvol_05.dsm
----------   1 root     system   2147483648 Feb 23 11:37 ddvol_06.dsm
root@Atlantic /tsm/stg/diskdata:
```

### 6.4.2 Tape volumes

Tape volumes require a different procedure to make them ready for use. Firstly, a tape volume has to be prepared. Most modern tape libraries rely on a barcode label on the side of the tape cartridge to provide the robot with information about the cartridge. Most DLT and LTO media come without labels, but typically cannot be used (in a library) without them. You should order labels when you order your tape supplies. Labels can be made to your specifications. A label normally has three letters (that you can choose to be meaningful if you like), and three numbers that typically run in sequence for each label - e.g. IBM000, IBM001, IBM002, ... IBM999 and so on. Each tape cartridge must be supplied with a label before you attempt to use it in a library.

**Tip:** Although Tivoli Storage Manager allows you to use a volume label (also known as VOLSER or Volume ID) longer than six characters, we strongly recommend using a maximum of six alphanumeric characters. This is to maintain compatibility with other ANSI label systems.

Tapes with external labels on the cartridge can be loaded into the library, either by opening the door and physically placing them in magazine or cartridge slots,
or importing them into the library via the bulk loader or I/O port. Methods of importing cartridges into a library are specific to the library. Please consult your documentation for instructions.

Now that the new tapes are in the library, Tivoli Storage Manager must write a label to them before they can be used. The barcode label on the side of the cartridge is usually used as the source for the label being written.

There are two methods to label tapes: using the administrative command `label libvolume` or using the external `dsmlabel` command. If you use `label libvolume`, the labelling process can also check the tapes in to Tivoli Storage Manager’s inventory. If you choose to use `dsmlabel`, you must then use `checkin libvolume` to check the tapes into inventory.

Once the tapes are checked in, they can be used, either in a scratch pool, or assigned as private volumes to a particular storage pool.

If a tape already has a label written to it (that is, it has been used before), the tape can simply be checked in to the library without having to be re-labelled.

For the examples in Example 6-18, we loaded 17 new cartridges into our IBM 3582 library. We used the `label libvolume` command to label and check the tapes into the library, and specified the option `LABELSource=Barcode` to tell the labelling process to use the barcode as the label.

Example 6-18   Labelling and checking tape in to the library

```
tsm: ATLANTIC> label libvolume 3582lib search=yes labelsource=barcode
checkin=scratch
ANS8003I Process number 888 started.

 tsm: ATLANTIC> q pr

 Process Number  Process Description  Status
-----------------  -------------------------------  -------------------------------
   25  LABEL LIBVOLUME  ANR8805I Labelling volumes in library 3582LIB; 6 volumes(s) labelled.
```

The `label libvolume` process runs in the background, and you can check the status using the query process command. The labelling process can take a long time if you are labelling a whole library-full of tapes. The activity log also shows the completion messages from the label libvolume process. You can then query the library’s contents using `query libvolume`, as shown in Example 6-19.
Example 6-19 Querying the activity log and library volumes

```
Example 6-19 Querying the activity log and library volumes

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>02/23/2006 14:35:07</td>
<td>ANR8801I LABEL LIBVOLUME process 25 for library 3582LIB completed; 17 volume(s) labelled, 17 volume(s) checked-in. (SESSION: 82, PROCESS: 25)</td>
</tr>
</tbody>
</table>
```

```
Example 6-19 Querying the activity log and library volumes

Library Name | Volume Name | Status | Owner | Last Use | Home Element | Device Type |
-------------|-------------|--------|-------|----------|--------------|-------------|
3582LIB      | 020AKK      | Scratch|       | 4,096    | LTO          |
3582LIB      | 021AKK      | Scratch|       | 4,097    | LTO          |
3582LIB      | 022AKK      | Scratch|       | 4,117    | LTO          |
3582LIB      | 023AKK      | Scratch|       | 4,099    | LTO          |
3582LIB      | 026AKK      | Scratch|       | 4,102    | LTO          |
3582LIB      | 027AKK      | Scratch|       | 4,116    | LTO          |
3582LIB      | 028AKK      | Scratch|       | 4,104    | LTO          |
3582LIB      | 029AKK      | Scratch|       | 4,103    | LTO          |
3582LIB      | 030AKK      | Scratch|       | 4,106    | LTO          |
3582LIB      | 031AKK      | Scratch|       | 4,107    | LTO          |
3582LIB      | 032AKK      | Scratch|       | 4,100    | LTO          |
3582LIB      | 033AKK      | Scratch|       | 4,109    | LTO          |
3582LIB      | 034AKK      | Scratch|       | 4,098    | LTO          |
3582LIB      | 036AKK      | Scratch|       | 4,101    | LTO          |
3582LIB      | 037AKK      | Scratch|       | 4,113    | LTO          |
3582LIB      | 038AKK      | Scratch|       | 4,114    | LTO          |
3582LIB      | 039AKK      | Scratch|       | 4,115    | LTO          |
```

The “Home Element” column is the numerical address of the cartridge slot in the library. The library user’s guide has a diagram to map the address to a physical slot. Note that query libvolume displays the inventory in order of the volume label, not by element or slot. Note also that the “Owner” and “Last Use” fields are not populated as the tapes have only just been checked in and not used as yet.

Repeating to messages

Depending on the method used to load the tapes into the library, you may need to answer a message generated by the server. The label libvolume or checkin libvolume process will not proceed until you answer the message. The message
is generated to give you time to load the cartridge(s). Example 6-20 shows a checkin process via the I/O port, the request it generates, and how to deal with it.

Example 6-20  Querying for, and answering messages

```plaintext
tsrm: ATLANTIC> checkin libvol 3582LIB search=bulk checklabel=barcode status=scratch
ANS8003I Process number 29 started.

tsrm: ATLANTIC> q pr

<table>
<thead>
<tr>
<th>Process Number</th>
<th>Process Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>29</td>
<td>CHECKIN LIBVOLUME</td>
<td>ANR8425I Checking in volumes in search mode in library 3582LIB.</td>
</tr>
</tbody>
</table>

tsrm: ATLANTIC> query request
ANS8352I Requests outstanding:
ANS8373I 001: Fill the bulk entry/exit port of library 3582LIB with all LTO volumes to be processed within 60 minute(s); issue 'REPLY' along with the request ID when ready.

tsrm: ATLANTIC> reply 001
ANS8499I Command accepted.

tsrm: ATLANTIC> q actlog begint=-00:05

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>02/23/2006 14:57:09</td>
<td>ANR8352I Requests outstanding: (SESSION: 82)</td>
</tr>
<tr>
<td>02/23/2006 14:57:09</td>
<td>ANR8373I 001: Fill the bulk entry/exit port of library 3582LIB with all LTO volumes to be processed within 60 minute(s); issue 'REPLY' along with the request ID when ready. (SESSION: 82)</td>
</tr>
<tr>
<td>02/23/2006 14:57:20</td>
<td>ANR2017I Administrator ADMIN issued command: REPLY 001 (SESSION: 82)</td>
</tr>
<tr>
<td>02/23/2006 14:57:20</td>
<td>ANR8499I Command accepted. (SESSION: 82)</td>
</tr>
<tr>
<td>02/23/2006 14:58:02</td>
<td>ANR8430I Volume 033AKK has been checked into library 3582LIB. (SESSION: 82, PROCESS: 29)</td>
</tr>
<tr>
<td>02/23/2006 14:58:02</td>
<td>ANR8431I CHECKIN LIBVOLUME process completed for library 3582LIB; 1 volume(s) found. (SESSION: 82, PROCESS: 29)</td>
</tr>
<tr>
<td>02/23/2006 14:58:02</td>
<td>ANR0985I Process 29 for CHECKIN LIBVOLUME running in the BACKGROUND completed with completion state SUCCESS at 14:58:02. (SESSION: 82, PROCESS: 29)</td>
</tr>
</tbody>
</table>

The process actually starts before we answer the request, but there is no way to tell that it is waiting unless you query for requests (or have an administrative session open in console mode). The request and reply are logged in the activity log, and we see the completion messages from our checkin libvol process.
6.5 Additional commands

The following sections provide some examples of commands directly related to data storage.

6.5.1 Auditing library contents

The `audit library` command verifies that the inventory of an automated library is consistent with the server's inventory for that library. You should audit your library if someone accidentally or deliberately moves tapes around in their slots, or inserts or removes volumes without using the correct Tivoli Storage Manager commands. It is also useful as a general check, if you suspect that Tivoli Storage Manager's own inventory of the tapes does not match the real situation (e.g., if you see messages in the activity log complaining that tapes are not where they are expected to be). If any inconsistencies are detected, the server updates its inventory to reflect the current state of the library. Missing volumes are deleted and moved volumes are updated with their new location. Volumes that are not part of the server's inventory are not added, they must be checked in.

The `audit library` command does not perform any operations until all volumes in any of the tape drives are dismounted, that is, the drives must be idle. You can force volume dismounts using the `dismount volume` command.

By default, `audit library` mounts each tape and reads the label. If the labels written on the tapes are the same as the barcodes, you can specify `CHECKLabel=Barcode`. The audit process will then read the barcode only, checking against the server's inventory. Be aware that the audit process can be time consuming, especially for large capacity libraries, as it must mount and read the label on every volume.

Example 6-21 shows the audit process for our 3582LIB library.

```plaintext
Example 6-21 Auditing library contents

```

tsm: ATLANTIC> audit library 3582lib checklabel=barcode
ANS8003I Process number 34 started.

```

```

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```
6.5.2 Auditing volume contents

The audit volume command checks for inconsistencies between the database references for objects stored on a volume, and what is actually found to be stored on the volume. The volume must be mounted in a tape drive in order to read its contents. The audit volume command is especially useful when integrity errors are detected on a volume, as you can determine what, if any, files on the volume are still readable and take appropriate action to restore it from a copy storage pool.

By contrast, the query content command (see 6.5.10, “Querying volume contents” on page 247) displays only the database’s view of what is stored and does not require the volume to be mounted.

Example 6-22 audits a volume named 031AKK and logs any discrepancies to the activity log.

Example 6-22 Audit volume process

```bash
  tsm: ATLANTIC> audit volume 031AKK fix=no
  ANR2310W This command will compare all inventory references to volume 031AKK with the actual data stored on the volume and will report any discrepancies; the data will be inaccessible to users until the operation completes.

  Do you wish to proceed? (Yes/No) y
  ANR2313I Audit Volume (Inspect Only) process started for volume 031AKK (process ID 40).
```
Specifying the **FIX=No** option, (which is the default), reports any discrepancies to the activity log only. No changes are made. It is recommended that you run with **FIX=No** first before running with **FIX=Yes**, just to see what will happen when the volume is “fixed”. Example 6-23 shows the process with **FIX=Yes** specified.

**Example 6-23  Audit volume process, Fix=Yes**

```bash
tsm: ATLANTIC> audit volume 031AKK fix=yes
ANR2310W This command will compare all inventory references to volume 031AKK with the actual data stored on the volume and will report any discrepancies; the data will be inaccessible to users until the operation completes.

Do you wish to proceed? (Yes/No) y
ANR2313I Audit Volume (Repair) process started for volume 031AKK (process ID 42).
ANS8003I Process number 42 started.
```

```bash
tsm: ATLANTIC> q pr
Process Process Description Status Number
------- -------------------- -------------------------------------------------
```

```bash
tsm: ATLANTIC>q act
Date/Time Message
------------------- ----------------------------------------------------------
02/23/2006 16:22:26 ANR8324I LTO volume 031AKK is expected to be mounted (R/W). (SESSION: 110)
```
6.5.3 Backup a storage pool

The `backup stgpool` command backs up a primary storage pool to a copy pool. If the primary storage pool is a tape storage pool, two physical drives will be required. The input volume from the primary storage pool will be mounted in one drive, while the output volume from the copy storage pool will be mounted in the other. The two drives can be in the same or different libraries. To back up a random access storage pool to a copy storage pool requires only one drive. Typically the storage pool backup process is automated: we describe how in 12.2.1, “Defining an offsite backup schedule” on page 365.

Backing up from a disk pool is generally quicker than backing up from a tape storage pool. However, current generation LTO3 drives on a SAN can outdo disks when streaming. We recommend that you perform your storage pool backups according to your tape hardware speed.

Nevertheless, we recommend that you size your disk pools sufficiently to hold all the data from a normal night's backup operation. Sufficiently sized disk pools will prevent migration to tape during the backup period.

Typically you would define one copy storage pool for a primary storage pool hierarchy. In our setup, both DISKDATA and TAPEDATA are backed up to the copy storage pool OFFDATA. Because the `backup stgpool` operation is incremental, only new files in the primary pool are copied to the copy pool. If we first back up DISKDATA, then TAPEDATA, any files that might have migrated from DISKDATA to TAPEDATA after we backed up DISKDATA do not get copied a second time from TAPEDATA to OFFDATA.

Example 6-24 backs up a storage pool named TAPEDATA to a copy pool named OFFDATA.

```
Example 6-24   Backup storage pool

  tsm: ATLANTIC> backup stgpool tapedata offdata
  ANS8003I Process number 18 started.
```
tsm: ATLANTIC> query proc

<table>
<thead>
<tr>
<th>Process Number</th>
<th>Process Description</th>
<th>Status</th>
</tr>
</thead>
</table>

Check the activity log to see the successful completion, as shown in Example 6-25.

**Example 6-25  Verifying that the storage pool backup completed**

```
tsm: ATLANTIC> query actlog
```

```
02/23/06 17:54:40  ANR2017I Administrator ADMIN issued command: BACKUP STGPOOL tapedata offdata
02/23/06 17:54:40  ANR0984I Process 18 for BACKUP STORAGE POOL started in the BACKGROUND at 17:54:40.
02/23/06 17:54:40  ANR2110I BACKUP STGPOOL started as process 18.
02/23/06 17:54:40  ANR1210I Backup of primary storage pool TAPEDATA to copy storage pool OFFDATA started as process 18.
02/23/06 17:54:40  ANR1228I Removable volume ALF007 is required for storage pool backup.
02/23/06 17:54:40  ANR8324I LTO volume ALF007 is expected to be mounted (R/W).
02/23/06 17:55:12  ANR8329I LTO volume ALF007 is mounted R/W in drive DR00 (/dev/rmt0), status: IDLE.
02/23/06 17:55:12  ANR8334I 1 volumes found.
02/23/06 17:55:15  ANR2017I Administrator ADMIN issued command: QUERY REQ
02/23/06 17:55:15  ANR8346I QUERY REQUEST: No requests are outstanding.
02/23/06 17:56:02  ANR8337I LTO volume CLA001 mounted in drive DR01 (/dev/rmt1).
02/23/06 17:56:02  ANR1340I Scratch volume CLA001 is now defined in storage pool OFFDATA.
02/23/06 17:56:12  ANR1212I Backup process 18 ended for storage pool TAPEDATA.
02/23/06 17:56:12  ANR0986I Process 18 for BACKUP STORAGE POOL running in the BACKGROUND processed 1646 items for a total of 6,459,588 bytes with a completion state of SUCCESS at 17:56:12.
02/23/06 17:56:12  ANR1214I Backup of primary storage pool TAPEDATA to copy storage pool OFFDATA has ended. Files Backed Up: 1646, Bytes Backed Up: 6459588, Unreadable Files: 0, Unreadable
```
It may be beneficial, if you have enough fast tape drives, to consider setting the `COPYSTGpools` attribute of the primary disk storage pools. The `COPYSTGpools` attribute causes the server to write to the copy storage pool set by `COPYSTGpools` at the same time as it is storing data in the primary disk pool. While this has distinct advantages (you don't have to back up your primary storage pool later on, for example), the backup process can slow down from the client's point of view, as it waits for two writes to complete instead of one.

### 6.5.4 Check a tape in to a library

The `checkin libvolume` command can perform two functions. Firstly, it can move a tape volume from an I/O port on the library, into an empty cartridge slot within the library. Secondly, it updates Tivoli Storage Manager's volume inventory for the library. If a tape has already been placed in a slot inside the library, `checkin libvolume` can simply search the library for the tape.

Before the next two examples, the tapes were checked out of the library and the tape magazines removed for library maintenance purposes. The magazines were placed back in the library in the same positions as before.

Example 6-26 shows the checkin process for scratch volumes.

#### Example 6-26 Checking in volumes in search mode

```bash
> checkin libvol 3582lib search=yes checklabel=barcode status=scratch
ANS8003I Process number 8 started.

> q pr
Process Number Process Description Status
------ ------------------- ---------------------------------------------
 8 CHECKIN LIBVOLUME ANR8425I Checking in volumes in search mode
                   in library 3582LIB.

> q act
Date/Time Message
-------------------  ----------------------------------------------------------
02/27/2006 10:54:38 ANR8430I Volume 039AKK has been checked into library
                      3582LIB. (SESSION: 128, PROCESS: 8)
02/27/2006 10:54:38 ANR8430I Volume 027AKK has been checked into library
                      3582LIB. (SESSION: 128, PROCESS: 8)
02/27/2006 10:54:38 ANR8443E CHECKIN LIBVOLUME: Volume 022AKK in library
                      3582LIB cannot be assigned a status of SCRATCH. (SESSION:
Notice that the volume 022AKK cannot be assigned a status of scratch. 022AKK belongs to storage pool TAPEDATA. Similarly with 023AKK (OFFDATA) and 020AKK (database backup).

To check the extra volumes in, we must check them in as private. Example 6-27 shows the checkin process for the private volumes.

**Example 6-27  Checking in tapes with private status**

```
tsm: ATLANTIC> checkin libvol 3582lib status=private checklabel=barcode search=yes
ANS8003I Process number 10 started.
```

atlantic> q act

```
Date/Time   Message
----------   ----------------------------------------------------------
02/27/2006 11:10:09  ANR8430I Volume 020AKK has been checked into library 3582LIB. (SESSION: 129, PROCESS: 10)
02/27/2006 11:10:09  ANR8430I Volume 023AKK has been checked into library 3582LIB. (SESSION: 129, PROCESS: 10)
02/27/2006 11:10:09  ANR8430I Volume 022AKK has been checked into library 3582LIB. (SESSION: 129, PROCESS: 10)
```
Notice that the “Last Use” column is blank, as these tapes were used before being checked out and back in again. The “Last Use” column only applies to tapes that have been used after being checked in.

### 6.5.5 Check out library volumes

To check out library volumes, use the `checkout libvol` command. Depending on the library and the operation you perform, there can be up to three parts to the checkout operation:

- Issue the command to check out the library volume.
- Check for outstanding messages requiring replies.
- Reply to the message(s).

If you are checking out a single volume, you can have it moved to the I/O port to make it easier to remove. If you are checking out a large number of tapes it may
be easier to check the volumes out, but have the checkout process leave them in the library for manual removal later on.

**Check out the volumes**

Example 6-28 shows checking out a single volume to the I/O port of the library.

*Example 6-28  Checking out a single volume from a library*

```plaintext
tsm: ATLANTIC> checkout libvolume 3582lib 033akk remove=yes
ANS8003I Process number 28 started.

tsm: ATLANTIC> q pr

<table>
<thead>
<tr>
<th>Process Number</th>
<th>Process Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>CHECKOUT LIBVOLUME</td>
<td>ANR8436I Checking out volume 033AKK from library 3582LIB.</td>
</tr>
</tbody>
</table>

```

```plaintext
tsm: ATLANTIC> q act

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>02/23/2006 14:52:50</td>
<td>ANR8829I Remove volume 033AKK from slot 16 of library 3582LIB at your convenience. (SESSION: 82, PROCESS: 28)</td>
</tr>
<tr>
<td>02/23/2006 14:52:50</td>
<td>ANR8438I CHECKOUT LIBVOLUME for volume 033AKK in library 3582LIB completed successfully. (SESSION: 82, PROCESS: 28)</td>
</tr>
</tbody>
</table>
```

Example 6-29 shows checking out multiple volumes together, by separating the volume labels with commas (no spaces). You can also specify a file name that contains a list of volumes to be checked out.

*Example 6-29  Checking out multiple volumes from a library*

```plaintext
tsm: ATLANTIC> checkout libvolume 3582lib 027akk,028akk,029akk remove=yes
ANS8003I Process number 53 started.

tsm: ATLANTIC> q pr

<table>
<thead>
<tr>
<th>Process Number</th>
<th>Process Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>53</td>
<td>CHECKOUT LIBVOLUME</td>
<td>ANR8436I Checking out volume 027AKK from library 3582LIB.</td>
</tr>
</tbody>
</table>
```
Check for messages
When checking volumes out of a library such as an IBM 3582 with only a single slot I/O port, the checkout command will move one tape to the I/O port, issue a message and wait for you to reply to it.

To check for outstanding messages, issue a `query request` command as shown in Example 6-30.

```plaintext
Example 6-30   Checking for messages

<table>
<thead>
<tr>
<th>command</th>
<th>output</th>
</tr>
</thead>
<tbody>
<tr>
<td>tsm: ATLANTIC&gt; query request</td>
<td>ANR83521 Requests outstanding:</td>
</tr>
<tr>
<td></td>
<td>ANR83221 015: Remove LTO volume 027AKK from entry/exit port of library 3582LIB; issue 'REPLY' along with the request ID when ready.</td>
</tr>
</tbody>
</table>
```

Reply to the message
Issue the `reply` command with the message number (015 from Example 6-30).

```plaintext
Example 6-31   Replying to a message

<table>
<thead>
<tr>
<th>command</th>
<th>output</th>
</tr>
</thead>
<tbody>
<tr>
<td>tsm: ATLANTIC&gt; reply 015</td>
<td>ANR84991 Command accepted.</td>
</tr>
</tbody>
</table>
```

The checkout command will continue to process each volume, issuing a message for each one.

6.5.6 Deleting storage-related objects
To remove storage-related objects, we use variations of the `delete` command. To delete objects in the storage hierarchy, you must first delete objects that depend on the object you wish to delete.

Suppose you want to delete a library. You must first remove any references to it. The following objects must first be removed before deleting the library:

- Paths to drives in the library
- Drives in the library
- The path to the library
If you wish to remove all objects associated with a library, you should also remove the storage pools and device classes using the library. You do not have to delete the device class or storage pools using the library to delete the library.

Tape volumes are bound to a device class; if you wish to delete the device class you must first delete all the tape volumes that are bound to it. Deleting all those tape volumes may not be desirable. However, if you wish to keep using the tapes, you will need to create a new library that uses the same device class as the one being deleted.

You can only delete a storage pool if there are no storage pool volumes assigned to it. If there are storage pool volumes assigned, you need to use delete volume to remove them first. With delete volume, you can specify whether or not to discard any data stored on the volumes. Be very careful with this command! You can also use move data to move data from one storage pool to another.

Example 6-32 shows the sequence of commands required to remove a library.

Example 6-32   Library deletion command sequence

```
tsm: ATLANTIC> del path atlantic dr00 srct=server destt=drive libr=3582lib
ANR1721I A path from ATLANTIC to 3582LIB DR00 has been deleted.

 tsm: ATLANTIC> del path atlantic dr01 srct=server destt=drive libr=3582lib
ANR1721I A path from ATLANTIC to 3582LIB DR01 has been deleted.

 tsm: ATLANTIC> del drive 3582lib dr00
ANR8412I Drive DR00 deleted from library 3582LIB.

 tsm: ATLANTIC> del drive 3582lib dr01
ANR8412I Drive DR01 deleted from library 3582LIB.

 tsm: ATLANTIC> del path atlantic 3582lib srct=server destt=library
ANR1721I A path from ATLANTIC to 3582LIB has been deleted.

 tsm: ATLANTIC> del library 3582lib
ANR8410I Library 3582LIB deleted.

 tsm: ATLANTIC> q libvol
ANR2034E QUERY LIBVOLUME: No match found using this criteria.
ANS8001I Return code 11.

 tsm: ATLANTIC> q vol devc=lto2-dc
```

<table>
<thead>
<tr>
<th>Volume Name</th>
<th>Storage Pool Name</th>
<th>Device Class Name</th>
<th>Estimated Capacity</th>
<th>Pct Util</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>022AKK</td>
<td>TAPEDATA</td>
<td>LTO2-DC</td>
<td>409,600.0</td>
<td>11.3</td>
<td>Filling</td>
</tr>
</tbody>
</table>
Note that once the library is deleted, no library volumes are present, even though we did not specifically check the volume out of the library before deleting it. Note also that the volumes are still bound to the device class `LTO2-DC`.

### 6.5.7 Mounted volumes

In some cases, you may wish to view which volumes are mounted, and dismount them before the mount retention period expires for the storage pool. Use the `query mount` and `dismount volume` commands. As shown in Example 6-33, there are two idle volumes mounted. We issue two `dismount` commands to unload them from the drives.

**Example 6-33  Dismounting volumes**

```
tsm: ATLANTIC> q mount
ANR8329I LTO volume 023AKK is mounted R/W in drive DR00 (/dev/rmt0), status: IDLE.
ANR8329I LTO volume 022AKK is mounted R/W in drive DR01 (/dev/rmt1), status: IDLE.
ANR8334I 2 matches found.

 tsm: ATLANTIC> dismount volume 023AKK
ANR8499I Command accepted.

 tsm: ATLANTIC> dismount volume 022AKK
ANR8499I Command accepted.

 tsm: ATLANTIC> q mount
ANR8331I LTO volume 023AKK is mounted R/W in drive DR00 (/dev/rmt0), status: DISMOUNTING.
ANR8331I LTO volume 022AKK is mounted R/W in drive DR01 (/dev/rmt1), status: DISMOUNTING.
ANR8334I 2 matches found.
```
period that the migrate stgpool command is active, the high migration threshold is ignored.

Example 6-34 shows the migration of the DISKDATA pool to TAPEDATA, and the messages you will see in the activity log.

Example 6-34  Manual migration of a storage pool

```
tsm: ATLANTIC> migrate stgpool diskdata low=0 dur=30
ANR2110I MIGRATE STGPOOL started as process 38.
ANR1000I Migration process 38 started for storage pool DISKDATA manually, highMig=80, lowMig=0, duration=30.
ANS8003I Process number 38 started.
```

```
tsm: ATLANTIC> q pr
```

<table>
<thead>
<tr>
<th>Process Number</th>
<th>Process Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>38</td>
<td>Migration</td>
<td>Disk Storage Pool DISKDATA, Moved Files: 0, Moved Bytes: 0, Unreadable Files: 0, Unreadable Bytes: 0. Current Physical File (bytes): 4,096 Waiting for mount of scratch volume (10 seconds).</td>
</tr>
</tbody>
</table>

```
tsm: ATLANTIC> q act
```

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>02/24/2006 09:23:51</td>
<td>ANR2017I Administrator ADMIN issued command: MIGRATE STGPOOL diskdata low=0 dur=30 (SESSION: 165)</td>
</tr>
<tr>
<td>02/24/2006 09:23:51</td>
<td>ANR2110I MIGRATE STGPOOL started as process 38. (SESSION: 165, PROCESS: 38)</td>
</tr>
<tr>
<td>02/24/2006 09:23:51</td>
<td>ANR1000I Migration process 38 started for storage pool DISKDATA manually, highMig=80, lowMig=0, duration=30. (SESSION: 165, PROCESS: 38)</td>
</tr>
<tr>
<td>02/24/2006 09:24:13</td>
<td>ANR8379I Mount point in device class LTO2-DC is waiting for the volume mount to complete, status: WAITING FOR VOLUME. (SESSION: 165)</td>
</tr>
<tr>
<td>02/24/2006 09:24:13</td>
<td>ANR8334I 1 matches found. (SESSION: 165)</td>
</tr>
<tr>
<td>02/24/2006 09:24:26</td>
<td>ANR8337I LTO volume 022AKK mounted in drive DR01 (/dev/rmt1). (SESSION: 165, PROCESS: 38)</td>
</tr>
<tr>
<td>02/24/2006 09:24:26</td>
<td>ANR1340I Scratch volume 022AKK is now defined in storage pool TAPEDATA. (SESSION: 165, PROCESS: 38)</td>
</tr>
<tr>
<td>02/24/2006 09:24:30</td>
<td>ANR0513I Process 38 opened output volume 022AKK. (SESSION: 165, PROCESS: 38)</td>
</tr>
</tbody>
</table>
02/24/2006 09:24:34 ANR1001I Migration process 38 ended for storage pool DISKDATA. (SESSION: 165, PROCESS: 38)

02/24/2006 09:24:34 ANR0986I Process 38 for MIGRATION running in the BACKGROUND processed 2166 items for a total of 77,815,808 bytes with a completion state of SUCCESS at 09:24:34. (SESSION: 165, PROCESS: 38)

02/24/2006 09:24:34 ANR0514I Session 165 closed volume 022AKK. (SESSION: 165)

Note the messages regarding the selection of a scratch tape (022AKK) and defining it in the TAPEDATA pool.

### 6.5.9 Moving data

The `move data` command moves data from one volume to another within the same storage pool, or to another storage pool. If you are moving data within the same tape storage pool you will require two drives free (one for the source volume, one for the target volume).

Move data is can be used for moving any remaining data from a tape giving errors, or moving data from a non-collocated tape to a collocated storage pool.

Example 6-35 shows the `move data` command required to move data from one tape to another in the same tape storage pool. Volume 021AKK has data from three different nodes. We have changed the **COLlocation** attribute from **No** to **Node**. The move process moves data from the single volume to three others, keeping the data from each node separate.

**Example 6-35   Moving data from one volume to another**

```plaintext
tsm: ATLANTIC> move data 021akk stg=tapedata
ANR2232W This command will move all of the data stored on volume 021AKK to other volumes within the same storage pool; the data will be inaccessible to users until the operation completes.

Do you wish to proceed? (Yes (Y)/No (N)) y
ANS8003I Process number 1 started.

tsm: ATLANTIC>q pr

<table>
<thead>
<tr>
<th>Process Number</th>
<th>Process Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Move Data</td>
<td>Volume 021AKK (storage pool TAPEDATA), Target Pool TAPEDATA, Moved Files: 59769, Moved Bytes: 8,817,810,249, Unreadable Files: 0, Unreadable Bytes: 0. Current Physical File (bytes):</td>
</tr>
</tbody>
</table>

```
6.5.10 Querying volume contents

You can see what files are on a volume using the `query content` command. *Query content* queries the database to display the contents of a volume, it does not mount and read the volume. A volume does not have to be in a library before running *query content*, since only the database is queried - not the volume itself. The output generated by *query content* can be very long, but can be reduced by specifying the **Count** option, which limits the number of files displayed to **Count**, or by specifying the **Node** or **Filespace** options.

Example 6-36 shows an example of the output from *query content*.

Example 6-36  Querying volume contents

tsm: ATLANTIC>q con 022akk

<table>
<thead>
<tr>
<th>Node Name</th>
<th>Type</th>
<th>Filespace</th>
<th>FSID</th>
<th>Client's Name for File Name</th>
</tr>
</thead>
</table>

---
--- ---- --- --- --- --- ---- ---- ----
PARIS Bkup \paris\c$ 1 \ AUTOEXEC.BAT
PARIS Bkup \paris\c$ 1 \ CONFIG.SYS
PARIS Bkup \paris\c$ 1 \ DOCUMENTS AND SETTINGS\ADMINISTRATOR\ NTUSER.INI
PARIS Bkup \paris\c$ 1 \ DOCUMENTS AND SETTINGS\ADMINISTRATOR-\ APPLICATION DATA\ADOBE\FRAMEMAKER\7-.0\ MAKER.INI

...
PARIS Bkup \paris\c$ 1 \LOTUS\123\ICONS\ RANGE.SMI
PARIS Bkup \paris\c$ 1 \LOTUS\123\ICONS\ RECORD.SMI
PARIS Bkup \paris\c$ 1 \LOTUS\123\ICONS\ SCRIPTNG.SMI
PARIS Bkup \paris\c$ 1 \LOTUS\123\ICONS\ SHEET.SMI

You can also use the **COPied** parameter, which will display files which either have or have not been backed up to a copy storage pool, depending on whether the parameter is set YES or NO.

### 6.5.11 Querying occupancy

The *query occupancy* command displays information on where a client's filenames are stored and how much space they occupy. The information provided by *query occupancy* is only update when an *audit license* command is run. If you have not run a license audit for some time, the results from query occupancy may not reflect reality.

Example 6-37 shows the output from the *query occupancy* command.

**Example 6-37   Querying occupancy**

tsm: ATLANTIC>q occ

<table>
<thead>
<tr>
<th>Node Name</th>
<th>Type</th>
<th>Filespace Name</th>
<th>FSID</th>
<th>Storage Pool Name</th>
<th>Number of Files</th>
<th>Physical Space Occupied (MB)</th>
<th>Logical Space Occupied (MB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PARIS</td>
<td>Bkup</td>
<td>\paris\c$</td>
<td>1</td>
<td>DISKDIRS</td>
<td>2,716</td>
<td>1.81</td>
<td>1.81</td>
</tr>
<tr>
<td>PARIS</td>
<td>Bkup</td>
<td>\paris\c$</td>
<td>1</td>
<td>OFFDATA</td>
<td>2,166</td>
<td>73.67</td>
<td>73.67</td>
</tr>
<tr>
<td>PARIS</td>
<td>Bkup</td>
<td>\paris\c$</td>
<td>1</td>
<td>TAPEDATA</td>
<td>2,166</td>
<td>73.67</td>
<td>73.67</td>
</tr>
<tr>
<td>PIERRE</td>
<td>Bkup</td>
<td>\pierre\c$</td>
<td>1</td>
<td>DISKDIRS</td>
<td>8,624</td>
<td>5.95</td>
<td>5.95</td>
</tr>
<tr>
<td>PIERRE</td>
<td>Bkup</td>
<td>\pierre\c$</td>
<td>1</td>
<td>OFFDATA</td>
<td>53,229</td>
<td>2,133.66</td>
<td>2,133.66</td>
</tr>
<tr>
<td>PIERRE</td>
<td>Bkup</td>
<td>\pierre\c$</td>
<td>1</td>
<td>TAPEDATA</td>
<td>53,229</td>
<td>2,123.66</td>
<td>2,123.66</td>
</tr>
</tbody>
</table>
The `query occupancy` command can also be used to determine whose filespaces are occupying a certain device class or storage pool, as shown in Example 6-38.

**Example 6-38  Querying occupancy based on device class**

```
Node Name  Type  Filespace Name  FSID  Storage Pool Name  Number of Files  Physical Space Occupied (MB)  Logical Space Occupied (MB)
----------  ----  ---------------  ----  -----------------  -----------------  -----------------  -----------------
PARIS Bkup  \paris\c$  1  OFFDATA  2,166  73.67  73.67
PARIS Bkup  \paris\c$  1  TAPEDATA  2,166  73.67  73.67
PIERRE Bkup  \pierre\c$  1  OFFDATA  53,229  2,133.66  2,133.66
PIERRE Bkup  \pierre\c$  1  TAPEDATA  53,229  2,123.66  2,123.66
```

### 6.5.12 Rename a storage pool

The `rename stgpool` command renames a storage pool. Note that if you change the name of a storage pool, you must update any management class copy groups that point to the original name.

Example 6-39 renames our DISKDATA pool to OLDRDATA.

**Example 6-39  Renaming a storage pool**

```
rename stg diskdata oldrdata
```

```
ANR2213I RENAME STGPOOL: Storage pool DISKDATA renamed to OLDRDATA.
```

```
tsm: ATLANTIC>q stg
Storage Pool Name  Device Class Name  Estimated Capacity Pct Util  Pct Migr  High Mig  Low Mig  Next Storage Pool
----------  ----------  --------  -----  -----  -----  ------  ------  ------  ----------
OLDRDATA  DISK  12 G  0.0  0.0  80  30  TAPEDATA
```

### 6.5.13 Reclamation

Data on tapes in sequential access storage pools will eventually expire, leaving portions of the tapes with empty areas (also known as fragmentation). Over time, fragmentation can cause many tapes to have very little valid data on them. Reclamation is the process where the valid data on a number of tapes is consolidated onto a smaller number of tapes. The tapes that are emptied by the
reclamation process are returned to scratch status for reuse. See “Data Storage” in IBM Tivoli Storage Management Concepts, SG24-4877.

Reclamation is usually scheduled during a period of low activity because it can be a very intensive operation, for both the server and the tape drives. However, you can run reclamation manually using the **reclaim stgpool** command.

The **reclaim stgpool** command takes a number of options. To set the reclamation threshold, set the **Threshold** parameter to a value between 50 and 99. The **Threshold** value represents the percentage of reclaimable space on a volume. To check the amount of reclaimable space on a volume, run a **query volume** command. Subtract the value in the **Pct Utilized** column from 100 to obtain the percentage of reclaimable space on the volume. The other parameter required for **reclaim stgpool** is the **Duration** parameter. **Duration** is the length of time reclamation will run for on the selected storage pool. If there is nothing to reclaim, or reclamation finishes before the duration is over, the process exits.

Example 6-40 shows an example of the **reclaim stgpool** command.

**Example 6-40  Reclaim stgpool command**

```
tsm: ATLANTIC> reclaim stgpool offdata threshold=85 duration=30

03/02/2006 11:00:28 ANR2017I Administrator ADMIN issued command: RECLAIM STGPOOL offdata threshold=85 duration=30 (SESSION: 5)
03/02/2006 11:00:28 ANR0984I Process 1 for SPACE RECLAMATION started in the BACKGROUND at 11:00:28. (SESSION: 5, PROCESS: 1)
03/02/2006 11:00:28 ANR2110I RECLAIM STGPOOL started as process 1. (SESSION: 5, PROCESS: 1)
03/02/2006 11:00:28 ANR4931I Reclamation process 1 started for copy storage pool OFFDATA manually, threshold=85, offsiteRclmLimit=No Limit, duration=30. (SESSION: 5, PROCESS: 1)
03/02/2006 11:00:28 ANR2753I (RECLAIM_OFFDATA):ANR2110I RECLAIM STGPOOL started as (SESSION: 5)
03/02/2006 11:00:28 ANR1040I Space reclamation started for volume 032AKK, storage pool OFFDATA (process number 1). (SESSION: 5, PROCESS: 1)
Notice that volume 032AKK, once empty, will not be deleted from the pool until after the reuse delay.

### 6.5.14 SQL commands

The Tivoli Storage Manager database can be queried using structured query language (SQL) commands. The implementation of SQL within Tivoli Storage Manager is based on the SQL-1992 and SQL-1999 standards but is not a complete implementation; some SQL commands such as UNION, INTERSECT and EXCEPT are not supported.

Three system catalog tables are available for querying:

- **SYSCAT.TABLES**: Contains information about all tables that can be queried.
SYSCAT.COLUMNS: Describes the columns in each table.
SYSCAT.ENUMTYPES: Defines the valid values for each enumerated data type.

For select operations, you can use the TABLES, COLUMNS and ENUMTYPES to display the database structure:

- select tabname, remarks from tables
- select tabname, colname, typename, remarks from columns
- select typename, values, remarks from enumtypes

When selecting the column data from the columns table, it is better to use a where clause to limit the output to that of the table you're looking for, as shown in Example 6-41.

Example 6-41 Querying the columns of a system table

```
tsm: LOCHNESS_SERVER1> select tabname, colname, typename, remarks from columns
   where tabname='LIBVOLUMES'
```

<table>
<thead>
<tr>
<th>TABNAME</th>
<th>COLNAME</th>
<th>TYPENAME</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIBVOLUMES</td>
<td>LIBRARY_NAME</td>
<td>VARCHAR</td>
<td>Library Name</td>
</tr>
<tr>
<td>LIBVOLUMES</td>
<td>VOLUME_NAME</td>
<td>VARCHAR</td>
<td>Volume Name</td>
</tr>
<tr>
<td>LIBVOLUMES</td>
<td>STATUS</td>
<td>VARCHAR</td>
<td>Status</td>
</tr>
<tr>
<td>LIBVOLUMES</td>
<td>OWNER</td>
<td>VARCHAR</td>
<td>Owner</td>
</tr>
<tr>
<td>LIBVOLUMES</td>
<td>LAST_USE</td>
<td>VARCHAR</td>
<td>Last Use</td>
</tr>
<tr>
<td>LIBVOLUMES</td>
<td>HOME_ELEMENT</td>
<td>INTEGER</td>
<td>Home Element</td>
</tr>
<tr>
<td>LIBVOLUMES</td>
<td>CLEANINGS_LEFT</td>
<td>INTEGER</td>
<td>Cleanings Left</td>
</tr>
<tr>
<td>LIBVOLUMES</td>
<td>DEVTYPE</td>
<td>VARCHAR</td>
<td>Device Type</td>
</tr>
<tr>
<td>LIBVOLUMES</td>
<td>MEDIATYPE</td>
<td>INTEGER</td>
<td>Media Type</td>
</tr>
<tr>
<td>LIBVOLUMES</td>
<td>OLD_STATUS</td>
<td>VARCHAR</td>
<td>Orig Status</td>
</tr>
</tbody>
</table>

Note that the table name is a string literal (enclosed in single quotes). The name must be supplied as it is stored in syscat.tables (that is, in uppercase). If it was supplied in lowercase, no data would have been returned.

You can generate your own custom queries and create your own commands by placing the queries into server scripts.

**Example 1**

Example 6-42 shows a select statement using the data obtained in Example 6-41. The query generates a list of tape volumes in the library, sorted by the slot (home_element) number.
Example 6-42  Selecting libvolume data

```
Example 6-43 counts the number of volumes within each storage pool. This can
be useful where you have large libraries with many volumes.
```

Example 6-43  Querying the number of volumes in each storage pool

```
Example 6-42  Selecting libvolume data

```
Example 3
Example 6-44 lists how many files have been backed up from each node. You could query the ARCHIVES table instead of BACKUPS, to see the number of files archived from each node.

Example 6-44  Querying the number of files backed up by each node

```
  tsm: ATLANTIC> select node_name as "Node", \
          count(*) as "Files" from backups group by node_name
  ANR2963W This SQL query may produce a very large result table, or may require a significant amount of time to compute.

  Do you wish to proceed? (Yes (Y)/No (N)) y

  Node     Files
  -----------------     --------------
  ATLANTIC   85
  PAMELA    12065
  PARIS     4882
  PIERRE    61853
```

Notice the warning that is displayed when a potentially complex or time/space-consuming query is issued. You can answer no if you prefer to run the query at another time.

Example 4
Example 6-45 shows the volumes where a node has data stored, and the storage pool that the volumes belong to.

Example 6-45  Querying volume usage by node

```
  tsm: ATLANTIC> select distinct node_name, \
          volume_name from volumeusage where node_name='PARIS'

  NODE_NAME              VOLUME_NAME            STGPOOL_NAME
  ------------------     ------------------     ------------------
  PARIS                  /tsm/stg/dirm/0000001B.BFS DISKDIRS
  PARIS                  /tsm/stg/dirm/0000002A.BFS DISKDIRS
  PARIS                  023AKK                 OFFDATA
  PARIS                  022AKK                 TAPEDATA
```

For more information on SQL commands, use the `help select` command.
6.6 Summary

You have now completed the storage pool section, in which we have covered topics related to configuring storage devices such as drives and libraries, managing tape volumes, and various related commands.

In the next chapter we focus on defining your policies (rules) for managing your data that has been backed up to Tivoli Storage Manager.
Data storage policies

In this chapter we focus on the actual storage policy implementation. Before continuing, you should have already filled out the planning sheets, and we assume that you have read and understood the IBM Tivoli Storage Management Concepts, SG24-4877. We have now covered planning through installation and customizing your storage devices. Now we will cover how to set up your storage policies.

A data storage environment consists of three types of resources: machines, rules, and data. The machines are computers containing data that must be backed up, and the rules specify how the backup copies are to be treated.

Depending on how you need to manage your backup data, your data storage policy can be very simple or very complex. The simplest policy would have one set of rules that apply to all of the data in your organization, while the most complex policy would be to have a unique set of rules for each individual file. Most installations fall somewhere between these two extremes.

IBM Tivoli Storage Manager has entities that group and organize the resources and define relationships between them. A machine, or node in IBM Tivoli Storage Manager terminology, is grouped together with other nodes into a policy domain. The domain links the nodes to a policy set which consists of management classes. A management class contains rules called copy groups that it links to the data. When the data is linked to particular rules, it is said to be bound to the management class that contains the rules.
7.1 Recommended setup

Figure 7-1 on page 259 shows the key components of our sample policy configuration. We define two policy domains, SERVER and WORKSTN. Both domains have similar policy sets and management classes, but their copy group details show that the SERVER domain has more copies, and longer retention periods than the WORKSTN domain. It is not necessary to define multiple domains, but this demonstrates that the policy is really defined in the copy groups, and that the rest of the constructs are used primarily for flexibility.

In our environment, we want our data to be treated in the following way:

- Nodes registered to the SERVER domain will retain a maximum of 3 object copies (VEREXIST), and inactive copies will be stored for a maximum of 100 days (RETEXTRA), after becoming inactive. If an object is deleted from a node file system, we will retain only the latest copy (VERDEL) for 100 days (RETONLY). Primarily, we want to store only consistent backup copies (SHRSTATIC). Files that are being changed during backup, such as log files, should be bound to the special management class whose rules allow storing such files, but first attempt to back them up consistently (SHRDYNAMIC). Their retention and versioning rules are the same as for the normal data. We will archive files for a year (RETVER). Further, we want to store a maximum of 3 logical volume backups, and keep the inactive image backups for a maximum of 120 days once they became inactive.

- Nodes registered to the WORKSTN domain will retain a maximum of 2 object copies (VEREXIST), while inactive copies will be stored for a maximum of 30 days (RETEXTRA), after becoming inactive. If an object is removed from a node file system, we will retain only the latest copy of the object (VERDEL) for 30 days (RETONLY). Primarily, we want to store only consistent backup copies (SHRSTATIC). Files that are being changed during backup, such as log files, should be bound to the special management class whose rules allow storing such files, but first attempt to back them up consistently (SHRDYNAMIC). Log files should be bind to a management class whose rules allow storing changing files eventually (SHRDYNAMIC). Their retention and versioning rules are the same as for the normal data. We will archive objects for 30 days (RETVER). Further, we want to store a maximum of 2 logical volume backups, and keep the inactive image backups for a maximum of 30 days once they became inactive (RETEXTRA).

Obviously, your environment will have specific data protection requirements which may differ from our setup. This is the purpose of the planning process. The provided values here may give you a reasonable starting point for later customizations.
In 1.1.1, “Our redbook support material” on page 5, we show how to load a predefined macro into IBM Tivoli Storage Manager. The macro `mac.policy`, which we provide to define the recommended policy settings in our redbook environment, is shown in B.1.3, “Define policy structure” on page 737.

7.1.1 Defining policy domains

The sample configuration consists of two policy domains: for servers and workstations respectively. The typical nature of the data found on each type of machine makes this a logical division of resources and follows the administrative boundaries used by many customers. Example 7-1 defines these policy domains, using the `define policy` command.

**Example 7-1  Recommended policy domains**

```
tsm: ATLANTIC>define domain server description="Server Nodes" backretention=100 archretention=365
```

![Sample policy definitions](image.png)
7.1.2 Defining policy sets

We recommend defining one policy set for each of the policy domains; as shown in Example 7-2. We use the `define policyset` command.

*Example 7-2  Defining a policy set per domain*

```bash
tsm: ATLANTIC> def policyset server server description="Policy Set for Server Nodes"
ANR1510I Policy set SERVER defined in policy domain SERVER.

tsm: ATLANTIC> def policyset server workstn description="Policy Set for Workstation Nodes"
ANR1510I Policy set WORKSTN defined in policy domain SERVER.
```

7.1.3 Defining management classes

We have defined four management classes for each domain in the sample configuration. These management classes are used to categorize the domain data:

- **DATA**: This is the default management class for each domain. It is used for most of the data in the environment.

- **DIRECTORY**: Directory objects are assigned to this class. Binding directories to a special management class allows us to properly set their expiration rules and control their final storage repository.

- **SPECIAL**: This management class is used to store files that are being modified during backup. An application log file could be bound to this management class to make sure that a copy is taken. A typical example of this type of file is an application log file that receives messages or errors. While the application is running, it is likely that the file will be modified with additional messages or errors while the scheduled Tivoli Storage Manager backup or archive operations are run. Let’s assume it is determined that it is OK to back up or archive this file, even if it is being updated, since the file will still be valid for restore. Since we do not want to stop the application so that the file is released cleanly for backup, we assign it to a management class whose specifications (in the backup-archive copy group definitions) include parameters for treatment of data that is being modified while a backup-archive
operation is being performed. One of these options allows the file to be backed up even if it is being modified.

- **IMAGE**: This management class is used to store logical volume backups, should you have such machines. This is useful if you want to handle the retention period differently for such operations. It is also useful if you further need to create a separate storage pool to store these backup; a tape storage pool, for example.

Space management clients are not covered in this redbook, but there is a space management parameter in the management class definition that we must change to avoid problems. The MIGDESTINATION parameter specifies the name of the storage pool for the migration of space managed files, and it defaults to a storage pool that we deleted during the recommended configuration steps. We point it to a dummy storage pool called NONE, which allows us to validate and activate the policy set without receiving any error messages.

Example 7-3 shows the management classes for the recommended configuration defined, using the `define mgmtclass` command. We assign the DATA management class as the default class for each policy set - with the `assign defmgmtclass` command.

*Example 7-3  Defining management classes*

```plaintext
tsm: ATLANTIC> define mgmtclass server server data migdestination=NONE
description="Default management class for Server domain"
ANR1520I Management class DATA defined in policy domain SERVER, set SERVER.

 ANR1538I Default management class set to DATA for policy domain SERVER, set SERVER.

 tsm: ATLANTIC> assign defmgmtclass server server data

 tsm: ATLANTIC> define mgmtclass server server directory migdestination=NONE
description="Directory management class for Server domain"
ANR1520I Management class DIRECTORY defined in policy domain SERVER, set SERVER.

 tsm: ATLANTIC> define mgmtclass server server special migdestination=NONE
description="Special management class for Server domain"
ANR1520I Management class SPECIAL defined in policy domain SERVER, set SERVER.

 tsm: ATLANTIC> define mgmtclass server server image migdestination=NONE
description="Image management class for Server domain"
ANR1520I Management class IMAGE defined in policy domain SERVER, set SERVER.

 tsm: ATLANTIC> define mgmtclass workstn workstn data migdestination=NONE
description="Default management class for Workstn domain"
ANR1520I Management class DATA defined in policy domain WORKSTN, set WORKSTN.
```
7.1.4 Defining backup copy groups

The reasons for creating two domains (WORKSTN and SERVER) are clearly illustrated in the backup copy group parameters. The two domains differ in the following ways:

- **VEREXISTS**: The WORKSTN domain only maintains two copies of existing data, as compared to three copies in the SERVER domain.
- **RETEXTRA**: The WORKSTN domain only keeps extra inactive copies for 30 days, as compared to 100 days in the SERVER domain.
- **RETONLY**: The WORKSTN domain keeps the last copy of deleted data for 30 days, as compared to 100 days in the SERVER domain.

**Note**: For expiration control of image backups, versions deleted (VERDEL) and retain only (RETONLY) settings do not apply - image backups are controlled by the VEREXIST and RETEXTRA options only. Nevertheless, in our example we set the values of retver/retonly verexist/verdel the same for both image management classes to avoid confusion.

Directory expiration should be governed by a separate management class. The backup copy group retention options for both existing versions and deleted versions for this management class should be set so that the directory objects do not expire before the files beneath them in the directory tree. In our case, we allow an unlimited number of directory objects to be stored within the Tivoli Storage Manager repository for as long as a file object associated with a
directory exists in the repository. In other words, we set directory object
expiration at least as long as the longest retention for the files. It is all right to
store an unlimited number of directory objects, since they occupy insignificant
space within the Tivoli Storage Manager server repository as compared to file
and other objects. This will ensure your clients can perform a point-in-time
restores within the defined expiration period.

Another parameter also illustrates the difference between the management
classes:

- **SERIALIZATION**: The backup copy group for the *special* management class
  is set up to use serialization parameter of SHRDYNAMIC instead of
  SHRSTATIC. Log files and other files where the files are always open, but
  which we nevertheless want to back up, should be bound to this management
class.

**Tip**: If some of your data require policy settings different than our
recommended defaults — for example, if you need to keep 7 copy versions of
certain files — then you need to create an additional management class for
this purpose, and assign the data to it using the INCLUDE option. See
“Options file” on page 109 for further information.

In Example 7-4 we define the backup copy group for each of the management
classes - using `define copygroup` command.

**Example 7-4  Defining backup copy group**

```
    tsm: ATLANTIC> define copygroup server server data type=Backup
destination=DISKDATA frequency=1 verexists=3 verdeleted=1 retextra=100 retonly=100
    mode=modified serialization=shrstatic
    ANR1530I Backup copy group STANDARD defined in policy domain SERVER, set
    SERVER, management class DATA.

    tsm: ATLANTIC> define copygroup server server directory type=Backup
destination=DISKDIRS frequency=1 verexists=nolimit verdeleted=nolimit retextra=100
    retonly=100 mode=modified serialization=shrstatic
    ANR1530I Backup copy group STANDARD defined in policy domain SERVER, set
    SERVER, management class DIRECTORY.

    tsm: ATLANTIC> define copygroup server server special type=Backup
destination=DISKDATA frequency=1 verexists=3 verdeleted=1 retextra=100 retonly=100
    mode=modified serialization=shrdynamic
    ANR1530I Backup copy group STANDARD defined in policy domain SERVER, set
    SERVER, management class SPECIAL.
```

```
    tsm: ATLANTIC> define copygroup server server image type=backup
```
destination=diskdata frequency=1 verexists=3 verdeleted=3 retextra=120 retonly=120 mode=modified serialization=static
ANR1530I Backup copy group STANDARD defined in policy domain SERVER, set SERVER, management class IMAGE.

tsm: ATLANTIC> define copygroup workstn workstn data type=Backup
destination=DISKDATA frequency=1 verexists=2 verdeleted=1 retextra=30 retonly=30
mode=modified serialization=shrstatic
ANR1530I Backup copy group STANDARD defined in policy domain WORKSTN, set WORKSTN, management class DATA.

tsm: ATLANTIC> define copygroup workstn workstn directory type=Backup
destination=DISKDIRS frequency=1 verexists=nolimit verdeleted=nolimit
retextra=30 retonly=30 mode=modified serialization=shrstatic
ANR1530I Backup copy group STANDARD defined in policy domain WORKSTN, set WORKSTN, management class DIRECTORY.

tsm: ATLANTIC> define copygroup workstn workstn special type=Backup
destination=DISKDATA frequency=1 verexists=2 verdeleted=1 retextra=30 retonly=30
mode=modified serialization=shrdynamic
ANR1530I Backup copy group STANDARD defined in policy domain WORKSTN, set WORKSTN, management class SPECIAL.

tsm: ATLANTIC> define copygroup workstn workstn image type=backup
destination=diskdata frequency=1 verexists=2 verdeleted=2 retextra=30 retonly=30
mode=modified serialization=static
ANR1530I Backup copy group STANDARD defined in policy domain WORKSTN, set WORKSTN, management class IMAGE.

7.1.5 Defining the archive copy group

For the sample configuration, we define archive copy groups only for the default management classes. The data management class in the SERVER domain keeps archived objects for a year, while in the WORKSTN policy domain, archives are retained for 100 days (Example 7-5). Files that are changing during archived are not stored. If it later turned out that we had additional archive requirements, e.g., to keep certain files for seven years, we could easily define a suitable archive copy group in an existing or new management class.

Example 7-5 Defining archive copy group

tsm: ATLANTIC>define copygroup server server data type=archive
destination=diskdata reter=365 serialization=shrstatic
ANR1535I Archive copy group STANDARD defined in policy domain SERVER, set SERVER, management class DATA.
7.2 Verifying policy definitions

To check the policy definitions, use the `query copygroup` command. The output displays the policy domain, policy set, management class, and copy group names, as well as the copy group parameters. Note that it is really the copy group definitions that define the policy for the domain; the rest of the constructs between the domain and copy group just provide flexibility in your configuration.

7.2.1 Backup copy groups

Example 7-6 shows how to check the settings for the recommended backup copy groups, using the `query copygroup` command to display the attributes.

```
Example 7-6   Querying backup copy groups

<table>
<thead>
<tr>
<th>Policy</th>
<th>Policy</th>
<th>Mgmt</th>
<th>Copy</th>
<th>Versions</th>
<th>Versions</th>
<th>Retain</th>
<th>Retain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domain</td>
<td>Set Name</td>
<td>Class</td>
<td>Group</td>
<td>Data</td>
<td>Data</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Name</td>
<td>Name</td>
<td>Name</td>
<td>Exists</td>
<td>Deleted</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>---------</td>
<td>-------</td>
<td>--------</td>
<td>----------</td>
<td>----------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>SERVER</td>
<td>SERVER</td>
<td>DATA</td>
<td>STANDARD</td>
<td>3</td>
<td>1</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>SERVER</td>
<td>SERVER</td>
<td>DIRECTORY</td>
<td>STANDARD</td>
<td>No Limit</td>
<td>No Limit</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>SERVER</td>
<td>SERVER</td>
<td>IMAGE</td>
<td>STANDARD</td>
<td>2</td>
<td>2</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>SERVER</td>
<td>SERVER</td>
<td>SPECIAL</td>
<td>STANDARD</td>
<td>2</td>
<td>1</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>
```
7.2.2 Archive copy groups

Example 7-7 shows how to check the settings for the archive copy groups. Use the `query copygroup` command to get a quick look at the attributes.

Example 7-7   Querying archive copy groups

```
tsm: ATLANTIC> query copygroup server server type=archive

Policy        Policy        Mgmt          Copy            Retain
Domain        Set Name      Class         Group          Version
Name                        Name          Name
---------     ---------     ---------     ---------     --------
SERVER        SERVER        DATA          STANDARD           365

  tsm: ATLANTIC> query copygroup workstn workstn type=archive

Policy        Policy        Mgmt          Copy            Retain
Domain        Set Name      Class         Group          Version
Name                        Name          Name
---------     ---------     ---------     ---------     --------
WORKSTN       WORKSTN       DATA          STANDARD           100
```

7.3 Validating and activating a policy set

The last step in setting up your policy is to validate and activate your policy set. The commands are very straightforward and have few parameters.

7.3.1 Validating the recommended policy sets

The `validate policyset` command checks for completeness in the management class and copy group definitions. It validates these policies and makes them ready for activation.

Example 7-8 shows how to validate the recommended policy sets.

Example 7-8   Validating policy sets

```
tsm: ATLANTIC> validate policyset server server
ANR1515I Policy set SERVER validated in domain SERVER (ready for activation).

  tsm: ATLANTIC> validate policyset workstn workstn
ANR1515I Policy set WORKSTN validated in domain WORKSTN (ready for activation).
```


7.3.2 Activating the recommended policy sets

The *activate policyset* command makes specified policy active, as the controlling policy within its policy domain.

Example 7-9 shows how to activate the recommended policy sets.

*Example 7-9  Activating policy sets*

```
tsm: ATLANTIC> activate policyset server server
Do you wish to proceed? (Yes/No) y
ANR1514I Policy set SERVER activated in policy domain SERVER.
```

```
tsm: ATLANTIC> activate policyset workstn workstn
Do you wish to proceed? (Yes/No) y
ANR1514I Policy set WORKSTN activated in policy domain WORKSTN.
```

```
tsm: ATLANTIC> query domain
```

<table>
<thead>
<tr>
<th>Policy Domain Name</th>
<th>Policy</th>
<th>Activated</th>
<th>Activated Default</th>
<th>Number of Registered Nodes</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SERVER</td>
<td>SERVER</td>
<td>DATA</td>
<td></td>
<td>0</td>
<td>Server Nodes</td>
</tr>
<tr>
<td>WORKSTN</td>
<td>WORKSTN</td>
<td>DATA</td>
<td></td>
<td>0</td>
<td>Workstation Nodes</td>
</tr>
</tbody>
</table>

7.3.3 Deleting the STANDARD policy domain

The installation process created a policy domain called STANDARD. Once you have created your required policy, you should remove the STANDARD domain information to clean up your environment. The *delete domain* command removes an existing policy domain. This command is very powerful in that it also removes the underlying policy sets, management classes, and copy groups that belong to the domain. For this reason, the *delete domain* command should be used with caution. Example 7-10 shows how to remove a policy domain named STANDARD.

*Example 7-10  Removing the standard domain*

```
tsm: ATLANTIC> delete domain standard
Do you wish to proceed? (Yes/No) yes
ANR1501I Policy domain STANDARD deleted.
```
If a policy domain contains nodes and filespaces, this command fails. You must remove all registered nodes from a policy domain before deleting it. There are two ways to accomplish this task:

- Delete the nodes and their filespaces
- Move the nodes including their filespaces to another domain

**Deleting a node**

To deleting a node, remove the node data with the `delete filespace` command, delete any backup sets registered to the server with the `delete backupset` command and remove the node definition with the `remove node` command. Example 7-11 shows how to remove the filespaces and node definition for the node DIOMEDE.

Be careful - this will remove all backed up, archived, and migrated data from the Tivoli Storage Manager server for that client node.

**Example 7-11 Removing filespaces and node definitions**

```
Example 7-11 Removing filespaces and node definitions

Do you wish to proceed? (Yes/No) y

Do you wish to proceed? (Yes/No) y
```

```
Example 7-11 Removing filespaces and node definitions

tsm: ATLANTIC> delete filespace DIOMEDE *
ANR2238W This command will result in the deletion of all inventory references to the data on filespaces that match the pattern * for node DIOMEDE, whereby rendering the data unrecoverable.

Do you wish to proceed? (Yes/No) y
ANS8003I Process number 18 started.

Do you wish to proceed? (Yes/No) y

Ansr2365I Backupset TRCKA_BS.18773 for node DIOMEDE has been deleted.

Do you wish to proceed? (Yes/No) y

ANS2061I Node DIOMEDE removed from policy domain STANDARD.
ANS2129I Administrative userid DIOMEDE defined ONLY for authority over node DIOMEDE has been removed.
```

**Moving a node**

The `update node` command can be used to assign a node to a new domain. The data is bound to the management classes in the new domain during the next backup operation. The process of assigning the data to the new domain's management classes is called rebinding.

If the new domain has the same management class names as the old one and providing that the copy group rules within management class definitions are the
same, very little change takes place, as the data is governed only by the management class name and not the policy domain name. However, if the new domain has completely different management class names, then the data is rebound to the default management class for the domain. The first backup after the domain change may take longer than normal, due to the rebinding process, but it is a one time operation and returns to normal speed thereafter.

**Note:** Be careful when migrating a node to another policy domain. If a client had data backed up under the old domain, the data is rebound to the same management class in the new domain, if it exists. If the management class does not exist in the new domain, the data is rebound to the default management class of the new domain. If this management class does not have a backup copy group, the data is rebound to the retention grace period defined in the new domain. This can lead to undesired expiration of backup versions.

Example 7-12 shows how to move the node SENEGAL from its current domain to the WORKSTN domain.

**Example 7-12  Moving a node to a different domain**

```console
$ tsm: ATLANTIC> update node SENEGAL domain=workstn
ANR2063I Node SENEGAL updated.
$ tsm: ATLANTIC> query node SENEGAL

<table>
<thead>
<tr>
<th>Node Name</th>
<th>Platform</th>
<th>Policy Domain</th>
<th>Days Since Last Access</th>
<th>Days Since Password Set</th>
<th>Locked?</th>
</tr>
</thead>
<tbody>
<tr>
<td>SENEGAL</td>
<td>WinNT</td>
<td>WORKSTN</td>
<td>&lt;1</td>
<td>&lt;1</td>
<td>No</td>
</tr>
</tbody>
</table>
```

### 7.4 Enforcing your policy

Once the policy is defined, you want to enforce it using the `expire inventory` command. This command makes sure that any extra copies of data in your copy groups are removed from the database. It also takes care of data that is older than your specified retention period. The backup copy group parameters `VEREXISTS`, `VERDELETED`, `RETEXTRA`, and `RETONLY` are applied to backup data through the expiration process as well as the archive copy group parameter `RETVER`. Example 7-13 shows how to expire the database references from the Tivoli Storage Manager server.
Example 7-13  Expiring inventory

Example 7-13  Expiring inventory

```
 tsm: ATLANTIC> expire inventory

 ANS8003I Process number 22 started.
```

This command can be computationally intensive; therefore, it should be run during quieter times on the Tivoli Storage Manager server.

The EXPINTERVAL parameter in the server options file specifies the number of hours between automatic expiration processing, and is initially configured for 24 hours. With automatic expiration processing enabled, the server runs inventory expiration at start-up and every 24 hours thereafter. We recommend setting the EXPINTERVAL to zero (disabling automatic expiration) and defining a daily administrative schedule to run this command at a convenient time. We show how to do this in 12.2.4, “Defining an expiration schedule” on page 370.

7.5 Summary

We expect that you now understand and have configured the policies for your data retention. Next we shall discuss user management, to provide you with an understanding of administration roles within Tivoli Storage Manager.
Managing Tivoli Storage Manager

This chapter explains the creation and maintenance of users of an IBM Tivoli Storage Manager system.
8.1 Management

Using the information you have gathered during the planning phase, as well as the understanding you have gained from reading IBM Tivoli Storage Management Concepts, SG24-4877, you should be able now define both users and clients on your Tivoli Storage Manager server.

There are two categories of users:

- Administrators
- Client nodes

8.1.1 Administrators

Administrators manage Tivoli Storage Manager server resources such as storage pools, devices, and data management policies.

You need at least one administrator and can have more with varying levels of authority. Administrators with system privileges can perform any Tivoli Storage Manager function. Administrators with policy, storage, operator, or analyst privileges can perform subsets of Tivoli Storage Manager functions.

Administrators primarily use the Tivoli Storage Manager command-line interface (CLI) or the Administration Center to enter commands acting against the Tivoli Storage Manager server.

Administrators may also use the Web backup-archive client to perform backup, restore, archive, and retrieve operations on behalf of other users remotely. A typical scenario is where help desk personnel use the web client to perform these client tasks for their end users without needing to physically present at the end user location, or to log on to the client machine. They can simply perform the operation from their browser. Use of the Web backup-archive client requires special client access authority for the client which will be restored.

All commands issued by administrators are logged to the server activity log. See 2.11, “Administrator IDs” on page 57 for planning considerations.

In smaller implementation, there may be only one Tivoli Storage Administrator performing both administrator and helpdesk services. In larger enterprises, these functions are probably both functionally and geographically dispersed, so the multiple administrators with different authorities are required.

8.1.2 Considerations

Creating an administrator is a two-step process:
1. Define the administrator ID.
2. Grant the necessary privileges.

The `register admin` command explicitly creates an administrator ID with certain defined privileges. If an administrator with the same name as the client node already exists during registration of a new node, then this administrator ID is automatically updated to grant owner access to it. You can use the optional CONTACT parameter to distinguish administrators.

The `grant authority` command grants the necessary privileges to an administrator. The only required parameters are the administrator name and the privileges being granted. You can reduce an administrator's authority by revoking one or more privilege classes and granting other classes as needed.

The `query admin` command displays information about one or more administrators. Any administrator can issue this command.

### 8.1.3 Default environment

During the initial server installation, Tivoli Storage Manager defines two administrator IDs automatically:

**SERVER_CONSOLE**

Allows you to administer the server after Tivoli Storage Manager is installed. At installation, the SERVER_CONSOLE ID is automatically registered as an administrator and given system authority. You can use the SERVER_CONSOLE ID to issue administrative commands.

When the server is started in interactive mode (or foreground), typically with the `dsmserver` command, a server console is started with a command prompt running with the assigned authority of the SERVER_CONSOLE ID. This is in contrast to running the server in background mode, either as a Windows service or under UNIX using the `nohup` command. In that case, no command prompt is presented.

In an emergency situation, administrative commands can be issued from the server console to correct situations, such as forgotten administrator passwords and locked IDs. This assumes your server console runs in a secure environment. If you cannot secure your server console from unauthorized access, you should revoke the privilege of the SERVER_CONSOLE id, perhaps to analyst. If you do this, you must first define at least one other new administrator ID with system privilege. We do not recommend reducing the SERVER_CONSOLE privileges, since it might be the only way to recover from certain emergencies if you have lost the password of all other administrative ids.

You cannot:
Register or update the SERVER_CONSOLE user ID
Lock or unlock the SERVER_CONSOLE user ID
Rename the SERVER_CONSOLE user ID
Remove SERVER_CONSOLE user ID
Assign a password to the SERVER_CONSOLE user ID
Route commands from the SERVER_CONSOLE user ID

We recommend having at least two systems administrators. Tivoli Storage Manager will not allow you to remove either the SERVER_CONSOLE ID or the last administrator ID with system privilege.

ADMIN
An administrator that has system privileges and an initial password of ADMIN. This administrator is used to set up your Tivoli Storage Manager environment. You should immediately change the password from the default. For enhanced security after your environment has been created, we recommend that you delete or lock this administrator, since many people know of this ID’s existence and could use it to gain access to your system.

8.1.4 Recommended administrators

We recommend that you define the following administrators to support your Tivoli Storage Manager environment:

- System
- Support
- Reporting
- Client

We also recommend that you use the optional CONTACT parameter to distinguish administrators. Although we have recommended certain administrator names, you do not have to use them. You can use any name suitable for your purposes.

In 1.1.1, “Our redbook support material” on page 5, we show how to load a predefined macro into Tivoli Storage Manager. The macro `mac.admins`, which we provide to define administrative ids for our redbook environment, is shown in B.1.1, “Define administrators” on page 734.

System
Define an ID for the Tivoli Storage Manager administrator and possibly another for your backup Tivoli Storage Manager administrator. These administrators should have system privileges.
In Example 8-1, we define an administrator named TSMADMIN1, and a backup named TSMADMIN2. The initial password for both administrators is TOMAZ. We grant these ids system privilege.

Example 8-1  Commands to create an administrator

```bash
tsm: ATLANTIC> register admin tsmadmin1 tomaz contact="IBM Tivoli Storage Manager Administrator"
ANR2068I Administrator TSMADMIN1 registered.

ANR2076I System privilege granted to administrator TSMADMIN1.

ANR2068I Administrator TSMADMIN2 registered.

ANR2076I System privilege granted to administrator TSMADMIN2.
```

Support

Define an id for your Tivoli Storage Manager technical support person. This id should have the system privilege.

In Example 8-2, we define a support administrator named SUPPORT. The initial password for this administrator is ALINE. We also grant system privilege to this id.

Example 8-2  Creating a support ID

```bash
tsm: ATLANTIC> register admin support aline contact="IBM Tivoli Storage Manager Support"
ANR2068I Administrator SUPPORT registered.

ANR2076I System privilege granted to administrator SUPPORT.
```

Reportings

Define an id for Tivoli Storage Manager reporting purposes. Although this administrator has no special privileges, it does have authority to issue QUERY commands. This is especially useful for producing regular reports through a method such as scripts. Disclosure of this administrator's password does not create a security exposure, because the administrator cannot change any Tivoli Storage Manager resources.
In Example 8-3, we define a support administrator named REPORT. The initial password for this administrator is MIKE.

```
Example 8-3  Creating a reporting ID

    tsm: ATLANTIC> register admin report mike contact="IBM Tivoli Storage Manager Reporting"
    ANR2068I Administrator REPORT registered.
```

**Client**

Define an ID for the Web administrative client access. This administrator would have client access authority to all nodes in the Tivoli Storage Manager environment. In particular, this administrator can perform restore operations on behalf of users. This is usually sufficient for smaller organizations. In larger organizations, you might require multiple administrators with this authority.

In Example 8-4, we define a client administrator named HELPDESK. The initial password for this administrator is LEILLA.

We will later (in “Granting access to client nodes” on page 282) give this administrator client access authority to the nodes which we define.

```
Example 8-4  Registering a client node

    tsm: ATLANTIC> register admin helpdesk leilla contact="IBM Tivoli Storage Manager Client Administrator"
    ANR2068I Administrator HELPDESK registered.
```

### 8.1.5 Working with administrators

In this section we explain how to perform various processes related to administrators that you will find useful in your Tivoli Storage Manager environment:

**Displaying administrators**

You use the `query admin` command to display administrators. If no administrator name is specified, all administrators are displayed. If an administrator name is specified, only that administrator's information is displayed.

In Example 8-5 we display the list of all administrators.

```
Example 8-5  Displaying administrators

    tsm: ATLANTIC> query admin

    Administrator        Days Since       Days Since      Locked?       Privilege Classes
```
Then, in Example 8-6, we display full details of the administrator HELPDESK.

**Example 8-6  Configuration for a helpdesk administrator**

```bash
tsm: ATLANTIC> query admin helpdesk format=detail

Administrator Name: HELPDESK
    Last Access Date/Time: 02/07/2006 04:33:42
    Days Since Last Access: <1
    Password Set Date/Time: 02/07/2006 04:33:42
    Days Since Password Set: <1
    Invalid Sign-on Count: 0
    Locked?: No
    Contact: IBM Tivoli Storage Manager Client Administrator
    System Privilege:
    Policy Privilege:
    Storage Privilege:
    Analyst Privilege:
    Operator Privilege:
    Client Access Privilege:
    Client Owner Privilege:
    Registration Date/Time: 02/07/2006 04:33:42
    Registering Administrator: ADMIN
    Managing profile:
    Password Expiration Period:
```

**Changing an administrator password**

An administrative user can change his or her own password using the `update admin` command. A user with system privilege can change any administrator's password. There is no way to determine the current password for an administrator — if it is forgotten or lost, another administrator must reset it.

Example 8-7 shows changing the password for the administrator named TSMADMIN2 to SHARKS.

**Example 8-7  Changing an administrator password**

```bash
tsm: ATLANTIC> update admin tsmadmin2 sharks
```
ANR2071I Administrator TSMADMIN2 updated.

When this command is logged to the server activity log, the password in the log is replaced by asterisks as showed in Example 8-8:

Example 8-8  The update command logged to the server activity log

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>02/07/2006</td>
<td>05:06:45</td>
<td>ANR2017I Administrator ADMIN issued command: UPDATE ADMIN tsmadmin2 ?***? (SESSION: 74)</td>
</tr>
<tr>
<td>02/07/2006</td>
<td>05:06:45</td>
<td>ANR2071I Administrator TSMADMIN2 updated. (SESSION: 74).</td>
</tr>
</tbody>
</table>

Deleting the ADMIN administrator

After you have defined your required system administrators, delete the installed system administration ID, ADMIN. Because you cannot delete an administrator if that administrator is currently accessing the server, you must logon to Tivoli Storage Manager as a different administrator to perform this task.

Example 8-9 shows the operation with the remove admin command.

Example 8-9  Deleting the admin administrator

root@Atlantic /: dsmadmc
IBM Tivoli Storage Manager
Command Line Administrative Interface - Version 5, Release 3, Level 2.0
(c) Copyright by IBM Corporation and other(s) 1990, 2005. All Rights Reserved.

Enter your user id:  tsmadmin1
Enter your password:

Session established with server ATLANTIC: AIX-RS/6000
Server Version 5, Release 3, Level 2.2
Server date/time: 02/07/06   09:28:42  Last access: 02/07/06   09:23:40

tsm: ATLANTIC> remove admin admin

Do you wish to proceed? (Yes (Y)/No (N)) y
ANR2069I Administrator ADMIN removed.

Attention: You can remove administrators from the server so that they no longer have access to administrator functions but you cannot remove the last administrator with system privileges and you cannot remove the administrator SERVER_CONSOLE.
8.2 Client nodes

When the Tivoli Storage Manager server is installed, the Tivoli Storage Manager backup-archive client and the administrative client are installed on the same machine as the server by default. Most installations of Tivoli Storage Manager also include backup-archive clients and application clients on other machines, often running on different operating systems.

Typically, a node corresponds directly to a machine - as in the case of a backup-archive client that is installed on a user's computer for file system backups. However, multiple nodes can exist on a single machine. For example, a system running Microsoft SQL Server contain both a Tivoli Storage Manager for Databases (Data Protection for SQL Server) application client for database and transaction log backups, and a regular backup-archive client for file system backups.

Each Tivoli Storage Manager backup-archive client must be registered with the Tivoli Storage Manager server before any backup and recovery operations can be performed for that backup-archive client. Although Tivoli Storage Manager provides two modes, open and closed, for registering client nodes to the server, we recommend for security reasons that you do not change the closed mode default.

8.2.1 Considerations

To register a client node, use the register node command. At a minimum, you need to supply a node name and a client access password. We recommend using the TCP/IP host name for the Tivoli Storage Manager node name. If you define your own Tivoli Storage Manager policy domains, then you must also use the DOMAIN parameter. Further, we recommend that you also specify the USERID parameter.

The DOMAIN parameter specifies the name of the policy domain to which the node is assigned. If you do not specify a policy domain name, the node is assigned to the default policy domain (STANDARD). Within our recommended environment, there are two domains, SERVER and WORKSTN, and no STANDARD domain. Consequently, if you use our environment, you must specify the DOMAIN parameter when registering a client node.

The USERID parameter specifies an administrative id who will be defined as an administrator with node owner (client access) authority to the client. Node authority allows an administrator to use the Web backup-archive client. When the USERID parameter is omitted, an administrator with the same name as the node is defined. This is the default. We recommend that you specify USERID=NONE.
and grant node authority to the HELPDESK administrator and other administrators explicitly through the `grant authority` command.

### 8.2.2 Default environment

Except for zOS, one client node is registered to the Tivoli Storage Manager server during the initial server installation - this is for the Tivoli Storage Manager server itself. The name of this client is CLIENT, with initial password CLIENT. The node is assigned to the STANDARD domain. To comply with our recommendation of using the hostname for each client node, you should use the `rename node` command to change the name of the node from CLIENT to the hostname, and the `update node` command to assign it to a new policy domain.

### 8.2.3 Working with client nodes

In this section, we explain how to perform various processes related to client nodes that you will find useful in your Tivoli Storage Manager environment.

**Registering a client node**

Use the `register node` command to define a client to the server. In our environment, we supply the required parameters (node name, node password, domain name), and an additional two parameters (contact, userid).

Table 8-1 shows a layout you can use for documenting the information needed to register the clients, completed with a set of sample client information.

<table>
<thead>
<tr>
<th>Node name</th>
<th>Contact</th>
<th>Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROPAGANDA</td>
<td>Tomaz - First Floor</td>
<td>SERVER</td>
</tr>
<tr>
<td>LOSGATOS</td>
<td>Aline - Second Floor</td>
<td>WORKSTN</td>
</tr>
<tr>
<td>MILES</td>
<td>Leilla - Help Desk</td>
<td>SERVER</td>
</tr>
</tbody>
</table>

Example 8-10 shows the commands to create these nodes. We give all nodes the same password, SHARKS.

---

**Example 8-10  Registering a client node**

```
tsm: ATLANTIC> register node propaganda sharks domain=server userid=none contact="TAL (Tomaz Aline Leilla)"
ANR2060I Node PROPAGANDA registered in policy domain SERVER.
```

```
tsm: ATLANTIC> register node losgatos sharks domain=workstn userid=none contact="Tomaz_Aline_Leilla@work"
ANR2060I Node LOSGATOS registered in policy domain WORKSTN.
```
ANR2060I Node LOSGATOS registered in policy domain WORKSTN.

**tsm**: ATLANTIC> **register node miles sharks domain=server userid=none**
**contact=Tomaz@home**
ANR2060I Node MILES registered in policy domain SERVER.

---

**Displaying client nodes**

Use the `query node` command, as shown in Example 8-11, to display client nodes. If you do not specify a node name, all nodes are displayed. If you do specify a node name, only that node’s information is displayed.

*Example 8-11  Displaying client node summary*

```plaintext
**tsm**: ATLANTIC> query node

<table>
<thead>
<tr>
<th>Node Name</th>
<th>Platform</th>
<th>Policy Domain Name</th>
<th>Days Since Last Access</th>
<th>Days Since Password Set</th>
<th>Locked?</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOSGATOS</td>
<td>WinNT</td>
<td>WORKSTN</td>
<td>&lt;1</td>
<td>&lt;1</td>
<td>No</td>
</tr>
<tr>
<td>MILES</td>
<td>AIX</td>
<td>SERVER</td>
<td>&lt;1</td>
<td>&lt;1</td>
<td>No</td>
</tr>
<tr>
<td>PROPAGANDA</td>
<td>AIX</td>
<td>SERVER</td>
<td>&lt;1</td>
<td>&lt;1</td>
<td>No</td>
</tr>
</tbody>
</table>
```

Example 8-12 shows the full details of the node named LOSGATOS.

*Example 8-12  Displaying full client node details*

```plaintext
**tsm**: ATLANTIC> query node losgatos format=detail

Node Name: LOSGATOS
Platform: WinNT
Client OS Level: 5.00
Client Version: Version 5, Release 3, Level 2.0
Policy Domain Name: WORKSTN
Last Access Date/Time: 02/07/2006 17:52:24
Days Since Last Access: <1
Password Set Date/Time: 02/07/2006 17:43:44
Days Since Password Set: <1
Invalid Sign-on Count: 0
Locked?: No
Contact: Tomaz_Aline_Leilla@work
Compression: Client
Archive Delete Allowed?: Yes
Backup Delete Allowed?: No
Registration Date/Time: 02/07/2006 17:43:44
Registering Administrator: TSMADMIN1
Last Communication Method Used:
Bytes Received Last Session: 0
Bytes Sent Last Session: 0
```
Granting access to client nodes

An administrator can perform all client operations on behalf of the user through the Web backup-archive client. The administrator needs node authority to perform those operations. An administrative user with system privilege can grant that authority.

Example 8-13 shows how to grant node authority for all nodes to a client administrator named HELPDESK.

Example 8-13  Granting access to client nodes

```
tsm: ATLANTIC> grant authority helpdesk classes=node node=*   
```

ANR2126I GRANT AUTHORITY: Administrator HELPDESK was granted ACCESS authority for client LOSGATOS.
ANR2126I GRANT AUTHORITY: Administrator HELPDESK was granted ACCESS authority for client MILES.
ANR2126I GRANT AUTHORITY: Administrator HELPDESK was granted ACCESS authority for client PROPAGANDA.
Now if we display the administrator details, with the `query admin` command, we can see it has client access privileges, as in Example 8-14.

**Example 8-14  Administrator has client access privilege**

```shell
tsm: ATLANTIC> query admin helpdesk format=detail

  Administrator Name: HELPDESK
  Last Access Date/Time: 02/07/2006 18:33:42
  Days Since Last Access: <1
  Password Set Date/Time: 02/07/2006 18:33:42
  Days Since Password Set: <1
  Invalid Sign-on Count: 0
  Locked?: No
  Contact: IBM Tivoli Storage Manager Client Administrator
  System Privilege:
  Policy Privilege:
  Storage Privilege:
  Analyst Privilege:
  Operator Privilege:
  Client Access Privilege: LOSGATOS MILES PROPAGANDA
  Client Owner Privilege:
  Registration Date/Time: 02/07/2006 04:33:42
  Registering Administrator: ADMIN
  Managing profile:
  Password Expiration Period:
```

If you create additional nodes and you want administrators to have authority to those nodes, the `grant authority` command must be reissued.

**Changing passwords for client nodes**

An administrative user with either system privilege, unrestricted policy privilege, or restricted policy privilege for the policy domain to which the client node is assigned can change the password of a client node.

In Example 8-15, we change the password for the client node named MILES to LAND, using the `update node` command.

**Example 8-15  Changing passwords for client nodes**

```shell
tsm: ATLANTIC> update node miles land
ANR2063I Node MILES updated.
```
Deleting filespaces for a client node

An administrative user with either system privilege, unrestricted policy privilege, or restricted policy privilege for the policy domain to which the client node is assigned, can delete node filespaces. Filespaces contain a client's backup and archive data. There are one or more filespaces for each client.

The `delete filespace` command creates a server process that deletes one or more file spaces as a series of batch database transactions. If the `delete filespace` process is canceled or if a system failure occurs, a partial deletion can occur. In this case, a subsequent `delete filespace` command for the same node will delete the remaining data. You must delete all backup and archive filespaces that belong to a client node before you can delete that client node.

**IMPORTANT:** Use the `delete filespace` command with caution - it really deletes the client's backed up and archived data from the Tivoli Storage Manager server.

Example 8-16 displays the filespaces for the client LOSGATOS.

**Example 8-16  Querying filespaces for a client node**

<table>
<thead>
<tr>
<th>Node Name</th>
<th>Filespace Name</th>
<th>FSID</th>
<th>Platform</th>
<th>Filespace Type</th>
<th>Is Filespace Unicode?</th>
<th>Capacity (MB)</th>
<th>Pct Util</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOSGATOS</td>
<td>/</td>
<td>1</td>
<td>AIX</td>
<td>JFS2</td>
<td>No</td>
<td>32.0</td>
<td>44.9</td>
</tr>
<tr>
<td>LOSGATOS</td>
<td>/opt</td>
<td>2</td>
<td>AIX</td>
<td>JFS2</td>
<td>No</td>
<td>128.0</td>
<td>76.1</td>
</tr>
</tbody>
</table>

Example 8-17, we delete the file space “/opt” for the client LOSGATOS. Note we are not deleting any files on the client itself - we are deleting all records of any files backed up or archived in that file system on the Tivoli Storage Manager server.

**Example 8-17  Deleting filespaces for a client node**

```
tsm: ATLANTIC> delete filespace losgatos /opt
ANR2238W This command will result in the deletion of all inventory references to the data on filespaces that match the pattern /opt (fsId=2) for node LOSGATOS, whereby rendering the data unrecoverable.
```
Filespace deletions can run in either background or foreground. The previous example was run in background. To monitor the process, use the `query process` command. You can view messages from the process in the server activity log.

To run filespace deletion in the foreground, add the `WAIT=YES` parameter to the command. Foreground processes write messages directly to your CLI session. If the filespace contains a large number of files, we recommend running the deletion in background.

Example 8-18 shows the results of deleting filespaces in foreground.

```
Example 8-18   Administrative command to delete filespaces

```tsm: ATLANTIC> delete filespace losgatos * wait=yes
ANR2238W This command will result in the deletion of all inventory references to the data on filespaces that match the pattern * (fsId=1) for node LOSGATOS, whereby rendering the data unrecoverable.

Do you wish to proceed? (Yes (Y)/No (N)) y
ANR0984I Process 15 for DELETE FILESPACE started in the FOREGROUND at 14:12:46.
ANR0800I DELETE FILESPACE * (fsId=1) for node LOSGATOS started as process 15.
ANR0802I DELETE FILESPACE * (fsId=1) (backup/archive data) for node LOSGATOS started.
ANR0806I DELETE FILESPACE * (fsId=1) complete for node LOSGATOS: 12 objects deleted.
ANR0987I Process 15 for DELETE FILESPACE running in the FOREGROUND processed 12 items with a completion state of SUCCESS at 14:12:46.
```tsm: ATLANTIC> q filespace losgatos
ANR2034E QUERY FILESPACE: No match found using this criteria.
ANS8001I Return code 11.

Deleting a client node

An administrative user with either system privilege, unrestricted policy privilege, or restricted policy privilege for the policy domain to which the client node is assigned, can delete a client node. Before removing a client node, you must delete all its backup and archive file. Use the `remove node` command, as shown in Example 8-19.

```
Example 8-19   Deleting a client node

```tsm: ATLANTIC> remove node losgatos
ANR2061I Node LOSGATOS removed from policy domain STANDARD.
ANR2129I Administrative userid LOSGATOS defined ONLY for authority over node LOSGATOS has been removed.
8.3 Client option sets

A Tivoli Storage Manager client session has a set of options which are used during backup, archive, restore, or retrieve processes. Options can be specified in two ways:

- In the client options file, which is created during the setup of a client (see “Options file” on page 109). A client options file is a set of Tivoli Storage Manager client options stored in one or two (UNIX/Linux clients only) files on the client.

- Using the client option set - this is optional. A client option set is a set of Tivoli Storage Manager client options stored in the Tivoli Storage Manager database. An option set can be associated with one or more Tivoli Storage Manager clients, but a client can be associated with only one option set.

8.3.1 Considerations

We recommend using client option sets to make administration easier, particularly in environments with a large number of clients, and as the number of available options grows. Using client option sets centralizes the management of those options and clients. It is easier to update a client option set once, than to perform the same update to the local client options file on each node.

Which value takes priority?

The options defined in a client option set are a subset of the available client options. Options such as communications are still stored on the client machine.

When the same option is specified in both the local options file and the option set, the client options file value takes priority by default. However, you can specify that individual options in an option set cannot be overridden in the client’s local options file, using the FORCE=YES parameter when defining the option.

Include-exclude rules

If you put include-exclude statements in the client options set, these will always over-ride the include-exclude statements in the client options file. You can imagine that the client options set include-exclude statements are added at the bottom of the client options file, so that they are evaluated first. The sequence number attached to each include-exclude statement in the client option set determines the order in which it is added to the existing include-exclude statements at the end of the client options file. Include-exclude statements in a client option set will always be seen and processed during backup first, before any statements in the client options file. Therefore, one set of default values can be defined for each type of client, in a client option set, yet the client machines can still be customized, within acceptable limits.
For example, suppose you have the following statements in a client option set:

```
include c:\test\* seq=1
exclude c:\working\* seq=2
```

And, suppose you have the following statements in a client options file:

```
exclude c:\test\*
include c:\working\*
```

The complete set of include-exclude specifications would be:

```
exclude c:\test\* (second last statement from the client options file)
include c:\working\* (last statement from the client options file)
include c:\test\* (sequence number 1 from the client option set)
exclude c:\working\* (sequence number 2 from the client option set)
```

**Reminder:** Include-exclude statements are processed from bottom to top.

Processing using this set of include-exclude statements would result in the files under C:\working not being backed up, and those files under C:\test being backed up.

### 8.3.2 Default environment

There are no client option sets created by default in a Tivoli Storage Manager environment.

### 8.3.3 Recommended client option sets

In our environment, we use multiple client option sets. All option sets are built from the base option set which we called “redbook”. This option set contains options other than the include-exclude specifications. All other option sets are based on the client platform. Each is built from the base option set with the addition of specific include-exclude recommendations for that platform.

### 8.3.4 Working with client option sets

In this section we explain how to perform various processes related to client option sets that you will find useful in your Tivoli Storage Manager environment.

**Creating a client option set**

To define a client option set:

1. Create the option set
2. Populate it with client options
You create a new client option set with the `define cloptset` command, or you can clone an existing option set with the `copy cloptset` command. You can add an option to an option set with the `define clientopt` command. You can remove an option from an option set with the `delete clientopt` command. You need system privilege or unrestricted policy privilege to issue these commands.

In Example 8-20 we define a client option set named WINDOWS and populate it with options.

Example 8-20   Creating a client option set

```plaintext
Example 8-20   Creating a client option set

Example 8-21 shows how to clone the client option set named WINDOWS to another named WINDOWS_CLONE, replacing the VERBOSE option with the QUIET option.

Example 8-21   Copying client option sets

8.3.5   Associating a client node with a client option set

The client node definition should be updated to use a client option set. You need either system privilege, unrestricted policy privilege, or restricted policy privilege for the policy domain to which the client node belongs to use the required `update node` command.
Use the SQL `select` command to view the names of all the client option sets, as shown in Example 8-22.

**Example 8-22  Select command for client option sets**

```sql
tsm: ATLANTIC> select * from cloptsets
```

<table>
<thead>
<tr>
<th>OPTIONSET_NAME</th>
<th>DESCRIPTION</th>
<th>LAST_UPDATE_BY</th>
<th>PROFILE</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIX</td>
<td>Include/Exclude list for AIX Systems</td>
<td>TSMADMIN1</td>
<td></td>
</tr>
<tr>
<td>WINDOWS</td>
<td>Include/Exclude list for Windows System</td>
<td>TSMADMIN1</td>
<td></td>
</tr>
</tbody>
</table>

In Example 8-23 shows how to associate the client node named MILES with the client option set AIX.

**Example 8-23  Associating a client with a client option set**

```sql
tsm: ATLANTIC> update node miles cloptset=aix
ANR2063I Node MILES updated.
```

**Deleting a client option set**

You need either system privilege or unrestricted policy privilege to delete a client option set with the `delete cloptset` command.

In Example 8-24, we delete the option set WINDOWS.

**Example 8-24  Deleting client option sets**

```sql
tsm: ATLANTIC> delete cloptset windows_list
Do you wish to proceed? (Yes (Y)/No (N)) y
ANR2048I DELETE CLOPTSET: Optionset WINDOWS deleted.
```

The association between a node and a client option set is removed automatically when that client option set is deleted. The node is not associated with another client option set until and unless you reissue the `update node` command.
8.4 Summary

You have now established administrative roles within your Tivoli Storage Manager server, which will allow the control, monitoring, and management of the data flow from the clients through the final storage media. Next we will discuss licensing options for your environment.
In this chapter we describe the tasks of licensing an IBM Tivoli Storage Manager system and monitoring its compliance. We discuss the process of registering, activating, and monitoring your licenses (but not the marketing or packaging of your licenses). This process is the same for each feature, no matter which package or product offering is purchased. The features will still need to have their respective licenses registered.

The method of packaging IBM Tivoli Storage Manager for purchase changes from time to time, which also changes entitlements of the product. Licenses by client versus purchases by processors are marketing issues and not license or product issues.
9.1 Licensed features

The base Tivoli Storage Manager server license supports an unlimited number of administrative clients, one backup-archive client using named pipes or shared memory protocol, and a selection of removable media devices. Table 9-1 lists all currently available licensed features you can add on to your base IBM Tivoli Storage Manager server license at V5.3 (for V5.2 options, see 9.6, “Tivoli Storage Manager V5.2 license features” on page 297).

With V5.3, you do not register licenses for any of the Tivoli Storage Manager agents (e.g. Tivoli Storage Manager for Databases, Tivoli Storage Manager for Mail). Agent license validation is done on the client side, independent from the server.

Table 9-1  Tivoli Storage Manager 5.3 licensed features

<table>
<thead>
<tr>
<th>Licensed feature</th>
<th>License files</th>
</tr>
</thead>
<tbody>
<tr>
<td>The base IBM Tivoli Storage Manager license: basic backup-archive with the base client and server.</td>
<td>tsmbasic.lic</td>
</tr>
<tr>
<td>IBM Tivoli Storage Manager Extended Edition: additional advanced functions including: Server-free data movement Disaster recovery manager Large libraries (greater than 3 drives or 40 slots) Tape Library Sharing over LAN NDMP backup and restore for NAS appliances</td>
<td>tsmee.lic</td>
</tr>
<tr>
<td>IBM Tivoli System Storage Archive Manager has additional functionality in: Data retention protection Event-based Retention Management Expiration/Deletion suspension (Deletion hold)</td>
<td>dataret.lic</td>
</tr>
</tbody>
</table>

The enrollment certificate files for all Tivoli Storage Manager licenses that can be registered with the server are on the Tivoli Storage Manager installation CD-ROM. You register those licenses that you need (and are entitled to) using the register license command, specifying the name of the enrollment certificate file. When registered, the licenses are stored in a file named nodelock in the current directory.
9.2 Registering licensed features

If you received a Tivoli Storage Manager evaluation (try-and-buy), the license registration is done automatically during the installation of the server and you do not need to do anything further.

If you bought a base Tivoli Storage Manager server license, you can buy licenses for licensed features, and register those licenses by specifying the license files using the `register license` command.

You can register any or all of the features shown in Table 9-1 on page 292. For example, if you want to register the Tivoli Storage Manager Extended Edition license, issue the commands shown in Example 9-1.

**Example 9-1  Registering licenses**

```bash
  tsm: ATLANTIC> reg license file=tsmbasic.lic
  ANR2852I Current license information:
  ANR2853I New license information:
  ANR2828I Server is licensed to support Tivoli Storage Manager Basic Edition.

  tsm: ATLANTIC> reg license file=tsmee.lic
  ANR2852I Current license information:
  ANR2853I New license information:
  ANR2828I Server is licensed to support Tivoli Storage Manager Basic Edition.
  ANR2828I Server is licensed to support Tivoli Storage Manager Extended Edition.
```
9.3 Saving your licenses

When license registration is complete, the licenses are stored in a file named `nodelock` in the server start directory.

Keep the installation CD-ROM which contains the license certificate files in a safe place to be used if you need to re-register your licenses. This might occur because:

- The server is corrupted.
- The server has moved to a different machine.
- The NODELOCK file is destroyed or corrupted.

9.4 License compliance

If license terms change, for example, if a new license is defined for the server, the server conducts an audit to determine if the current server configuration conforms to the license terms.

The server also periodically audits compliance with the license terms. The results of this audit are used to check and enforce license terms. If 30 days have elapsed since the previous license audit, the administrator cannot cancel the audit.
If the server uses a licensed feature but the license is not registered, the function fails. When you issue a command associated with an unlicensed feature, Tivoli Storage Manager does not issue a warning message, and the command fails.

If a Tivoli Storage Manager system exceeds the terms of its license agreement, one of the following occurs:

- The server issues a warning message indicating that it is not in compliance with the licensing terms.
- Operations fail because the server is not licensed for specific features.

In either case, you must contact your IBM account representative or authorized IBM Software reseller to modify your agreement.

### 9.5 Monitoring licenses

There are two commands to monitor the license registration on your Tivoli Storage Manager system:

- `query license`
- `audit license`

#### 9.5.1 Displaying license information

Use the `query license` command to display details of your current licenses and determine licensing compliance as shown for a Tivoli Storage Manager V5.3 server in Example 9-2.

```
Example 9-2   Displaying license information

  tsm: ATLANTIC> q license

  Last License Audit: 02/16/06 14:53:43
  Number of TDP for Oracle in use: 0
  Number of TDP for Oracle in try buy mode: 0
  Number of TDP for MS SQL Server in use: 0
  Number of TDP for MS SQL Server in try buy mode: 0
  Number of TDP for MS Exchange in use: 0
  Number of TDP for MS Exchange in try buy mode: 0
  Number of TDP for Lotus Notes in use: 0
  Number of TDP for Lotus Notes in try buy mode: 0
  Number of TDP for Lotus Domino in use: 0
  Number of TDP for Lotus Domino in try buy mode: 0
  Number of TDP for Informix in use: 0
  Number of TDP for Informix in try buy mode: 0
  Number of TDP for SAP R/3 in use: 0
```
9.5.2 Auditing licenses

An administrator can monitor license compliance by issuing the administrative command `audit licenses` as shown in Example 9-3. This command is used to compare the current configuration with the current licenses.

Example 9-3 Auditing licenses

```
  tsm: ATLANTIC>audit license
  ANR2817I AUDIT LICENSES: License audit started as process 143.
  ANS8003I Process number 3 started.
```

9.5.3 Scheduling automatic license audits

Use the `set licenseauditperiod` command to specify the number of days between automatic audits performed by the Tivoli Storage Manager server. In Example 9-4, we set the audit period to 30 days.

Example 9-4 Defining a audit tomfooleries

```
  tsm: ATLANTIC> set licenseauditperiod 30
```
### 9.6 Tivoli Storage Manager V5.2 license features

For reference purposes, Table 9-2 on page 297 shows the license features for Tivoli Storage Manager V5.2.

#### Table 9-2  Tivoli Storage Manager 5.2 licensed features

<table>
<thead>
<tr>
<th>Licensed feature</th>
<th>License files</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional backup-archive clients: The base IBM Tivoli Storage Manager license supports one backup-archive client; Licensing additional clients with any number of clients (replace x with valid number of clients)</td>
<td>xclient.lic</td>
</tr>
<tr>
<td>IBM Tivoli Storage Manager for Space Management; Hierarchical storage management (HSM) clients, also known as space-managed clients</td>
<td>spacemgr.lic</td>
</tr>
<tr>
<td>IBM Tivoli Storage Manager Disaster Recovery Manager</td>
<td>drm.lic</td>
</tr>
<tr>
<td>IBM Tivoli Storage Manager for Databases; Tivoli Data Protection for Oracle</td>
<td>oracle.lic</td>
</tr>
<tr>
<td>IBM Tivoli Storage Manager for Databases; Tivoli Data Protection for MS SQL Server</td>
<td>mssql.lic</td>
</tr>
<tr>
<td>IBM Tivoli Storage Manager for Mail; Tivoli Data Protection for MS Exchange</td>
<td>msexch.lic</td>
</tr>
<tr>
<td>IBM Tivoli Storage Manager for Mail; Tivoli Data Protection for Lotus Notes®</td>
<td>lnotes.lic</td>
</tr>
<tr>
<td>IBM Tivoli Storage Manager for Mail; Tivoli Data Protection for Lotus Domino®</td>
<td>domino.lic</td>
</tr>
<tr>
<td>IBM Tivoli Storage Manager for Databases; Tivoli Data Protection for Informix®</td>
<td>informix.lic</td>
</tr>
<tr>
<td>IBM Tivoli Storage Manager for Applications; Tivoli Data Protection for R/3</td>
<td>r3.lic</td>
</tr>
<tr>
<td>IBM Tivoli Storage Manager for Hardware; Tivoli Data Protection for EMC Symmetrix</td>
<td>emcsymm.lic</td>
</tr>
<tr>
<td>IBM Tivoli Storage Manager for Hardware; Tivoli Data Protection for EMC Symmetrix for R/3</td>
<td>emcsymr3.lic</td>
</tr>
<tr>
<td>IBM Tivoli Storage Manager for Hardware; Tivoli Data Protection for ESS</td>
<td>ess.lic</td>
</tr>
<tr>
<td>IBM Tivoli Storage Manager for Hardware; Tivoli Data Protection for ESS for R/3</td>
<td>essr3.lic</td>
</tr>
<tr>
<td>Licensed feature</td>
<td>License files</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Managed libraries</td>
<td>library.lic</td>
</tr>
<tr>
<td>Library sharing</td>
<td>libshare.lic</td>
</tr>
<tr>
<td>IBM Tivoli Storage Manager for Applications; WebSphere® Application Server</td>
<td>was.lic</td>
</tr>
<tr>
<td>IBM Tivoli Storage Manager for NDMP</td>
<td>ndmp.lic</td>
</tr>
<tr>
<td>Managed system for SAN use</td>
<td>mgsyssan.lic</td>
</tr>
<tr>
<td>Managed system for LAN use</td>
<td>mgsyslan.lic</td>
</tr>
</tbody>
</table>
Administrative client

In our previous chapters we have discussed the various stages from planning through implementation of the server and clients, then moved on to the storage setup, licensing, and administrative roles. Here we describe administrative interfaces available in IBM Tivoli Storage Manager.

With V5.3 of Tivoli Storage Manager, a new Web-based administrative interface for the Tivoli Storage Manager environment is available. This is the Administration Center, which is hosted in the Integrated Solutions Console (ISC) framework. Administration Center has replaced the previous server-bound Web administrative interface, which is no longer supported in V5.3 and later, since it uses a completely different administrative API.

We cover briefly the installation and setup of the ISC with the Administration Center component, as well as the command-line administrative client. Further, we demonstrate capabilities of both tools regarding managing and monitoring Tivoli Storage Manager environments.

IBM Tivoli Storage Manager has always provided a command line interface, called the administrative client, that allows you to manage and monitor one or more IBM Tivoli Storage Manager servers and resources. Various graphical interfaces (GUIs) on different versions have also been available.

For details on ISC and Administration Center setup, refer to IBM Tivoli Storage Manager Version 5.3 Technical Guide, SG24-6638.
10.1 Administration Center

The Administration Center Web-interface provides an easy way to manage multiple server instances from a single browser window. It is available since Tivoli Storage Manager V5.3, and is hosted in the Integrated Solution Console (ISC) framework. ISC is a general framework, supporting multiple modules that serve different purposes. The Administration Center module enables you to manage and monitor your Tivoli Storage Manager environment specifically.

10.1.1 Installation

Both products, Administration Center and Integrated Solutions Console are distributed separately. ISC is available via regular system order, while Administration Center is available via the normal IBM service FTP site. To install:

1. Install the ISC
2. Install the Administration Center into ISC

Since ISC is built on top of WebSphere Application Server and PortalBase, it requires some significant system resources. We recommend installing it on a different machine than the one running the Tivoli Storage Manager server.

Essentially, there are three ways to install ISC. You may run the Java-based installation wizard, console installation wizard or perform silent, unattended, installation. The complete installation procedure (for ISC and Administration Center) is covered in detail, including screenshots, in *IBM Tivoli Storage Manager Version 5.3 Technical Guide*, SG24-6638.

After installing the ISC, you can install the Administration Center. Again, you can use the installation wizard, console installation wizard or silent installation method. Note, the ISC must be running when installing Administration Center.

After a successful installation following URL will be launched automatically, displaying the ISC logon screen:

http://<machine name>:<Web Administration Port>/ibm/console

If you set up ISC with the default values, the port number is either 8421 for HTTP connection or 8422 for secure web administration port.

For complete details on software and hardware requirements on all supported platforms, time needed to set up ISC and Administration Center and known limitations, refer to the *IBM Tivoli Storage Manager Administration Center Readme*. 
10.1.2 Administration Center interface

To access the Administration Center, type http://<machine_name>:<port>/ibm.console, in your browser as shown in Figure 10-1. We installed the ISC and Administration center on the system DIOMEDE.

Figure 10-1 ISC login screen

Enter the ISC administrator ID and password and click Log In to start the Administration Center, see Figure 10-2 on page 302.

Tip: ISC administrator IDs are discussed in the section ISC User and Group Management in Chapter 12 of IBM Tivoli Storage Management Concepts, SG24-4877.

Now you are ready to manage your Tivoli Storage Manager Server. Administration Center allows you to define server connections, that means to set up a connection between the Administration Center and a Tivoli Storage Manager server instance. Remember, Administration Center is not of itself a server instance, it is a standalone product, and therefore you have to define the connection.
Administration Center is a task oriented interface, that guides you through the administration of Tivoli Storage Manager servers. Without deep knowledge of Tivoli Storage Manager internals and exact command syntax, you may easily define and configure all the components of a Tivoli Storage Manager server, including:

- **Storage devices**: storage pools, volumes, libraries and drives, etc.
- **Policy domains client nodes**: policy sets, management classes and copy groups as well as register nodes to the domains, define their central client option sets, and schedule tasks to be executed on clients.
- **Server Maintenance**: which helps you to define and schedule basic server maintenance procedures, such as backing up primary storage pools and database, identifying copy storage pool and database backup volumes to be moved to the offsite location, as well as migration and reclamation processes.
- **Health Monitor**: which assists you to determine the overall status of server operations, helps you to obtain detailed information about client node schedules, the server database and recovery log, and the status of storage devices managed by the server. The health monitor also provides access to
the server activity log, so you can view messages generated during server operations.

- **Disaster Recovery Management**: if your servers are licensed for Tivoli Storage Manager Extended Edition, you can use this function to automatically generate a disaster recovery plan and track media.

Figure 10-3 shows the defined connections to our servers and their status as seen by the Health Monitor. As you can see, you can manage all your enterprise environment from just one place, with just a TCP/IP connection to your servers from the Administration Center.

![Figure 10-3 Server environment overview and their health status in Administration Center](image)

Additionally, Administration Center allows you to issue commands to your server using a Java-based command line administrative interface from your browser window, see Figure 10-4 on page 304. To start the CLI, select **Use Command Line** from any **Select Action** pull-down where the list of servers is displayed. If
you think you can accomplish a given task using the CLI, you can use this tool, without having to install the CLI code, which is described in the following section.

![Java-based command line administrative interface in Administration Center](image)

We recommend that you use the Administration Center administrative interface, since it allows you to perform all Tivoli Storage Manager administrator functions from a single place using task oriented wizards without the need to study all server commands and possible consequences.

**10.2 Administrative client**

Now we will consider the Tivoli Storage Manager administrative client, which provides a command line interface (CLI) to a Tivoli Storage Manager server. We
explain how to install a Tivoli Storage Manager administrative client and tell you what options to configure. Some examples of the interfaces for various types of access are also included.

The command line administrative client is a tool that looks and operates the same on all supported platforms. There is no dependency between the platform running the administrative client and that of the server - e.g. you can administer a UNIX, Linux or zOS server with a client installed on Windows and vice versa.

### 10.2.1 Code installation

The command line administrative client (CLI) is provided as a part of the backup-archive client package. Therefore, you need to install the base backup-archive client on the machines you intend to manage Tivoli Storage Manager servers from, using the CLI. Typically, the CLI is installed on the Tivoli Storage Manager server itself and any workstations used by the administrators.

On UNIX and Linux, the CLI is installed automatically with the backup-archive client package, there is no option to install just the CLI.

Not so on Windows. The CLI is also part of the backup-archive client package, but it is not installed automatically by a *Typical* installation using the InstallShield wizard. To install the CLI on Windows, choose the *Custom* installation and make sure to choose the administrative client feature to be installed, as shown in Figure 10-5 on page 306.

Note, even if you specify to install the administrative client only, the Microsoft Software Installer installs corequisite packages, such as backup-archive client GUI, web files and API client.
A faster method is to make a silent installation using `msiexec`, where you may specify the administrative client to be installed, as in Example 10-1.

**Example 10-1 Silent installation of administrative client interface using msiexec**

```
c:\> msiexec /i "C:\WindowsClient5.3.2\tsmcli\x32\client\Disk1\IBM Tivoli Storage Manager Client.msi" RebootYesNo="No" REBOOT="Suppress" ALLUSERS=1 INSTALLDIR="c:\program files\tivoli\tsm" ADDLOCAL="AdministrativeCmd" TRANSFORMS=1033.mst /qn /l*v "c:\tmp\admincli_inst.log"
```

### 10.2.2 Administrative command-line client customization

Regardless of the client platform, to use the CLI you must:

- Configure the client options file is
- Have a Tivoli Storage Manager server administrator ID with the appropriate authority granted. See 8.1.4, “Recommended administrators” on page 274 for information on creating an administrator ID.

Client options for the administrative client are set in the client options files. Assuming a TCP/IP communications method, the only required option is the TCPSERVERADDRESS. We recommend using a DNS name instead of the dotted IP address for the TCPSERVERADDRESS. A dotted IP address is inflexible, because it creates management issues if the Tivoli Storage Manager
server is moved, or the addressing scheme is changed. Other useful parameters include the date, time, number and language format options. Note that UNIX and Linux clients require the additional SERVERNAME stanza in their options files.

When the TCPSERVERADDRESS option is set, the client will attempt to connect at the default TCP/IP port, 1500. If your server is listening for client connections on another port, specify that port using TCPPORT client option.

With Tivoli Storage Manager V5.1 and higher, you can separate client and administrative sessions using the new client and server option TCPADMINPORT, see Example 10-2. This can be useful in communications across a firewall, since you may create different set of rules for backup-archive clients and administrative clients.

You can use the TCPADMINPORT option provided that the Tivoli Storage Manager server instance also has the TCPADMINPORT option set in the server options file (Example 10-2). Administrative client sessions are allowed on either port, unless the server option ADMINONCLIENTPORT is set NO, but by default will use the port specified by TCPADMINPORT, see Example 10-3.

Table 10-1 summarizes some of the most common administrative client options.

<table>
<thead>
<tr>
<th>Option</th>
<th>Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCPSERVERADDRESS</td>
<td>atlantic</td>
<td>The DNS name or IP address</td>
</tr>
<tr>
<td>TCPPORT</td>
<td>1500</td>
<td>Default</td>
</tr>
<tr>
<td>TCPADMINPORT</td>
<td>1505</td>
<td>Port Number</td>
</tr>
<tr>
<td>DATEFORMAT</td>
<td>3</td>
<td>YYYY-MM-DD</td>
</tr>
<tr>
<td>TIMEFORMAT</td>
<td>1</td>
<td>hh:mm:ss</td>
</tr>
<tr>
<td>NUMBERFORMAT</td>
<td>1</td>
<td>1,000.00</td>
</tr>
</tbody>
</table>

Example 10-2 Necessary client options for establishing an administrative session

Example 10-3 shows starting a CLI session and displaying the port.

Example 10-3 Establishing an administrative session on TCPADMINPORT

C:\Documents and Settings\Administrator>dsmadmc
IBM Tivoli Storage Manager
Enter your user id: admin

Enter your password: *****

Session established with server ATLANTIC: AIX-RS/6000
Server Version 5, Release 3, Level 2.2
Server date/time: 02/21/2006 14:19:43  Last access: 02/21/2006 14:12:30

tsm: ATLANTIC> q option tcpadminport

<table>
<thead>
<tr>
<th>Server Option</th>
<th>Option Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>TcpAdminport</td>
<td>1505</td>
</tr>
</tbody>
</table>

tsm: ATLANTIC> q session

<table>
<thead>
<tr>
<th>Sess Comm.</th>
<th>Sess Method</th>
<th>Wait</th>
<th>Bytes Sent</th>
<th>Bytes Recvd</th>
<th>Platform</th>
<th>Client Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Tcp/Ip Run</td>
<td>0 S</td>
<td>309</td>
<td>223</td>
<td>Admin</td>
<td>WinNT</td>
</tr>
</tbody>
</table>

In Example 10-4, we confirm that the session is running on the required port.

Example 10-4  Administrative session is opened on port 1505

root@Atlantic /: netstat | grep 1505
tcp4 0 0 atlantic.1505 diomede.2148 ESTABLISHED

10.2.3 Command line interface

The CLI is a character mode interface, and therefore is well suited for users who like to type commands, or are used to similar interfaces including UNIX shells or Windows command prompts. It is also useful if you cannot access the Web administrative interface for any reason (e.g. no browser available on a particular system).

To start the CLI, enter dsmadmc at the operating system prompt. You will be prompted for an administrative ID and password. Without authentication, you cannot logon to the Tivoli Storage Manager server. Example 10-5 shows the start of an administrative client session on AIX.
Obviously, the client can only connect to the Tivoli Storage Manager server if the server instance is actually running.

Example 10-5  Dsmadmc command line client

root@Atlantic /: dsmadmc
IBM Tivoli Storage Manager
Command Line Administrative Interface - Version 5, Release 3, Level 2.0
(c) Copyright by IBM Corporation and other(s) 1990, 2005. All Rights Reserved.

Enter your user id:  admin

Enter your password:

Session established with server ATLANTIC: AIX-RS/6000
Server Version 5, Release 3, Level 2.2
Server date/time: 02/21/2006 14:40:06  Last access: 02/21/2006 14:24:23

tsm: ATLANTIC>

You then type administrative Tivoli Storage Manager commands at the prompt tsm: SERVERNAME>. Once an administrative command is executed, you always return back to the tsm: SERVERNAME> prompt. This interactive method is also called loop mode. If you use the interactive mode, you do not have to re-enter your password with each command.

Another way to start a CLI session is the so-called batch mode. You simply type dsmadmc together with the administrative ID, the password, and the actual command that you want to execute. In this mode, the administrative client processes the command and returns to the operating system prompt.

To get help from the CLI prompt, type help xxx where xxx is blank, a command, or a Tivoli Storage Manager message number.

As well as providing an interface for executing commands, the CLI offers two other modes that are used for monitoring purposes only. You cannot enter administrative commands while in either of these two modes. These modes are:

- **Console mode**: When dsmadmc is run with -consolemode argument (see Example 10-6 on page 310, after authentication, all activity log messages are displayed as they are generated. In this mode, you can watch the status of your server instance without having to search the activity log interactively.
- **Mount mode**: Similar to console mode, but displays only messages related to mount and dismount operations on volumes, including requests to the administrator to checkout or checkin a volume. Example 10-7 shows how to start mount mode - with dsmadmc -mountmode.
Example 10-6  Administrative client run in console mode

C:\>dsmadmc -consolemode
IBM Tivoli Storage Manager
Command Line Administrative Interface - Version 5, Release 3, Level 2.0
(c) Copyright by IBM Corporation and other(s) 1990, 2005. All Rights Reserved.

Enter your user id:  admin

Enter your password:  *****

Session established with server ATLANTIC: AIX-RS/6000
  Server Version 5, Release 3, Level 2.2
  Server date/time: 02/21/2006 14:52:16  Last access: 02/21/2006 14:40:06

ANR2017I Administrator ADMIN issued command: QUERY LIBVOL
ANR2017I Administrator ADMIN issued command: QUERY DEVCCLASS
ANR2017I Administrator ADMIN issued command: BACKUP DB type=full scratch=yes
devclass=lto2-dc wait=yes
ANR0984I Process 1 for DATABASE BACKUP started in the FOREGROUND at 14:52:59.
ANR2280I Full database backup started as process 1.
ANR8337I LTO volume 028AKK mounted in drive LT01 (/dev/rmt0).
ANR0513I Process 1 opened output volume 028AKK.
ANR1360I Output volume 028AKK opened (sequence number 1).
ANR4554I Backed up 960 of 1953 database pages.
ANR4554I Backed up 1920 of 1953 database pages.
ANR1361I Output volume 028AKK closed.
ANR0515I Process 1 closed volume 028AKK.
ANR4550I Full database backup (process 1) complete, 1953 pages copied.
ANR0985I Process 1 for DATABASE BACKUP running in the FOREGROUND completed with
  completion state SUCCESS at 14:53:35.
ANR8336I Verifying label of LTO volume 028AKK in drive LT01 (/dev/rmt0).
ANR8468I LTO volume 028AKK dismounted from drive LT01 (/dev/rmt0) in library
  LIB1.

Example 10-7  Administrative client run in mount mode

C:\>dsmadmc -mountmode
IBM Tivoli Storage Manager
Command Line Administrative Interface - Version 5, Release 3, Level 2.0
(c) Copyright by IBM Corporation and other(s) 1990, 2005. All Rights Reserved.

Enter your user id:  admin

Enter your password:  *****

Session established with server ATLANTIC: AIX-RS/6000
  Server Version 5, Release 3, Level 2.2
  Server date/time: 02/21/2006 14:58:44  Last access: 02/21/2006 14:52:16
If you are familiar with operating system shell environments, you will find the CLI to be a powerful tool for administering Tivoli Storage Manager server instances. You may build automated scripts, that ease administration tasks or provide comprehensive monitoring outputs. For detailed information on `dsmadmc` command arguments, syntax and features, see *IBM Tivoli Storage Manager Administrator's Reference* for your server platform.

### 10.3 Summary

You should now understand what tasks are possible using the administrative client interfaces. We will now proceed to the next chapter, which discusses client operations in detail.
Part 3

Operational details

In this part of the book we discuss client and server operational tasks, such as backup, restore, archive, retrieval functions, client and server interfaces, client scheduling, administration tasks, and scheduling, as well as many routine operations which should be performed daily or weekly. We also include some more advanced operational tasks, such as server-to-server exporting, setting up Tivoli Storage Manager to send Tivoli Enterprise Console® alerts, and a rather lengthy section on performance.
Client operations

Continuing on from the setup and configuration part of this redbook, we have now begun the operational portion in which our initial discussions will center on how to perform backup-archive client operations such as backing up, restoring, archiving and retrieving data. Sample commands are given for both UNIX and Windows platforms.

For more information on client operations, see the IBM Tivoli Storage Manager Backup-Archive Client Installation and User's Guide for the appropriate platform.
11.1 Running backup operations

To start backing up a file, directory, or the whole machine, use the *incremental* command - which is the default option from the GUI. This command backs up all new or changed files in your default client domain, or in the file systems specified that are not excluded from backup operations.

An alternative backup command is the *selective* command (option *Always backup* from the GUI). During a selective backup, Tivoli Storage Manager sends copies of files to the server, regardless of whether they have changed since the last backup. This might result in having more than one copy of the same file version on the server. If that occurs, you might not have as many different file copy versions on the server as you intended. Your version limit might consist of identical files. To avoid that, you should normally use the *incremental* command to back up only changed and new files. However, you could consider doing a periodic *selective* backup operation to regroup all the files of one machine onto one tape. This might be helpful if you are not collocating data, or as an alternative to the backup set functionality. We recommend that the Tivoli Storage Manager administrator defines appropriate collocation settings for the target storage pools, so you don’t need to run selective backups. Remember that the backup set functionality usually performs this task more efficiently, as it is done entirely within the server and without requiring re-sending of any client data to the server.

You can also backup one or more volumes or RAW volumes as a single object by using the *backup image* command. Image backups are much faster than full file system backups. It also occupies less space on the Tivoli Storage Manager server database since only one object entry is required to represent the whole image. You can perform a static image backup, which unmounts and remounts the volume as read-only to prevent applications from accessing it during the backup process. If you do not want to remount the volume as read-only, you can perform a dynamic image backup.

A set of files which are on different file spaces can also be backed up to one virtual filespace on the Tivoli Storage Manager server. The *backup group* command allows you to create a consistent point-in-time backup of a group of files that is managed as a single logical entity.

Journal based backup is supported on Windows and AIX (at V5.3.3.0 and higher) clients. If the journal engine service is installed and running, then by default, incremental backups will automatically perform journal-based backup on the selected file systems that are monitored by the journal engine service.

Table 11-1 gives some examples of backup operations using a UNIX backup/archive client.
<table>
<thead>
<tr>
<th>If you want to perform this operation...</th>
<th>... then this is the client command:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incremental backup of the client domain</td>
<td>dsmc incremental</td>
</tr>
<tr>
<td>Incremental backup of a file system (/home)</td>
<td>dsmc incremental /home/</td>
</tr>
<tr>
<td>Incremental backup of all files in a directory (/home/fred) and all its subdirectories</td>
<td>dsmc incremental /home/fred/ -subdir=yes</td>
</tr>
<tr>
<td>Selective backup of a file system (/home) and all its subdirectories</td>
<td>dsmc selective /home/ -subdir=yes</td>
</tr>
<tr>
<td>Selective backup of all files in a directory (/home/fred) and all its subdirectories</td>
<td>dsmc selective /home/fred/ -subdir=yes</td>
</tr>
<tr>
<td>Point-in-time, full Logical Volume backup for a file system (/tsm)</td>
<td>dsmc backup image /tsm</td>
</tr>
<tr>
<td>Logical Volume backup for a RAW device (/dev/test)</td>
<td>dsmc backup image /dev/test</td>
</tr>
<tr>
<td>Full backup of all files in /home/list1 to the virtual filesystem=/virtualtsm containing group leader grp</td>
<td>dsmc backup group -filelist=/home/list1 -groupname=grp -virtualfsname=/virtualtsm</td>
</tr>
</tbody>
</table>

Table 11-2 gives some examples of backup operations using a Windows backup/archive client.

<table>
<thead>
<tr>
<th>If you want to perform this operation...</th>
<th>... then this is the client command:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incremental backup of the client domain</td>
<td>dsmc incremental</td>
</tr>
<tr>
<td>Incremental backup of all files in a directory (c:\wilma) and all its subdirectories</td>
<td>dsmc incremental c:\wilma* -subdir=yes</td>
</tr>
<tr>
<td>Selective backup of a directory (c:\wilma)</td>
<td>dsmc selective c:\wilma*</td>
</tr>
<tr>
<td>Selective backup of all files in a directory (c:\wilma) and all its subdirectories</td>
<td>dsmc selective c:\wilma* -subdir=yes</td>
</tr>
<tr>
<td>Point-in-time full Logical Volume backup for a drive</td>
<td>dsmc backup image d:\</td>
</tr>
</tbody>
</table>
11.1.1 Exclude rules preventing some files from being backed up

Suppose there are two files in a directory c:\tsm - myfile.doc and myfile. We configure an exclude rule to avoid some of the files as shown in Example 11-1.

Example 11-1 Include/exclude settings in dsm.opt

```
exclude c:\...
include c:\TS\*.*
```

The DSMC INCR command will never back up the file c:\tsm\myfile, because it is not caught by the INCLUDE statement and therefore is excluded under the EXCLUDE rule. It does not matter if you use *.* or * on the INCR command. Example 11-2 shows that the file myfile is excluded, but myfile.doc is included. Look at the objects inspected and the objects backed up statistics.

Example 11-2   Windows incremental backup using *.* search string

C:\Program Files\Tivoli\TSM\baclient>dsmc i c:\TS\*.*
IBM Tivoli Storage Manager
Command Line Backup/Archive Client Interface
  Client Version 5, Release 3, Level 2.0
  Client date/time: 02/20/2006 14:13:12
(c) Copyright by IBM Corporation and other(s) 1990, 2005. All Rights Reserved.

Node Name: TSM_CLIENT_DEMO
Session established with server LOCHNESS_SERVER1: Windows
  Server Version 5, Release 3, Level 2.2
  Server date/time: 02/20/2006 14:13:47  Last access: 02/20/2006 14:12:56

Incremental backup of volume 'c:\tsm\*.*'
Directory--> 0 \klchv3x\c$\TS [Sent]
Directory--> 0 \klchv3x\c$\TS\charlotte [Sent]
Directory--> 0 \klchv3x\c$\TS\eduardo [Sent]
Directory--> 0 \klchv3x\c$\TS\martin [Sent]
Directory--> 0 \klchv3x\c$\TS\norbert [Sent]
Directory--> 0 \klchv3x\c$\TS\peter [Sent]
Normal File--> 104,908 \klchv3x\c$\TS\myfile.doc [Sent]
Successful incremental backup of '\\klchv3x\c$\TS\*'

Total number of objects inspected: 8
Total number of objects backed up: 7
Total number of objects updated: 0
Total number of objects rebound: 0
Total number of objects deleted: 0
Total number of objects expired: 0
Total number of objects failed: 0
Total number of subfile objects: 0
Total number of bytes transferred: 103.78 KB
Data transfer time: 0.01 sec
Network data transfer rate: 10,378.22 KB/sec
Aggregate data transfer rate: 5.88 KB/sec
Objects compressed by: 0%
Subfile objects reduced by: 0%
Elapsed processing time: 00:00:17
Example 11-3 shows that even if the string on the backup command is changed from ".*" to ".", the file myfile is still excluded from the backup. Please note that we have deleted the file space that was created by the previous test, from the server.

Example 11-3  Windows incremental backup using * search string

C:\Program Files\Tivoli\TSM\baclient> dsmc i c:\TS\*
IBM Tivoli Storage Manager
Command Line Backup/Archive Client Interface
  Client Version 5, Release 3, Level 2.0
  Client date/time: 02/20/2006 14:15:15
(c) Copyright by IBM Corporation and other(s) 1990, 2005. All Rights Reserved.

Node Name: TSM_CLIENT_DEMO
Session established with server LOCHNESS_SERVER1: Windows
  Server Version 5, Release 3, Level 2.2
  Server date/time: 02/20/2006 14:15:50  Last access: 02/20/2006 14:13:53

Incremental backup of volume 'c:\tsm\*'
Directory-->        0 \klchv3\c$\TS [Sent]
Directory-->        0 \klchv3\c$\TS\charlotte [Sent]
Directory-->        0 \klchv3\c$\TS\eduardo [Sent]
Directory-->        0 \klchv3\c$\TS\martin [Sent]
Directory-->        0 \klchv3\c$\TS\norbert [Sent]
Directory-->        0 \klchv3\c$\TS\peter [Sent]
Normal File-->    104,908 \klchv3\c$\TS\myfile.doc [Sent]
Successful incremental backup of '\\klchv3\c$\TS\*'

Total number of objects inspected:    8
Total number of objects backed up:    7
Total number of objects updated:      0
Total number of objects rebound:      0
Total number of objects deleted:      0
Total number of objects expired:      0
Total number of objects failed:       0
Total number of subfile objects:      0
Total number of bytes transferred:    103.78 KB
Data transfer time:                  0.00 sec
Network data transfer rate:          0.00 KB/sec
Aggregate data transfer rate:        6.89 KB/sec
Objects compressed by:                0%
Subfile objects reduced by:          0%
Elapsed processing time:             00:00:15

The same happens for the corresponding dsmc selective commands.
11.1.2 UNIX command line examples and output

Here are some UNIX backup examples. They were taken on an AIX client, but all UNIX and Linux clients work quite similarly.

Incremental backup

Example 11-4 shows an incremental backup operation.

Example 11-4  UNIX incremental backup

root@Atlantic /tsm: dsmc incr /TS/ -su=yes
IBM Tivoli Storage Manager
Command Line Backup/Archive Client Interface
  Client Version 5, Release 3, Level 2.0
  Client date/time: 02/20/06   15:17:55
(c) Copyright by IBM Corporation and other(s) 1990, 2005. All Rights Reserved.

Node Name: ATLANTIC
Session established with server LOCHNESS_SERVER1: Windows
  Server Version 5, Release 3, Level 2.2
  Server date/time: 02/20/06   15:17:12  Last access: 02/20/06   15:10:02

Incremental backup of volume '/TS/
Directory--> 256 /TS/charlotte [Sent]
Directory--> 256 /TS/eduardo [Sent]
Directory--> 256 /TS/lost+found [Sent]
Directory--> 256 /TS/martin [Sent]
Directory--> 4,096 /TS/norbert [Sent]
Directory--> 256 /TS/peter [Sent]
Directory--> 4,096 /TS/sys [Sent]
Normal File--> 1,048,576 /TS/charlotte/data1 [Sent]
Normal File--> 1,048,576 /TS/charlotte/data2 [Sent]
Normal File--> 1,048,576 /TS/charlotte/data3 [Sent]
Normal File--> 1,048,576 /TS/eduardo/data1 [Sent]
Normal File--> 1,048,576 /TS/eduardo/data2 [Sent]
Normal File--> 1,048,576 /TS/eduardo/data3 [Sent]
Normal File--> 1,048,576 /TS/martin/data1 [Sent]
Normal File--> 1,048,576 /TS/martin/data2 [Sent]
Normal File--> 1,048,576 /TS/martin/data3 [Sent]
Normal File--> 1,048,576 /TS/norbert/data1 [Sent]
Normal File--> 1,048,576 /TS/norbert/data2 [Sent]
Normal File--> 1,048,576 /TS/norbert/data3 [Sent]
Normal File--> 1,048,576 /TS/peter/data1 [Sent]
Normal File--> 1,048,576 /TS/peter/data2 [Sent]
Normal File--> 1,048,576 /TS/peter/data3 [Sent]
Normal File--> 105 /TS/sys/devconfig.txt [Sent]
Normal File--> 233 /TS/sys/dsmserv.dsk [Sent]
Normal File-->  67,985 /TS/sys/dsmserv.opt [Sent]
Normal File-->    9 /TS/sys/hbaapi.lvl [Sent]
Normal File-->  1,027 /TS/sys/rc.tsmserver [Sent]
Normal File-->  641 /TS/sys/volhist.txt [Sent]
Successful incremental backup of '/TS/*'

Total number of objects inspected:       28
Total number of objects backed up:       28
Total number of objects updated:          0
Total number of objects rebound:          0
Total number of objects deleted:          0
Total number of objects expired:          0
Total number of objects failed:           0
Total number of bytes transferred:    15.06 MB
Data transfer time:                    1.28 sec
Network data transfer rate:        11,967.25 KB/sec
Aggregate data transfer rate:      7,686.76 KB/sec
Objects compressed by:                    0%
Elapsed processing time:           00:00:02

Logical volume backup
Example 11-5 shows an example of a full logical volume backup operation.

Example 11-5  UNIX logical volume backup

root@Atlantic /tsm: dsmc backup image /home -se=lochness
IBM Tivoli Storage Manager
Command Line Backup/Archive Client Interface
  Client Version 5, Release 3, Level 2.0
  Client date/time: 02/20/06   15:20:47
(c) Copyright by IBM Corporation and other(s) 1990, 2005. All Rights Reserved.

Node Name: ATLANTIC
Session established with server LOCHNESS_SERVER1: Windows
  Server Version 5, Release 3, Level 2.2
  Server date/time: 02/20/06   15:20:05  Last access: 02/20/06   15:18:50

Backup Image Function Invoked.

Using static image backup.
Volume -->     33,554,432 /home [Sent]
Image Backup processing of '/home' finished without failure.

Total number of objects inspected:       1
Total number of objects backed up:       1
Total number of objects updated: 0
Total number of objects rebound: 0
Total number of objects deleted: 0
Total number of objects expired: 0
Total number of objects failed: 0
Total number of bytes transferred: 32.00 MB
Data transfer time: 5.00 sec
Network data transfer rate: 6,553.60 KB/sec
Aggregate data transfer rate: 9,860.06 KB/sec
Objects compressed by: 0%
Elapsed processing time: 00:00:03

**Note on AIX JFS and raw volumes:** The backup image command knows the difference between a raw logical volume (with no file system) and a logical volume with a JFS (journaled file system) defined to it. You cannot use the backup image function to try to back up a defined JFS file system using its raw device specification. In the previous example, if you try to run a `dsmc backup image /dev/tsm`, the command will fail because this is a JFS file system. On the other hand, you will be able to perform a `dsmc backup image /dev/testlv00`, provided it is a raw logical volume, with no JFS file system definitions in place.

Example 11-6 shows a successful raw image backup (/dev/test) and a failure (/dev/tsm) when trying to use the backup image function on a defined JFS file system:

**Example 11-6 UNIX raw logical volume backup**

root@Atlantic /tsm: `lsfs testlv00`
`lsfs: 0506-915 No record matching /tsm/testlv00 was found in /etc/filesystems.`

root@Atlantic /tsm: `dsmc backup image /dev/testlv00`
IBM Tivoli Storage Manager
Command Line Backup/Archive Client Interface
   Client Version 5, Release 3, Level 2.0
   Client date/time: 02/20/06 15:39:25
(c) Copyright by IBM Corporation and other(s) 1990, 2005. All Rights Reserved.

Node Name: ATLANTIC
Session established with server LOCHNESS_SERVER1: Windows
   Server Version 5, Release 3, Level 2.2
   Server date/time: 02/20/06 15:38:42 Last access: 02/20/06 15:30:56

Backup Image Function Invoked.

Using static image backup.
Volume --> 33,554,432 /dev/testlv00 [Sent]
Image Backup processing of '/dev/testlv00' finished without failure.

Total number of objects inspected: 1
Total number of objects backed up: 1
Total number of objects updated: 0
Total number of objects rebound: 0
Total number of objects deleted: 0
Total number of objects expired: 0
Total number of objects failed: 0
Total number of bytes transferred: 32.00 MB
Data transfer time: 5.00 sec
Network data transfer rate: 6,553.60 KB/sec
Aggregate data transfer rate: 10,794.67 KB/sec
Objects compressed by: 0%
Elapsed processing time: 00:00:03

root@Atlantic /tsm: lsfs /dev/hd1
Name         Nodename     Mount Pt   VFS  Size   Options  Auto
Accounting
/dev/hd1       --         /home   jfs2  65536   --     yes

root@Atlantic /tsm: dsmc backup image /dev/hd1 -se=lochness
IBM Tivoli Storage Manager
Command Line Backup/Archive Client Interface
  Client Version 5, Release 3, Level 2.0
  Client date/time: 02/20/06  15:43:23
(c) Copyright by IBM Corporation and other(s) 1990, 2005. All Rights Reserved.

Node Name: ATLANTIC
Session established with server LOCHNESS_SERVER1: Windows
  Server Version 5, Release 3, Level 2.2
  Server date/time: 02/20/06  15:42:40  Last access: 02/20/06  15:38:42

Backup Image Function Invoked.

ANS1063E The specified path is not a valid file system or logical volume name.

**Group backup**

Example 11-7 here, Example 11-8 on page 325, and Example 11-9 on page 326, show examples of commands related to and including the `backup group`.

Example 11-7 shows the output of the query filesystem command. At this point, we have not executed the `backup group` command yet.
**Example 11-7  Query filesystem**

```
Example: `q files`  
Session established with server LOCHNESS_SERVER1: Windows
  Server Version 5, Release 3, Level 2.2
  Server date/time: 02/20/2006 15:43:38  Last access: 02/20/2006 15:30:55

<table>
<thead>
<tr>
<th>Node Name</th>
<th>Filespace</th>
<th>FSID Platform</th>
<th>Filespace Type</th>
<th>Is Filespace Unicode?</th>
<th>Capacity (MB)</th>
<th>Pct Util</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATLANTIC</td>
<td>/TS</td>
<td>1 AIX</td>
<td>JFS2</td>
<td>No</td>
<td>32.0</td>
<td>48.3</td>
</tr>
<tr>
<td>ATLANTIC</td>
<td>/home</td>
<td>2 AIX</td>
<td>JFS2</td>
<td>No</td>
<td>32.0</td>
<td>1.1</td>
</tr>
<tr>
<td>ATLANTIC</td>
<td>/dev/testlv00</td>
<td>3 AIX</td>
<td>RAW</td>
<td>No</td>
<td>32.0</td>
<td>100.0</td>
</tr>
<tr>
<td>TSM_CLIENT_DEMO</td>
<td>\klchv3x-c$</td>
<td>3 WinNT</td>
<td>NTFS</td>
<td>Yes</td>
<td>38,154.3</td>
<td>21.1</td>
</tr>
</tbody>
</table>
```

In Example 11-8, first we have created a list of files to backup in a file called filelist. We then execute the `backup group` command.

**Example 11-8  Backup group command and output**

```
Example: `more filelist`
/home/guest/data1  
/TS/charlotte/data1  
/TS/charlotte/data  
/TS/eduardo/data1  
/TS/martin/data2  
/TS/norbert/data1  
/TS/peter/data3  
/usr/tivoli/tsm/client/ba/bin/dsm.opt  
filelist: END

Example: `dsmc backup group -filelist=/TS/filelist  
-grouppname=residentgrp -virtualfsname=/tsmresidentfs -mode=full`

IBM Tivoli Storage Manager
Command Line Backup/Archive Client Interface
Client Version 5, Release 3, Level 2.0
Client date/time: 02/20/2006 17:40:02
(c) Copyright by IBM Corporation and other(s) 1990, 2005. All Rights Reserved.
```
Backup GROUP function invoked mode= FULL.

<table>
<thead>
<tr>
<th>Type</th>
<th>Path</th>
<th>Sent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Directory</td>
<td>/home/guest</td>
<td>256</td>
</tr>
<tr>
<td>Normal File</td>
<td>/home/guest/data1</td>
<td>1024</td>
</tr>
<tr>
<td>Directory</td>
<td>/TS/charlotte</td>
<td>256</td>
</tr>
<tr>
<td>Normal File</td>
<td>/TS/charlotte/data1</td>
<td>1024</td>
</tr>
<tr>
<td>Normal File</td>
<td>/TS/charlotte/data2</td>
<td>1024</td>
</tr>
<tr>
<td>Directory</td>
<td>/TS/eduardo</td>
<td>256</td>
</tr>
<tr>
<td>Normal File</td>
<td>/TS/eduardo/data1</td>
<td>1024</td>
</tr>
<tr>
<td>Directory</td>
<td>/TS/martin</td>
<td>256</td>
</tr>
<tr>
<td>Normal File</td>
<td>/TS/martin/data2</td>
<td>1024</td>
</tr>
<tr>
<td>Directory</td>
<td>/TS/norbert</td>
<td>4096</td>
</tr>
<tr>
<td>Normal File</td>
<td>/TS/norbert/data1</td>
<td>1024</td>
</tr>
<tr>
<td>Directory</td>
<td>/TS/peter</td>
<td>256</td>
</tr>
<tr>
<td>Normal File</td>
<td>/TS/peter/data3</td>
<td>1024</td>
</tr>
<tr>
<td>Directory</td>
<td>/usr/tivoli</td>
<td>256</td>
</tr>
<tr>
<td>Directory</td>
<td>/usr/tivoli/tsm</td>
<td>256</td>
</tr>
<tr>
<td>Directory</td>
<td>/usr/tivoli/tsm/client</td>
<td>256</td>
</tr>
<tr>
<td>Directory</td>
<td>/usr/tivoli/tsm/client/ba</td>
<td>4096</td>
</tr>
<tr>
<td>Normal File</td>
<td>/usr/tivoli/tsm/client/ba/bin</td>
<td>655</td>
</tr>
<tr>
<td>Normal File</td>
<td>/TS/filelist</td>
<td>171</td>
</tr>
</tbody>
</table>

Backup processing of 'residentgrp' finished without failure.

Total number of objects inspected: 20
Total number of objects backed up: 20
Total number of objects updated: 0
Total number of objects rebound: 0
Total number of objects deleted: 0
Total number of objects expired: 0
Total number of objects failed: 0
Total number of bytes transferred: 7.00 MB
Data transfer time: 0.59 sec
Network data transfer rate: 11,954.42 KB/sec
Aggregate data transfer rate: 3,551.03 KB/sec
Objects compressed by: 0%
Elapsed processing time: 00:00:02

Example 11-9 is on the Tivoli Storage Manager server - it shows that a new filespace is created, /tsmresidentsfs, after completion of the backup group command. Notice that the filespace type is TSMVFS.

Example 11-9  Query filespace output after group backup

```bash
$ tsm: LOCHNESS_SERVER1>q files
```
<table>
<thead>
<tr>
<th>Node Name</th>
<th>Filespace</th>
<th>FSID Platform Type</th>
<th>Filespace Name</th>
<th>FSID Platform Type</th>
<th>Filespace Name</th>
<th>FSID Platform Type</th>
<th>Filespace Name</th>
<th>FSID Platform Type</th>
<th>Filespace Name</th>
<th>FSID Platform Type</th>
<th>Filespace Name</th>
<th>FSID Platform Type</th>
<th>Filespace Name</th>
<th>FSID Platform Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATLANTIC</td>
<td>/TS</td>
<td>1 AIX</td>
<td>JFS2</td>
<td>No</td>
<td>32.0</td>
<td>48.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATLANTIC</td>
<td>/home</td>
<td>2 AIX</td>
<td>JFS2</td>
<td>No</td>
<td>32.0</td>
<td>1.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATLANTIC</td>
<td>/dev/testv00</td>
<td>3 AIX</td>
<td>RAW</td>
<td>No</td>
<td>32.0</td>
<td>100.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TSM_CLIENT_DEMO</td>
<td>\klchv3x-c$</td>
<td>3 WinNT</td>
<td>NTFS</td>
<td>Yes</td>
<td>38,154.3</td>
<td>21.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WINHSM_CLIENT_DEMO</td>
<td>winhsm_file</td>
<td>2 Windows</td>
<td>API:TSM</td>
<td>Yes</td>
<td>183.3</td>
<td>100.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Important:** The `backup group` command can only be executed from the Tivoli Storage Manager backup-archive command line.

On the Tivoli Storage Manager client, we can see details of the group with the `query group` command, as shown in Example 11-10. We can see the members of the group with the `showmembers` option.

**Example 11-10  Client queries the group**

```
tsm> q group /tsmresidents/*

          Size  Backup Date        Mgmt Class A/I Type Group
--------------  ---    -----------        ---------- --- ---- -----
              7,351,355  B  02/20/2006 16:13:43    DEFAULT     A  FULL /tsmresidents/residentgrp

nt/identgr

nt/identgr

tsm> q group /tsmresidents/residentgrp -showmembers

          Size  Backup Date        Mgmt Class A/I Type Group
--------------  ---    -----------        ---------- --- ---- -----
              7,351,355  B  02/20/2006 16:13:43    DEFAULT     A  FULL /tsmresidents/residentgrp

```

```
Create backup set

A backup set is created on the server. It can go to file or sequential storage. In Example 11-11 we create a backup set of the client filespace /TS onto disk storage, using a FILE device class.

Example 11-11 Create a backup set

tsm: ATLANTIC>generate backupset atlantic BS1 /TS devc=seqf-dc wait=yes
ANR0984I Process 137 for GENERATE BACKUPSET started in the FOREGROUND at 16:47:18.
ANR3500I Backup set for node ATLANTIC as BS1.136180 being generated.
ANR3501I Backup set for ATLANTIC as BS1.136180 completed successfully - processed 33 files.
ANR3505I Backup set for ATLANTIC as BS1.136180 used volume /tsm/stg/seqf/43247638.ost.
ANR0987I Process 137 for GENERATE BACKUPSET running in the FOREGROUND processed
33 items with a completion state of SUCCESS at 16:47:19.

```
tsm: ATLANTIC>q backupset
          Node Name: ATLANTIC
        Backup Set Name: BS1.136180
           Date/Time: 03/24/2006 16:47:19
         Retention Period: 365
     Device Class Name: SEQF-DC
         Description: No Description
```

The server automatically creates a file to store the backup set, /tsm/stg/seqf/43247638.ost. The client can see the backup set created using the `query backup` set command, as in Example 11-12.

```
Example 11-12  Client query backup set

```
```
tsm> q backupset
          Backup Set Name                  Generation Date   Retention Description
          ------------------------------- ------------------- ---------- -----------
                      1 BS1.136180                     03/24/2006 16:47:19 365        No Description
```
```
tsm>
```

The point of backup sets is that they can be made to portable media - like tapes or written to CD’s. The media can then be made available on the client for direct restore. In our case, we are using the backup-archive client on the Tivoli Storage Manager server itself, and we wrote the backup set to a disk file. Therefore this file is automatically available for restore, which we will see in the 11.2.1, “UNIX command line examples and output” on page 336.

### 11.1.3 Windows GUI backup examples

Figure 11-1 shows the Windows backup GUI. From this window you can select specific files or folders you want to back up and you can select from an incremental, selective, or image backup. For graphical navigation on platforms other than Windows use the Java or Web client - the look and feel is very similar on all.
The estimate function (see the *Estimate* button next to the *Backup* button), calculates the total amount of data that selected for back up and estimates the amount of time it will take to back it up. Figure 11-2 shows the estimate output for the files selected in the previous figure. This function is historical - that is, the calculated length of time for the backup is based on the throughput of the previous client operation. Therefore, the first time you use the Tivoli Storage Manager client and run the estimate function, the *estimated transfer time* is grayed out, since there is no previous data to refer to.
After the backup operation is complete, a status report similar to Figure 11-3 displays. This report contains data such as the total amount of files backed up and the transfer rate during the backup operation. The **View** button is available only if there were errors encountered during the operation.
11.1.4 Additional backup options for Windows

In this section we discuss backup options available for Windows clients only:

- Adaptive subfile backups should be used if backups are sent on a device with very limited bandwidth, such as a modem. Only changed portions of the files are sent over the network. This reduces traffic on the network and speeds up backup as well. Set the `subfilebackup`, `subfilecachepath`, `subfilecachesize` in the client options file, dsm.opt.

- You can perform open file backups on Windows 2000/2003/XP clients if the Logical Volume Snapshot Agent (LVSA) is installed and configured. Tivoli Storage Manager takes a point-in-time copy of a file that is locked (opened) by another application. LVSA can be installed using the client configuration wizard.

- You can back up the Windows 2000/XP system objects together or individually. We recommend that you back it up together to maintain consistency. For Windows 2003 clients, you can backup system state and system services. Tivoli Storage Manager uses the Microsoft Volume Shadowcopy Services (VSS) to do this. Figure 11-4 shows how to back up the system object from the Tivoli Storage Manager GUI. It is recommended to perform a full backup of all the components of the system object at the same time so that it is in a consistent state.
11.2 Running restore operations

To restore a file, a directory, or even the whole machine, you need to know two things: what you want to restore (file name, directory), and optionally, from when (point-in-time), if you want to restore a file version other than the most recent one.

**Important:** You do not need to know where the data actually is. When you request a file, Tivoli Storage Manager finds its location in the server database and seeks the right disk portion, or mounts the right tape volume.

To restore files, specify the directories or selected files either at the command line or by clicking down through the directory structure displayed in the GUI. Both
the GUI and the command line interface have search functions in case you don’t know the exact filenames or directories needed for restore. You can also select the files from a list using the PICK option with the command line restore command, as shown in Example 11-13.

Example 11-13  UNIX restore with pick option

```
$ tsm> restore /TS/* -subdir=yes -pick
```

TSM Scrollable PICK Window - Restore

<table>
<thead>
<tr>
<th>#</th>
<th>Backup Date/Time</th>
<th>File Size</th>
<th>A/I</th>
<th>File</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>02/20/06 15:17:12</td>
<td>256 B A</td>
<td></td>
<td>/TS/charlotte</td>
</tr>
<tr>
<td>2</td>
<td>02/20/06 15:17:12</td>
<td>256 B A</td>
<td></td>
<td>/TS/eduardo</td>
</tr>
<tr>
<td>3</td>
<td>02/20/06 15:17:12</td>
<td>256 B A</td>
<td></td>
<td>/TS/lost+found</td>
</tr>
<tr>
<td>4</td>
<td>02/20/06 15:17:12</td>
<td>256 B A</td>
<td></td>
<td>/TS/martin</td>
</tr>
<tr>
<td>5</td>
<td>02/20/06 15:17:12</td>
<td>4.00 KB A</td>
<td></td>
<td>/TS/norbert</td>
</tr>
<tr>
<td>6</td>
<td>02/20/06 15:17:12</td>
<td>256 B A</td>
<td></td>
<td>/TS/peter</td>
</tr>
<tr>
<td>7</td>
<td>02/20/06 15:17:12</td>
<td>4.00 KB A</td>
<td></td>
<td>/TS/sys</td>
</tr>
<tr>
<td>8</td>
<td>02/20/06 15:17:12</td>
<td>1.00 MB A</td>
<td></td>
<td>/TS/charlotte/data1</td>
</tr>
<tr>
<td>9</td>
<td>02/20/06 15:17:12</td>
<td>1.00 MB A</td>
<td></td>
<td>/TS/charlotte/data2</td>
</tr>
<tr>
<td>10</td>
<td>02/20/06 15:17:12</td>
<td>1.00 MB A</td>
<td></td>
<td>/TS/charlotte/data3</td>
</tr>
<tr>
<td>11</td>
<td>02/20/06 15:17:12</td>
<td>1.00 MB A</td>
<td></td>
<td>/TS/eduardo/data1</td>
</tr>
<tr>
<td>12</td>
<td>02/20/06 15:17:12</td>
<td>1.00 MB A</td>
<td></td>
<td>/TS/eduardo/data2</td>
</tr>
<tr>
<td>13</td>
<td>02/20/06 15:17:12</td>
<td>1.00 MB A</td>
<td></td>
<td>/TS/eduardo/data3</td>
</tr>
<tr>
<td>14</td>
<td>02/20/06 15:17:12</td>
<td>1.00 MB A</td>
<td></td>
<td>/TS/martin/data1</td>
</tr>
<tr>
<td>15</td>
<td>02/20/06 15:17:12</td>
<td>1.00 MB A</td>
<td></td>
<td>/TS/martin/data2</td>
</tr>
</tbody>
</table>

The options at the bottom of the screen allow you to select all or some of the file entries for restore.

You can restore files to their original directory, or to a different location. Depending on what you are restoring, you may need to use the PRESERVEPATH option, which specifies how much of the source path you want to preserve and append to the destination path specified with the restore operation.

A file copy can be in one of three states: active, inactive, or expired. An active file copy is the most current copy of the file, an inactive file copy is a previous copy of the file (or any copy of a file which no longer exists on the client), and an expired file copy is a copy to be removed from the Tivoli Storage Manager server. Only active versions are presented for restore unless you use the INACTIVE or LATEST options: The INACTIVE option instructs Tivoli Storage Manager to
display and restore an inactive backup if an active one is not available, and the
LATEST option restores the most recent backup version of a file, even if that
backup is inactive. You cannot restore an expired file version.

Table 11-3 gives some examples of restore operations using a UNIX
backup/archive client:

<table>
<thead>
<tr>
<th>If you want to perform this operation...</th>
<th>.... then this is the client command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restore a single file (/home/barney)</td>
<td>dsmc restore /home/barney</td>
</tr>
<tr>
<td>Restore a directory and all files from that level (/home)</td>
<td>dsmc restore &quot;/home/&quot;</td>
</tr>
<tr>
<td>Restore all files in a directory (/home) with all its subdirectories</td>
<td>dsmc restore &quot;/home/&quot; -subdir=yes</td>
</tr>
<tr>
<td>Restore a full directory (/home to /temp) with all subdirectories and write full path on destination</td>
<td>dsmc restore /home/barney /temp -preservepath=complete -subdir=yes</td>
</tr>
<tr>
<td>Restore a Logical Volume image to an existing mounted file system (/tsm)</td>
<td>dsmc restore image /tsm</td>
</tr>
<tr>
<td>Restore a RAW device to an existing allocated area (/dev/testlv)</td>
<td>dsmc restore image /dev/testlv</td>
</tr>
<tr>
<td>Restore a backup set (barney_monthlyBS.1234) from the server</td>
<td>dsmc restore backupset barney_monthlyBS.1234</td>
</tr>
<tr>
<td>Restore a backup set using local tape unit (/dev/rmt0)</td>
<td>dsmc restore backupset /dev/rmt0 -location=tape</td>
</tr>
<tr>
<td>Restore a subset of files from a tape backup set</td>
<td>dsmc restore backupset /dev/mt0 /home/*.log -location=tape</td>
</tr>
<tr>
<td>Restore all members in the /virtualtsm/grp group backup to their original location</td>
<td>dsmc restore group {virtualtsm}/grp</td>
</tr>
</tbody>
</table>

Note: Only a UNIX root user can perform the backup and restore image operations

Table 11-4 gives some examples of restore operations using a Windows backup-archive client:
### 11.2.1 UNIX command line examples and output

Here are some command line examples.

#### File restore

Example 11-14 shows a UNIX restore operation and its command output. To simulate a real-life scenario, we deleted the original data from the client before doing the restore, so we are not prompted for collision options.

**Example 11-14  UNIX restore output**

```plaintext
$ tsm> restore /TS/* -subdir=yes
Restoring function invoked.

ANS1247I Waiting for files from the server...
Restoring 256 /TS/charlotte [Done]
Restoring 256 /TS/eduardo [Done]
Restoring 256 /TS/lost+found [Done]
Restoring 256 /TS/martin [Done]
Restoring 4,096 /TS/norbert [Done]
Restoring 256 /TS/peter [Done]
Restoring 4,096 /TS/sys [Done]
Restoring 1,048,576 /TS/charlotte/data1 [Done]
Restoring 1,048,576 /TS/charlotte/data2 [Done]
Restoring 1,048,576 /TS/charlotte/data3 [Done]
Restoring 1,048,576 /TS/eduardo/data1 [Done]
Restoring 1,048,576 /TS/eduardo/data2 [Done]
```

**Tip:** Use the option `verifyimage` with the restore image command to detect bad sectors in the destination volume.

---

<table>
<thead>
<tr>
<th>If you want to perform this operation...</th>
<th>.... then this is the client command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restore a single file (C:\tsm\betty.doc)</td>
<td><code>dsmc restore c:\tsm\betty.doc</code></td>
</tr>
<tr>
<td>Restore a directory and all files from that level (C:\tsm)</td>
<td><code>dsmc restore c:\tsm\</code></td>
</tr>
<tr>
<td>Restore the image d:</td>
<td><code>dsmc restore image d:</code></td>
</tr>
<tr>
<td>Restore all files from a directory (C:\tsm,) with all its subdirectories</td>
<td><code>dsmc restore c:\tsm\ -subdir=yes</code></td>
</tr>
<tr>
<td>Restore a full subdirectory (C:\tsm to D:\temp) with all subdirectories, and write full path on destination</td>
<td><code>dsmc restore c:\tsm\ d:\temp -preservepath=complete -subdir=yes</code></td>
</tr>
</tbody>
</table>
Backup set restore

Example 11-15 shows a partial restore from a local backup set which is on disk. In this case, some of the files already exist so we had the option to replace the existing copy, skip restoring that object or terminate the restore option. Note that a partial restore from a backup set is available only using the command line interface. If you use the GUI, then you can only restore the complete backup set.

Example 11-15  UNIX partial backup set restore

    tsm> restore backupset /tsm/stg/seqf/43247638.ost /TS/peter/*
       -subdir=yes -location=file
    Restore function invoked.

    ANS1247I Waiting for files from the server...

    --- User Action is Required ---
    File '/TS/peter/data1' exists
Select an appropriate action
1. Replace this object
2. Replace all objects that already exist
3. Skip this object
4. Skip all objects that already exist
A. Abort this operation
Action [1,2,3,4,A] : 2
Restoring 1,048,576 /TS/peter/data1 [Done]
Restoring 1,048,576 /TS/peter/data2 [Done]
Restoring 1,048,576 /TS/peter/data3 [Done]

Restore processing finished.

Total number of objects restored: 3
Total number of objects failed: 0
Total number of bytes transferred: 3.00 MB
Data transfer time: 1.77 sec
Network data transfer rate: 1,730.94 KB/sec
Aggregate data transfer rate: 757.23 KB/sec
Elapsed processing time: 00:00:08

An example of restoring from a backup set which is available on the Tivoli Storage Manager server is shown in Example 11-16. We first query the server to find out the name of the backup sets which have already been generated.

Example 11-16  UNIX full backup set restore

```
  tsm> q backupset
  Session established with server LOCHNESS_SERVER1: Windows
       Server Version 5, Release 3, Level 2.2
       Server date/time: 02/20/06  17:16:08  Last access: 02/20/06  17:11:52

    Backup Set Name             Generation Date  Retention Description
--------------------------------------------------------------------
 1  060220ATLANTIC.10271        02/20/06  17:15:35  365        No Description

  tsm> restore backupset 060220ATLANTIC.10271
  Restore function invoked.

  ANS1247I Waiting for files from the server...
  Restoring 256 /TS/charlotte [Done]
  Restoring 256 /TS/eduardo [Done]
  Restoring 256 /TS/lost+found [Done]
  Restoring 256 /TS/martin [Done]
  Restoring 4,096 /TS/norbert [Done]
  Restoring 256 /TS/peter [Done]
  Restoring 4,096 /TS/sys [Done]
```
If the backup set is made to tape, you can also restore from it if you have the same kind of tape drive on the client. In that case, you take the tape from the Tivoli Storage Manager server, put it in the client’s tape drive, and specify that device name (e.g. /dev/rmt0) and -location=tape on the restore backupset command.

**Group restore**

Example 11-17, Example 11-18 and Example 11-19 show how to restore from a group backup. Example 11-17 shows you how to list the groups backed up in a specific virtual Tivoli Storage Manager filespace. We have two group backups in the /tsmresidentfs virtual Tivoli Storage Manager filespace.

Example 11-17   Query group output
Example 11-18 shows the output of the command `dsmc restore group /tsmresidentfs/* -pick -showmembers`. You can choose a specific file to restore that belongs in a specific group by including the option `showmembers`.

**Example 11-18 Restore group command**

```plaintext
tsm> restore group /tsmresidentfs/* -pick -showmembers
```

IBM Tivoli Storage Manager Scrollable PICK Window - Restore Group

<table>
<thead>
<tr>
<th>#</th>
<th>Backup Date/Time</th>
<th>File Size</th>
<th>A/I</th>
<th>Type Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>02/21/2006 11:08:38</td>
<td>7.01 MB</td>
<td>A</td>
<td>FULL /tsmresidentfs/Tivoli S</td>
</tr>
<tr>
<td>2</td>
<td>02/20/2006 17:39:19</td>
<td>7.01 MB</td>
<td>A</td>
<td>FULL /tsmresidentfs/resident</td>
</tr>
</tbody>
</table>
```

Example 11-19 shows the contents of the group `residentgrp` and the output of the restore. From the pick window, you may choose the specific file that you want to restore. In the example, we chose to restore the file `data1` in the directory `/home/guest`.

**Example 11-19 Restore group command and output**

```
TSM Scrollable PICK Window - Restore
```
### Backup History

<table>
<thead>
<tr>
<th>#</th>
<th>Backup Date/Time</th>
<th>File Size A/I</th>
<th>File</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>02/20/2006 17:39:19</td>
<td>1.00 MB</td>
<td>/TS/charlotte/data1</td>
</tr>
<tr>
<td>2</td>
<td>02/20/2006 17:39:19</td>
<td>1.00 MB</td>
<td>/TS/charlotte/data2</td>
</tr>
<tr>
<td>3</td>
<td>02/20/2006 17:39:19</td>
<td>1.00 MB</td>
<td>/TS/eduardo/data1</td>
</tr>
<tr>
<td>4</td>
<td>02/20/2006 17:39:19</td>
<td>1.00 MB</td>
<td>/home/guest/data1</td>
</tr>
<tr>
<td>5</td>
<td>02/20/2006 17:39:19</td>
<td>1.00 MB</td>
<td>/TS/martin/data2</td>
</tr>
<tr>
<td>6</td>
<td>02/20/2006 17:39:19</td>
<td>1.00 MB</td>
<td>/TS/norbert/data1</td>
</tr>
<tr>
<td>7</td>
<td>02/20/2006 17:39:19</td>
<td>1.00 MB</td>
<td>/TS/peter/data3</td>
</tr>
<tr>
<td>8</td>
<td>02/20/2006 17:39:20</td>
<td>655 B</td>
<td>/usr/tivoli/tsm/client/ba/bi</td>
</tr>
</tbody>
</table>

---

**11.2.2 Windows GUI restore examples**

Figure 11-5 shows the restore GUI. You may select specific files, directories or complete drives to restore. To restore inactive files, select `display inactive/active files` from the view menu. For graphical navigation on platforms other than Windows use the Java or Web client.
The estimate function, as described in 11.1.3, “Windows GUI backup examples” on page 329, is also available when doing a restore operation. You can also opt to do a point-in-time restore if you do not want to restore the latest backup or if you want to restore files backed up on a specific date. Figure 11-6 shows the point-in-time function.
You can specify other restore options, such as to prompt when a file with the same name is present in the destination path, or to restore files or folders only from the source path. Figure 11-7 shows the restore options window.

---

**Figure 11-6  Point-in-time restore function**

**Figure 11-7  Restore options**
After choosing the files, directories, or drives you want to restore, you will be prompted for the destination of the restore operation, as shown in Figure 11-8. You can select to restore the files you selected in the original path or to a different directory or drive.

![Figure 11-8: Restore destination options](image)

A detailed report is available after the restore operation, as in Figure 11-9. If there were errors during the restore, click the View button to see the details.
For Windows users, you can restore the system object using the GUI as shown in Figure 11-10. We recommend that you restore the components of the system object together to make sure that the system state is consistent after the restore operation. See 20.1, “Windows bare machine recovery” on page 636 for more information on restoring a Windows system object backup for bare machine recovery.
11.3 Running archive operations

The `archive` command archives a single file, selected files, or all files in a directory and its subdirectories on a Tivoli Storage Manager server. Use this command to save files that you want to keep in their present condition for a long period of time, and to control them by expiration date only. There is no version control for archives. You can also use archives to release storage space on your workstation and delete files as you archive them using the `DELETEFILES` option. Typically, you use archives to save information with either a legal requirement (for example, account information, annual reports, billing information, or annual customer reports); or an internal audit requirement (for example, application logs, user activity information, or employee files).
When you use the `archive` command with the ARCHMC option, you can select any available management class in the active policy set that has an archive copygroup. If you omit this option then the default management class is used. This enables you to select the retention period (according to the retention period in days specified in the archive copygroup) for all the data you are archiving. The output of each archive operation is called an archive package and is by default given a description of the time and date when the archive was made.

To override the default description, specify your own text with the DESCRIPTION option. You can later use the assigned archive package description to add additional files to an existing package. The package description can also be used to query for existing packages or to retrieve files from the package, without needing to know exactly what files were contained in it. The description is case-sensitive.

Table 11-5 gives some examples of archive operations using a UNIX backup/archive client:

<table>
<thead>
<tr>
<th>If you want to perform this operation...</th>
<th>.... then this is the client command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Archive all files from a directory (/home)</td>
<td><code>dsmc archive /home/ -subdir=yes</code></td>
</tr>
<tr>
<td>Archive files from different directories (/home and /temp)</td>
<td><code>dsmc archive /home/ /temp/-subdir=yes</code></td>
</tr>
<tr>
<td>Archive files from a directory (/home) to a management class called Y1 (which is one year retention)</td>
<td><code>dsmc archive /home/ -archmc=y1</code></td>
</tr>
<tr>
<td>Create a new archive package called &quot;PEBBLES-FILES&quot; from a directory (/home)</td>
<td><code>dsmc archive /home/ -subdir=yes -description=&quot;PEBBLES-FILES&quot;</code></td>
</tr>
<tr>
<td>Add files from a directory (/temp) to an archive package called &quot;PEBBLES-FILES&quot;</td>
<td><code>dsmc archive /temp/ -subdir=yes -description=&quot;PEBBLES-FILES&quot;</code></td>
</tr>
</tbody>
</table>
Table 11-6 gives some examples of archive operations using a Windows backup/archive client:

**Table 11-6  Archive command examples: Windows**

<table>
<thead>
<tr>
<th>If you want to perform this operation...</th>
<th>.... then this is the client command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Archive all files from a directory (c:\tsm)</td>
<td>dsmc archive c:\tsm \ -subdir=yes</td>
</tr>
<tr>
<td>Archive files from different directories</td>
<td>dsmc archive c:\tsm \ c:\temp\</td>
</tr>
<tr>
<td>(c:\tsm and c:\temp)</td>
<td>-subdir=yes</td>
</tr>
<tr>
<td>Archive files from a directory (c:\tsm)</td>
<td>dsmc archive c:\tsm \ -archmc=y1</td>
</tr>
<tr>
<td>to a management class called Y1 (which</td>
<td></td>
</tr>
<tr>
<td>is one year retention)</td>
<td></td>
</tr>
<tr>
<td>Create a new package called</td>
<td>dsmc archive c:\tsm \ -subdir=yes</td>
</tr>
<tr>
<td>&quot;PEBBLES-FILES&quot; from a directory (c:\tsm)</td>
<td>-description=&quot;PEBBLES-FILES&quot;</td>
</tr>
<tr>
<td>Add files from a directory (c:\temp)</td>
<td>dsmc archive c:\temp \ -subdir=yes</td>
</tr>
<tr>
<td>to an archive package called &quot;PEBBLES-FILES&quot;</td>
<td>-description=&quot;PEBBLES-FILES&quot;</td>
</tr>
</tbody>
</table>

### 11.3.1 UNIX command line examples and output

Example 11-20 shows an archive operation and its command output.

**Example 11-20  UNIX archive command output**

```bash
No output.
```

```bash
no output.
```

```bash
archive /TS/* -subdir=yes -desc="Monthly Archive" -archmc=archmc
```

Archive function invoked.

<table>
<thead>
<tr>
<th>Directory --&gt;</th>
<th>Normal File --&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>4,096 /TS/ [Sent]</td>
<td>171 /TS/filelist [Sent]</td>
</tr>
<tr>
<td>256 /TS/charlotte [Sent]</td>
<td>0 /TS/restore [Sent]</td>
</tr>
<tr>
<td>256 /TS/eduardo [Sent]</td>
<td>2,229 /TS/dsmerror.log [Sent]</td>
</tr>
<tr>
<td>256 /TS/lost+found [Sent]</td>
<td>1,048,576 /TS/charlotte/data1 [Sent]</td>
</tr>
<tr>
<td>256 /TS/martin [Sent]</td>
<td>1,048,576 /TS/charlotte/data2 [Sent]</td>
</tr>
<tr>
<td>4,096 /TS/norbert [Sent]</td>
<td>1,048,576 /TS/charlotte/data3 [Sent]</td>
</tr>
<tr>
<td>256 /TS/eduardo/data1 [Sent]</td>
<td>1,048,576 /TS/eduardo/data2 [Sent]</td>
</tr>
<tr>
<td>1,048,576 /TS/eduardo/data3 [Sent]</td>
<td>1,048,576 /TS/eduardo/data3 [Sent]</td>
</tr>
</tbody>
</table>
Archive processing of '/TS/*' finished without failure.

Total number of objects inspected: 32
Total number of objects archived: 32
Total number of objects updated: 0
Total number of objects rebound: 0
Total number of objects deleted: 0
Total number of objects expired: 0
Total number of objects failed: 0
Total number of bytes transferred: 15.07 MB

Data transfer time: 1.29 sec
Network data transfer rate: 11,933.99 KB/sec
Aggregate data transfer rate: 7,672.37 KB/sec
Objects compressed by: 0%
Elapsed processing time: 00:00:02

---

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### 11.3.2 Windows GUI archive examples

Figure 11-11 shows the archive GUI window. You may select specific files, directories or complete drives to archive. You may enter your own description for the files you want to archive. If you do not enter one, by default, the description will be the date the archive was made. For graphical navigation on platforms other than Windows use the Java or Web client.

![Windows archive GUI](image)

**Figure 11-11   Windows archive GUI**

The estimate function is also available for the archive operation. See 11.1.3, “Windows GUI backup examples” on page 329 for more information on the estimate function. You can modify archive options shown in Figure 11-12, such as choosing a specific management class for the archive operation. If you do not specify a management class, the archive operation will use the archive copy group in the default management class. You can also specify to delete the files from the client system after they are successfully archived.
A detailed report similar to Figure 11-13 is available for viewing. It will show the archive statistics and the errors encountered if any.
11.4 Running retrieve operations

The `retrieve` command obtains copies of archived files from the Tivoli Storage Manager server. You can specify either selected files or whole directories to retrieve archived files. The DESCRIPTION field allows you to search for the descriptions assigned to the files when they were archived.

Table 11-7 gives some examples of retrieve operations using a UNIX backup/archive client.

Table 11-7  Retrieve command examples: UNIX

<table>
<thead>
<tr>
<th>If you want to perform this operation...</th>
<th>.... then this is the client command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retrieve a single file (/home/myfile1)</td>
<td>dsmc retrieve /home/myfile1</td>
</tr>
<tr>
<td>Retrieve files from a directory (/home)</td>
<td>dsmc retrieve /home</td>
</tr>
<tr>
<td>Retrieve files from a directory (/home) with a description &quot;MYDATA_NOV2002&quot; and save them into another location (/temp)</td>
<td>dsmc retrieve /home/ /temp/ -subdir=yes -description=&quot;MYDATA_NOV2002&quot;</td>
</tr>
</tbody>
</table>

Table 11-8 gives you some examples of retrieve operations using a Windows backup/archive client.

Table 11-8  Retrieve command examples: Windows

<table>
<thead>
<tr>
<th>If you want to perform this operation...</th>
<th>.... then this is the client command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retrieve a single file (c:\tsm\myfile1)</td>
<td>dsmc retrieve c:\tsm\myfile1</td>
</tr>
<tr>
<td>Retrieve files from a directory (c:\tsm)</td>
<td>dsmc retrieve c:\tsm\ -subdir=yes</td>
</tr>
<tr>
<td>Retrieve files from a directory (c:\tsm) with a description &quot;MYDATA_NOV2002&quot; and save them into another location (c:\temp)</td>
<td>dsmc retrieve c:\tsm\ c:\temp\ -subdir=yes -description=&quot;MYDATA_NOV2002&quot;</td>
</tr>
</tbody>
</table>

Note:

1. The description field is case-sensitive.
2. The same restore rules apply for the retrieve operations when using the PRESERVEPATH option.
11.4.1 UNIX command line examples and output

Example 11-21 shows command output for a retrieve operation on the objects stored for Eduardo. The retrieved data does not exist on the client workstation before the retrieve operation, so we are not prompted for collision options.

Example 11-21 UNIX retrieve command output

```
> tsm> retrieve /TS/eduardo/* -desc="Monthly Archive"
Retrieval function invoked.

Retrieving 256 /TS/eduardo [Done]
Retrieving 1,048,576 /TS/eduardo/data1 [Done]
Retrieving 1,048,576 /TS/eduardo/data2 [Done]
Retrieving 1,048,576 /TS/eduardo/data3 [Done]

Retrieve processing finished.

Total number of objects retrieved: 4
Total number of objects failed: 0
Total number of bytes transferred: 3.00 MB
Data transfer time: 1.66 sec
Network data transfer rate: 1,846.62 KB/sec
Aggregate data transfer rate: 1,015.30 KB/sec
Elapsed processing time: 00:00:03
> tsm>
```

11.4.2 Windows GUI retrieve examples

Figure 11-14 shows the Tivoli Storage Manager retrieve GUI (Windows). You can choose to retrieve specific files within an archive package or you can retrieve the whole archive package. For graphical navigation on platforms other than Windows use the Java or Web client.
The estimate function is also available for retrieve operations. The function is already discussed under 11.1.3, “Windows GUI backup examples” on page 329.
You can specify retrieve options similar to restore options as shown in Figure 11-15. You can choose to overwrite files without prompting you or to retrieve files or directories only from the package you selected.

![Retrieve Options Window](image)

*Figure 11-15  Retrieve options*
Once you have chosen the files or package you want to archive, you will be prompted for the destination of the retrieve operation, as shown in Figure 11-16. You may choose to retrieve the files back to their original location or to a different path.

![Figure 11-16 Retrieve destination](image)
A detailed status report similar to Figure 11-17 is available for review. This contains the retrieve statistics and the errors encountered if any.

![Detailed Status Report](image)

Figure 11-17    Retrieve report

### 11.5 Summary

You are now familiar with the client operations, such as backup, restore, archive, and retrieve. The client command line and graphical interfaces were also discussed in this chapter. The next chapter will cover the administrative and client scheduling.
Scheduling

Scheduling is at the core of efficient IBM Tivoli Storage Manager operations. Having a comprehensive and integrated set of schedules allows the server to run with very little intervention during normal operational periods. IBM Tivoli Storage Manager scheduling is divided into two categories: administrative scheduling and client scheduling. The two categories differ in three key areas:

- **Execution location**: An administrative schedule performs an action on the IBM Tivoli Storage Manager server while the client schedule can only execute on the IBM Tivoli Storage Manager client.

- **Domain privilege**: Only an administrator with system privilege can manage an administrative schedule, while administrator with policy privileges in the client’s domain can manage the client schedule. The feature’s granularity can be very useful when distributing management control across a large enterprise.

- **An administrative schedule can only initiate an internal IBM Tivoli Storage Manager command, whereas a client schedule can initiate an internal client action such as an incremental backup, or run an external command such as a shell script or executable.**

For both types of schedules, there are four key pieces of information:

- A command or action to be executed
- When the command or action executes
- The period, or window, in which the command or action should start
- How often the command or action should be repeated
The command or action that you run may be an incremental backup (client schedule) or a storage pool migration (administrative schedule) that should run every day at a particular time. You also have to estimate how long the command runs so that you can synchronize your schedules and balance the load on the server.

In addition, there is a special client schedule called *Clientaction*, which is for a client action that you only want to run once. If the client scheduler mode is “server-prompted”, the schedule runs immediately. If the client scheduler mode is “client polling”, the schedule runs the next time the client polls the server. For example, if you wish to initiate a backup on a new client, and you want it to run immediately, you set the scheduler mode of the client to “server-prompted”, and define a clientaction to perform an incremental backup on the node.

Introduced with IBM Tivoli Storage Manager 5.3 are different *styles* of schedules. Both client and administrative schedules can now be either *Classic* or *Enhanced*. The styles refer to the way in which schedules are started and repeated. *Classic* refers to the original style of setting the start time and repetition of the schedule using a limited number of options. *Enhanced* refers to the new style, which provides more specific options for setting the repetition. You can now configure a schedule to happen, for example, on the last day of each month.

In this chapter we provide scheduling rules of thumb and recommendations that will give you a good base configuration.
12.1 The wheel of life

Figure 12-1 shows the recommended series of operations that should occur in a Tivoli Storage Manager environment and the sequence in which those operations should occur. The actual start time and duration of the various operations depend on your scheduling requirements. The sequence of events, however, should not deviate too much from that shown here.

The circle represents a 24-hour clock, indicating the hours of the day. The daily schedule has a period where clients perform their backups. Once the clients are finished, the server performs housekeeping. The server makes copies of the disk storage pools for off-siting. The server backs up its database, deletes volume history, saves the device configuration, and creates a list of tapes for vault processing. The server then migrates the data from disk storage pools to on-site tape pools, and reclaims blank space from tape pools. Finally, the expiration process runs before a new round of client backups begins for that night. We describe these actual operations in more detail in the following sections.

The Tivoli Storage Manager server clock determines all schedule start times, regardless of the time zones of the clients.

Many factors influence the actual start time and duration of the various operations, including the client backup window, storage pool sizes, amount of data, and so on. Nevertheless, you need to carefully consider the timing and sequencing, if not, jobs can overlap and not complete properly, or jobs can tie up server resources unnecessarily.

In the following sections, we explain how such things can be accomplished.
12.2 Administrative schedules

An administrative schedule is a directive to trigger an action on the Tivoli Storage Manager server. It consists of an internal server command and parameters describing when the action should happen. As each administrative schedule can only run one server command, the command itself may be a “run” command, that runs an internally defined server script containing other internal server commands.

Example 12-1 shows the syntax to define an administrative schedule named **DB_BACKUP** for a full database backup starting at 7 a.m. every morning.
Example 12-1  Defining an administrative schedule

```plaintext
Example 12-1  Defining an administrative schedule

```tsm: ATLANTIC>define schedule db_backup type=administrative cmd="backup db devc=lto2-dc type=full" starttime=07:00 active=yes description="Daily Database Backup"
ANR2577I Schedule DB_BACKUP defined.

```tsm: ATLANTIC>query sched type=admin

<table>
<thead>
<tr>
<th>Schedule Name</th>
<th>Start Date/Time</th>
<th>Duration</th>
<th>Period</th>
<th>Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>DB_BACKUP</td>
<td>02/17/06 07:00:00</td>
<td>1 H</td>
<td>1 D</td>
<td>Any</td>
</tr>
</tbody>
</table>

The option “active=yes” must be entered if you want the schedule to run. The
default is “no”. The update schedule command can be used at a later point in time
to enable or disable the schedule. The query schedule command provides
information on schedules. If you do not include “type=admin” it will, by default, print
information about client schedules.

We have assembled a series of administrative schedules to help you set up a
Tivoli Storage Manager environment that will minimize user intervention while
providing a high level of data availability.

The first step in setting up administrative schedules is knowing which commands
to run. Table 12-1 shows our recommendations for commands that should be
scheduled and where to find more information on them. The table also includes
our estimates on various other factors based on a typical implementation.

Client schedules are not, of course, administrative, but they are included to
emphasize that all scheduling in your environment should be based on your
client schedules. The table has a recommended set of schedules with all of the
specifics required to execute in your environment if you follow the
recommendations made in this redbook.

Table 12-1  Recommended schedules

<table>
<thead>
<tr>
<th>#</th>
<th>Function</th>
<th>Task</th>
<th>Duration (Hrs)</th>
<th>Task Dependency</th>
<th>Refer to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Back up client data to Tivoli Storage Manager server</td>
<td>Schedule client backups</td>
<td>6.0</td>
<td>Site Requirements</td>
<td>12.3 on page 374</td>
</tr>
</tbody>
</table>
We recommend that no other schedules or administrative tasks are performed during client backups, so that backups have the maximum system resources.
available to them to minimize the backup time. Running administrative tasks or schedules during the client backup window will only take processing cycles away from the backup tasks.

### 12.2.1 Defining an offsite backup schedule

When the client backups are complete, the new data in the primary storage pools should be copied to a copy storage pool. The copy storage pool tapes, along with the database backup tapes, should be taken to a secure off-site location or vault. The copy storage pool and database backup tapes are referred to collectively as the offsite backups, and will be used to restore your environment in the event of a catastrophic failure or disaster.

#### Flow of events

The order of execution of these tasks should be as follows:

1. Check that there are no running sessions with the clients. When you back up the primary storage pools and database, you want to make sure that you are capturing an up-to-date copy. If a client is still backing up its data, wait until it is done before starting the offsite backups.

2. Back up the primary storage pools to their copy storage pool. See 6.5.3, “Backup a storage pool” on page 236 for more information.
   
   a. Back up the DISKDIRS storage pool to the OFFDIRS storage pool.
   b. Back up the DISKDATA storage pool to the OFFDATA storage pool.
   c. Back up the TAPEDATA storage pool to the OFFDATA storage pool.

3. Back up the database. See 5.8, “Database backup” on page 200 for more information.

Since all of these commands are going to take a variable amount of time to execute, and they should be run in sequence, it makes sense to use a server script to run them. This will guarantee that each command will complete its tasks before another command is started.

#### Defining the server script

Example 12-2 displays the commands you would use to manually accomplish the offsite backup tasks. We can put the commands into a server script, to run them one after the other.

**Example 12-2  Commands for storage pool backup**

```sql
select * from sessions where upper(session_type)='NODE'
backup stgpool diskdirs offdirs wait=yes
backup stgpool diskdata offdata wait=yes
backup stgpool tapedata offdata wait=yes
```
When working interactively, you would use the query session command to check if any clients are still backing up. If you see any clients still backing up, you can just wait for a while and try again. However, a script cannot tell from the output of query session if there are any clients backing up. Instead, we use the SQL select statement (as shown in the first line of Example 12-2) and check its return code. If clients are still backing up, the return code is true. We can then make the script reschedule itself for a later time. If the return code is false (that is, no clients are backing up), we can proceed with the storage pool backups.

Example 12-3 shows the finished script for our recommended configuration. In 1.1.1, “Our redbook support material” on page 5, we show how to load a predefined macro into Tivoli Storage Manager. The macro mac.scripts, which we provide to define a script to back up storage pools and the database to an offsite location, is shown in B.1.5, “Define server scripts” on page 741.

Example 12-3  Contents of “REDBOOK_OFFSITE” script
/*--------------------------------------------*/
/*  Script Name:  REDBOOK_OFFSITE  */
/*  Description: Back up all primary storage */
/*               pools, followed by the       */
/*               database. If there are      */
/*               active node sessions,       */
/*               reschedule to run again in */
/*               20 minutes                  */
/*               The script will back up */
/*               three storage pools named */
/*               diskdirs, diskdata and      */
/*               tapedata to copypools named */
/*               offdata and offdirs.       */
/*  Example: run redbook_offsite  */
/*  -----------------------------------------*/
select * from sessions where -
  upper(session_type)='NODE'
if (rc_ok) goto reschedule
backup stgpool diskdirs offdirs wait=yes
backup stgpool diskdata offdata wait=yes
backup stgpool tapedata offdata wait=yes
backup db devclass=coffsite type=full scratch=yes
exit
reschedule:
delete schedule redbook_offsite_retry type=admin
define schedule redbook_offsite_retry type=admin -
  cmd="run redbook_offsite" -
  active=yes starttime=NOW+0:20 peru=onetime
You can call the script anything you like, but it should represent the function performed by the script, and not be already in use. You can check this with the `query script` command. Example 12-4 shows that the intended name of our script, “REDBOOK_OFFSITE” is not in use as yet.

```
Example 12-4 Query script output

    tsm: LOCHNESS_SERVER1> query script

    Name Description                        Managing profile
    -------------------------- ---------------
    Q-COLUMNS Query columns from a TSM database table
    Q-TABLES Show available TSM database tables
```

Once the script is defined to the server, you need to define a schedule that will run the script for you every day at 4 a.m. The macro, `mac.schedules`, which we provide to define recommended schedules in our redbook environment, is shown in B.1.4, “Define schedules” on page 739 and includes the schedule definition command in Example 12-5.

```
Example 12-5 Defining the REDBOOK_OFFSITE schedule

    tsm: LOCHNESS_SERVER1> define schedule redbook_offsite type=admin cmd="run redbook_offsite" desc="Backup all data for off site storage" startime=04:00 active=yes

    ANR2577I Schedule REDBOOK_OFFSITE defined.

    tsm: LOCHNESS_SERVER1> q sched redbook* type=admin

    * Schedule Name        Start Date/Time  Duration  Period  Day
    -------------------------------------------------------------
    REDBOOK_OFFSITE 02/20/2006 04:00:00 1 H 1 D Any
```

### 12.2.2 Defining the volume history schedules

If you have licensed the Disaster Recovery Manager (DRM), we recommend that you run a schedule to back up the volume history on a daily basis. DRM will handle expiry of database backups.

If you are not using DRM, we recommend that you run one schedule to delete the old database backup volume history, and also one schedule to back up the volume history, on a daily basis.
Every volume that is used by Tivoli Storage Manager, including the volumes used for server database backups, is tracked in the server database. You can access this information while the server is up with the `query volhistory` command. The volume history information is very important because it tells you which volume holds your most recent database backup. If the server database is lost or corrupted, you need to know which is the latest backup in order to restore your database. However, if you cannot start the server, the database is not available, and you cannot retrieve the information. Therefore, a separate copy of the volume history information should be periodically saved to a text file. You can specify the file name with the `VOLUMEHISTORY` option in the server options file (`dsmserv.opt`). You can specify multiple `VOLUMEHISTORY` entries in the options file to specify more than one file. We recommend maintaining at least two copies of the volume history file, in case one becomes unusable.

When you back up the database, the previous database backups become obsolete. However, it is wise to save the older backup for a short time before returning them to scratch volume status for reuse. DRM will take care of database backup expiry, but if you have not licensed it, you must delete the volume history yourself. Use the `delete volhistory` command to do this. We recommend deleting any database backups that are older than seven days. The delete volhistory command will never delete the current database backup, so we use "today-6" when specifying the "TODate" option.

The two recommended schedules are: `DELETE_VOLHIST` and `BACKUP_VOLHIST`.

### DELETE_VOLHIST

We define a schedule to delete volume history, called `DELETE_VOLHIST` specifying a type of `TYPE=DBBACKUP` as shown in Example 12-6.

#### Example 12-6  Defining the DELETE_VOLHIST schedule

```bash
tsm: LOCHNESS_SERVER1>define schedule delete_volhist type=admin cmd="delete volhistory type=dbbackup todate=today-6" description="Delete volume history information for database backups" starttime=07:00 active=yes
ANR2577I Schedule DELETE_VOLHIST defined.
```

```bash
tsm: LOCHNESS_SERVER1>q sched delete* t=a
```

<table>
<thead>
<tr>
<th>* Schedule Name</th>
<th>Start Date/Time</th>
<th>Duration</th>
<th>Period</th>
<th>Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>DELETE_VOLHIST</td>
<td>02/20/2006 07:00:00</td>
<td>1 H</td>
<td>1 D</td>
<td>Any</td>
</tr>
</tbody>
</table>
```
Some operations, like the `delete volhistory` command, do update the volume history in the server database, but do not update the external volume history files. To ensure that the external volume history data is current, you should schedule a daily volume history backup using the `backup volhistory` command. Example 12-7 shows how to create the schedule.

**Example 12-7  Defining the BACKUP_VOLHIST schedule**

```bash
tsm: LOCHNESS_SERVER1> define schedule backup_volhist type=admin cmd="backup volhistory" description="Backup volume history file" starttime=07:05 active=yes
ANR2577I Schedule BACKUP_VOLHIST defined.
```

12.2.3  Defining a migration schedule

Migration of your primary storage pools during client backup can and will slow down the client backup sessions and can impact the scheduling of other server processes. We recommend scheduling primary storage pool migration outside the client backup window. Also, make sure that the disk-based storage pools are large enough to hold the daily backup data from the clients, to avoid a server-triggered migration during client backups.

With Tivoli Storage Manager V5.3, migration is now a single-step process with the introduction of the `migrate stgpool` command. Previously, to migrate data from a storage pool, you had to change the storage pool high and low migration thresholds to start the migration, wait a suitable amount of time, and then reset the thresholds to their normal operational values. In terms of scheduling, you had to create two schedules, one to set the thresholds to a low value, and another some time later to reset them.

With the `migrate stgpool` command, you specify a temporary low migration threshold, and a duration for which the temporary threshold is valid. At the end of the period, the threshold is reset to its previous value. During the period that the migrate stgpool command is active, the high migration threshold is ignored.

A single schedule is required to perform migration. Example 12-8 shows the command required.
Example 12-8  Defining the MIGRATION schedule

```
tsm: LOCHNESS_SERVER1> define schedule MIGRATION type=admin cmd="migrate stgpool
diskdata lo=0 duration=180" desc="Perform migration on DISKDATA storage pool"
starttime=07:00 active=yes
ANR2577I Schedule MIGRATION defined.
```

```
tsm: LOCHNESS_SERVER1> q sched migration t=a

* Schedule Name     Start Date/Time     Duration Period Day
- ----------------- ----------------- ------- ------ ---
  MIGRATION 02/21/2006 07:00:00 1 H 1 D Any
```

12.2.4 Defining an expiration schedule

Managing the amount of space used by your database is important. When client backup and archive data expires, the references and metadata must be removed from the database. The client backup process handles half of the task by marking expired data references while backing up client data. The second half of the task is handled by the expire inventory command, which physically removes the marked entries from the database.

The default Tivoli Storage Manager configuration file is a 24 hour cycle for expiration, with expiration processing beginning 24 hours from when you first start the server. Unfortunately, this situation is rarely ever satisfactory. Expiration of inventory can be computationally intensive and it is best scheduled during a quiet server time to minimize its impact on server operations. It is also helpful to run inventory expiration before you run reclamation, so that the reclamation process can consolidate newly-expired space.

Therefore, we recommend scheduling the expire inventory command daily as shown in Example 12-9. The schedule assumes you have disabled the default expiration execution as recommended in 7.4, “Enforcing your policy” on page 269.

Example 12-9  Defining an inventory expiration schedule

```
tsm: LOCHNESS_SERVER1> define schedule EXPIRE_INVENTORY type=admin
description="Inventory expiration" cmd="expire inventory" starttime=10:00
active=yes
ANR2577I Schedule EXPIRE_INVENTORY defined.
```

```
tsm: LOCHNESS_SERVER1> q sched expire* t=a

* Schedule Name     Start Date/Time     Duration Period Day
- ----------------- ----------------- ------- ------ ---
```

IBM Tivoli Storage Manager Implementation Guide
12.2.5 Defining a reclamation schedule

Data on tapes in sequential access storage pools will eventually expire, leaving portions of the tapes with empty areas (also known as fragmentation). Over time, fragmentation can cause many tapes to have very little valid data on them. Reclamation is the process where the valid data on a number of tapes is consolidated onto a smaller number of tapes. The tapes that are emptied by the reclamation process are returned to scratch status for reuse. See “Data Storage” in IBM Tivoli Storage Management Concepts, SG24-4877.

We recommend controlling when the reclamation process runs using a schedule which sets and resets the reclamation threshold for each storage pool. Outside of the scheduled reclamation periods, the REClaim parameter for the storage pool should remain at 100, disabling reclamation from running. Controlling reclamation is desirable because it demands heavy use of the tape drives and might interfere with normal backup or restore operations if allowed to be run by the server.

Tivoli Storage Manager V5.3 introduces the reclaim stgpool command, which makes reclamation a one-step process. Previously, you had to update the storage pool, selecting a threshold to trigger reclamation. Then, you would wait for a period of time, and run another update stgpool command to reset the reclamation threshold to its previous value. You can still use the two-step update storage pool method, but the reclaim stgpool command is preferred.

The reclaim stgpool command takes a number of options. To set the reclamation threshold, set the Threshold parameter to a value between 50 and 99. The ThReshold value represents the percentage of reclaimable space on a volume. To check the amount of reclaimable space on a volume, run a query volume command. Subtract the value in the Pct Utilized column from 100 to obtain the percentage of reclaimable space on the volume. The other parameter required for reclaim stgpool is the DUration parameter. DUration is the length of time reclamation will run for on the selected storage pool.

Each sequential storage pool should have one schedule to perform reclamation. We have three sequential storage pools in our recommended configuration. Example 12-10 shows three schedules to perform the reclamations.

Example 12-10  Defining reclamation schedules

```sql
  tsm: LOCHNESS_SERVER1>define schedule RECLAIM OFFDIRS type=admin
description="Perform reclamation on the OFFDIRS storage pool" cmd="reclaim stgpool
offdirs threshold=85 duration=60" starttime=11:00 active=yes
```
12.2.6 Defining a licensing audit schedule

Occasionally, you may wish to check storage statistics for your clients - i.e. how much data the clients are storing on the server, and what type of data that is. The `query auditoccupancy` command provides information on client data usage, as shown in Example 12-11.

Example 12-11  Audit occupancy data

```
tsm: LOCHNESS_SERVER1>q auditocc
License information as of last audit on 02/21/2006 at 11:04:40.

<table>
<thead>
<tr>
<th>Node Name</th>
<th>Backup Storage Used (MB)</th>
<th>Archive Storage Used (MB)</th>
<th>Space-Managed Storage Used (MB)</th>
<th>Total Storage Used (MB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOCHNESS</td>
<td>37</td>
<td>0</td>
<td>0</td>
<td>37</td>
</tr>
<tr>
<td>PAMELA</td>
<td>0</td>
<td>184</td>
<td>0</td>
<td>184</td>
</tr>
<tr>
<td>PIERRE</td>
<td>888</td>
<td>101</td>
<td>0</td>
<td>989</td>
</tr>
<tr>
<td>PARIS</td>
<td>267</td>
<td>12</td>
<td>0</td>
<td>289</td>
</tr>
<tr>
<td>ATLANTIC</td>
<td>118</td>
<td>0</td>
<td>0</td>
<td>118</td>
</tr>
<tr>
<td>BANDA</td>
<td>353</td>
<td>0</td>
<td>0</td>
<td>353</td>
</tr>
</tbody>
</table>
```
The data displayed by `query auditoccupancy` is updated whenever the `audit licenses` command is run on the Tivoli Storage Manager server. We recommend auditing the licenses daily to maintain up to date client statistics. The schedule definition is shown in Example 12-12.

**Example 12-12  License audit schedule definition**

```bash
tsm: LOCHNESS_SERVER1>define schedule AUDIT_LICENSE type=admin description="Audit licenses" cmd="audit licenses" starttime=00:00 active=yes
ANR2577I Schedule AUDIT_LICENSE defined.

tsm: LOCHNESS_SERVER1>q sched audit* t=a

* Schedule Name Start Date/Time Duration Period Day
- ---------------- -------------------- -------- ------ ---
  AUDIT_LICENSE 02/21/2006 00:00:00 1 H 1 D Any
```

### 12.2.7 Querying administrative events

You can query the scheduled events using the `query event` and `query schedule` commands. Example 12-13 shows the outputs from these commands.

**Example 12-13  Querying administrative events**

```bash
tsm: LOCHNESS_SERVER1>q schedule * type=admin

* Schedule Name Start Date/Time Duration Period Day
- ---------------- -------------------- -------- ------ ---
  AUDIT_LICENSE 02/21/2006 00:00:00 1 H 1 D Any
  BACKUP_VOLHIST 02/20/2006 07:05:00 1 H 1 D Any
  DELETE_VOLHIST 02/20/2006 07:00:00 1 H 1 D Any
  EXPIRE_INVENTORY 02/21/2006 10:00:00 1 H 1 D Any
  MIGRATION 02/21/2006 07:00:00 1 H 1 D Any
  RECLAIM_OFFDATA 02/21/2006 11:00:00 1 H 1 D Any
  RECLAIM_OFFDIRS 02/21/2006 10:00:00 1 H 1 D Any
  RECLAIM_TAPEDATA 02/21/2006 14:00:00 1 H 1 D Any
  REDBOOK_OFFSITE 02/20/2006 04:00:00 1 H 1 D Any

tsm: LOCHNESS_SERVER1>q event * type=admin

Scheduled Start Actual Start Schedule Name Status
----------------- ----------------- --------------- --------
02/21/2006 04:00:00 02/21/2006 04:00:24 REDBOOK_OFFSITE Completed
02/21/2006 07:00:00 02/21/2006 07:00:24 DELETE_VOLHIST Completed
02/21/2006 07:05:00 02/21/2006 07:05:24 BACKUP_VOLHIST Completed
02/21/2006 10:00:00 02/21/2006 10:31:54 RECLAIM_OFFDIRS Completed
02/21/2006 11:00:00 02/21/2006 11:00:24 RECLAIM_OFFDATA Completed
The `query schedule` command shows the schedules in alphabetical order, while the `query event` command shows the chronological order. Note that for both commands you must specify `type=admin` (or `t=a`) to report on administrative objects.

### 12.3 Client schedules

A client schedule is a directive to trigger an action on one or more Tivoli Storage Manager clients. It differs from an administrative schedule in that it specifies that an action be performed on the Tivoli Storage Manager client. The client scheduling system consists of a server portion and a client portion. The server part is integrated into the Tivoli Storage Manager process and is responsible for managing the schedules and notifying clients. The client scheduler is a separate process on the Tivoli Storage Manager client and provides communication between the server and client. See “Scheduling” in *IBM Tivoli Storage Management Concepts*, SG24-4877 for further information on the client portion of the client scheduling system.

A Tivoli Storage Manager client with an active scheduler process can be scheduled to perform any of the following actions:

- Backup (either incremental or selective)
- Archive
- Restore
- Retrieve
- External command or script
- Macro
- Image backup or restore (UNIX)

The most common use of client schedules is to for an automatic incremental backup process for a group of machines.

At this point in the configuration of Tivoli Storage Manager, you should have installed the Tivoli Storage Manager client software on your clients and defined them to a policy domain. You should also have activated the scheduler service on the client so that it is ready to accept schedules. The remaining activities are performed on the server. To complete a client schedule you need to perform the following operations on the server:

1. Define a client schedule
2. Associate a client with the schedule
3. Verify the client schedule

12.3.1 Defining a client backup schedule

In 1.1.1, “Our redbook support material” on page 5, we show how to load a predefined macro into Tivoli Storage Manager. The macro `mac.schedules`, which we provide to define schedules for our redbook environment, is shown in B.1.4, “Define schedules” on page 739.

The `define schedule` command defines a schedule to the Tivoli Storage Manager server. You then use the `define association` command to associate each client with the schedule.

To define a client schedule, specify the following information:

- **Policy domain name**: The schedule will be created within this policy domain and can only be associated with nodes within that domain. Only administrators who have policy rights for the domain, or system rights can control these schedules.

- **Schedule name**: The schedule name can be any unique name you choose, up to 30 characters long. It should represent the function it performs.

- **Start time**: The time of day that you want the schedule to trigger your action.

- **Startup duration**: The period in which the scheduler will initiate the schedule after the start time.

Client schedules are very dependent on site requirements, but we have some recommendations that are applicable for a wide range of environments.

Our recommended policy configuration includes two policy domains, one for servers and one for workstations. We must therefore define a client backup schedule for each domain. The parameters for each schedule are very similar except for the domain name. The schedules start at 10 p.m. with a startup window of 3 hours. The commands and output are shown in Example 12-14.

**Example 12-14  Defining client schedules**

```plaintext
tsm: LOCHNESS_SERVER1>define schedule server server_nightly action=incremental
starttime=22:00 duration=3 durunits=hours period=1 perunits=days
description="Nightly backup schedule for SERVER domain"
ANR2500I Schedule SERVER_NIGHTLY defined in policy domain SERVER.

 ANR2500I Schedule WORKSTN_NIGHTLY defined in policy domain WORKSTN.
```
Domain * Schedule Name Action Start Date/Time Duration Period Day
------- - --------------- ------ ------------------- -------- ------ ---
SERVER SERVER_NIGHTLY Inc Bk 02/21/2006 22:00:00 3 H 1 D Any
WORKSTN WORKSTN_NIGHTLY Inc Bk 02/21/2006 22:00:00 3 H 1 D Any

Note that we do not specify a type or style of schedule. If we omit the Type, client is assumed. If we omit the SCHEDStyle, classic is assumed.

12.3.2 Defining an enhanced client schedule

An enhanced client schedule performs the same actions as a classic client schedule, but allows you to be more specific with repetition intervals.

Before Tivoli Storage Manager V5.3, there were limited options for setting the repetition parameters. You could not, for example, schedule a backup to run on the first Wednesday of each month. With enhanced schedules, you can.

We wish to schedule an image backup of the C drive of our Windows workstations on the last Friday of every month, at 1 a.m. When defining the schedule, we use the SCHEDStyle=enhanced option, and use the MONTH, DAYOFMonth, WEEKofmonth and DAYofweek options. Example 12-15 shows the command.

Example 12-15  Defining an enhanced client schedule

tsm: LOCHNESS_SERVER1>define sched workstn monthly_image starttime=01:00 action=imagebackup object="C:" schedstyle=enhanced month=any weekofmonth=last dayofweek=friday description="Monthly image backup for workstations"
ANR2500I Schedule MONTHLY_IMAGE defined in policy domain WORKSTN.

tsm: LOCHNESS_SERVER1>define association workstn monthly_image pamela
ANR2510I Node PAMELA associated with schedule MONTHLY_IMAGE in policy domain WORKSTN.

tsm: LOCHNESS_SERVER1>query event workstn monthly_image enddate=12/31/2006

<table>
<thead>
<tr>
<th>Scheduled Start</th>
<th>Actual Start</th>
<th>Schedule Name</th>
<th>Node Name</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>02/24/2006 01:00:00</td>
<td></td>
<td>MONTHLY_IMAGE</td>
<td>PAMELA</td>
<td>Future</td>
</tr>
<tr>
<td>03/31/2006 01:00:00</td>
<td></td>
<td>MONTHLY_IMAGE</td>
<td>PAMELA</td>
<td>Future</td>
</tr>
<tr>
<td>04/28/2006 01:00:00</td>
<td></td>
<td>MONTHLY_IMAGE</td>
<td>PAMELA</td>
<td>Future</td>
</tr>
<tr>
<td>05/26/2006 01:00:00</td>
<td></td>
<td>MONTHLY_IMAGE</td>
<td>PAMELA</td>
<td>Future</td>
</tr>
<tr>
<td>06/30/2006 01:00:00</td>
<td></td>
<td>MONTHLY_IMAGE</td>
<td>PAMELA</td>
<td>Future</td>
</tr>
<tr>
<td>07/28/2006 01:00:00</td>
<td></td>
<td>MONTHLY_IMAGE</td>
<td>PAMELA</td>
<td>Future</td>
</tr>
</tbody>
</table>
The query event output shows the projected dates that the schedule will run for the rest of 2006, all of which are the last Fridays of each month.

Figure 12-2 and Figure 12-3 on page 378 show the corresponding panels from the Administration Center, selecting the day of week and week of the month.

![Enhanced schedule repetition, day of week, ISC panel](Figure 12-2)
12.3.3 Associating a client with a schedule

Once the schedule is defined, we need to specify which client nodes will run it. The define association command forms the link between the schedule and the node. Nodes are associated to schedules within their own domain. A node must be registered on the server before defining an association for it, but it does not necessarily have to be in contact with the server. Example 12-16 shows the actual commands and the output.

Example 12-16   Associating clients with schedules

```plaintext
ts害: LOCHNESS_SERVER1>define association server server_nightly lochness
ANR2510I Node LOCHNESS associated with schedule SERVER_NIGHTLY in policy domain SERVER.

nts: LOCHNESS_SERVER1>define association server server_nightly atlantic
ANR2510I Node ATLANTIC associated with schedule SERVER_NIGHTLY in policy domain SERVER.

nts: LOCHNESS_SERVER1>define association workstn workstn_nightly pamela,pierre
ANR2510I Node PAMELA associated with schedule WORKSTN_NIGHTLY in policy domain WORKSTN.
ANR2510I Node PIERRE associated with schedule WORKSTN_NIGHTLY in policy domain WORKSTN.

nts: LOCHNESS_SERVER1>query assoc
```
Notice that you can specify more than one node by separating the node names with a comma only. (no spaces between commas and node names).

12.3.4 Verifying the client schedules

Check when the schedules are due to run using the `query event` command. If the nodes and schedules are set up and associated correctly, you will see an entry for each node/schedule pair, as shown in Example 12-17.

**Example 12-17  Querying client events**

```
<table>
<thead>
<tr>
<th>Scheduled Start</th>
<th>Actual Start</th>
<th>Schedule Name</th>
<th>Node Name</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>02/12/00 22:00:00</td>
<td></td>
<td>SERVER_NIGHTLY</td>
<td>LOCHNESS</td>
<td>Future</td>
</tr>
<tr>
<td>02/12/00 22:00:00</td>
<td></td>
<td>SERVER_NIGHTLY</td>
<td>ATLANTIC</td>
<td>Future</td>
</tr>
<tr>
<td>02/12/00 22:00:00</td>
<td></td>
<td>WORKSTN_NIGHTLY</td>
<td>PAMELA</td>
<td>Future</td>
</tr>
<tr>
<td>02/12/00 22:00:00</td>
<td></td>
<td>WORKSTN_NIGHTLY</td>
<td>PIERRE</td>
<td>Future</td>
</tr>
</tbody>
</table>
```

The scheduled events are listed as expected. One final task you can perform to ensure that the client knows about the schedule is to start the backup-archive client, and issue a `query schedule` command. In Example 12-18, we query the schedules on the client PIERRE.

**Example 12-18  Querying a client schedule from the client**

IBM Tivoli Storage Manager
Command Line Backup/Archive Client Interface
  Client Version 5, Release 3, Level 2.0
  Client date/time: 02/21/2006 14:43:21
(c) Copyright by IBM Corporation and other(s) 1990, 2005. All Rights Reserved.

Node Name: PIERRE
Session established with server LOCHNESS_SERVER1: Windows
  Server Version 5, Release 3, Level 2.2
Server date/time: 02/21/2006 14:39:15  Last access: 02/20/2006 16:50:14

```
q sched
  Schedule Name: WORKSTN_NIGHTLY
  Description: Nightly backup schedule for Workstation domain
  Schedule Style: Classic
    Action: Incremental
    Options:
    Objects:
      Priority: 5
  Next Execution: 7 Hours and 21 Minutes
    Duration: 1 Hour
    Period: 1 Day
    Day of Week: Any
    Month:
    Day of Month:
    Week of Month:
      Expire: Never

quit
```
Routine tasks

IBM Tivoli Storage Manager, like any other software system, has to be maintained and operated, in order to check that the tasks which are implemented are still working. To accomplish this, you may need to consider how many people will be dedicated to Tivoli Storage Manager.

Depending on the size of your installation, this can range from a single person to a complete team. In this chapter, we consider staffing requirements and discuss the various routine operations for which they will be responsible.
13.1 Operations staff

The operations team is responsible for monitoring, correcting errors, and working together with technical support to isolate any non-specific error condition. Basically, you need the following logical roles among your current or future Tivoli Storage Manager operations team. Depending on the actual number of people in the team, some or all of these roles may be combined into the same actual person:

- **Operator**: Handles Tivoli Storage Manager daily tasks and special server procedures.

- **Technical Support**: Installs new client code, upgrades server code, activates trace functions, deals with hardware configurations, answers end-user questions and handles error conditions.

- **Storage Administrator**: Performs sanity checks in the environment, evaluates capacity planning issues, and manages storage pools.

- **System Administrator**: Manages Tivoli Storage Manager policies, defines new nodes and management classes, and reports error conditions to technical support.

Tivoli Storage Manager provides a centralized point for backup, restore, archive, and retrieve operations, as well as backup sets and logical volume operations. All of these functions require monitoring and special operational procedures. As a rule of thumb, consider having at least two people responsible for Tivoli Storage Manager, so that each one can handle the workload in case of a problem (this way you can also avoid the risk of concentrating all your Tivoli Storage Manager information in only one person).

All the personnel directly involved in Tivoli Storage Manager administration — the Tivoli Storage Manager operations team — need to divide their Tivoli Storage Manager workload into some basic activities:

- **Server procedures**: Start and stop the Tivoli Storage Manager server.

- **Daily operations**: Check database free space, check activity log, check volumes in and out, send tapes to off-site, request to bring tapes on-site, check Tivoli Storage Manager devices, back up Tivoli Storage Manager database (or monitor its execution), and label new tapes.

- **Error or critical conditions**: Bring an off-site volume for the restore, create another database or recovery log, and deal with storage pool shortages, mirror write failures, communication errors, device problems, media errors, off-site tape not found, full or partial disaster recovery, and any other non-specific problems.
13.2 Server procedures

In this section we show how to start and stop a Tivoli Storage Manager server. Tivoli Storage Manager is essentially a software program that runs as any other application in your system. This means that you can start the server and let it run continuously and uninterrupted for days, weeks, or even longer if desired.

13.2.1 Starting the Tivoli Storage Manager server

The Tivoli Storage Manager server can run in either foreground or background. When running in foreground, you can have an active open console, with all system messages displayed (similar to Example 10-6 on page 310). From this server console, you can issue all administrative commands (depending on the authority which is available for the SERVER_CONSOLE administrator ID — see 8.1.2, “Considerations” on page 272). When running in background, you can close the active window without stopping the server process. This is the recommended way if you are planning to have the Tivoli Storage Manager server automatically started or stopped.

In this section we explain how to start a Tivoli Storage Manager server (we assume that it is not running yet). Otherwise, you must stop it first and issue the commands we explain. You can have the Tivoli Storage Manager server automatically started, in which case you need to configure it as a background process. If you wish to have it started manually, then the Tivoli Storage Manager server needs to be configured as a foreground process. For further details on how to start the Tivoli Storage Manager server, refer to the Tivoli Storage Manager Quick Start manual which comes with the product software.

Active console mode

To start a Tivoli Storage Manager server in foreground, run `dsmserv` in the Tivoli Storage Manager system directory. All output messages will be redirected to standard output. If you run the server in foreground, closing the window automatically halts the server.

Example 13-1 shows how to manually start the Tivoli Storage Manager server on AIX in active console mode. This server console session is established using a predefined administrator ID SERVER_CONSOLE. All Tivoli Storage Manager system messages are displayed on the console. The Tivoli Storage Manager server is ready to receive and send data to the client machines.

Example 13-1   Startup of server to demonstrate the console

```
root@Atlantic /usr/tivoli/tsm/server/bin: dsmserv
```
When you start the server, check the startup messages — either as they appear on the screen or by querying the server activity log. You will soon become familiar with them, so that you know what messages are “normal”, and what messages are cause for concern. For example, if one of the mirrored database or log volumes cannot be brought online, usually because of a disk problem, it will trigger a startup error message. If you note this when the server starts, you can start investigating and fixing the problem straight away. On Windows systems, you can also start the server in active console mode from the Tivoli Storage Manager server utilities program.

Figure 13-1 shows the main Tivoli Storage Manager server utilities screen and the Launch option to start Tivoli Storage Manager in console mode.
You can start the Tivoli Storage Manager server in background, either manually or with each system start.

**Manual start**

On UNIX/Linux, to manually start the Tivoli Storage Manager server in background, run the script rc.admserv, from the Tivoli Storage Manager installation directory, as shown in Figure 13-2.

*Example 13-2 Starting Tivoli Storage Manager in AIX*

```
root@Atlantic /usr/tivoli/tsm/server/bin: nohup rc.admserv >/dev/console 2>&1
```

On Windows, the Tivoli Storage Manager server is installed as a manual service. To start it, go to **Settings** → **Control Panel** → **Administrative Tools** → **Services**, select the Tivoli Storage Manager server service, and start it.
**Automatic start**

On AIX, after the Tivoli Storage Manager server installation, the system is configured to start the Tivoli Storage Manager server automatically during the system startup. The following entry is added to the system initialization file /etc/inittab:

```
autosrvr:2:once:/usr/tivoli/tsm/server/bin/rc.admserv >/dev/console 2>&1
#Start the IBM Tivoli Storage Manager server
```

Solaris, HP-UX, and Linux also use the /etc/inittab for automatic startup of processes, however you may prefer to put the commands into another of the possible startup files. We recommend that you refer to your operating system documentation and discuss with the system administrator to decide on the best configuration.

On Windows, the Tivoli Storage Manager server is installed as a manual service. To change its status to automatic, go to **Settings → Control Panel → Administrative Tools → Services**, select the Tivoli Storage Manager server service and change its startup setting to automatic.

The Tivoli Storage Manager server will be started automatically the next time the system is rebooted. You can then check that the server is running by trying to connect to the server from an administrative client or a backup-archive client, or by checking whether the Tivoli Storage Manager server process (UNIX/Linux) or service (Windows 2000/2003) is running.

**Administrative console session**

If you start the Tivoli Storage Manager server in the background, we highly recommend running an additional administrative client session in console mode on the administrative workstation. This session displays all Tivoli Storage Manager messages so that you can easily monitor the Tivoli Storage Manager system. However, it is not an active session, that is, you cannot issue administrative commands here. Example 13-3 starts an administrative session in console mode.

```
Example 13-3  Starting an admin session in console mode

root@Atlantic /usr/tivoli/tsm/server/bin: dsmadmc -console -id=report -password=mike
IBM Tivoli Storage Manager
Command Line Administrative Interface - Version 5, Release 3, Level 2.0
(c) Copyright by IBM Corporation and other(s) 1990, 2005. All Rights Reserved.

Session established with server TSM: AIX-RS/6000
  Server Version 5, Release 3, Level 2.2
  Server date/time: 02/14/06  14:01:13  Last access: 02/14/06  14:00:42
```
13.2.2 Stopping the Tivoli Storage Manager server

There are two ways of stopping a Tivoli Storage Manager server:

- **Immediate stop**: This brings the server down immediately. All system processes and client activity are interrupted.

- **Drain system activity and stop**: This is the recommended way, because you can understand what processes were in progress and what you may need to restart later on. Performing basic pre-checks and then stopping gives you (and the operations team) an idea of the workload that may need to be restarted. It is also a more orderly and therefore cleaner shutdown than the immediate stop.

**Stopping the Tivoli Storage Manager server immediately**

You can halt the server without warning if an unplanned operating system problem requires the server to be stopped. On Windows, terminate the server by stopping the service. To change the status of the server service, go to Settings → Control Panel → Administrative Tools → Services, select the Tivoli Storage Manager server service and stop it.

When you halt the server, all processes are abruptly stopped and client sessions are canceled, even if they are not completed. Any in-progress transactions are rolled back when the server is restarted. When the server is halted, neither administrator activity nor client operations are possible. We recommend that you halt the server only after current administrative and client node sessions have completed or canceled.

On all platforms, including Windows, use the `halt` command to shut down the Tivoli Storage Manager server, as shown in Example 13-4:

```
Example 13-4 Halt command

  tsm: ATLANTIC> halt
  ANR2017I Administrator SERVER_CONSOLE issued command: HALT
  ANR7835I Server thread 1 terminated in response to server shutdown.
  ANR7835I Server thread 14 terminated in response to server shutdown.
  ....
  ANR7835I Server thread 41 terminated in response to server shutdown.
  ANR7835I Server thread 43 terminated in response to server shutdown.
  ANR7835I Server thread 44 terminated in response to server shutdown.
  ANR0991I Server shutdown complete.
```

**Note**: We recommend that you create a specific analyst administrator for this purpose, so that it can only query the server.
Draining system activity before stopping the server

To shut down the server without severely impacting administrative and client node activity with the server, we recommend taking some steps before actually issuing the `halt` command to the server:

1. **Disable the server:** Prevents new client node sessions from starting.
   Disabling new client sessions prevents users from establishing client node sessions with the server. This command does not affect current client sessions in progress or system processes like migration and reclamation. To disable client node access to the server, use the `disable sessions` command, as shown in Example 13-5:

   **Example 13-5  Disable sessions**
   ```
   tsm: ATLANTIC> disable sessions
   ```
   When you disable client sessions from the server, administrators can still access it, and current client node activity completes unless the user logs off or you cancel the client node session.

   You can issue the `query status` command to determine if the server is enabled or disabled.

2. **Query for session information:** Identify any existing administrative and client node sessions.
   When an administrator or client accesses Tivoli Storage Manager, either an administrative or client node session is established with the server. Each session is assigned a unique session number - you can see that because of the multi-threading features of the Tivoli Storage Manager client, node ATLANTIC has many active sessions with the server. To request information about client sessions, enter the `query session` command, as in Example 13-6:

   **Example 13-6  Query session**
   ```
   tsm: ATLANTIC> query session
   ```
   ![Example output]

   **Note:** The QUIESCE option with the `halt` command is recommended only if you plan to do a database dump by using the `dsmc dumpdb` command immediately after halting. Because Tivoli Storage Manager supports online database backup (`backup db` command), the `dsmc dumpdb` command should rarely, if ever, be needed.
3. **Notify users:** Notify any existing administrative and client node sessions that you plan to shut down the server. Tivoli Storage Manager does not provide a network notification facility; you must use external means to notify users.

4. **Cancel any existing administrative or client node sessions:** To cancel a session, you must identify it by its session number. You can identify the session number by issuing the `query session` command. For example, in the screen above, one session number is 20 (client ATLANTIC). You can cancel that session by entering the `cancel session` command, as shown in Example 13-7.

**Example 13-7 Cancel session command**

```
  tsm: ATLANTIC> cancel session 20
```

A client may still have other active sessions running. If you want to cancel just those client sessions, you will have to cancel them one by one.

On the other hand, if you want to cancel all backup-archive client sessions, enter the `cancel session all` command, as shown in Example 13-8:

**Example 13-8 Cancel session all**

```
  tsm: ATLANTIC> cancel session all
  ANR0490I Canceling session 21 for node ATLANTIC (AIX)
  ANR0490I Canceling session 22 for node ATLANTIC (AIX)
  ANR0483W Session 21 for node ATLANTIC (AIX) terminated - forced by administrator.
  ANR0483W Session 22 for node ATLANTIC (AIX) terminated - forced by administrator.
```

If an operation, such as a backup or an archive process, is interrupted when you cancel the session, Tivoli Storage Manager rolls back the results of the current transaction. That is, any changes that are not yet committed to the database are undone. If necessary, the cancellation process may be delayed. For example, while a client restore session is in a restartable state, the file space is locked and no files can be moved from sequential volumes. This prevents the data from being migrated, moved, reclaimed, or backed up by...
another operation. These sessions will automatically expire when the specified restore interval has passed. For further details, see the query restore and cancel restore commands.

5. Find out if any other processes are running, such as server migration or inventory expiration, by using the query process command. If a database backup process is running, allow it to complete before halting the server. If other types of processes are running, cancel them by using the cancel process command.

6. Halt the server and all server operations by using the halt command as explained in “Stopping the Tivoli Storage Manager server immediately” on page 387.

13.3 Event monitoring

Tivoli Storage Manager provides a complete set of messages that can be enabled, disabled, stored, or even forwarded to other Tivoli Storage Manager servers, user programs, systems management consoles like Tivoli Enterprise Console (TEC) from Tivoli, or to (SNMP) management applications. These components are known as event receivers. You can enable the event receivers which are available and appropriate to your environment. Since event logging has a full set of functions and features that are beyond of the scope of this book, we only cover some basic settings.

Tivoli Storage Manager divides the range and the source of the messages by prefixes. For example, prefix ANR is for server messages, and most of prefix ANS messages are from backup-archive client sessions. Details of all these messages are explained in IBM Tivoli Storage Manager Messages, GC35-0382.

You can enable or disable messages for any particular receiver, except for one - you cannot disable server events from being sent to the server activity log.

At server startup, events are logged automatically to both the Tivoli Storage Manager server console and the Tivoli Storage Manager activity log. Messages can appear on the server console, the administrative client, an operator terminal, the Administration Center, the backup-archive client, or the space-management client.

The Tivoli Storage Manager activity log helps the administrator track server activity and monitor the system. The activity log contains messages generated by the server and is stored in the database. All messages sent to the server console are stored in the activity log. Examples of the types of messages stored in the activity log include:

- When client sessions start or end
- When migration starts or ends
- When backed up files are expired from data storage
- Any output generated from background processes

### 13.3.1 Event receivers

To check if event logging is enabled for a receiver, use the `query status` command and check the Active Receivers field as shown in Example 13-9.

**Example 13-9   Checking the active receivers field**

```
localhost:ATLANTIC> query status
Storage Management Server for AIX-RS/6000 - Version 5, Release 3, Level 2.2

   Server Name: ATLANTIC
   Server host name or IP address: 
   Server TCP/IP port number: 1500
      Crossdefine: Off
   Server Password Set: No
   Server Installation Date/Time: 02/03/06 15:18:02
   Server Restart Date/Time: 02/14/06 14:07:22
      Authentication: On
      Password Expiration Period: 90 Day(s)
      Invalid Sign-on Attempt Limit: 0
      Minimum Password Length: 0
      Registration: Closed
      Subfile Backup: No
      Availability: Enabled
      Accounting: Off
      Activity Log Retention: 1 Day(s)
      Activity Log Number of Records: 457
      Activity Log Size: <1 M
      Activity Summary Retention Period: 30 Day(s)
      License Audit Period: 30 Day(s)
      Last License Audit: 02/14/06 13:44:25
   Server License Compliance: Valid
      Central Scheduler: Active
      Maximum Sessions: 100
      Maximum Scheduled Sessions: 50
      Event Record Retention Period: 10 Day(s)
      Client Action Duration: 5 Day(s)
      Schedule Randomization Percentage: 25
      Query Schedule Period: Client
      Maximum Command Retries: Client
      Retry Period: Client
      Scheduling Modes: Any
      Log Mode: Normal
      Database Backup Trigger: Not Defined
```
We recommend running the `begin eventlogging` command to make sure that all defined receivers are active. Use this command to begin logging events to one or more receivers. Event logging automatically begins when the server is started for the console and activity log, and for any receivers that are started automatically based on entries in the server options file. A receiver for which event logging has begun is an active receiver. Example 13-10 shows you how to activate all defined receivers.

**Example 13-10  Activating defined receivers**

```bash
$ tsm: ATLANTIC> begin eventlogging
ANR1825I Event logging active for the CONSOLE receiver.
ANR1825I Event logging active for the ACTLOG receiver.
```

We recommend enabling nodename logging, so that you can also monitor client activity centrally in the server. Note that enabling client events to the activity log will increase the Tivoli Storage Manager database utilization. You can set a retention period for the log records by using the `set actlogretention` command.

To enable a specific receiver (such as CONSOLE, ACTLOG, EVENTSERVER, FILE, FILETEXT, SNMP, TIVOLI, USEREXIT) use the `enable events` command as shown in Example 13-11.

**Example 13-11  Enable events command**

```bash
$ tsm: ATLANTIC> enable events actlog all nodename=* 
ANR1844I ENABLE EVENTS command processed
```

**Tip for Windows:** Windows also has the EVENTLOG receiver, which sends events to the application eventlog, so that you can use the Windows Event Viewer to monitor a Tivoli Storage Manager system. We recommend sending the error and severe category events to the Windows Event Log.
13.4 Health monitoring

After the Integration Solutions Console (ISC) and Administration Center are installed, Tivoli Storage Manager servers should be added to the portal. Only Tivoli Storage Manager V5.3 and later releases can be added.

Health Monitoring uses the Tivoli Storage Manager Server Administrator account ADMIN_CENTER. This account is locked by default and needs to be unlocked and enabled as shown below before you can use Health Monitoring. You need to do this for all your Tivoli Storage Manager servers.

Attention: Ensure that the ADMIN_CENTER password is known to all of your Tivoli Storage Manager Administrators so that it does not become locked.

13.4.1 Enabling the ADMIN_CENTER account

To enable the ADMIN_CENTER account:

1. Open a view of your Tivoli Storage Manager server so that you can see the drop-down menu option Server Properties, as shown in Figure 13-2.

2. In the Server Properties portlet, select Administrators and check the box next to the ADMIN_CENTER account.

Figure 13-2 Server Properties view showing Administrators
3. Select **Modify Administrator** from the drop-down menu.

4. Update the password if necessary and ensure that the **Lock** check box is NOT checked, as shown in Figure 13-3.

![Figure 13-3 Illustrates ADMINCENTER account update password and Lock box unchecked.](image)

### 13.4.2 Using Health Monitoring

Using the Health Monitor, you get an overall view of how the servers and their storage devices are running. The health monitor analyzes the information it obtains from each server to present an overall health status:

**Normal (green)**

The server is running and the health monitor identified no problems.

**Unknown (blue)**

The server could not be contacted. Possible causes include:

- The server is not currently running.
- Network problems prevent communications with the server.
The administrator name that the health monitor uses, ADMIN_CENTER, is locked or does not exist on the server.

There were internal errors in the health monitor.

Click the server name to get more information about possible causes.

**Warning or Needs Attention (yellow)**
The health monitor detected conditions that might develop into significant problems. You need to take preventive actions for the server's database, storage devices, or both. Click the server name for details.

**Critical or Error (red)**
The health monitor detected significant problems in the server's database, storage devices, or both. The problems prevent the server from operating normally. For example, the database or recovery log is out of space, or a library is not functioning.

To configure the Health Monitor to check the health of Tivoli Storage Manager servers:

1. Open the Administration Center in the ISC.
2. Click Health Monitoring in the Navigation Tree.
3. Select **Configure Health Monitoring** in the drop-down menu in the Health Monitor portlet, as shown in Figure 13-4.

![Figure 13-4 Health monitor drop-down selection](image-url)
4. Enter the password and refresh interval to enable the Health Monitor, as shown in Figure 13-5. Click OK to complete.

Figure 13-5 Defining the Health Monitor password and refresh interval.

5. To display the status of a Tivoli Storage Manager Server, click Health Monitor in the Navigation Tree. Select the Health Monitor drop-down to display more details, as shown in Figure 13-6.

Figure 13-6 Health monitor details.

The expanded view of the Health Monitor provides further access to Schedule Information events, Server database, and Recovery log management functions, Activity log viewer with date and message type filters and Storage Device status.
13.5 Operational Reporting

The Tivoli Storage Manager Operational Reporting feature automates some of the monitoring tasks you typically perform manually. By generating reports and monitors, Operational Reporting notifies you if a server requires attention. Operational reports can be scheduled to run daily and are generated even if there are no problems. Operational monitors are special types of reports, and can be scheduled to run hourly. The monitors will send you a notification only if there are issues.

Operational Reporting does not maintain a separate database of information and is not a trending tool. Operational Reporting is included as part of the Tivoli Storage Manager for Windows server and is also available as a stand-alone package for a Windows server.

For information on installing the stand-alone package, see “Installing the IBM Tivoli Storage Manager Operational Reporting Stand-alone Package” in the IBM Tivoli Storage Manager for Windows Administrator’s Guide.

13.5.1 Functions

Operational Reporting is administered through the Microsoft Management Console on a Windows machine. Operational Reporting runs as a service and supports multiple Tivoli Storage Manager servers running on a single machine.

An operational report consists of the following parts:

- Standard report
- Customized summary
- Optional extensions that you can create.

You can select which sections to include in the report. The Operational Reporting installation package contains two default custom summary templates as:

- One for a report
- One for a monitor

Default e-mail messages will notify you if the server is running smoothly, or if there are issues such as failed or missed schedules. You can also link to a Web summary page to check operational reports about your server. An operational monitor will notify you either through e-mail or by sending an instant message to your Windows desktop.

Figure 13-7 shows the quick glance view of your Tivoli Storage Manager environment health using the Daily Report.
Operational Reporting can write data to a file that can be read by a TEC log file adapter. The log file adapter reads the information and forwards it to the Tivoli Enterprise Console. For more information on Operational Reporting, see *IBM Tivoli Storage Manager Version 5.3 Technical Guide*, SG24-6638.

### 13.6 Daily sanity checks

This section shows you how to perform some basic, yet important, system validations on your Tivoli storage Manager environment. These checks are run manually, but obviously many could and should, be automated.

We show the commands using the CLI - the same information is also available from the Administration Center; however use of the CLI allows you to script these...
commands. We recommend that you start by issuing these commands daily - then once you feel confident that the environment is performing smoothly, you might switch to a weekly schedule for some of the commands - to balance the amount of information to process, with the need to keep informed.

You should run monitoring commands as part of the daily operations check, as a sync-point for all your administrators, especially if there are multiple teams working different shifts and/or locations.

Tivoli storage Manager has a rich set of commands that allow you to monitor and create your own reports. The `query` command set is the base for most information form the server. Type `help query` or `help query <command>` for more details on all the options.

### Display database information
This section shows some important Tivoli Storage Manager queries for the database and recovery log. The queries are listed in alphabetical order.

To display information about your current database occupancy and how much space is still available for extension, use the `query db` command, as shown in Example 13-12.

**Example 13-12  Query db command and format, detailed report**

```
TSM: ATLANTIC> query db

Available Assigned Maximum Maximum Page Total Used Pct Max.
Space Capacity Extension Reduction Size Usable Pages Util Pct
--------- -------- --------- --------- ------- --------- --------- ----- ----- 
1,024 1,024 0 984 4,096 262,144 9,409 3.6 3.6

TSM: ATLANTIC> query db format=detail

Available Space (MB): 1,024
Assigned Capacity (MB): 1,024
Maximum Extension (MB): 0
Maximum Reduction (MB): 992
Page Size (bytes): 4,096
Total Usable Pages: 262,144
Used Pages: 8,361
Pct Util: 3.2
Max. Pct Util: 3.2
Physical Volumes: 2
Buffer Pool Pages: 131,072
Total Buffer Requests: 1,964
Cache Hit Pct.: 84.83
Cache Wait Pct.: 0.00
```
Backup in Progress?: No
Type of Backup In Progress:
Incrementals Since Last Full: 0
Changed Since Last Backup (MB): 29.43
Percentage Changed: 90.10
Last Complete Backup Date/Time: 02/24/2006 07:00:23
Estimate of Recoverable Space (MB): 0
Last Estimate of Recoverable Space (MB): 02/17/2006 11:48:26

Display database volumes information
Use the query dbvolume command to display information on one or more database volumes, including available, allocated, and free space on the volume. This command displays information about the specified database volume and any database volume copies, as shown in Example 13-13.

Example 13-13 Viewing database volumes

```
> query dbvol

<table>
<thead>
<tr>
<th>Volume Name</th>
<th>Copy</th>
<th>Volume Name</th>
<th>Copy</th>
<th>Volume Name</th>
<th>Copy</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Copy 1)</td>
<td>Status</td>
<td>(Copy 2)</td>
<td>Status</td>
<td>(Copy 3)</td>
<td>Status</td>
</tr>
<tr>
<td>/tsm/db/primary-</td>
<td>Sync'd</td>
<td>/tsm/db/mirror/-</td>
<td>Sync'd</td>
<td></td>
<td>Undefined</td>
</tr>
<tr>
<td>/dbp_01.dsm</td>
<td></td>
<td>/dbm_01.dsm</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

Display information on the recovery log
Use the query log command to display allocation information about the recovery log, including utilization, expansion, and reduction abilities, as in Example 13-14.

Example 13-14 Query log command

```
> query log

Available Assigned Maximum Maximum Page Total Used Pct Max.
Space Capacity Extension Reduction Size Usable Pages Util Pct
(MB) (MB) (MB) (MB) (bytes) Pages Util
--------- -------- --------- --------- ------- --------- --------- ----- ----- 
512 512 0 504 4,096 130,560 308 0.2 0.4

> query log format=detail

Available Space (MB): 512
Assigned Capacity (MB): 512
Maximum Extension (MB): 0
Maximum Reduction (MB): 508
Page Size (bytes): 4,096
Total Usable Pages: 130,560
Used Pages: 233
Information on log volumes

Use the `query logvolume` command to display information on one or more recovery log volumes, including available, allocated, and free space on the volume. This command displays information about the specified recovery log volume and any recovery log volume copies; the output is shown in Example 13-15.

Example 13-15  Viewing the log volumes

```
TS M: ATLANTIC>query logvolume

Volume Name       Copy    Volume Name       Copy    Volume Name       Copy
(Copy 1)          Status  (Copy 2)          Status  (Copy 3)          Status
----------------  ------  ----------------  ------  ----------------  -----
/tsm/log/primar-y/logp_01.dsm             /tsm/log/mirror-y/logm_01.dsm             
Sync'd             Sync'd                        Status             Undef-
```

Display sequential volume history information

Use the `query volhistory` command to display sequential volume history information that has been collected by the server, as shown in Example 13-16.

Example 13-16  Using the volume history for information on sequential volumes

```
TS M: ATLANTIC>query volhistory

Date/Time: 02/24/2006 09:24:26
Volume Type: STGNEW
Backup Series:
Backup Operation:
  Volume Seq:
  Device Class: LTO2-DC
  Volume Name: 022AKK
Volume Location:
Command:

  Date/Time: 02/24/2006 09:28:21
  Volume Type: STGNEW
Backup Series:
```
13.6.1 Data storage

In this section, we describe some important Tivoli Storage Manager queries for data storage. The queries are listed in alphabetical order.

**Client node storage utilization**

Use the `query auditoccupancy` command (Example 13-17) to display information about the client node server storage utilization. The displayed information is current as of the last license audit processed by the Tivoli Storage Manager server. You can use this information to determine if you need to balance client node storage utilization needs, as well as to bill clients for storage usage.

*Example 13-17  Auditoccupancy command*

```plaintext
tsm: ATLANTIC> query auditoccupancy
License information as of last audit on 02/26/06 at 16:43:26.

<table>
<thead>
<tr>
<th>Node Name</th>
<th>Backup Storage Used (MB)</th>
<th>Archive Storage Used (MB)</th>
<th>Space-Managed Storage Used (MB)</th>
<th>Total Storage Used (MB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLIENT</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>ATLANTIC</td>
<td>1,236</td>
<td>0</td>
<td>0</td>
<td>1,236</td>
</tr>
<tr>
<td>MILES</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LOSGATOS</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PROPAGANDA</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>TRCKA</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PARIS</td>
<td>4,670</td>
<td>0</td>
<td>0</td>
<td>4,670</td>
</tr>
<tr>
<td>DIOMEDE</td>
<td>159</td>
<td>0</td>
<td>0</td>
<td>159</td>
</tr>
</tbody>
</table>
```
Display drive information
Use the `query drive` command to display information about a drive located in a server-attached library. Use this command to validate if all drives are online, as shown in Example 13-18.

Example 13-18  Query drive command to discover drive details

```
  tsm: ATLANTIC> query drive

  Library Name  Drive Name     Device Type  On-Line
  ------------  -----------     -----------  -------
  3582_SHARED  DR00           LTO         Yes
  3582_SHARED  DR01           LTO         Yes
```

Query a library volume
Use the `query libvolume` command to display information about one or more volumes that have been previously checked into an automated library for use by the Tivoli Storage Manager server. This command includes both scratch and private tapes, as shown in Example 13-19.

Example 13-19  Query libvolume command

```
  tsm: ATLANTIC> query libvolume

  Library Name  Volume Name  Status     Owner    Last Use  Home     Device Type
  ------------  -----------  ----------  --------  ---------  -------  -----------
  3582_SHARED  020AKK       Private    ATLANTIC  Data     4,096    LTO
  3582_SHARED  021AKK       Scratch    ATLANTIC  Data     4,097    LTO
  3582_SHARED  026AKK       Scratch    ATLANTIC  Data     4,102    LTO
  3582_SHARED  027AKK       Scratch    ATLANTIC  Data     4,116    LTO
  3582_SHARED  028AKK       Scratch    ATLANTIC  Data     4,104    LTO
  3582_SHARED  029AKK       Scratch    ATLANTIC  Data     4,103    LTO
  3582_SHARED  030AKK       Scratch    ATLANTIC  Data     4,106    LTO
  3582_SHARED  031AKK       Scratch    ATLANTIC  Data     4,107    LTO
  3582_SHARED  038AKK       Scratch    ATLANTIC  Data     4,114    LTO
  3582_SHARED  039AKK       Scratch    ATLANTIC  Data     4,115    LTO
```

Number of scratch tapes
You can use an SQL query to display the number of scratch tapes available in the library, as shown in Example 13-20. You want to be sure not to run out of scratch tapes, or backup and migration operations may fail.
Example 13-20  SQL statement to query for scratch tapes

```
select count(*) as NUM_SCRATCH_TAPES from LIBVOLUMES where STATUS = 'Scratch'
```

<table>
<thead>
<tr>
<th>NUM_SCRATCH_TAPES</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
</tr>
</tbody>
</table>

Sequential access storage pool media

Use the `query media` command to display information about the sequential access primary and copy storage pool volumes as shown in Example 13-21.

**Example 13-21  Query media command**

```
query media * stg=offdata
```

<table>
<thead>
<tr>
<th>Volume Name</th>
<th>State</th>
<th>Location</th>
<th>Automated LibName</th>
</tr>
</thead>
<tbody>
<tr>
<td>039AKK</td>
<td>Mountable in library</td>
<td></td>
<td>3582_SHARED</td>
</tr>
<tr>
<td>040AKK</td>
<td>Mountable in library</td>
<td></td>
<td>3582_SHARED</td>
</tr>
</tbody>
</table>

Display file space information by storage pool

Use the `query occupancy` command to display information on where a client's file spaces are stored and how much space they occupy. This command can be used to display information about file spaces that are stored in primary or copy storage pools, as shown in Example 13-22.

**Example 13-22  Query occupancy command**

```
query occupancy
```

<table>
<thead>
<tr>
<th>Node Name</th>
<th>Type Filespace Name</th>
<th>FSID Storage Pool Name</th>
<th>Number of Files</th>
<th>Physical Space Occupied (MB)</th>
<th>Logical Space Occupied (MB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATLANTIC</td>
<td>Bkup /</td>
<td>DISKDATA</td>
<td>1,002</td>
<td>12.09</td>
<td>12.09</td>
</tr>
<tr>
<td>ATLANTIC</td>
<td>Bkup /usr</td>
<td>DISKDATA</td>
<td>20,324</td>
<td>1,223.98</td>
<td>1,223.98</td>
</tr>
<tr>
<td>ATLANTIC</td>
<td>Bkup /TSM4SBR</td>
<td>DISKDATA</td>
<td>4</td>
<td>1,051.15</td>
<td>1,051.15</td>
</tr>
<tr>
<td>DIOMEDE</td>
<td>Bkup \diomede-\c$</td>
<td>DISKDATA</td>
<td>4,263</td>
<td>158.78</td>
<td>158.78</td>
</tr>
<tr>
<td>PARIS</td>
<td>Bkup \klchv4f-\c$</td>
<td>DISKDATA</td>
<td>31,167</td>
<td>4,520.61</td>
<td>4,520.61</td>
</tr>
<tr>
<td>PARIS</td>
<td>Bkup \klchv4f-\c$</td>
<td>DISKDIRS</td>
<td>2,734</td>
<td>1.83</td>
<td>1.83</td>
</tr>
</tbody>
</table>
Query one or more pending mount requests
Use the `query request` command to display information about one or more pending mount requests as shown in Example 13-23. Mount requests are issued for any library or manual drive that doesn't have a separate library manager configured.

**Example 13-23  Query request command**

```bash
tsm: ATLANTIC> query request
ANR8352I Requests outstanding:
ANR8323I 003: Insert ANY volume 041AKK R/W into entry/exit port of library 3582_SHARED within 60 minute(s); issue 'REPLY' along with the request ID when ready.
```

Query one or more storage pools
Use the `query stgpool` command to display information about one or more storage pools as shown in Example 13-24.

**Example 13-24  Command to query the server's storage pools**

```bash
tsm: ATLANTIC> query stgpool
```

<table>
<thead>
<tr>
<th>Storage Pool Name</th>
<th>Device Class Name</th>
<th>Estimated Capacity</th>
<th>Pct</th>
<th>Pct</th>
<th>High Mig Pct</th>
<th>Low Mig Pct</th>
<th>Next Storage Pool</th>
</tr>
</thead>
<tbody>
<tr>
<td>DISKDATA</td>
<td>DISK</td>
<td>12 G</td>
<td>56.7</td>
<td>56.7</td>
<td>80</td>
<td>30</td>
<td>TAPEDATA</td>
</tr>
<tr>
<td>DISKFILE</td>
<td>SEQF-DC</td>
<td>0.0 M</td>
<td>0.0</td>
<td>0.0</td>
<td>90</td>
<td>70</td>
<td>TAPEDATA</td>
</tr>
<tr>
<td>NONE</td>
<td>DISK</td>
<td>0.0 M</td>
<td>0.0</td>
<td>0.0</td>
<td>90</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>OFFDATA</td>
<td>LTO2-DC</td>
<td>409,600,00 G</td>
<td>0.0</td>
<td>0.0</td>
<td>90</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>OFFDIRS</td>
<td>LTO2-DC</td>
<td>0.0 M</td>
<td>0.0</td>
<td>0.0</td>
<td>90</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>TAPEDATA</td>
<td>LTO2-DC</td>
<td>409,600,00 G</td>
<td>0.0</td>
<td>0.0</td>
<td>90</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>TAPEDATA_LF</td>
<td>LT02C</td>
<td>0.0 M</td>
<td>0.0</td>
<td>0.0</td>
<td>90</td>
<td>70</td>
<td></td>
</tr>
</tbody>
</table>

Query one or more storage pool volumes
Use the `query volume` command to display information about one or more storage pool volumes as shown in Example 13-25. This command displays information about volumes defined to Tivoli Storage Manager. Scratch volumes are not
displayed by this command, since they have only been checked into a library as a scratch volume, but not yet defined or used by Tivoli Storage Manager.

**Example 13-25 Query volume command**

<table>
<thead>
<tr>
<th>Volume Name</th>
<th>Storage Pool Name</th>
<th>Device Class Name</th>
<th>Estimated Capacity</th>
<th>Pct</th>
<th>Volume Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>/tsm/stg/dirm/00000001B.-</td>
<td>DISKDIRS</td>
<td>DIRM-DC</td>
<td>1.8</td>
<td>100.0</td>
<td>Full</td>
</tr>
<tr>
<td>/tsm/stg/dirm/00000002A.-</td>
<td>DISKDIRS</td>
<td>DIRM-DC</td>
<td>64.0</td>
<td>0.0</td>
<td>Filling</td>
</tr>
<tr>
<td>/tsm/stg/diskdata/ddvol-</td>
<td>DISKDATA</td>
<td>DISK</td>
<td>2,048.0</td>
<td>41.1</td>
<td>On-Line</td>
</tr>
<tr>
<td>_01.dsm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/tsm/stg/diskdata/ddvol-</td>
<td>DISKDATA</td>
<td>DISK</td>
<td>2,048.0</td>
<td>49.2</td>
<td>On-Line</td>
</tr>
<tr>
<td>_02.dsm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/tsm/stg/diskdata/ddvol-</td>
<td>DISKDATA</td>
<td>DISK</td>
<td>2,048.0</td>
<td>71.2</td>
<td>On-Line</td>
</tr>
<tr>
<td>_03.dsm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/tsm/stg/diskdata/ddvol-</td>
<td>DISKDATA</td>
<td>DISK</td>
<td>2,048.0</td>
<td>66.6</td>
<td>On-Line</td>
</tr>
<tr>
<td>_04.dsm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/tsm/stg/diskdata/ddvol-</td>
<td>DISKDATA</td>
<td>DISK</td>
<td>2,048.0</td>
<td>68.4</td>
<td>On-Line</td>
</tr>
<tr>
<td>_05.dsm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/tsm/stg/diskdata/ddvol-</td>
<td>DISKDATA</td>
<td>DISK</td>
<td>2,048.0</td>
<td>43.7</td>
<td>On-Line</td>
</tr>
<tr>
<td>_06.dsm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>020AKK</td>
<td>TAPEDATA_LF</td>
<td>LT02C</td>
<td>381,468.0</td>
<td>0.7</td>
<td>Filling</td>
</tr>
<tr>
<td>022AKK</td>
<td>TAPEDATA</td>
<td>LT02-DC</td>
<td>409,600.0</td>
<td>0.0</td>
<td>Filling</td>
</tr>
<tr>
<td>023AKK</td>
<td>OFFDATA</td>
<td>LT02-DC</td>
<td>409,600.0</td>
<td>0.0</td>
<td>Filling</td>
</tr>
</tbody>
</table>

**13.6.2 Client-server activity**

In this section, we describe some important Tivoli Storage Manager queries for client-server activities. The queries are listed in alphabetical order.

**Search activity log for messages**

One of the basic commands to access the activity log is the *query actlog* command. Use the *query actlog* command to search the server activity log for messages, as shown in Example 13-26. You can select messages by date/time range, message number, or string expression. If the command is issued without parameters, all messages that were generated in the last hour are displayed.

**Example 13-26 Query actlog command output**

```
02/27/2006 09:20:14      ANR8323I 001: Insert ANY volume 041AKK R/W into entry/exit port of library 3582_SHARED within 60 minute(s); issue 'REPLY' along with the request ID
```
To search for warning messages, use the query shown in Example 13-27.

Example 13-27  Using the search parameter with query actlog

```
tsm: ATLANTIC>query actlog search="ANR????W"
```

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>02/27/2006 08:33:01</td>
<td>ANR0568W Session 51 for admin ADMIN (AIX) terminated - connection with client severed. (SESSION: 51)</td>
</tr>
<tr>
<td>02/27/2006 08:43:27</td>
<td>ANR2121W ATTENTION: More than 28 MB of the database has changed and the last database backup was more than 24 hours ago. Use the BACKUP DB command to provide for database recovery.</td>
</tr>
<tr>
<td>02/27/2006 09:09:55</td>
<td>ANR8925W Drive DR00 in library 3582_SHARED has not been confirmed for use by server STA_DIOMEDE for over 900 seconds. Drive will be reclaimed for use by others.</td>
</tr>
</tbody>
</table>
Query scheduled and completed events

Use the query event command to display scheduled and completed events. This command takes two forms, depending on whether the query applies to scheduled client operations or scheduled administrative commands.

Each scheduled client operation and administrative command is called an event. The server tracks each scheduled event and records the results of each function in the database. An event record is created whenever processing of a scheduled command is started or missed.

The query event command may display information about an event for which there is no event record. For example, if you request information about a scheduled event in the future, the query event command displays the status of Future for the event even though no event record has been created for this event. In addition, the query event command displays the status for past events whose event records have already been removed from the database. In this case, the server returns the status of Uncertain, because the actual event status cannot be determined without the event records. Without parameters, the command displays scheduled client events as shown in Example 13-28.

Example 13-28 Query event command

```
  tsm: ATLANTIC> q event * *

  Scheduled Start  Actual Start  Schedule Name  Node Name  Status
  -----------------  -------------  ------------  ----------  ------
  02/27/06  00:00:00  02/27/06  00:30:11  INCR_DAILY PROPAGANDA  Completed
  02/27/06  01:00:00  02/27/06  02:00:10  INCR_DAILY LOSGATOS  Completed
  02/27/06  03:00:00  02/27/06  03:30:00  INCR_DAILY DIOMEDE  Future
  02/27/06  03:30:00  02/27/06  04:00:00  INCR_DAILY ATLANTIC  Future
```

To query scheduled administrative events use the type=administrative parameter, as shown in Example 13-29.

Example 13-29 Query event type syntax

```
  tsm: ATLANTIC> query event * type=administrative

  Scheduled Start  Actual Start  Schedule Name   Status
  -----------------  -------------  ------------  ------
  02/27/06  06:00:00  02/27/06  06:00:20  MIGRATION_START  Completed
  02/27/06  11:00:00  02/27/06  11:00:00  MIGRATION_STOP  Future
  02/27/06  12:00:00  02/27/06  12:00:00  EXPIRATION  Future
  02/27/06  13:00:00  02/27/06  13:00:00  RECLAIM_START  Future
  02/27/06  13:00:00  02/27/06  13:00:00  RECLAIM STOP  Future
  02/27/06  18:00:00  02/27/06  18:00:00  RECLAIM_STOP  Future
  02/27/06  18:00:00  02/27/06  18:00:00  RECL_DRM_STOP  Future
```
Query one or more server processes

Use the `query process` command to display information about one or more active background processes, as shown in Example 13-30.

**Example 13-30  Query process command**

```
<table>
<thead>
<tr>
<th>Process Number</th>
<th>Process Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Database Backup</td>
<td>Full backup: 0 pages of 8383 backed up. Waiting for mount of scratch volume (3 seconds).</td>
</tr>
</tbody>
</table>
```

Query restartable restore sessions

Use the `query restore` command to display information about the restartable restore sessions recorded in the server database. Certain restore operations invoke a special protocol with Tivoli Storage Manager. These special restores are called restartable restore sessions. It is desirable to know which restores are using this protocol for two reasons:

1. Restartable restore sessions that fail for some reason (network outage, client failure, or server outage) can be restarted from the last committed transaction where the restore operation left off. This can save valuable time because these restore operations do not have return to the beginning of the operation. The `query restore` command displays the restartable restore sessions.

2. Restartable restore sessions lock the filespace, and do not allow files to be moved off of sequential volumes. The `query restore` command displays the restartable restore sessions and their associated filespace, as shown in Example 13-31. The `cancel restore` command can be used to cancel a restartable restore session.

**Example 13-31  Query restore for any restartable restore processes**

```
<table>
<thead>
<tr>
<th>Sess Number</th>
<th>Restore State</th>
<th>Elapsed Minutes</th>
<th>Node Name</th>
<th>Filespace Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1</td>
<td>Restartable</td>
<td>1</td>
<td>ATLANTIC</td>
<td>/usr</td>
</tr>
</tbody>
</table>
```
Query one or more client sessions

Use the `query session` command to display information on one or more administrative and client node sessions, as shown in Example 13-32. For backup and restore, there are usually at least two sessions, and sometime more - one is a control session.

**Example 13-32   Query session**

```markdown
<table>
<thead>
<tr>
<th>Sess Comm.</th>
<th>Sess</th>
<th>Wait</th>
<th>Bytes</th>
<th>Bytes</th>
<th>Sess</th>
<th>Platform</th>
<th>Client</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>112</td>
<td>Tcp/Ip</td>
<td>IdleW</td>
<td>4 S</td>
<td>1.1 K</td>
<td>803</td>
<td>Node</td>
<td>AIX</td>
</tr>
<tr>
<td></td>
<td>ATLANTIC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>113</td>
<td>Tcp/Ip</td>
<td>RecvW</td>
<td>0 S</td>
<td>1.3 K</td>
<td>719.4 M</td>
<td>Node</td>
<td>AIX</td>
</tr>
<tr>
<td></td>
<td>ATLANTIC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>145</td>
<td>Tcp/Ip</td>
<td>IdleW</td>
<td>0 S</td>
<td>1.1 K</td>
<td>803</td>
<td>Node</td>
<td>AIX</td>
</tr>
<tr>
<td></td>
<td>ATLANTIC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>236</td>
<td>Tcp/Ip</td>
<td>RecvW</td>
<td>0 S</td>
<td>1.3 K</td>
<td>719.4 M</td>
<td>Node</td>
<td>AIX</td>
</tr>
<tr>
<td></td>
<td>ATLANTIC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>145</td>
<td>Tcp/Ip</td>
<td>Run</td>
<td>0 S</td>
<td>111.6 K</td>
<td>106</td>
<td>Admin</td>
<td>WINNT</td>
</tr>
<tr>
<td></td>
<td>ADMIN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>236</td>
<td>Tcp/Ip</td>
<td>Run</td>
<td>0 S</td>
<td>10.8 K</td>
<td>706</td>
<td>Admin</td>
<td>AIX</td>
</tr>
<tr>
<td></td>
<td>ADMIN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

13.7 Storage media management

This section shows you how to use Tivoli Storage Manager removable media (tapes or optical media), how to label them, and how to manage the many possible stages a tape can have. When Tivoli Storage Manager accesses a removable media volume, it checks the volume name in the label header to ensure that the correct volume is accessed. Although we use the term *tape* for simplicity, this section applies equally to optical media.

Tape is a vital component of the storage hierarchy. When you start using Tivoli Storage Manager, you have to create storage pools to hold all your data. After a storage pool is defined, you also need to define volumes to the storage pool, so that you have space to store the data. Tivoli Storage Manager allows you to use and reuse removable media to store data.
13.7.1 Tape use overview

All tape volumes must be labeled before they can be used. A volume can be either explicitly defined, or not. If you want a volume to be used only when it is requested by name, then you define it to Tivoli Storage Manager. A defined volume is a private volume and is assigned to a specific storage pool. A volume that is not defined is a scratch volume. A storage pool can request available scratch volumes up to the number specified for that storage pool.

How does a tape get used in Tivoli Storage Manager?

1. Tapes are labelled and checked into the library. In a manual library, checking in simply means storing them (for example, on shelves). Checkin to an automated library means adding media to the library volume inventory. You have to decide whether to checkin as private or scratch volumes - using scratch volumes is more convenient in most cases.

2. Tapes get used in a number of Tivoli Storage Manager operations - client backup, archive, and HSM operations, server database backups, storage pool backups, migrations, and reclamations. Tapes are selected automatically for each of these operations according to server policies and availability.

Some tapes are kept on-site, and others are sent off-site for disaster recovery purposes.

3. The data on a tape volume changes over time as a result of:
   - Expiration of files.
   - Movement and deletion of file spaces by an administrator.
   - Automatic reclamation of media. The amount of data on the volume and the reclamation threshold set for the storage pool affects when the volume is reclaimed. When the volume is reclaimed, any valid, unexpired data is moved to other volumes or possibly to another storage pool (for storage pools with single-drive libraries).

When a volume becomes empty because all valid data either expires or is moved to another volume, the volume is available for reuse. The empty volume becomes a scratch volume again if it was initially a scratch volume.

If an off-site volume becomes empty, you are informed that you can bring it back on-site for reuse.

4. You determine when the media has reached its end of life - that is, when you do not want to use it any more either because it is too old to reliably store data or because you are upgrading to newer tape technology.

Figure 13-8 shows this process.
We give more information on physical location of tapes in 13.7.3, “On-site and off-site tape management” on page 414.

13.7.2 Label and checkin tapes

The `label libvolume` command requires parameters to specify:

- The name of the library where the storage volume is located
- The name of the storage volume
- Whether to overwrite a label on the volume
- Whether to search an automated library for volumes for labeling
- How to assign the labels:
  - To prompt for volume names in SCSI libraries
  - To read and use the barcode label in SCSI, 349X, and ACSLS libraries
- Whether to check in the volume:
– to the scratch pool
– or as a private volume

► The type of device (applies to 349X libraries only).

Depending on the library that you have (349x, SCSI, or MANUAL) the command syntax may be slightly different. For further details, type:

    help label libvolume.

The `label libvolume` command requires at least one drive that is not in use by any other Tivoli Storage Manager process. If there are mounted but idle volumes, use the `dismount volume` command to dismount the idle volume and make the drive available. By default, the `label libvolume` command does not overwrite an existing label - use the `OVERWRITE=YES` parameter to change this.

**Attention:** Overwriting an existing volume label, destroys all of the data that resides on the volume. Before relabeling a volume that still contains valid data, you can either move the data (`move data` command) or delete the contents of the volume (`delete volume` command with `discarddata=yes`). The labels on VolSafe volumes can be overwritten only once.

To label new tapes (scratch tapes) in a SCSI library with no barcode reader, follow Example 13-33. You will be prompted to enter a label for each tape in turn.

*Example 13-33   Labeling tapes without barcodes*

    tsm: ATLANTIC> label libv MYLIB search=yes labelsource=prompt checkin=scratch
    ANS8003I Process number 11 started.

    tsm: ATLANTIC> query request
    ANR8809I 011: Please provide the label name for the volume in slot element 34 of library MYLIB by issuing REPLY n LABEL=xxx within 60 minutes, where n is the request ID and xxx is the desired label name.

    tsm: ATLANTIC> reply 11 label=043akk
    ANR8499I Command accepted.

    tsm: ATLANTIC> query actlog search=043akk

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>02/14/06 13:56:29</td>
<td>ANR2017I Administrator TSMADMIN1 issued command: REPLY 11 label=043AKK</td>
</tr>
<tr>
<td>02/14/06 13:56:45</td>
<td>ANR8810I Volume 043AKK has been labeled in library MYLIB.</td>
</tr>
<tr>
<td>02/14/06 13:56:58</td>
<td>ANR8427I CHECKIN LIBVOLUME for volume 043AKK in library MYLIB completed successfully.</td>
</tr>
<tr>
<td>02/14/06 13:57:09</td>
<td>ANR2017I Administrator TSMADMIN1 issued command: QUERY</td>
</tr>
</tbody>
</table>
Checking in tapes in a library with barcode reader is shown in Example 6-18 on page 230.

If you have a manual library (e.g. a single standalone 8mm drive) with no barcode reader, specify the label you want to use, as shown in Example 13-34.

**Example 13-34 Manual library tape management**

```plaintext
tsm: ATLANTIC> label libvolume 8mmlib 043CC1 overwrite=yes
ANS8003I Process number 12 started.

tsm: ATLANTIC> query process
	Process Process Description Status
	-------- -------------------- --------------------------------------------------
	12 LABEL LIBVOLUME ANR8804I Labelling volume 043CC in library 8MMLIB.

tsm: ATLANTIC> query actlog search=043CC
```

```plaintext
<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>02/19/06 13:07:25</td>
<td>ANR2017I Administrator TSMADMIN1 issued command: LABEL libvolume 8MMLIB 043CC overwrite=yes</td>
</tr>
<tr>
<td>02/19/06 13:07:25</td>
<td>ANR8326I 012: Mount 8MM volume 043CC R/W in drive RMT1 (/dev/mt1) of library 8MMLIB within 60 minutes.</td>
</tr>
<tr>
<td>02/19/06 13:09:41</td>
<td>ANR8372I 012: Remove 8MM volume 043CC from drive RMT1 (/dev/rmt1) of library 8MMLIB.</td>
</tr>
<tr>
<td>02/19/06 13:09:41</td>
<td>ANR8800I LABEL LIBVOLUME for volume 043CC in library 8MMLIB completed successfully.</td>
</tr>
<tr>
<td>02/19/06 13:09:57</td>
<td>ANR2017I Administrator TSMADMIN1 issued command: QUERY ACTLOG search=043CC</td>
</tr>
</tbody>
</table>
```

**Tip:** Although Tivoli Storage Manager allows you to use a volume identification longer than six characters, we strongly recommend that you use up to six alphanumeric characters for the label (also known as VOLSER or Volume ID). This should be compatible with other ANSI styled label systems.

### 13.7.3 On-site and off-site tape management

Detailed information on this topic is in Chapter 19, “Disaster Recovery Manager” on page 597. We will simply summarize the process here. The distinction between on-site data and off-site data copies is a key component to successfully
handle many tape management procedures and one of the key concepts for Tivoli Storage Manager.

For our discussion, we assume that all data that is available in the company is on-site data. All data that is remotely stored in another location is off-site data.

In Figure 13-9 shows on-site and off-site tape volumes.

![Figure 13-9 On-site and off-site distinction.](image)

Tapes used for on-site data are copied to different tapes to be sent to an off-site location. Tivoli Storage Manager keeps track of all volumes and their locations - on-site and off-site.

Figure 13-10 shows a typical tape management with enhanced control of the actual state of the tapes.
Providing that all your primary storage pools are being backed up, then under normal conditions, the off-site tapes contain exactly the same versions of valid data that you have on-site. This means that on-site and off-site volumes mirror the same data, correct to the time of the last storage pool backup operation. This does not mean that you have the same amount of tapes, but simply shows that what you have “inside” is the same that you have “outside” (regardless of the number of tapes).

Figure 13-11 shows how data is generically processed on tape from the moment the data is backed up until it is sent to the off-site location.
13.7.4 Moving data from on-site to off-site

The commands explained in this section show how to move data from on-site to off-site. Note that Tivoli Disaster Recovery Manager (see Chapter 19, “Disaster Recovery Manager” on page 597) automatically performs most of the tape movement operations described here, reducing the need for generating, testing and maintaining separate scripts.

For manually mounted devices, Tivoli Storage Manager sends messages to request that volumes be mounted when they are needed. When Tivoli Storage Manager needs to write to a tape, it first tries to write to a previously used tape in the storage pool with enough room for new data (within the restrictions of collocation, if enabled). If that is not possible, Tivoli Storage Manager asks to mount a SCRATCH (unused) tape for use. In manual libraries, there is no inventory — that is, the command `query libvolume` does not apply. Therefore there is no concept of checking volumes in and out.

For devices in automated libraries (such as a tape autochanger), Tivoli Storage Manager interacts with the library to mount volumes, but sends messages when
the library needs attention from an operator. Tivoli Storage Manager also tracks the inventory of media in each automated library. You need to manage new tapes that you have labeled by the `label libvolume` command or they are reclaimed volumes from off-site.

The steps that you need to perform to send data off-site are:

1. Back up your vital data to the copy storage pools.
2. List all volumes that must be sent to off-site.
3. Check out volumes from the library.
4. Update the volume location to off-site.

**Backup your vital data**

Use the `backup stgpool` command to create copies of files that reside in a primary storage pool, and store them in a copy storage pool, as shown in Example 13-35. File versions are only copied if they do not already exist in the copy storage pool — if a file is already present in the specified copy storage pool, then it is not recopied. However, if a copy of a physical file already exists in the copy storage pool, but the copy is marked damaged, a new copy will be created, provided that the primary physical file is not also marked damaged. The following commands back up on-site data from the DISKDATA and DISKDIRS storage pools to the OFFDATA and DISKDIRS storage pools respectively. This task can also be automated using a server script, as shown in Example 12-5 on page 367.

*Example 13-35   Creating off-site backups*

```
 tsm: ATLANTIC> backup stgpool diskdata offdata
 ANR2017I Administrator TSMADMIN1 issued command: BACKUP STGPOOL diskdata
     offdata
 ANR0984I Process 23 for BACKUP STORAGE POOL started in the BACKGROUND at
     15:12:44.
 ANR2110I BACKUP STGPOOL started as process 23.
 ANR1210I Backup of primary storage pool DISKDATA to copy storage pool OFFDATA
     started as process 23.
 ANR8337I 3582SHARED volume 044AKK mounted in drive RMT1 (/dev/rmt1).
 ANR1340I Scratch volume 044AKK is now defined in storage pool OFFDATA.
 ANR1212I Backup process 23 ended for storage pool DISKDATA.
 ANR0986I Process 23 for BACKUP STORAGE POOL running in the BACKGROUND processed
     146 items for a total of 12,578,213 bytes with a completion state of SUCCESS at
     15:16:32.
 ANR1214I Backup of primary storage pool DISKDATA to copy storage pool OFFDATA
     has ended.  Files Backed Up: 146, Bytes Backed Up: 12578213, Unreadable Files:
     0, Unreadable Bytes: 0.
```
List volumes to send to off-site

Use the `query volume` command to list all off-site tapes that need to go to the off-site location. In our example, we assume that an off-site tape is any tape that belongs to the copy storage called OFFDATA and OFFDIRS which is still available in the library, and therefore, must be moved to a separate safe location (a vault). By using the ACCESS and STATUS parameters, we can distinguish between volumes newly added to the off-site pool, which therefore need to be taken off-site, and volumes already safely off-site. These are shown in Example 13-36.

**Example 13-36  More query volume command syntax examples**

```plaintext
tsm: ATLANTIC> query volume * access=readwrite,readonly status=full,filling stgpool=offdata
```

<table>
<thead>
<tr>
<th>Volume Name</th>
<th>Storage Pool Name</th>
<th>Device Class Name</th>
<th>Estimated Capacity (MB)</th>
<th>Pct</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>034AKK</td>
<td>OFFDIRS</td>
<td>COFFSITE</td>
<td>5,000.0</td>
<td>0.1</td>
<td>Filling</td>
</tr>
</tbody>
</table>
```

---

044AKK OFFDATA COFFSITE 5,000.0 0.2 Filling

```plaintext
tsm: ATLANTIC> backup stgpool diskdirs offdirs
```

ANR2017I Administrator TSMADMIN1 issued command: BACKUP STGPOOL diskdirs offdirs

ANR0984I Process 28 for BACKUP STORAGE POOL started in the BACKGROUND at 15:17:44.

ANR2110I BACKUP STGPOOL started as process 28.

ANR1210I Backup of primary storage pool DISKDIRS to copy storage pool OFFDIRS started as process 28.

ANR8337I 3582SHARED volume 034AKK mounted in drive RMT1 (/dev/rmt0).

ANR1340I Scratch volume 034AKK is now defined in storage pool OFFDIRS.

ANR1212I Backup process 23 ended for storage pool DISKDIRS.

ANR0986I Process 28 for BACKUP STORAGE POOL running in the BACKGROUND processed 146 items for a total of 106,496 bytes with a completion state of SUCCESS at 15:18:21.

ANR1214I Backup of primary storage pool DISKDIRS to copy storage pool OFFDIRS has ended. Files Backed Up: 146, Bytes Backed Up: 106496, Unreadable Files: 0, Unreadable Bytes: 0.

```plaintext
tsm: ATLANTIC> query volume * stg=offdirs
```

<table>
<thead>
<tr>
<th>Volume Name</th>
<th>Storage Pool Name</th>
<th>Device Class Name</th>
<th>Estimated Capacity (MB)</th>
<th>Pct</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>034AKK</td>
<td>OFFDIRS</td>
<td>COFFSITE</td>
<td>5,000.0</td>
<td>0.1</td>
<td>Filling</td>
</tr>
</tbody>
</table>
```
The `query volume` command lists the volumes just used, 044AKK and 034AKK. The off-site movement operation must take into account two types of volumes: FULL and FILLING. You must issue the command for both status, so that you move all needed volumes.

We recommend that you keep a record of these volumes for tracking purposes.

### Checking out volumes from the library

This command is only used if you have an automated tape library. Use the `checkout libvolume` commands to remove Tivoli Storage Manager control of a storage volume located in a library. You must use the same volume listing that you got from the previous `query volume` section. In our case, the volumes are 044AKK and 034AKK, as shown in Example 13-37.

#### Example 13-37  Checkout library volume command

```bash
tsm: ATLANTIC> checkout libv 3582SHARED 044AKK
ANR2017I Administrator TSMADMIN1 issued command: CHECKOUT libv 3582SHARED 044AKK
ANR0984I Process 27 for CHECKOUT LIBVOLUME started in the BACKGROUND at 16:00:11.
ANR8434I CHECKOUT LIBVOLUME: Operation for volume 044AKK in library 3582SHARED started as process 27.
ANR8336I Verifying label of 3582SHARED volume 044AKK in drive RMT2 (/dev/rmt1).
ANR8307I 008: Remove 3582SHARED volume 044AKK from slot with element number 21 of library 3582SHARED; issue 'REPLY' along with the request ID when ready.

ANR2017I Administrator TSMADMIN1 issued command: CHECKOUT libv 3582SHARED 044AKK
ANR0984I Process 27 for CHECKOUT LIBVOLUME started in the BACKGROUND at 16:00:11.
ANR8434I CHECKOUT LIBVOLUME: Operation for volume 044AKK in library 3582SHARED started as process 27.
ANR8336I Verifying label of 3582SHARED volume 044AKK in drive RMT2 (/dev/rmt1).
ANR8307I 008: Remove 3582SHARED volume 044AKK from slot with element number 21 of library 3582SHARED; issue 'REPLY' along with the request ID when ready.

tsm: ATLANTIC> reply 8
ANR8499I Command accepted.
ANR8438I CHECKOUT LIBVOLUME for volume 044AKK in library 3582SHARED completed successfully.
ANR0985I Process 27 for CHECKOUT LIBVOLUME running in the BACKGROUND completed with completion state SUCCESS at 16:02:46.

tsm: ATLANTIC> checkout libv 3582SHARED 034AKK
```
ANR2017I Administrator TSMADMIN1 issued command: CHECKOUT libv 3582SHARE 034AKK
ANR0984I Process 16 for CHECKOUT LIBVOLUME started in the BACKGROUND at 16:03:11.
ANR8434I CHECKOUT LIBVOLUME: Operation for volume 034AKK in library 3582SHARE started as process 16.
ANR8336I Verifying label of 3582SHARE volume 034AKK in drive RMT2 (/dev/rmt1).
ANR8307I 009: Remove 3582SHARE volume 034AKK from slot with element number 25 of library 3582SHARE; issue 'REPLY' along with the request ID when ready.

tsm: ATLANTIC> reply 9
ANR8499I Command accepted.
ANR8438I CHECKOUT LIBVOLUME for volume 034AKK in library 3582SHARE completed successfully.
ANR0985I Process 27 for CHECKOUT LIBVOLUME running in the BACKGROUND completed with completion state SUCCESS at 16:03:49.

---

Tip: A REPLY command is not required if you specify a wait time of zero using the optional WAITTIME parameter on the checkin libvolume command. The default wait time is 60 minutes.

Update volume location to off-site

Before you update the volume information to the off-site location, you have to make sure that the desired volumes have been physically sent and delivered to the off-site location. To avoid a situation in which the volumes are requested for mounts while in transition to the off-site location, you can set the volumes to unavailable while in transition, by using the update volume command with STATUS set to UNAVAILABLE.

You can change the off-site location name to one suitable for your site. Once in the off-site location, Tivoli Storage Manager never asks for volumes with a status of off-site to be mounted.

The next example assumes that you have the volumes 044AKK and 034AKK from the previous backup stgpool commands and the volumes have been delivered to the off-site location. Now you want to update their location to “ITSO vault” as shown in Example 13-38.

Example 13-38 Update volume access location syntax example

tsm: ATLANTIC> update volume * access=offsite location="ITSO vault" whereaccess=readwrite,readonly wherestg=offdata wherestatus=full,filling

ANR2207I Volume 044AKK updated.

ANR2207I Volume 044AKK updated.

tsm: ATLANTIC> query volume 044AKK format=detail
13.7.5 Off-site tape management to on-site

In this section we show how to move off-site volumes to the on-site location. These off-site volumes either have no active data on them (status of EMPTY) or are being returned to recreate damaged data in a primary storage pool.

Off-site tapes can be seen as your second good copy of critical data. As you perform backup and archive operations, all data is saved in storage pools, which are the basic unit for on-site operations. When you perform a `backup stgpool` command, Tivoli Storage Manager verifies which data has not previously been sent to off-site yet and then performs the copy operation of any new data. This means the operation is incremental and hence minimizes the amount of time required to execute it.

As backup and archive data age and expire, the off-site tapes contain less and less active data. Off-site tape reclamation consolidates these tape volumes, replacing the partially filled tapes with full and empty tapes. The newly emptied tapes remain in a pending state until after the reuse delay period has expired. At this time the status of the tape changes to EMPTY. Empty tapes can be brought back on-site and returned to the scratch pool.

These are the steps that you need to perform to receive tapes from off-site:

1. Identify the volumes to be brought on-site.
2. Update the volume location.
3. Move the tape volumes from off-site to on-site.
4. Check in storage volumes into a library.

**Identify volumes to bring on-site**

You must first check which volumes are available to return on-site. The following `query volume` command shows two volumes (040AKK and 041AKK) that are now available to be brought back as shown in Example 13-39.

*Example 13-39  More examples of the query volume command*

```
tsm: ATLANTIC> query volume * access=offsite status=empty
Volume Name      Storage Pool Name  Device Class Name  Estimated Capacity (MB)  Pct  Util     Status
------------------------  -----------  ---------------  -------------------------  -----  --------  ------
040AKK          OFFDATA      COFFSITE                   0.0    0.0  Empty
041AKK          OFFDIRS      COFFSITE                   0.0    0.0  Empty
```
We recommend that you keep a record of these volumes for tracking purposes and use it as a shipping list for your off-site location.

The tape volumes should now be moved from the off-site location to your on-site location.

**Updating volume locations to on-site**

When the previously identified tape volumes have been returned on-site, you must update the location and access mode, so that the volume can be reused. In the next example, both volumes are deleted from the storage pool location and are now considered scratch volumes, as shown in Example 13-40.

*Example 13-40  More update volume syntax examples*

```plaintext
tsm: ATLANTIC> update volume * access=readwrite location="" wherestg=offdata
   wherestatus=empty whereaccess=offsite
   ANR2208I Volume 040AKK deleted from storage pool OFFDATA.

   tsm: ATLANTIC> update volume * access=readwrite location="" wherestg=offdirs
   wherestatus=empty whereaccess=offsite
   ANR2208I Volume 041AKK deleted from storage pool OFFDIRS.
```

**13.7.6 Checking volumes into a library**

To inform the server that a new volume is available in an automated library, check in the volume with the `checkin libvolume` command or `label libvolume` command with the `checkin` option specified. When a volume is checked in, the server adds the volume to its library volume inventory. You can use the `label libvolume` command to check in and label volumes in one operation.

When you check in a volume, you must supply the name of the library and the status of the volume (private or scratch). Do not mix volumes with barcode labels and volumes without barcode labels in a library device because barcode scanning can take a long time for unlabeled volumes. Use the `checklabel=yes` (not NO or BARCODE) option on the `checkin libvolume` command when checking VolSafe volumes into a library. This is true for both ACSLS and SCSI libraries.

The volumes are checked in as scratch, because they are empty. This is demonstrated in Example 13-41. We do not specify to label them because these tapes have returned from previous use - and therefore we can use their existing labels.
Example 13-41  Checkin libvolume for searching and defining scratch tapes

tsm: ATLANTIC> checkin libvolume 3582SHARED search=yes status=scratch
ANR2017I Administrator TSMADMIN1 issued command: CHECKIN libvolume 3582SHARED search=yes status=scratch
ANR0984I Process 10 for CHECKIN LIBVOLUME started in the BACKGROUND at 17:00:36.
ANR8422I CHECKIN LIBVOLUME: Operation for library 3582SHARED started as process 10.
ANR8430I Volume 040AKK has been checked into library 3582SHARED.
ANR8430I Volume 041AKK has been checked into library 3582SHARED.
ANR8431I CHECKIN LIBVOLUME process completed for library 3582SHARED; 2 volume(s) found.
ANR0985I Process 10 for CHECKIN LIBVOLUME running in the BACKGROUND completed with completion state SUCCESS at 17:05:29.

Allowing swapping of volumes when the library is full
If no empty slots are available in the library when you are checking in volumes, the check-in fails unless you allow swapping. If swapping is allowed and the library is full, Tivoli Storage Manager selects a volume to eject before checking in the volume you requested. Tivoli Storage Manager ejects the volume that it selects for the swap operation from the library and replaces the ejected volume with the volume that is being checked in. Use the SWAP=YES option on the checkin libvolume command to allow swapping, for example:

    checkin libvolume 3582SHARED 045AKK swap=yes

Tivoli Storage Manager selects the volume to eject by checking first for any available scratch volume, then for the least frequently mounted volume.

Tip: For further details about the checkin command and swap option, type: help checkin libvolume

13.7.7  Reclaiming off-site tapes

Off-site storage pool volumes expire their data in the same way as on-site volumes. The expiration process run by the Tivoli Storage Manager updates expired file version for both on-site and off-site volumes. You do not need to mount the off-site volume for this — it is done entirely as a server database update operation.

Off-site tapes also become emptier over time and need to be reclaimed. We need the reclamation process so that the size of our off-site storage pool does not grow indefinitely. We already know that reclaiming on-site volumes requires mounting the volume to be reclaimed, and copying its valid data onto a new tape,
thereby freeing the empty tape for reuse. It would be very inconvenient if reclaiming off-site volumes also required them to be mounted. Fortunately, this is not the case.

When an off-site volume is eligible for reclamation, Tivoli Storage Manager will determine the ON-SITE volumes, which contain the same valid data remaining on the off-site tape. It mounts the on-site tape and copies those files onto a new or existing volume belonging to the copy storage pool. This volume is then eligible to be transported off-site and the old off-site volume now switches to PENDING and then the EMPTY state. We can then bring it back on-site for reuse.

Tivoli Storage Manager will only ask to bring the old (unused off-site) tape after you send the new tape to off-site.

### 13.7.8 Database backup management

Managing Tivoli Storage Manager database backups is a critical task in the total environment. Database backups should be done every day, and the copies should be moved off-site to provide disaster recovery.

The steps involved in the movement of backups from on-site to off-site, and their return, are similar to those for storage pool data. Tivoli Disaster Recovery Manager simplifies the management of on-site/off-site tape movement for both storage pool and database data. We highly recommend using Tivoli Disaster Recovery Manager.

**Moving database backups off-site**

The steps that you need to perform to send database backups off-site are:

1. Back up your database.
2. Identify the volumes to be taken off-site.
3. Remove volumes from the library.
4. Move the volumes off-site.

**Back up your database**

You can perform a backup of the database at any time, by using the `backup db` command. For examples, see 5.8, “Database backup” on page 200.

This task can also be automated using a server script as shown in Example 12-1 on page 363.

Database backup volumes are tracked in a different manner to those of storage pools. Use the `query volhistory` command to identify tape volumes containing database backups. Alternately, you can use the activity log messages to identify
those tapes. Assuming that the database backup has been done, the command
to display the volumes is shown in Example 13-42.

Example 13-42   Querying the volume history file for db backups

```
tsm: ATLANTIC> query volhist type=dbbackup begindate=today

  Date/Time: 02/22/06   17:30:24
  Volume Type: BACKUPFULL
  Backup Series: 17
  Backup Operation: 0
  Volume Seq: 1
  Device Class: LTO2
  Volume Name: 046AKK
  Volume Location: 
  Command:
```

The volumes you require are those identified in the database backup with the
latest time stamp.

**Remove backups from library**

This step only applies if your backup tapes are in a library. You can use the
`checkout libvolume` command to remove database backup tapes from the library.
This is the same process as that for storage pool data (see Example 13-43).

Example 13-43   Removing the db backups from the library

```
tsm: ATLANTIC> checkout libv 3582SHARED 046AKK

ANR2017I Administrator TSMADMIN1 issued command: CHECKOUT libv 3582SHARED
046AKK
ANR0984I Process 17 for CHECKOUT LIBVOLUME started in the BACKGROUND at
18:06:33.
ANR8434I CHECKOUT LIBVOLUME: Operation for volume 046AKK in library 3582SHARED
started as process 13.
ANR8336I Verifying label of 3582SHARED volume 046AKK in drive RMT2 (/dev/rmt2).
ANR8322I 011: Remove 3582SHARED volume 046AKK from entry/exit port of library
3582SHARED; issue 'REPLY' along with the request ID when ready.

 ANR2017I Administrator TSMADMIN1 issued command: REPLY 11
 ANR2017I Administrator TSMADMIN1 issued command: REPLY 11
ANR8499I Command accepted.
ANR8438I CHECKOUT LIBVOLUME for volume 046AKK in library 3582SHARED completed
successfully.
ANR0985I Process 17 for CHECKOUT LIBVOLUME running in the BACKGROUND completed
with completion state SUCCESS at 18:07:40.
```
**Move volumes off-site**
You should move the backup volumes to your off-site location. We recommend that you track the tapes in a movement log.

**Reusing backup tapes**
You should keep a minimum of three days of database backup tapes. If you want to allow for holiday weekends, then a larger number, such as four or five, may be more appropriate. Our redbook environment uses five tapes.

The steps that you need to perform to reuse database backup tapes are:

1. Identify the volumes to be brought on-site.
2. Move the tape volumes from off-site to on-site.
3. Update the volume to scratch.
4. Check in storage volumes into a library.

**Identify the volumes to be brought on-site**
Database backups remain active until their entry is deleted from the volume history. However, once it has been deleted, Tivoli Storage Manager has no knowledge of the volume at all.

As there is no way to display just the oldest database backup volumes, we use the `query volhistory` command to identify all tape volumes containing database backups older than a specific number of days. The volumes you require are those with the oldest timestamp. The following command uses nine days, as shown in Example 13-44.

*Example 13-44  Query for dbbackup volumes in the past nine days*

```
tsm: ATLANTIC> query volhistory type=dbbackup enddate=today-9

Date/Time: 02/13/06  16:03:24
  Volume Type: BACKUPFULL
  Backup Series: 17
  Backup Operation: 0
  Volume Seq: 1
  Device Class: LTO2
  Volume Name: 023AKK
  Volume Location:
  Command:
```

**Move the tape volumes from off-site to on-site**
You should move the backup volumes from your off-site location to your site. We recommend that you track the tapes in a movement log.
**Update the volume to scratch**

You use the `delete volhistory` command to return the database backup volumes to scratch. Because there is no way to just delete the oldest database backup volumes, you must delete backups that are older than a specified number of days. Example 13-45 uses five days.

*Example 13-45  Deleting volume history five days and older*

```bash
> delete volhistory type=dbbackup todate=today-5
```

Do you wish to proceed? (Yes/No) y

ANR2467I DELETE VOLHISTORY: 1 sequential volume history entries were successfully deleted.

**Check in storage volumes into a library**

This step only applies if your backup tapes are in a library.

Use the `checkin libvolume` command (Example 13-46) to put the database backup tapes into the library. This is the same process as that for the storage pool data, which is shown in Example 13-41 on page 425.

*Example 13-46  Checkin library volume syntax example*

```bash
> checkin libvolume 3582SHARED search=yes status=scratch
```

ANR2017I Administrator TSMADMIN1 issued command: CHECKIN libvolume 3582SHARED search=yes status=scratch

ANR0984I Process 14 for CHECKIN LIBVOLUME started in the BACKGROUND at 19:21:12.

ANR8422I CHECKIN LIBVOLUME: Operation for library 3582SHARED started as process 14.

ANR8430I Volume 047AKK has been checked into library 3582SHARED.

ANR8431I CHECKIN LIBVOLUME process completed for library 3582SHARED; 1 volume(s) found.

ANR0985I Process 14 for CHECKIN LIBVOLUME running in the BACKGROUND completed with completion state SUCCESS at 19:22:39.

### 13.8 Error conditions

Tivoli Storage Manager can write error information to both the Tivoli Storage Manager activity log or the operating system log. Some errors may not be related to Tivoli Storage Manager. Thus, it may detect a system failure which may be related to hardware problems, or even a software component reporting error conditions.
13.8.1 Tivoli Storage Manager errors

Error analysis is a key point to your Tivoli Storage Manager environment. If for any reason Tivoli Storage Manager cannot write data to a tape, it may retry the operation (using hardware built-in recovery features) or it may fail due to a non-recoverable error. Tivoli Storage Manager will notify all error conditions to the console, the Tivoli Storage Manager activity log, or the operating system log. For example, you can check that Tivoli Storage Manager has an error condition logged by using the `query actlog` command with the SEARCH parameter as shown in Example 13-47.

Example 13-47  Actlog syntax used for identifying an error

```plaintext
  tsm: ATLANTIC> query actlog begindate=02/01/2006 search=*error*
```

ANR2017I Administrator TSMADMIN1 issued command: QUERY ACTLOG
begindate=02/01/2006 search=*error*

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>02/23/06  00:50:03</td>
<td>ANR8302E I/O error on drive RMT1 (/dev/rmt1)</td>
</tr>
<tr>
<td></td>
<td>(OP=LOCATE,</td>
</tr>
<tr>
<td></td>
<td>CC=0, KEY=03, ASC=31, ASCQ=00,</td>
</tr>
<tr>
<td></td>
<td>SENSE=70.00.03.00.00.00.00.58.00.00.00.00.31.00.FE.0A.36-</td>
</tr>
<tr>
<td></td>
<td>.30.40.51.00.09.01.31.08.0E.B8.50.00.00.28.00.00.31.89.0-</td>
</tr>
<tr>
<td></td>
<td>3.18.33.36.00.06.33.3D.00.06.00.00.00.DD.39.00.33.42.04.-</td>
</tr>
<tr>
<td></td>
<td>00.00.03.FF.00.00.DD.73.06.00, Description=An</td>
</tr>
<tr>
<td></td>
<td>undetermined error has occurred). Refer to Appendix</td>
</tr>
<tr>
<td></td>
<td>B in</td>
</tr>
<tr>
<td></td>
<td>the 'Messages' manual for recommended action.</td>
</tr>
</tbody>
</table>

```plaintext
[02/23/06 00:50:03] ANR8302E I/O error on drive RMT1 (/dev/rmt1)
(OP=LOCATE, CC=0, KEY=03, ASC=31, ASCQ=00, SENSE=70.00.03.00.00.00.00.58.00.00.00.00.31.00.FE.0A.36-.30.40.51.00.09.01.31.08.0E.B8.50.00.00.28.00.00.31.89.0-.3.18.33.36.00.06.33.3D.00.06.00.00.00.DD.39.00.33.42.04.-00.00.03.FF.00.00.DD.73.06.00, Description=An undetermined error has occurred). Refer to Appendix B in the 'Messages' manual for recommended action.]
```
02/24/06  03:21:45 ANR1414W Volume 032AKK access mode is "read-only" due to previous write error.

The example shows two library errors and one volume error. The volume error may be because of a true hardware problem or a media error. In this case, you may try to use another tape to isolate the problem or even use another tape unit. You might realize that it was just a matter of cleaning the unit.

13.8.2 Machine errors

Although Tivoli Storage Manager can handle many error conditions, it cannot resolve all possible errors. Therefore, when an unexpected error condition is met, Tivoli Storage Manager notifies the operating system event logging so that you may further isolate the problem. Note that not all error messages are true problems. Sometimes, they are simply information messages (for example, if a 3590 tape needs cleaning, then the 3494 library manager may mount the tape and create an information record indicating that a CLEAN operation was performed).

AIX error report using errpt

You can locate Tivoli Storage Manager errors in the AIX error log by using the operating system command **errpt.** You also can use the system management interface tool (SMIT) fast path to run the errpt command. To use the SMIT fast path, enter **smit errpt.**

Notice that the information shown in Figure 13-48 may not be all from Tivoli Storage Manager. In this example, the LFTDD error is not related to Tivoli Storage Manager. The **lmcpd** and **rmt1** errors might be a Tivoli Storage Manager problem or a hardware problem. You and/or the technical staff must investigate the conditions when the problem occurs and take the required actions.

**Example 13-48  Output example for the AIX errpt command**

```
root@ / > errpt | pg

IDENTIFIER TIMESTAMP  T C RESOURCE_NAME  DESCRIPTION
0F78A011  0215052600 T H rmt1           RECOVERY LOGIC INITIATED BY DEVICE
C6ACA566  0214122700 U S lmcpd          MESSAGE REDIRECTED FROM SYSLOG
C6ACA566  0214121300 U S lmcpd          MESSAGE REDIRECTED FROM SYSLOG
C6ACA566  0214083800 U S lmcpd          MESSAGE REDIRECTED FROM SYSLOG
D1A1AE6F  0212153100 I H rmt1           TAPE SIM/MIM RECORD
E507DCF9  0212083000 P S    LFTDD       SOFTWARE PROGRAM ERROR
E507DCF9  0212083000 P S    LFTDD       SOFTWARE PROGRAM ERROR
```
You can use the `errpt -a` command to look at the error details, as shown in Example 13-49.

*Example 13-49  AIX errpt command sample*

```
root@ / > errpt -a
LABEL: SYSLOG
IDENTIFIER:C6ACA566
Date/Time:       Thu Feb 23 00:50:03
Sequence Number: 45343
Machine Id:      000D0659A00
Node Id:         sm010
Class:           S
Type:            UNKN
Resource Name:   lmcpd
Description
MESSAGE REDIRECTED FROM SYSLOG
User Causes
OPERATOR REDIRECTED SYSLOG MESSAGES TO ERROR LOG
Recommended Actions
REVIEW DETAILED DATA
Detail Data
SYSLOG MESSAGE
ERROR on 3494a, volume 012AKK, ERA 83 Library Drive Exception
```

Example 13-50 shows another AIX `errpt` sample.

*Example 13-50  Another AIX errpt sample*

```
root@ / > errpt -a
LABEL: SYSLOG
IDENTIFIER:C6ACA566
Date/Time:       Fri Feb 24 03:21:45
Sequence Number: 45343
Machine Id:      000D0659A00
Node Id:         sm010
Class:           S
Type:            UNKN
Resource Name:   lmcpd
```
Description
MESSAGE REDIRECTED FROM SYSLOG

User Causes
OPERATOR REDIRECTED SYSLOG MESSAGES TO ERROR LOG

Recommended Actions
REVIEW DETAILED DATA

Detail Data
SYSLOG MESSAGE
ERROR on 3494a, volume 024AKK, ERA 83 Library Drive Exception

Windows System event viewer
Tivoli Storage Manager logs error, information, and warning conditions to the Windows system application log. You can browse it by using the Event Viewer utility which comes with Windows system.

Figure 13-12 shows an example of our Windows environment logging errors about the Tivoli Storage Manager application. Note that not all of these may be true error conditions. You must evaluate if it is actually a problem or simply a misconfiguration.
In this example, we selected for further analysis, one of the red events (indicated by the small Stop sign), which is an error condition. Figure 13-13 shows that a `QUERY DRIVE` command was executed in one of our Tivoli Storage Manager server test environment, but no drives were found since none were defined.
13.9 Summary

In this chapter we have covered many of the ongoing tasks that should be performed to ensure that your Tivoli Storage Manager environment enjoys a long and healthy life. Although automation is important for many tasks, the administrator must always be notified of actions taken, or warnings issued. You need to ensure that communication between the administrators and the Tivoli Storage Manager environment has been automated using alerts or e-mail notifications, which do require customization. In our next chapter we will move on to more advanced operational topics.
Advanced operations

In this chapter we cover exporting data from the server, server groups, reorganizing the database, and integrating the IBM Tivoli Storage Manager environment with the IBM Tivoli Enterprise Console (TEC).

The ability to export data and definitions from server to server is an efficient way to move (migrate) a client node from one server to another. Server groups is an efficient way of querying multiple servers with a single command. Reorganizing your database can provide a performance increase if the database has become fragmented. Integration with TEC provides an extra dimension to enterprise management.
14.1 Export server to server

In this section we cover the facility to export and import data directly between servers using TCP/IP.

Before Tivoli Storage Manager V5.2, you could export to media, physically move the media onto another server, then import. Often, this tended to be problematic and slow. With the new export function, you can export and import between servers directly.

Here we review the export process, and later in the chapter we describe an example scenario.

Tivoli Storage Manager server export and import processing supports the following functions:

- Direct server export to server import via TCP/IP between two servers of the same or differing platforms. Using the network eliminates the need for compatible sequential device types between servers for data movement.
- Merging of imported data into existing client file spaces on the server.
- Ability to export client file data based on a date and time specification, allowing maintenance of duplicate copies of client data on two or more servers.

You can still use the previous version of the `export` and `import` commands, specifying a sequential access deviceclass. For details, see the “EXPORT NODE -- To Sequential Media” section of the chapter “Administrative Commands” in the Administrator’s Reference for your server operating system platform.

14.2 Exporting data directly to another server

You can export all server control information or a subset of server control information when specifying one or more of the following `export` commands:

- `export admin`
- `export node`
- `export policy`
- `export server`

When you export data to a target server, you must specify the server name that will import the data.
14.2.1 Preparing to export to another server for immediate import

When you export data to another server over the network, the export triggers an immediate import on the target server. You can export data to a Tivoli Storage Manager server of the same or different operating system as the originating server. A server-to-server export operation performs the following operations:

1. Opens a session with the target server.
2. Authenticates with the administrator’s user ID and password.
3. Starts the equivalent of an import server process on the target server.

Prerequisites for exporting

- Tivoli Storage Manager must be installed and configured on the target server. This includes defining volumes for the database and recovery log, and defining initial server storage, as described in Chapter 5, “Database and recovery log” on page 177 and Chapter 6, “Data storage” on page 205.
- Enterprise configuration can optionally be defined for the target server so you can distribute consistent policies, administrators, schedules and scripts to the target server. For more information on enterprise configuration, see the chapter “Working with a Network of IBM Tivoli Storage Manager Servers” in the Administrator's Guide for your server operating system platform.
- The target server must be defined on the originating server, and vice versa, using the define server command.
- The administrator who will perform the export must be defined with the same administrator name and password on the target server, with System authority on the target server.

14.2.2 Exporting administrator information to another server

When you issue the export admin command, the server exports administrator definitions. Each administrator definition includes:

- Administrator name, password, and contact information
- Any administrative privilege classes the administrator has been granted
- Whether the administrator ID is locked from server access

You can specify a list of administrator names, or you can export all administrator names. Example 14-1 on page 440 shows an export of all administrator definitions to the target server LOCHNESS. Note that the PREVIEWImport=Yes option allows you to preview the export without actually exporting the data, to see how much space will actually be required on the target server. To actually perform the operation, re-run the command without the PREVIEW option.
### Example 14-1  Exporting administrators

```plaintext
tsm: ATLANTIC> export admin * toserver=lochness preview=yes
ANR0609I EXPORT ADMIN started as process 8.
ANS8003I Process number 8 started.

tsm: ATLANTIC> q act
```

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>03/01/2006 14:41:47</td>
<td>ANR2017I Administrator ADMIN issued command: EXPORT ADMIN * toserver=lochness previewimport=yes (SESSION: 252)</td>
</tr>
<tr>
<td>03/01/2006 14:41:47</td>
<td>ANR0984I Process 8 for EXPORT ADMIN started in the BACKGROUND at 14:41:47. (SESSION: 252, PROCESS: 8)</td>
</tr>
<tr>
<td>03/01/2006 14:41:47</td>
<td>ANR0609I EXPORT ADMIN started as process 8. (SESSION: 252, PROCESS: 8)</td>
</tr>
<tr>
<td>03/01/2006 14:41:47</td>
<td>ANR0402I Session 253 started for administrator ADMIN (Server) (Memory IPC). (SESSION: 252)</td>
</tr>
<tr>
<td>03/01/2006 14:41:47</td>
<td>ANR0408I Session 254 started for server ADMIN (Windows) (Tcp/Ip) for server registration. (SESSION: 252)</td>
</tr>
<tr>
<td>03/01/2006 14:41:47</td>
<td>ANR0610I EXPORT ADMIN started by ADMIN as process 8. (SESSION: 252)</td>
</tr>
<tr>
<td>03/01/2006 14:41:47</td>
<td>ANR0638I EXPORT ADMIN: Processing administrator ADMIN. (SESSION: 252)</td>
</tr>
<tr>
<td>03/01/2006 14:41:47</td>
<td>ANR0638I EXPORT ADMIN: Processing administrator ADMIN_CENTER. (SESSION: 252)</td>
</tr>
<tr>
<td>03/01/2006 14:41:47</td>
<td>ANR0638I EXPORT ADMIN: Processing administrator ATLANTIC. (SESSION: 252)</td>
</tr>
<tr>
<td>03/01/2006 14:41:47</td>
<td>ANR0638I EXPORT ADMIN: Processing administrator PARIS. (SESSION: 252)</td>
</tr>
<tr>
<td></td>
<td>...</td>
</tr>
<tr>
<td></td>
<td>...</td>
</tr>
<tr>
<td>03/01/2006 14:41:47</td>
<td>ANR0617I EXPORT ADMIN: Processing completed with status SUCCESS. (SESSION: 252)</td>
</tr>
<tr>
<td>03/01/2006 14:41:47</td>
<td>ANR0625I EXPORT ADMIN: Copied 11 administrators. (SESSION: 252)</td>
</tr>
<tr>
<td>03/01/2006 14:41:47</td>
<td>ANR0629I EXPORT ADMIN: Copied 872 bytes of data. (SESSION: 252)</td>
</tr>
<tr>
<td>03/01/2006 14:41:47</td>
<td>ANR0611I EXPORT ADMIN started by ADMIN as process 8 has ended. (SESSION: 252)</td>
</tr>
<tr>
<td>03/01/2006 14:41:47</td>
<td>ANR0986I Process 8 for EXPORT ADMIN running in the BACKGROUND processed 11 items for a total of 872 bytes with a completion state of SUCCESS at 14:41:47. (SESSION: 252)</td>
</tr>
</tbody>
</table>
14.2.3 Exporting client node information to another server

When you issue the `export node` command, the server exports client node definitions. Each client node definition includes:

- User ID, password, and contact information
- Name of the policy domain to which the client is assigned
- File compression status
- Whether the user has the authority to delete backed up or archived files from server storage
- Whether the client node ID is locked from server access

You can also specify whether to export file data. File data includes file space definitions and authorization rules, as well as the file objects themselves. You can to export file data in any of the following groupings of files:

- Active and inactive versions of backed up files, archive copies of files, and space-managed files
- Active versions of backed up files, archive copies of files, and space-managed files
- Active and inactive versions of backed up files
- Active versions of backed up files
- Archive copies of files
- Space-managed files

**Tip:** When you specify a list of node names or node patterns, the server will not report the node names or patterns that do not match any entries in the database. Check the summary statistics in the activity log to verify that the server exported all intended nodes.

Example 14-2 shows the export node process in preview mode.

*Example 14-2 Exporting a node*

```
**tsm:** ATLANTIC>**export node paris filedata=all toserver=lochness**
ANR0609I EXPORT NODE started as process 9.
ANS8003I Process number 9 started.

**tsm:** ATLANTIC>**q pr**

<table>
<thead>
<tr>
<th>Process Number</th>
<th>Process Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>EXPORT NODE</td>
<td>ANR0648I Have copied the following: 1 Nodes 1 Filespaces 3895 Backup Files 547429051 Bytes</td>
</tr>
</tbody>
</table>
```
14.2.4 Exporting policy information to another server

When you issue the `export policy` command, the server exports the following information belonging to each specified policy domain:

- Policy domain definitions
- Policy set definitions, including the active policy set
- Management class definitions, including the default management class
- Backup copy group and archive copy group definitions
- Schedule definitions
- Associations between client nodes and schedules

Example 14-3 on page 443 shows the export policy process in preview mode, and a selection of messages logged to the activity log.
Example 14-3 Exporting policy domains

```bash
tsm: ATLANTIC> export policy * toserver=lochness_serverl previewimport=yes
```

ANR0609I EXPORT POLICY started as process 14.
ANS8003I Process number 14 started.

tsm: ATLANTIC> q act

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>03/01/2006 15:08:29</td>
<td>ANR2017I Administrator ADMIN issued command: EXPORT POLICY * toserver=lochness previewimport=yes (SESSION: 255)</td>
</tr>
<tr>
<td>03/01/2006 15:08:29</td>
<td>ANR0984I Process 14 for EXPORT POLICY started in the BACKGROUND at 15:08:29. (SESSION: 255, PROCESS: 14)</td>
</tr>
<tr>
<td>03/01/2006 15:08:29</td>
<td>ANR0609I EXPORT POLICY started as process 14. (SESSION: 255, PROCESS: 14)</td>
</tr>
<tr>
<td>03/01/2006 15:08:29</td>
<td>ANR0402I Session 259 started for administrator ADMIN (Server) (Memory IPC). (SESSION: 255)</td>
</tr>
<tr>
<td>03/01/2006 15:08:29</td>
<td>ANR0408I Session 260 started for server ADMIN (Windows) (Tcp/Ip) for server registration. (SESSION: 255)</td>
</tr>
<tr>
<td>03/01/2006 15:08:29</td>
<td>ANR0610I EXPORT POLICY started by ADMIN as process 14. (SESSION: 255)</td>
</tr>
<tr>
<td>03/01/2006 15:08:29</td>
<td>ANR0639I EXPORT POLICY: Processing domain SERVER. (SESSION: 255)</td>
</tr>
<tr>
<td>03/01/2006 15:08:29</td>
<td>ANR0640I EXPORT POLICY: Processing policy set ACTIVE in policy domain SERVER. (SESSION: 255)</td>
</tr>
<tr>
<td>03/01/2006 15:08:29</td>
<td>ANR0640I EXPORT POLICY: Processing policy set SERVER in policy domain SERVER. (SESSION: 255)</td>
</tr>
<tr>
<td>03/01/2006 15:08:29</td>
<td>ANR0641I EXPORT POLICY: Processing management class IMAGE in domain SERVER, set SERVER. (SESSION: 255)</td>
</tr>
<tr>
<td>03/01/2006 15:08:29</td>
<td>ANR0642I EXPORT POLICY: Processing backup copy group in domain SERVER, set ACTIVE, management class SPECIAL. (SESSION: 255)</td>
</tr>
<tr>
<td>03/01/2006 15:08:29</td>
<td>ANR0605I EXPORT POLICY: No schedule associations were found in policy domain * for exporting. (SESSION: 255)</td>
</tr>
<tr>
<td>03/01/2006 15:08:29</td>
<td>ANR0617I EXPORT POLICY: Processing completed with status SUCCESS. (SESSION: 255)</td>
</tr>
<tr>
<td>03/01/2006 15:08:29</td>
<td>ANR0620I EXPORT POLICY: Copied 4 domain(s). (SESSION: 255)</td>
</tr>
<tr>
<td>03/01/2006 15:08:29</td>
<td>ANR0621I EXPORT POLICY: Copied 7 policy sets. (SESSION: 255)</td>
</tr>
<tr>
<td>03/01/2006 15:08:29</td>
<td>ANR0622I EXPORT POLICY: Copied 22 management classes. (SESSION: 255)</td>
</tr>
<tr>
<td>03/01/2006 15:08:29</td>
<td>ANR0623I EXPORT POLICY: Copied 27 copy groups. (SESSION: 255)</td>
</tr>
<tr>
<td>03/01/2006 15:08:29</td>
<td>ANR0629I EXPORT POLICY: Copied 4822 bytes of data. (SESSION: 255)</td>
</tr>
<tr>
<td>03/01/2006 15:08:29</td>
<td>ANR0611I EXPORT POLICY started by ADMIN as process 14 has ended. (SESSION: 255)</td>
</tr>
</tbody>
</table>
| 03/01/2006 15:08:29 | ANR0986I Process 14 for EXPORT POLICY running in the
14.3 Export and import server to server

This section demonstrates how to export a client’s data and metadata to another Tivoli storage Manager server, using server-to-server communication.

14.3.1 Moving a complete node’s data and meta data

In our lab we have configured the following environment:

- Tivoli Storage Manager AIX server (Atlantic)
- Tivoli Storage Manager Windows 2003 server (Lochness)
- Tivoli Storage Manager Windows XP client (Paris)

Figure 14-1 shows our setup.
The Windows XP Tivoli Storage Manager backup-archive client Sarah is currently configured to send its data to the Windows server Lochness. As shown in Example 14-4, we issue a **define server** command on the two servers, which will then allow us to authenticate and pass each other data.

On Atlantic, we issue the command.

**Example 14-4  Defining server Lochness on Atlantic**

```plaintext
tsm: ATLANTIC>define server lochness serverpassword=itso hladdress=9.43.86.84 lladdress=1500
ANR1660I Server LOCHNESS defined successfully.
```

Example 14-5 shows the reciprocal command on Lochness.

**Example 14-5  Defining server Atlantic on Lochness**

```plaintext
tsm: LOCHNESS_SERVER1>define server atlantic serverpassword=itso hladdress=9.43.86.49 lladdress=1500
ANR1660I Server ATLANTIC defined successfully.
```

After defining the two servers, we can issue the **export node** command on Atlantic. Lochness is the target server. Example 14-6 shows the example.

**Example 14-6  Exporting the node, Sarah**

```plaintext
tsm: LOCHNESS_SERVER1>export node sarah filedata=all toserver=atlantic
ANR0609I EXPORT NODE started as process 5.
ANS8003I Process number 5 started.
```

After starting the export process, you can monitor the progress on both servers using **query process**.

**Example 14-7  Querying processes on each node**

```plaintext
tsm: LOCHNESS_SERVER1>q pr

<table>
<thead>
<tr>
<th>Process Number</th>
<th>Process Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>EXPORT NODE</td>
<td>ANR0648I Have copied the following: 1 Nodes 2 Filespaces 9559 Backup Files 979764778 Bytes (0 errors have been detected). Current input volume(s): 029AKK,(89 Seconds) C:\TSMDATA\STG\DISKDIRS\00000020.BFS, (119 Seconds)</td>
</tr>
</tbody>
</table>
```

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Once the process is complete, the results can be found in the actlog output as shown in Example 14-8 and Example 14-9.

**Example 14-8  Lochness’ activity log for the export process**

```plaintext
tsm: LOCHNESS_SERVER1>q act

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>03/01/2006</td>
<td>ANR2017I Administrator ADMIN issued command: EXPORT NODE sarah filedata=all toserver=atlantic (SESSION: 32)</td>
</tr>
<tr>
<td>03/01/2006</td>
<td>ANR0984I Process 5 for EXPORT NODE started in the BACKGROUND at 16:13:08. (SESSION: 32, PROCESS: 5)</td>
</tr>
<tr>
<td>03/01/2006</td>
<td>ANR0609I EXPORT NODE started as process 5. (SESSION: 32, PROCESS: 5)</td>
</tr>
<tr>
<td>03/01/2006</td>
<td>ANR0642I Session 41 started for administrator ADMIN (Server) (Memory IPC). (SESSION: 32)</td>
</tr>
<tr>
<td>03/01/2006</td>
<td>ANR0408I Session 42 started for server ADMIN (AIX-RS/6000) (Tcp/Ip) for server registration. (SESSION: 32)</td>
</tr>
<tr>
<td>03/01/2006</td>
<td>ANR0610I EXPORT NODE: Processing node SARAH in domain WORKSTN. (SESSION: 32)</td>
</tr>
</tbody>
</table>
| 03/01/2006    | ANR0635I EXPORT NODE: Processing file space \\
|               | for node SARAH fsId 1 . (SESSION: 32)                                                       |
| 03/01/2006    | ANR0637I EXPORT NODE: Processing file space SYSTEM OBJECT for node SARAH fsId 2 . (SESSION: 32) |
| ...          |                                                                                             |
| 03/01/2006    | ANR0510I Session 32 opened input volume 029AKK. (SESSION: 32)                                |
| 03/01/2006    | ANR0405I Session 42 ended for administrator ADMIN (AIX-RS/6000). (SESSION: 32)               |
| 03/01/2006    | ANR0514I Session 32 closed volume 029AKK. (SESSION: 32)                                      |
| 03/01/2006    | ANR0617I EXPORT NODE: Processing completed with status SUCCESS. (SESSION: 32)                |
```
Example 14-9  Atlantic’s activity log of the import process

tsm: ATLANTIC>q act

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>03/01/2006 16:14:05</td>
<td>ANR0407I Session 269 started for administrator ADMIN (Windows) (Tcp/IP lochness.itsosj.sanjose.ibm.com(2998)). (SESSION: 269)</td>
</tr>
<tr>
<td>03/01/2006 16:14:05</td>
<td>ANR0984I Process 23 for IMPORT (from Server LOCHNESS_SERVER1) started in the BACKGROUND at 16:14:05. (SESSION: 269, PROCESS: 23)</td>
</tr>
<tr>
<td>03/01/2006 16:14:05</td>
<td>ANR4711I IMPORT SERVER (DATES=ABSOLUTE REPLACEDEFS=NO MERGE=NO PREVIEW=NO) by administrator ADMIN from server LOCHNESS_SERVER1 (Process 5) starting as process 23. (SESSION: 269, PROCESS: 23)</td>
</tr>
<tr>
<td>03/01/2006 16:14:05</td>
<td>ANR0610I IMPORT (from Server LOCHNESS_SERVER1) started by ADMIN as process 23. (SESSION: 269, PROCESS: 23)</td>
</tr>
<tr>
<td>03/01/2006 16:14:10</td>
<td>ANR0615I IMPORT (from Server LOCHNESS_SERVER1): Reading EXPORT NODE data from server LOCHNESS_SERVER1 exported 03/01/06 16:13:08. (SESSION: 269, PROCESS: 23)</td>
</tr>
<tr>
<td>03/01/2006 16:14:10</td>
<td>ANR0635I IMPORT (from Server LOCHNESS_SERVER1): Processing node SARAH in domain WORKSTN. (SESSION: 269, PROCESS: 23)</td>
</tr>
<tr>
<td>03/01/2006 16:14:10</td>
<td>ANR2034E QUERY NODE: No match found using this criteria. (SESSION: 269)</td>
</tr>
<tr>
<td>03/01/2006 16:14:10</td>
<td>ANR2060I Node SARAH registered in policy domain WORKSTN. (SESSION: 269)</td>
</tr>
<tr>
<td>03/01/2006 16:14:10</td>
<td>ANR2099I Administrative userid SARAH defined for OWNER access to node SARAH. (SESSION: 269)</td>
</tr>
<tr>
<td>03/01/2006 16:14:10</td>
<td>ANR0636I IMPORT (from Server LOCHNESS_SERVER1): Processing file space \sarah\c$ for node SARAH as file space \sarah\c$. (SESSION: 269, PROCESS: 23)</td>
</tr>
<tr>
<td>03/01/2006 16:14:10</td>
<td>ANR0636I IMPORT (from Server LOCHNESS_SERVER1): Processing file space SYSTEM OBJECT for node SARAH as file space</td>
</tr>
</tbody>
</table>
Note that the number of bytes exported and imported match (5,086,013,044), as they should.

To compare the two nodes, query the occupancy for Sarah on each server as shown in Example 14-10 and Example 14-11.

**Example 14-10  Querying occupancy on Lochness**

```plaintext
tsm: LOCHNESS_SERVER1>q occ sarah
```

<table>
<thead>
<tr>
<th>Node Name</th>
<th>Type</th>
<th>Filespace Name</th>
<th>FSID</th>
<th>Storage Pool Name</th>
<th>Number of Files</th>
<th>Physical Space Occupied (MB)</th>
<th>Logical Space Occupied (MB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SARAH</td>
<td>Bkup</td>
<td>\sarah\c$</td>
<td>1</td>
<td>DISKDIRS</td>
<td>2,714</td>
<td>1.84</td>
<td>1.84</td>
</tr>
<tr>
<td>SARAH</td>
<td>Bkup</td>
<td>\sarah\c$</td>
<td>1</td>
<td>OFFDATA</td>
<td>33,329</td>
<td>4,591.80</td>
<td>4,591.80</td>
</tr>
<tr>
<td>SARAH</td>
<td>Bkup</td>
<td>\sarah\c$</td>
<td>1</td>
<td>OFFDIRS</td>
<td>2,714</td>
<td>1.84</td>
<td>1.84</td>
</tr>
<tr>
<td>SARAH</td>
<td>Bkup</td>
<td>\sarah\c$</td>
<td>1</td>
<td>TAPEDATA</td>
<td>33,329</td>
<td>4,591.80</td>
<td>4,591.80</td>
</tr>
<tr>
<td>SARAH</td>
<td>Bkup</td>
<td>SYSTEM OBJECT</td>
<td>2</td>
<td>OFFDATA</td>
<td>1,810</td>
<td>243.42</td>
<td>243.42</td>
</tr>
<tr>
<td>SARAH</td>
<td>Bkup</td>
<td>SYSTEM OBJECT</td>
<td>2</td>
<td>TAPEDATA</td>
<td>1,810</td>
<td>243.42</td>
<td>243.42</td>
</tr>
</tbody>
</table>
Example 14-11  Querying occupancy on Atlantic

```bash
tsm: ATLANTIC> q occ sarah
```

<table>
<thead>
<tr>
<th>Node Name</th>
<th>Type</th>
<th>Filespace Name</th>
<th>FSID</th>
<th>Storage Pool Name</th>
<th>Number of Files</th>
<th>Physical Space Occupied (MB)</th>
<th>Logical Space Occupied (MB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SARAH</td>
<td>Bkup</td>
<td>\sarah\c$</td>
<td>1</td>
<td>DISKDATA</td>
<td>33,329</td>
<td>4,580.45</td>
<td>4,580.45</td>
</tr>
<tr>
<td>SARAH</td>
<td>Bkup</td>
<td>\sarah\c$</td>
<td>1</td>
<td>DISKDIRS</td>
<td>2,714</td>
<td>0.75</td>
<td>0.75</td>
</tr>
<tr>
<td>SARAH</td>
<td>Bkup</td>
<td>SYSTEM OBJECT</td>
<td>2</td>
<td>DISKDATA</td>
<td>1,810</td>
<td>242.84</td>
<td>242.84</td>
</tr>
</tbody>
</table>

Note that although Lochness appears to have more data for Sarah, we can see that the extra data are in copy storage pools. The actual number of files and directories, and the amount of data stored, is identical (including policy details).

After changing the destination server to Atlantic in Sarah’s dsm.opt file, the first backup will only send its incremental (changed) files since the last backup completed with Lochness.

The last step in the process is to delete the exported node from the originating server (that is, delete Sarah from Lochness). Use `delete filespace` to remove Sarah’s data, then `remove node` once all the filespaces have been removed.

14.3.2 Moving a node’s metadata

There may be situations where you may require moving just a node’s metadata. The metadata is all the details about the client node, but not the actual managed data for that client. The command for this operation is shown in Example 14-12—note the parameter `filedata=none`.

Example 14-12  Exporting metadata only

```bash
tsm: ATLANTIC> export node paris domains=workstn filedata=none toserver=lochness
ANR0609I EXPORT NODE started as process 888.
ANS8003I Process number 888 started.
```

After the export process, and changing the destination server in dsm.opt on Paris, the node Paris will connect to Lochness exactly as it would after a full data export. However, as there is no data on Lochness belonging to Paris, a complete backup (initial incremental) will be performed.
14.4 Moving a node back to an originating server

Suppose that we exported the client Sarah from the server Lochness to Atlantic. However, suppose also that we did not remove it, nor its managed backup data, from Lochness. We then switched Sarah to do backups to Atlantic. Some time passes, and we want to export Sarah back to the server Lochness, with all of the data. Using the merge feature of the export node command, we can ensure that the data originally on Lochness belonging to Sarah are brought up to date with subsequent backups performed on Atlantic. Here are some details on merging of files.

14.4.1 Merge file spaces

You can merge imported client backup, archive, and space-managed files into existing file spaces, and automatically skip duplicate files that may exist in the target file space on the server. Optionally, you can have new file spaces created. Choosing to merge file spaces allows you to restart a cancelled import operation because files that were previously imported can be skipped in the subsequent import operation. The merge option is available when you issue an export server or export node command. When you merge file spaces, the server performs versioning of the imported objects based on the policy bound to the files. An import operation may leave the target file space with more versions than policy permits. Files are versioned to maintain the policy intent for the files, especially when incremental export (using the FROMDate and FROMTime parameters) is used to maintain duplicate client file copies on two or more servers.

Here is how the server merges imported files, based on the type of object, when you specify MERGEfilespaces=Yes.

Archive objects

If an archive object for the imported node having the same TCP/IP address, TCP/IP port, name, insert date, and description is found to already exist on the target server, the imported object is skipped. Otherwise, the archive object is imported.

Backup objects

If a backup object for the imported node has the same TCP/IP address, TCP/IP port, insert date, and description as the imported backup object, the imported object is skipped. When backup objects are merged into existing file spaces, versioning will be done according to policy just as it occurs when backup objects are sent from the client during a backup operation. To do this:
If the imported backup object has a later (more recent) insert date than an active version of an object on the target server with the same node, file space, TCP/IP address, and TCP/IP port, then the imported backup object becomes the new active copy, and the active copy on the target server is made inactive. Tivoli Storage Manager expires this inactive version based on the number of versions that are allowed in policy.

If the imported backup object has an earlier (less recent) insert date than an active copy of an object on the target server with the same node, file space, TCP/IP address, TCP/IP port, then the imported backup object is inserted as an inactive version.

If there are no active versions of an object with the same node, file space, TCP/IP address, and TCP/IP port on the target server, and the imported object has the same node, file space, TCP/IP address, and TCP/IP port as the versions, then:

- An imported active object with a later insert date than the most recent inactive copy will become the active version of the file.
- An imported active object with an earlier insert date than the most recent inactive copy will be imported as an inactive version of the file.

Any imported inactive objects will be imported as other inactive versions of the object.

**Using the mergefilesystems option**

Following our successful export of Sarah’s data to Atlantic, we run a **dsmc incr** command on Sarah. Example 14-13 shows the updated occupancy figures on both servers after an incremental backup from Sarah to Atlantic.

**Example 14-13  Updated occupancy after an incremental backup**

```
<table>
<thead>
<tr>
<th>Node Name</th>
<th>Type</th>
<th>Filespace Name</th>
<th>FSID</th>
<th>Storage Pool Name</th>
<th>Number of Files</th>
<th>Physical Space Occupied (MB)</th>
<th>Logical Space Occupied (MB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SARAH</td>
<td>Bkup</td>
<td>\sarahr\c$</td>
<td>1</td>
<td>DISKDIRS</td>
<td>2,714</td>
<td>1.84</td>
<td>1.84</td>
</tr>
<tr>
<td>SARAH</td>
<td>Bkup</td>
<td>\sarahr\c$</td>
<td>1</td>
<td>OFFDATA</td>
<td>33,329</td>
<td>4,591.80</td>
<td>4,591.80</td>
</tr>
<tr>
<td>SARAH</td>
<td>Bkup</td>
<td>\sarahr\c$</td>
<td>1</td>
<td>TAPEDATA</td>
<td>33,329</td>
<td>4,591.80</td>
<td>4,591.80</td>
</tr>
<tr>
<td>SARAH</td>
<td>Bkup</td>
<td>SYSTEM OBJECT</td>
<td>2</td>
<td>OFFDATA</td>
<td>1,810</td>
<td>243.42</td>
<td>243.42</td>
</tr>
<tr>
<td>SARAH</td>
<td>Bkup</td>
<td>SYSTEM OBJECT</td>
<td>2</td>
<td>TAPEDATA</td>
<td>1,810</td>
<td>243.42</td>
<td>243.42</td>
</tr>
</tbody>
</table>
```

```
tsm: ATLANTIC>q occ sarah
```
We can see that on Atlantic, there are now 114 more files from C: and 1810 more files from the SYSTEM OBJECT.

We now run the **export node** operation, as shown in Example 14-14, to send the node Sarah back to Lochness, using the `mergefilespaces=yes` option.

**Example 14-14  Export with MERGEfilespaces**

```
tsm: ATLANTIC>export node sarah filledata=all toserver=lochness
mergefilespaces=yes
```

After the process has completed, the activity log on Lochness shows that only a small number of files were transferred; the export process only transferred what was necessary to bring Lochness up to date (Example 14-15).

**Example 14-15  Activity log entries for export with MERGEfilespaces**

```
tsm: LOCHNESS_SERVER1>q act
```

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>03/02/2006 11:10:32</td>
<td>ANR0627I IMPORT (from Server ATLANTIC): Copied 2 file spaces 0 archive files, <strong>1954</strong> backup files, and 0 space managed files. (SESSION: 6, PROCESS: 2)</td>
</tr>
<tr>
<td>03/02/2006 11:10:32</td>
<td>ANR0656W IMPORT (from Server ATLANTIC): <strong>Skipped</strong> 0 archive files, <strong>37859</strong> backup files, and 0 space managed files. (SESSION: 6, PROCESS: 2)</td>
</tr>
<tr>
<td>03/02/2006 11:10:32</td>
<td>ANR0628I IMPORT (from Server ATLANTIC): Used 0 volume(s). (SESSION: 6, PROCESS: 2)</td>
</tr>
<tr>
<td>03/02/2006 11:10:32</td>
<td>ANR0629I IMPORT (from Server ATLANTIC): Copied 277982016 bytes of data. (SESSION: 6, PROCESS: 2)</td>
</tr>
<tr>
<td>03/02/2006 11:10:32</td>
<td>ANR0611I IMPORT (from Server ATLANTIC) started by ADMIN as process 2 has ended. (SESSION: 6, PROCESS: 2)</td>
</tr>
<tr>
<td>03/02/2006 11:10:32</td>
<td>ANR0986I Process 2 for IMPORT (from Server ATLANTIC) running in the BACKGROUND processed <strong>1956</strong> items for a</td>
</tr>
</tbody>
</table>
The additional files that were backed up while connected to Atlantic are now visible on Lochness’ query occupancy output as shown in Example 14-16.

Example 14-16  Occupancy after filespaces are merged

```
Node Name Type   Filespace Name   FSID  Storage Pool Name  Number of Files Physical Space Occupied (MB) Logical Space Occupied (MB)
SARAH  Bkup  \sarah\c$        1     DISKDATA           33,443       4,601.39            4,601.39
SARAH  Bkup  SYSTEM          2     DISKDATA           3,620        486.40              486.40
```

```
Node Name Type   Filespace Name   FSID  Storage Pool Name  Number of Files Physical Space Occupied (MB) Logical Space Occupied (MB)
SARAH  Bkup  \sarah\c$        1     DISKDATA           114        20.92               20.92
SARAH  Bkup  \sarah\c$        1     DISKDIRS          2,738       1.85               1.85  
SARAH  Bkup  \sarah\c$        1     OFFDATA          33,329     4,591.80            4,591.80
SARAH  Bkup  \sarah\c$        1     TAPEDATA        33,329     4,591.80            4,591.80
SARAH  Bkup  SYSTEM          2     DISKDATA           1,810      242.91             242.91
SARAH  Bkup  SYSTEM          2     OFFDATA           1,810      243.42             243.42
SARAH  Bkup  SYSTEM          2     TAPEDATA        1,810      243.42             243.42
```

The occupancy on Lochness is now the same as Atlantic. Note that the occupancy is the same even though the files are stored in different storage pools.
Using the fromdate and fromtime options
You can limit the file data exported to objects that were stored on the server on or after a specific date and time. You can use the FROMDate and FROMTime parameters to export data based on the date and time the file was originally stored in the server.

The FROMDate and FROMTime parameters only apply to client user file data; these parameters have no effect on other exported information (for example, policies). If clients continue to back up to the originating server while their data is being moved to a new server, you can move the backup data that was stored on the originating server after the export operation was initiated. The FROMDate and FROMTime options are available when you issue an export server or export node command.

14.4.2 Suggestions for leveraging the export feature
Here are some reasons why you may want to export data:

- Splitting an overloaded server into two or three servers:
  - Server-to-server export is faster than server-to-media and media-to-server import.
  - Server-to-server export transfers data from different server platforms.
- Moving some clients temporarily to do server maintenance:
  - One disadvantage is the amount of data moved — either during the initial export, or if the client does a full incremental during the first backup after being moved.
- Migrating from an earlier version of Tivoli Storage Manager with older tape technology, to a new version with new tape technology (possibly with new server platform):
  a. Set up new server platform, Tivoli Storage Manager and new tape technology.
  b. Set up disk-based storage pool with NEXTstgpool pointing to new tape technology.
  c. Export administrators and policies from old server.
  d. Export nodes from old server when network load permits.

14.5 Server groups and remote command routing
Two often-overlooked features of server-to-server communications are the server group and remote command routing. Remote command routing allows
you to run a command on another server. Server groups allow you to route commands to multiple servers by specifying the group name.

To configure a server group, use these commands:

1. **define servergroup.** Defines a name of a group for use with remote command routing.

2. **define grpmember.** Adds servers to a group.

In Example 14-17, we create a new group and add two members. Use **query servergroup** to display information about server groups.

```plaintext
Example 14-17   Defining a server group and members

```

```plaintext
tsm: LOCHNESS_SERVER1>define servergroup redserv desc="Redbook SG24-5416 Server Group"
ANR1673I Server group REDSERV defined successfully.

```

```plaintext
tsrm: LOCHNESS_SERVER1>define grpmember redserv atlantic, lochness
ANR1674I Member ATLANTIC defined successfully in server group REDSERV.
ANR1674I Member LOCHNESS defined successfully in server group REDSERV.

```

```plaintext
tsm: LOCHNESS_SERVER1>q servergroup

<table>
<thead>
<tr>
<th>Server Group</th>
<th>Members</th>
<th>Description</th>
<th>Managing profile</th>
</tr>
</thead>
<tbody>
<tr>
<td>REDSERV</td>
<td>ATLANTIC</td>
<td>Redbook SG24-5416 Server Group</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LOCHNESS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

```

To use a server group for command routing, simply specify the group name followed by a colon (:), followed by the command you wish to run on each server in the group. Similarly, to route a command to a single server, specify the server name followed by a colon, followed by the command you wish to run.

Example 14-18 shows routing commands to a single server, and a server group.

```plaintext
Example 14-18   Remote command routing

```

```plaintext
tsm: LOCHNESS_SERVER1>atlantic: q session
ANR1699I Resolved ATLANTIC to 1 server(s) - issuing command Q SESSION against server(s).
ANR1687I Output for command 'Q SESSION ' issued against server ATLANTIC follows:

<table>
<thead>
<tr>
<th>Sess Number</th>
<th>Comm Method</th>
<th>Sess Wait State</th>
<th>Time</th>
<th>Bytes Sent</th>
<th>Bytes Recvd</th>
<th>Sess Platform</th>
<th>Client Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>415</td>
<td>Tcp/IP</td>
<td>Run</td>
<td>0 S</td>
<td>157</td>
<td>195</td>
<td>Admin</td>
<td>ADMIN</td>
</tr>
</tbody>
</table>
```

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ANR1688I Output for command 'Q SESSION ' issued against server ATLANTIC completed.
ANR1694I Server ATLANTIC processed command 'Q SESSION ' and completed successfully.
ANR1697I Command 'Q SESSION ' processed by 1 server(s): 1 successful, 0 with warnings, and 0 with errors.

ANR1699I Resolved REDSERV to 2 server(s) - issuing command Q DB against server(s).
ANR1687I Output for command 'Q DB ' issued against server ATLANTIC follows:

<table>
<thead>
<tr>
<th>Available Space (MB)</th>
<th>Assigned Capacity (MB)</th>
<th>Maximum Extension (MB)</th>
<th>Reduction (MB)</th>
<th>Maximum Size (bytes)</th>
<th>Total Pages</th>
<th>Used Pages</th>
<th>Util Pct</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,024</td>
<td>1,024</td>
<td>0</td>
<td>984</td>
<td>4,096</td>
<td>262,144</td>
<td>8,515</td>
<td>3.2</td>
</tr>
</tbody>
</table>

ANR1688I Output for command 'Q DB ' issued against server ATLANTIC completed.
ANR1687I Output for command 'Q DB ' issued against server LOCHNESS_SERVER1 follows:

<table>
<thead>
<tr>
<th>Available Space (MB)</th>
<th>Assigned Capacity (MB)</th>
<th>Maximum Extension (MB)</th>
<th>Reduction (MB)</th>
<th>Maximum Size (bytes)</th>
<th>Total Pages</th>
<th>Used Pages</th>
<th>Util Pct</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,024</td>
<td>2,024</td>
<td>0</td>
<td>1,516</td>
<td>4,096</td>
<td>518,144</td>
<td>130,250</td>
<td>25.1</td>
</tr>
</tbody>
</table>

ANR1688I Output for command 'Q DB ' issued against server LOCHNESS_SERVER1 completed.
ANR1694I Server ATLANTIC processed command 'Q DB ' and completed successfully.
ANR1694I Server LOCHNESS_SERVER1 processed command 'Q DB ' and completed successfully.
ANR1697I Command 'Q DB ' processed by 2 server(s): 2 successful, 0 with warnings, and 0 with errors.

Server groups make it easy to query multiple servers with a single command.

14.6 Reorganizing the database

Over time, database volumes can become fragmented. You can restore the efficiency of the database and improve database performance, by unloading and reloading it. The database reload process compresses and reorganizes the
database. The procedure includes estimating the reorganization statistics, unloading the database, formatting database and recovery log volumes to prepare for loading, and then loading the database. The server cannot be running during a database unload or load, as the load operations read device information from the device configuration file, not from the server's database.

**Note:** We recommend using a device class of FILE for the `dsmcmd unloadb` and `dsmcmd loaddb` operations. If you use any other type of device class for the operations, you must use a drive that is assigned to a manual library (library type of MANUAL). If the drive that you want to use is not assigned to a manual library, you must edit the device configuration file to temporarily change the definition so that it appears to be in a manual library.

**Do you really need to reorganize the database?**

Reorganizing the Tivoli Storage Manager database is not a task to be taken lightly. The load operation can take a long time (24+ hours) if your database is large. To facilitate the process, Tivoli Storage Manager V5.3 introduced the `estimate dbreorgstats` command. This command examines the database and logs, and records an estimate of recoverable space in the activity log. You can use this information to decide whether to go ahead. Example 14-19 shows the command output.

The `estimate dbreorgstats` command itself may run for some time, consuming I/O. It should not be run when the server is particularly active. In the case below, it took close to two minutes to run on a database of about 500MB.

**Example 14-19  Estimate dbreorgstats**

```bash
$ tsm: LOCHNESS_SERVER1> estimate dbreorgstats
ANS8003I Process number 3 started.

$ tsm: LOCHNESS_SERVER1> q pr

<table>
<thead>
<tr>
<th>Process Number</th>
<th>Process Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>ESTIMATE DBREORG</td>
<td>Processing table 62 of 140 total tables.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Evaluated 86578 pages.</td>
</tr>
</tbody>
</table>

$ tsm: LOCHNESS_SERVER1> q act search=reorg

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>03/02/2006 11:50:14</td>
<td>ANR2017I Administrator ADMIN issued command: ESTIMATE DBREORSTATS (SESSION: 12)</td>
</tr>
<tr>
<td>03/02/2006 11:50:14</td>
<td>ANR0984I Process 3 for ESTIMATE DBREORG started in the</td>
</tr>
</tbody>
</table>
```
As you can see from the example, we would recover only 89MB, not enough to justify the operation.

However, if you have recently deleted a number of nodes with large numbers of files, you may find that you can recover significant amounts of space.

**Procedure for reorganizing the database**

To reorganize the database, follow these steps:

1. **Important:** *First backup the database.* If an outage occurs while loading your database, you can use the backup to recover the database.

2. Ensure that a current device configuration file exists. You must also specify the name of the device configuration file with the `DEVCONFig` option in the server options file.

   **Important:** If you specified more than one file with the `DEVCONFig` option, remove all but one file name for the dump and load process. After the process is complete, you can add the other file names back.

   The device configuration file includes a copy of the device class, library, and drive definitions for the server. The utility commands used for the dump and load procedure need the device definitions. See the *IBM Tivoli Storage Manager Administrator's Reference* for details on the `DEVCONFig` option.

3. Ensure that the device configuration file contains the required definitions for the device that you want to use for the operations.

   - To use a disk device, you must use a device class of type `FILE` for the operations, and the device class definition must exist in the device configuration file.
To use other sequential device types, check the definition of the library and the drive in the device configuration file. The library and the drive must be defined as a *manual* library and drive. If not, make a copy of your device configuration file and store the original file in a safe place. Edit the copy of the file to have temporary manual definitions for the library and the drive you will use. Follow these guidelines:

- For the library definition, change the library type to `MANUAL` and remove any parameters not allowed for a `MANUAL` type of library. For example, you have the library defined in your device configuration file like this:

```
DEFINE LIBRARY 3582LIB LIBTYPE=SCSI SHARED=YES
```

You need to change the definition to this:

```
DEFINE LIBRARY 3582LIB LIBTYPE=MANUAL
```

- For the drive definition, remove any parameters that do not apply to a drive in a manual library. For example, you have the drive defined like this:

```
DEFINE DRIVE 3582LIB DR00 ELEMENT=256
```

You need to change the definition to this:

```
DEFINE DRIVE 3582LIB DR00
```

See the *IBM Tivoli Storage Manager Administrator’s Reference* for details on the `define library` and `define drive` commands.

4. Before unloading the database, estimate how many tapes you will need:

- If the server is *not* running, use the size of your existing physical database volumes as an estimate of how many tapes to use.

- If the server is running, you can use the following steps to estimate the number of tapes required:
  
  i. Request information about the database:

     `query db`

  ii. From the output of the command, multiply the *Used Pages* by the *Page Size* to determine space occupied by the database.

  iii. Use the result to estimate the number of tapes of a specific device class that you will need to unload the database. The space required will likely be less than your estimate.

5. **Halt** the server if it is still running.

6. With the server *not* running, use the `DSMSERV UNLOADDB` utility to unload the database. For example, issue this command:

   `dsmserv unloaddb devclass=lto2-dc scratch=yes`
Because the library is defined to be a manual library, you will need to manually mount the tapes.

**Important:** Keep track of the order in which the tape volumes are written when the database is unloaded. You must specify the volume names in the same order when you reload the database using the `DSMSEsrv LOADDB` utility. For this task you can either:

- Review the output generated by the `DSMSEsrv UNLOADDB` utility and record the order of the volumes.
- Manually view the volume history file to identify the tape volumes containing the unloaded database. The volumes have a volume type of `DUMPDB`. (Do not restart the server and issue `query volhistory` at this step.)

7. Format the database and recovery log using the `DSMSEsrv LOADFORMAT` utility. This utility prepares the existing server database for the `DSMSEsrv LOADDB` utility. For example, issue this command:

    dsmserv loadformat 1 c:\tsmdata\rlp\logv_01.dsm 1 c:\tsmdata\dbp\dbv_01.dsm

The command above prepares one recovery log volume (c:\tsmdata\rlp\logv_01.dsm), and one database volume (c:\tsmdata\dbp\dbv_01.dsm).

8. Reload the database using the volumes that contain the data from the unload operation. For example:

    dsmserv loaddb devclass=lto2-dc volumenames=DBD001,DBD002

For the volume names, ensure that you do the following operations:

- Enter the volume names in the same order in which they were used for the `dsmserv UNLOADDB` utility.
- Separate the volume names with a comma and no intervening spaces.

9. If you edited your device configuration file in step 3, replace the edited version of the device configuration file with the original version.

10. Start the server.
14.7 Tivoli Storage Manager and TEC integration

Tivoli Storage Manager includes the Tivoli receiver, a Tivoli Enterprise Console (TEC) adapter for sending Tivoli Storage Manager events to the TEC. You can specify the events to be logged based on their source. The valid event names are listed in Table 14-1.

Table 14-1  TEC event names

<table>
<thead>
<tr>
<th>Event Name</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSM_SERVER_EVENT</td>
<td>Tivoli Storage Manager server</td>
</tr>
<tr>
<td>TSM_CLIENT_EVENT</td>
<td>Tivoli Storage Manager clients</td>
</tr>
<tr>
<td>TSM_APPL_EVENT</td>
<td>Tivoli Storage Manager API</td>
</tr>
<tr>
<td>TSM_TDP_DOMINO_EVENT</td>
<td>Data Protection for Lotus Domino</td>
</tr>
<tr>
<td>TSM_TDP_EXCHANGE_EVENT</td>
<td>Data Protection for MS Exchange Server</td>
</tr>
<tr>
<td>TSM_TDP_INFORMIX_EVENT</td>
<td>Data Protection for Informix</td>
</tr>
<tr>
<td>TSM_TDP_ORACLE_EVENT</td>
<td>Data Protection for Oracle</td>
</tr>
<tr>
<td>TSM_TDP_SQL_EVENT</td>
<td>Data Protection for MS SQL</td>
</tr>
<tr>
<td>TSM_TDP_SAP_R3_EVENT</td>
<td>Data Protection for mySAP</td>
</tr>
<tr>
<td>TSM_TDP_ESS_DB2_EVENT</td>
<td>Data Protection for IBM ESS for DB2®</td>
</tr>
<tr>
<td>TSM_TDP_ESS_Oracle_EVENT</td>
<td>Data Protection for IBM ESS for Oracle</td>
</tr>
</tbody>
</table>

This section shows how to enable and configure Tivoli as an event receiver on the Tivoli Storage Manager server. See the IBM Tivoli Storage Manager Administrator’s Guide for more information on TEC configuration.

The application clients (Data Protection for ...) must have enhanced TEC support enabled in order to route the events to TEC. Because of the high number of messages, you should not enable all messages from a node for logging to TEC.

To set up TEC as a receiver for event logging:

1. Define the Tivoli Storage Manager event classes to the TEC with the `ibmtsm.baroc` file, which is distributed with the server. Before the events are displayed on a TEC, you must import `ibmtsm.baroc` into an existing rule base or create a new rule base and activate it. You must then define an event source and event group. The section “Logging Events to the Tivoli Enterprise Console” in IBM Tivoli Storage Manager Administrator’s Guide shows how to perform these tasks.
2. Enable events for logging to the Tivoli receiver (TEC). The following enables logging for severe and error messages coming from all Tivoli Storage Manager nodes and servers to TEC. Refer to the IBM Tivoli Storage Manager Administrator's Guide for more information on enabling and disabling events for logging.

```
enable events TIVOLI error,severe
```

3. In the server options file (dsmserv.opt), specify the location of the host on which the TEC server is running. For example, to specify a TEC server at the IP address 9.114.22.345:1555, enter the following commands:

```
technhost 9.114.22.345
tecport 1555
```

4. Begin TEC event logging. You do this in one of two ways:
   - To begin event logging automatically at server start up, specify the following server option:
     
     ```
tecbegineventlogging yes
```
   - or:
     
     ```
begin eventlogging tivoli
```

### 14.8 Summary

We have covered some details on implementing a server-to-server export, server groups, reorganizing your database, and how to integrate the Tivoli Storage Manager alerts with the Tivoli Enterprise Console (TEC) environment. In the following chapter we will increase the degree of complexity, by discussing performance tuning. Before moving into the tuning section, you need a good understanding of the Tivoli Storage Manager environment and a good understanding of the many directly related infrastructure components; this is very important.

**Note:** See the TEC documentation for instructions on removing an existing baroc file, if needed, and installing a new baroc file.
Performance considerations

In this chapter we emphasize the importance of a complete tuning methodology. We hope you will gain an understanding of all the related components, and understand the importance of making changes one at a time, then retesting against a base line performance number.

Misinterpreting the results of performance related testing is also common. Ensure that you follow a logical and documented process. Careful and concise might be two important words when describing a tuning exercise.

We discuss parameters that can be tuned to get the maximum performance during backup, archive, restore, and retrieve operations. Remember that an IBM Tivoli Storage Manager implementation is typically quite complex, covering a range of variables which could affect performance.

You will find much more detailed information on performance tuning and the available parameters in IBM Tivoli Storage Manager Performance Tuning Guide, SC32-9101.
15.1 How to measure performance

In measuring Tivoli Storage Manager performance, you need to fine-tune some parameters and run specific testing scenarios. Fine-tuning Tivoli Storage Manager is not just for backup, since the restore window is as important, or more so, than the backup window. Some parameters might improve backup at the expense of restore and vice versa. Or they might improve both operations but require more system resources. You need to determine the best balance in your environment, depending on the frequency and criticality of each backup and restore operation.

In most cases where the backup parameters are different from the restore parameters, the backup and restore windows can be maximized.

Getting the maximum performance of the system, requires performing and recording a series of tests, so that the throughput can be tabulated. These tests should encompass both for backup and restore.

Tivoli Storage Manager performance can be influenced by various tuning parameters. Tuning these functions for good performance requires diligence and expertise on the part of the installer. The number of parameters that may be set within Tivoli Storage Manager are quite small; it is the tuning of the client, server, and network options that can become very complex.

Performance tuning for a single platform function is quite complex, but due to years of experience, it is generally well understood. However, Tivoli Storage Manager functions in the client-server realm typically support many operating systems, work across networks, and accept different communication protocols. Consequently, there are many more factors that affect performance. All of these factors can affect Tivoli Storage Manager performance significantly:

- Average client file size
- Percentage of files changed since last incremental backup
- Percentage of bytes changed since last incremental backup
- Client hardware (CPUs, RAM, disk drives, network adapters)
- Client operating system Client activity (non-Tivoli Storage Manager workload)
- Communication protocol type
- Communication controller hardware
- Network utilization
- Network speed
- Network reliability
- Server hardware (CPUs, RAM, disk drives, network adapters)
- Server storage pool devices (disk, tape, optical)
- Server activity (non-Tivoli Storage Manager workload)
- Final output repository type (disk, tape, optical)
Clearly, with so many combinations and possibilities, it is not feasible to discuss all possible combinations of these parameters within the scope of this book. This book should be taken as advice to follow when faced with performance questions - so that you do not limit yourself to considering only the Tivoli Storage Manager tunable parameters covered here.

Performance tuning and bottleneck discovery are complex tasks requiring deep knowledge of Tivoli Storage Manager, the underlying operating system, and the attached hardware components. Unless you really know what you are doing, you should consider hiring someone more experienced for these tasks.

Remember that a high performance environment without any bottlenecks does not exist. But as long as you know your bottlenecks, and have reduced them and the constraints they cause, you are on the right path.

### 15.1.1 Network benchmarking

Network benchmarking in Tivoli Storage Manager is the process of measuring a given network’s capacity at a specific time during the day or evening.

Sometimes during a Tivoli Storage Manager deployment, our customers have commented that the product does not perform as expected, that backup times are very slow, and they ask what is wrong with the backup product. It should be understood that all backup products are essentially an integration of bottlenecks. As a result, you need to be able to isolate and address these weak links as issues are identified.

A very large percentage of these poorly performing configuration are not related to Tivoli Storage Manager at all. But, how do you prove this when the network has some busy moments during the day, but reaches complete saturation during evening hours? Obviously, measurements taken at 11:00AM are not useful to determine what's going on at 11:00PM.

The answer to this very vague problem is to benchmark the network bandwidth precisely before (and/or after) the backup starts. Customers normally ask: “Who will do this, and how are they going to time this precise effort to occur at 11:30 p.m.? Our evening operations staff is small and rather busy during these hours; they don't have time to be running benchmarks.”

Here’s how it works: The first task is to generate a data file that is “sizable” — based on the network over which you are running.

For example, if you are running over a switched 100 megabit (averaging 10 MBps), you would create a file sized between 256–512 MB. A 10 megabit network (averaging 1 MBps) would benchmark against a file sized between 64 to 128MB. Sun Solaris nodes have a handy command, `mkfile`, which is perfectly
suited for creating exact sized files; otherwise you can use a compression 
application to combine and or compress a bunch of smaller files into one big file 
of x MB. DO NOT try to push multiple smaller files that equal the total size that 
you are trying to move — this will skew your benchmarks!

The next task is to automate an ftp logon and push/pull this file from the Tivoli 
Storage Manager client to the Tivoli Storage Manager server. This is cleverly 
done by creating an ftp script that will:

1. Connect to the ftp daemon on the Tivoli Storage Manager server.
2. Push a file over to the Tivoli Storage Manager server.
3. Pull the file from the Tivoli Storage Manager server to local system.
4. Delete the file on the Tivoli Storage Manager server after the pull.
5. Logoff.

Example 15-1 and Example 15-1 show two typical ftp scripts; the first one is for 
Microsoft platforms; the second is for UNIX platforms. With minor modifications, 
you can get this code to work on your own platforms.

Example 15-1   ftp sample script for Windows

```bash
@echo off
echo open 9.48.202.28     > $ftp$.cmd

echo user username password >> $ftp$.cmd
echo bin                >> $ftp$.cmd
rem echo hash        >> $ftp$.cmd
echo cd <targetdirectory> >> $ftp$.cmd
echo dir       >> $ftp$.cmd
echo put <samplefile> >> $ftp$.cmd
echo get <samplefile> >> $ftp$.cmd
echo del <samplefile> >> $ftp$.cmd
rem echo dir       >> $ftp$.cmd
echo bye       >> $ftp$.cmd

FTP.EXE -n -s:$ftp$.cmd
del $ftp$.cmd
```

Example 15-2   Sample ftp script for UNIX

```bash
ftp -n TSM-Server <<- EOF!
user username password
cd <targetdirectory>
put <samplefile>
get <samplefile>
get <samplefile>
delete <samplefile>
bye
EOF!
```
So how do you launch the ftp script right before the backup occurs? By including your ftp script in a Tivoli Storage Manager client options file (or dsm.sys on UNIX/Linux) as pre-schedule (and/or post-schedule) commands:

```
PRESCHEDULECMD c:\temp\ftpbench.bat
POSTSCHEDULECMD c:\temp\ftpbench.bat
```

The script will then run automatically. How do you find the output? All the output from the script will be logged into the node’s dsmsched.log file. When you come in the next morning, locate the file and search for the ftp statistics. Example 15-3, shows that a move of a 13MB file achieved a transfer rate of 162.26 KB per second over a VPN link from Dover, New Jersey to Austin, Texas:

**Example 15-3 Sample ftp script execution**

```
226 Transfer complete.
ftp: 723 bytes received in 0.01Seconds 72.30Kbytes/sec.
ftp> get db-13mb.txt
200 PORT command successful.
150 Opening data connection for db-13mb.txt (13631488 bytes).
226 Transfer complete.
ftp: 13631488 bytes received in 84.01Seconds 162.26Kbytes/sec.
ftp> bye
221 Goodbye.
```

Now this should give us a good idea of what the traffic is at the exact time of the night that you are trying to complete your backups. Once that is achieved, you can then extrapolate the data to a spreadsheet and then calculate the time it will take to complete your backups for the amount of data you have.

Please note that the ftp transfer statistics, as collected above, might mask an underlying performance problem reading from local or writing to remote disk. If you want to verify that the disk I/O is not the bottleneck, you can collect the transfer statistics without actual reading from/ writing to disk as shown in Example 15-4 for UNIX systems.

**Example 15-4 UNIX: ftp command without disk bottleneck**

```
ftp <servername>
bin
put "|dd if=/dev/zero bs=64k count=10000" /dev/null
quit
```

Example 15-5 shows an example connecting to a z/OS system and switching to the *dev.null directory to avoid write I/O on the target system. The local file is being read from in this example.
Example 15-5  z/OS: ftp command without disk bottleneck

C:\>ftp <system>
Connected to <system>.
220-FTPD1 IBM FTP CS V1R2 at <SYSTEM>, 15:44:09 on 2006-02-27.
220 Connection will close if idle for more than 5 minutes.
User (<system>:(none)): triple8
331 Send password please.
Password:
230 TRIPLE8 is logged on. Working directory is "TRIPLE8."
ftp> cd *dev.null
250-Working Directory for PUT is NULL Device;
250 for GET is "TRIPLE8." name prefix.
ftp> bin
200 Representation type is Image
ftp> put TESTFILE.exe zz.exe
200 Port request OK.
125 Storing data in the Null directory (*dev.null).
250 Transfer completed successfully.
ftp: 225904 bytes sent in 0.03Seconds 7530.13Kbytes/sec.
ftp> quit
221 Quit command received. Goodbye.

You can also use the ftp transfer statistics and compare those against the backup/restore numbers from a selective file backup and restore. When dealing with just a single large file, we will not see any database processing overhead but will collect comparable numbers for network throughput. To avoid any file caching side effects, create a file that is larger than the client memory, then ftp transfer the file from the server to the client and back. The preferred target directory is the directory where your server’s disk storage pools are located.

Doing the put/get will provide output similar to Example 15-6.

Example 15-6  FTP statistics for the put transfer of a 500MB file

C:\>ftp banda.itsosj.sanjose.ibm.com
Connected to banda.itsosj.sanjose.ibm.com.
User (banda.itsosj.sanjose.ibm.com:(none)): maximilian
331-Password:
230-Last login: Fri Mar  3 11:02:27 PST 2006 on ftp from ::ffff:9.43.86.888
230-User maximilian logged in.
ftp> put 500MBFile
200 PORT command successful.
150 Opening data connection for 500MBFile.
226 Transfer complete.
ftp: 536801936 bytes sent in 0.32Seconds 16625.06Kbytes/sec.
ftp> quit
221 Quit command received. Goodbye.
Opening data connection for 500MBFile (524288000 bytes).
Transfer complete.
ftp: 536801936 bytes received in 57.13 Seconds 9396.97 Kbytes/sec.

Now backup the same file from your client machine to the Tivoli Storage Manager server as shown in Example 15-7.

Example 15-7  Back up of a 500MB test file

```
 tsm> sel 500MBFile
 Selective Backup function invoked.
 Normal File--> 524,288,000 /home/root/500MBFile [Sent]
 Selective Backup processing of '/home/root/500MBFile' finished without failure.

 Total number of objects inspected: 1
 Total number of objects backed up: 1
 Total number of objects updated: 0
 Total number of objects rebound: 0
 Total number of objects deleted: 0
 Total number of objects expired: 0
 Total number of objects failed: 0
 Total number of bytes transferred: 500.02 MB
 Data transfer time: 43.59 sec
 Network data transfer rate: 11,745.37 KB/sec
 Aggregate data transfer rate: 11,115.00 KB/sec
 Objects compressed by: 0%
 Elapsed processing time: 00:00:46
```

So the time taken to complete the backup for this single object (46 seconds), is close to the time it took to transfer the file using ftp (57.13 seconds) - that is good. Now check the restore numbers as shown in Example 15-8.

Example 15-8  Restore of a 500MB test file.

```
 Restore function invoked.

 Restoring 524,288,000 /home/root/500MBFile [Done]
 Restore processing finished.

 Total number of objects restored: 1
 Total number of objects failed: 0
 Total number of bytes transferred: 500.02 MB
 Data transfer time: 416.28 sec
 Network data transfer rate: 1,229.97 KB/sec
 Aggregate data transfer rate: 1,216.43 KB/sec
 Elapsed processing time: 00:07:03
```
So now, why did it take so long to restore the object? From the ftp statistics we know that the network is capable of transferring the file at about the same time in both directions. We will answer the question in the next sections.

### 15.1.2 Tivoli Storage Manager client performance tracing

The Tivoli Storage Manager client can optionally collect instrumentation statistics for commands executed.

> **Attention:** Using these tracing facilities is done at your own risk.

From a performance standpoint, do not activate the trace settings if you are in a stable environment and are not experiencing problems. Trace routines require processing time and could slow down application response times. If a problem occurs, you can always activate the trace routines to gather trace information for diagnostic purposes. Call your IBM Service Representative for assistance in diagnosing Tivoli Storage Manager problems.

The Tivoli Storage Manager client includes client instrumentation procedures that provide performance instrumentation statistics broken down by threads. Activating this feature will generate a file that contains the summary statistics.

Tivoli Storage Manager V5.3 and higher clients (all except Novell clients), use filename dsminstr.report.pnnnnn, where nnnnn is the process id of the dsmc process. On Novell systems the filename will be just dsminstr.report. The file will be in the directory set in the DSM_LOG environment variable.

On earlier Tivoli Storage Manager clients, the filename is dsminstr.report, stored in the client installation directory. Once created, subsequent traces will append to this file.

The report only shows threads with instrumented activities, and logs only the CLI client and scheduler, not the GUI. Example 15-9 shows how to enable tracing.

**Example 15-9  Client performance tracing**

<table>
<thead>
<tr>
<th>Command Line</th>
<th>Options File</th>
</tr>
</thead>
<tbody>
<tr>
<td>testflag=instrument:detail</td>
<td>testflag=instrument:detail</td>
</tr>
</tbody>
</table>

The output file name cannot be specified, but after the task is complete, you can rename it to something meaningful name, for example YYMMDD_client_stats.txt. Example 15-10 shows the output for the backup of the 500MB file - we have shown only the thread information that is important to this investigation.
**Example 15-10  Client instrumentation statistics: backup**

TSM Client final instrumentation statistics: Thu Feb 23 09:52:13 2006

Instrumentation class: Client detail
Completion status: Success

---

Detailed Instrumentation statistics for

Thread: 1029  Elapsed time    44.384 sec
Section      Actual (sec) Average(msec)  Frequency used

<table>
<thead>
<tr>
<th>Section</th>
<th>Actual (sec)</th>
<th>Average (msec)</th>
<th>Frequency used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Dirs</td>
<td>0.000</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>Solve Tree</td>
<td>0.000</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>Compute</td>
<td>0.008</td>
<td>0.0</td>
<td>2001</td>
</tr>
<tr>
<td>BeginTxn Verb</td>
<td>0.000</td>
<td>0.0</td>
<td>1</td>
</tr>
<tr>
<td>Transaction</td>
<td>0.025</td>
<td>25.3</td>
<td>1</td>
</tr>
<tr>
<td>File I/O</td>
<td>0.628</td>
<td>0.3</td>
<td>2002</td>
</tr>
<tr>
<td>Compression</td>
<td>0.000</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>Encryption</td>
<td>0.000</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>CRC</td>
<td>0.000</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>Delta</td>
<td>0.000</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>Data Verb</td>
<td>43.587</td>
<td>21.8</td>
<td>2001</td>
</tr>
<tr>
<td>Confirm Verb</td>
<td>0.005</td>
<td>5.1</td>
<td>1</td>
</tr>
<tr>
<td>EndTxn Verb</td>
<td>0.048</td>
<td>48.2</td>
<td>1</td>
</tr>
<tr>
<td>Sleep</td>
<td>0.010</td>
<td>10.0</td>
<td>1</td>
</tr>
<tr>
<td>Thread Wait</td>
<td>0.040</td>
<td>39.6</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>0.034</td>
<td>0.0</td>
<td>0</td>
</tr>
</tbody>
</table>

---

We didn't expect anything spectacular from this trace as the backup was running fine, so now let us compare it to the restore numbers. The statistics, again an extract only, are shown in Example 15-11.

**Example 15-11  Client instrumentation statistics: restore**

TSM Client final instrumentation statistics: Thu Feb 23 10:44:29 2006

Instrumentation class: Client detail
Completion status: Success

---
Detailed Instrumentation statistics for

Thread: 772  Elapsed time  422.012 sec
Section       Actual (sec)  Average(msec)  Frequency used
------------------------------------------------------------------
Process Dirs     0.001           1.0              1
Solve Tree       0.000           0.0              0
Compute          0.000           0.0              0
BeginTxn Verb    0.000           0.0              2
Transaction      0.043          21.5              2
File I/O         2.729           1.4           2002
Compression      0.000           0.0              0
Encryption       0.000           0.0              0
CRC              0.000           0.0              0
Delta            0.000           0.0              0
Data Verb        416.477         207.6          2006
Confirm Verb     0.000           0.0              0
EndTxn Verb      0.000           0.0              0
Sleep            0.000           0.0              0
Thread Wait      0.371          185.3              2
Other            2.392           0.0              0
------------------------------------------------------------------

The statistics show, from the File I/O section, that it takes slightly longer to write the file compared to the read. But this section is only taking a small amount of time during the restore. The majority of the time is spent in the Data Verb section. This now could be some server related processing or indicate a communication problem between the server and the client. Before we look at the server generated statistics under 15.1.3, “Tivoli Storage Manager server performance tracing” on page 473, we explain the sections of the client instrumentation traces:

**Client Setup**
Initial processing including signon, authorization, and queries for policy set and file system information.

**Process Dirs**
Processing directory and file information before backing up or restoring any files. For incremental backup, it includes querying the server for backup status information. For classic restore, it includes retrieving the file list. For no-query-restore, this is not used.

**Solve Tree**
For selective backup, determining if there are any new directories in the path that need to be backed up. This
involves querying the server for backup status information on directories. This can be large if there are a large number of directories.

**Compute**
Computing throughput and transfer sizes

**Transaction**
A general category to capture all time not accounted for in the other sections. Includes file open/close time, which can be large, especially during restore of many small files. Also includes message display time which can be large if running without the quiet option, or with detailed traces enabled. Average time for this section is not meaningful.

**BeginTxn Verb**
Frequency used indicates the number of transactions that were used during the session.

**File I/O**
Requesting data to be read or written on the client file system.

**Compression**
Compressing or uncompressing data.

**Encryption**
Encrypting or decrypting data.

**CRC**
Computing or comparing CRC values.

**Delta**
Adaptive subfile backup processing, including determining the changed file bytes or blocks.

**Data Verb**
Sending or receiving data to/from the communication layer. High data verb time prompts an investigation of server performance and the communication layer (which includes elements of both the client and server).

**Confirm Verb**
During backup, sending a confirm verb and waiting for a response to confirm that the data is being received by the server.

**EndTxn Verb**
During backup, waiting for the server to commit the transaction. This includes updating the database pages in memory, and writing the recovery log data. For backup direct to tape, this includes flushing the tape buffers.

Please note that the trace facilities can be changed at any time by development without notification.

### 15.1.3 Tivoli Storage Manager server performance tracing

The Tivoli Storage Manager server can collect instrumentation statistics for a period of time.
Attention: Using these tracing facilities is done at your own risk.

From a performance standpoint, do not activate the trace settings if you are in a stable environment and are not experiencing problems. Trace routines require processing time and could slow down the response times of your workstation applications. If a problem occurs, you can always activate the trace routines to gather trace information for diagnostic purposes. Call your Tivoli Service Representative for assistance in diagnosing Tivoli Storage Manager problems.

Tivoli Storage Manager server performance instrumentation shows threads with disk, tape or network I/O operations during the observation period. To activate performance instrumentation, use the `instrumentation begin` command as in Example 15-12.

Example 15-12  Start server performance instrumentation

```plaintext
tsm> INSTRumentation Begin [Maxthread=number]
```

By default, a maximum number of 1024 threads can be instrumented. To end performance instrumentation, enter the `instrumentation end` command as in Example 15-13.

Example 15-13  Stop server performance instrumentation

```plaintext
tsm> INSTRumentation End > <valid_path_and_filename>
```

By default, the output is sent to the console or administrative display, use a pipe to redirect it to a file. We collected the server instrumentation traces for the backup and the restore attempt. Since we know we are backing up a file of 500 MB it is easy to identify the related threads from the server trace by looking at the Total KB section. Example 15-14 shows the threads for the backup.

Example 15-14  Server instrumentation statistics: backup

```
Thread 46 SessionThread (Win Thread ID 2860) 09:47:57.875-->09:48:42.281
Session ID 79 BANDA (AIX)
Operation       Count  Tottime  Avgtime  Mintime  Maxtime  InstTput  Total KB
----------------------------------------------------------------------------
Network Recv    24752   44.249    0.002    0.000    0.031  11571.4    512024
Network Send       11    0.000    0.000    0.000    0.000                  0
Acquire Latch      65    0.000    0.000    0.000    0.000
Acquire XLatch    134    0.000    0.000    0.000    0.000
Thread Wait      2012    0.110    0.000    0.000    0.047
Unknown                  0.047
----------------------------------------------------------------------------
Total                   44.406                             11530.5    512024
```

Attention: Using these tracing facilities is done at your own risk.
By matching the threads reading and writing data for a single session, the bottleneck can be seen. In Example 15-14 - it is the network. A faster network would increase backup times. This proves one simple statement: the process can only be as fast as the slowest component involved. But we are interested in why the restore was so slow. So now have a look at those server instrumentation statistics as shown in Example 15-15.

Example 15-15  Server instrumentation statistics: restore

By matching the threads reading and writing data for a single session, the bottleneck can be seen. In Example 15-14 - it is the network. A faster network would increase backup times. This proves one simple statement: the process can only be as fast as the slowest component involved. But we are interested in why the restore was so slow. So now have a look at those server instrumentation statistics as shown in Example 15-15.

Example 15-15  Server instrumentation statistics: restore

By matching the threads reading and writing data for a single session, the bottleneck can be seen. In Example 15-14 - it is the network. A faster network would increase backup times. This proves one simple statement: the process can only be as fast as the slowest component involved. But we are interested in why the restore was so slow. So now have a look at those server instrumentation statistics as shown in Example 15-15.

Example 15-15  Server instrumentation statistics: restore

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Example 15-15  Server instrumentation statistics: restore

By matching the threads reading and writing data for a single session, the bottleneck can be seen. In Example 15-14 - it is the network. A faster network would increase backup times. This proves one simple statement: the process can only be as fast as the slowest component involved. But we are interested in why the restore was so slow. So now have a look at those server instrumentation statistics as shown in Example 15-15.
Here we see that the server can read from the storage pool volume with an instrumented throughput of 54MB/s, but the data is sent back to the client with only about 1.2MB/s. From the **Network Recv** section of the backup trace, we know that the client is sending the data with 24752 verbs, but the server is sending the data back with only 4017 verbs (**Network Send** of the restore trace).

This makes us review the client and server communications options and here we find the cause of the problem: since we were running with a minimal client systems option file, we did not specify the DISKBUFFSIZE or the related ENABLELANFREE option. With ENABLELANFREE set to NO, the DISKBUFFSIZE on our AIX system defaulted to 256KB for the DISKBUFFSIZE. This doesn't work well with the Windows Tivoli Storage Manager server communication when it transmits data back to the AIX client. So we specified a value of DISKBUFFSIZE to 32 and the improved result for the restore is shown with Example 15-16. The restore time is now down to 46 seconds - success!

**Example 15-16   Restore after configuration change.**

```
# dsmc res /home/root/500MBFile
IBM Tivoli Storage Manager
Command Line Backup/Archive Client Interface
   Client Version 5, Release 3, Level 3.0 0220FB
   Client date/time: 02/23/06   13:46:40
(c) Copyright by IBM Corporation and other(s) 1990, 2006. All Rights Reserved.

Node Name: BANDA
Session established with server LOCHNESS_SERVER1: Windows
   Server Version 5, Release 3, Level 2.2
   Server date/time: 02/23/06   13:42:24  Last access: 02/23/06   13:27:49

Restore function invoked.

Restoring     524,288,000 /home/root/500MBFile [Done]

Restore processing finished.

Total number of objects restored:         1
Total number of objects failed:           0
Total number of bytes transferred:    500.06 MB
Data transfer time:                   41.12 sec
Network data transfer rate:        12,452.21 KB/sec
Aggregate data transfer rate:      11,026.84 KB/sec
Elapsed processing time:           00:00:46
```
This example should provide you with a basic idea of the steps needed to approach and investigate Tivoli Storage Manager performance related questions within your environment.

Often the first clue to a performance problem is unexpected results. These symptoms should be documented for later analysis and possible correlation with log data provided by the client and the server. Performance tuning is an iterative process and usually the first performance trace leads to further tracing either on the client, the network, or the server. Document your changes to the configuration and keep track of the results after the changes are applied.

As described in 15.1, “How to measure performance” on page 464, the number of influencing factors is huge, and each of them requires detailed consideration to increase overall performance.

Note: If archive performance is an issue, make sure to consult Tivoli Storage Manager Performing Tuning Guide, Appendix A. Using TSM's Archive Function, SG32-9101.

15.2 Architecture-based performance tuning

In this section we describe some design considerations for a Tivoli Storage Manager implementation. We first offer some conceptual guidelines to follow, as well as providing list of parameters for precise tuning.

15.2.1 Database and recovery log

When implementing a Tivoli Storage Manager server, consider using multiple disk volumes for the database and recovery log files. This enables the server process to spread its I/O (input / output) over several volumes in parallel, which increases read and write performance. Subsequently, a greater quantity of smaller disks can provide better performance than would fewer and larger disks of the same rotation speed.

To support the above configuration, you may be able to “stripe” the database and log volumes across multiple disks, which would balance the I/O load so that it is not only spread over multiple database volumes, but also over multiple disks.
Another option is to put multiple database volumes on a striped volume set of disks to increase performance.

When located on separate disk volumes, mirroring can increase not only server stability, but also server performance. The Tivoli Storage Manager server can access multiple database copies at the same time and prioritizes the volume copy with the shortest response time. Thus if your hardware does not support mirroring, the Tivoli Storage Manager server does this very well, provided that you balance the I/O with the appropriate volume placement.

Tivoli Storage Manager access to the database for read/writing is done in high random order - keep in mind that large read ahead buffers defined for the volumes might rather hurt performance than help you.

### 15.2.2 Storage pools

The advice given in the previous section is also valid for disk storage pools - i.e., you can increase performance by using multiple small volumes for disk storage pools instead of using one big volume.

Figure 15-1 shows the side effects of placing multiple storage pool volumes on a single disk - the increased seek activity can degrade performance.
It is also preferable to send backups of large amounts of data, such as entire client databases, directly to tape instead of buffering in a disk storage pool. This allows the client to take advantage of the high streaming performance of most advanced tape drives when writing large files and avoids extra data movement from the migration process which will likely be immediately triggered.

Backups of file servers and workstations should be directed to a disk storage pool to avoid tape mount delays. Also, a disk storage pool supports more multiple sessions than the available tape devices.

15.2.3 Versioning

Keeping a lot of different backup versions of a stored file generates many Tivoli Storage Manager server database. The management overhead of this may result in decreased performance. The planning process is important, to make sure you keep only as many versions as really needed.

Incremental backup is nearly always preferred over selective backup, because selective backup generates a new version every time, regardless of whether the specific file has changed or not.
15.2.4 Client configuration

Using the powerful include and exclude options, you can specify the amount of files to be backed up to a very detailed level. Careful use of these options can reduce the daily amount of backup data significantly and thus improve both client and server performance.

15.2.5 LAN-free backup/restore

Using LAN-free backups can unburden LAN traffic significantly, as well as reduce the overhead on the Tivoli Storage Manager server, since the data is directly transferred to tape. This feature is important, especially for clients whose backups are routed to tape directly — databases, for example.

15.3 Tivoli Storage Manager server

In this section we discuss the most common tuning parameters for all Tivoli Storage Manager servers.

15.3.1 Server database and recovery log

This section covers server options to influence the performance and behavior of the server database and the recovery log.

**BUFPOOLSIZEx**

Cache storage is provided by the database buffer pool size, which allows frequently used database pages to remain cached in memory. This means faster access times and better performance, because the pages can be read and updated from memory instead of requiring I/O operations to external storage. The larger the database buffer pool, the more space there is to keep pages in memory. However, since the buffer pool is implemented in real memory, its size must be balanced against total memory requirements for the whole system and any other workloads.

To measure the effectiveness of the database buffer pool, monitor the cache hit percentage. This number indicates how often a database page request could be satisfied from the cache as opposed to requiring a disk access. An optimal setting for the database buffer pool is one in which the cache hit percentage is greater than or equal to 98%. To check the cache hit percentage, use the `query db f=d` command as shown in Example 15-17. This shows our cache hit percentage is 99.89% which is fine.

*Example 15-17  query db f=d*

```
tsm: LOCHNESS_SERVER1>q db format=detail
```
<table>
<thead>
<tr>
<th>Available Space (MB)</th>
<th>2,024</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assigned Capacity (MB)</td>
<td>2,024</td>
</tr>
<tr>
<td>Maximum Extension (MB)</td>
<td>0</td>
</tr>
<tr>
<td>Maximum Reduction (MB)</td>
<td>1,616</td>
</tr>
<tr>
<td>Page Size (bytes)</td>
<td>4,096</td>
</tr>
<tr>
<td>Total Usable Pages</td>
<td>518,144</td>
</tr>
<tr>
<td>Used Pages</td>
<td>104,680</td>
</tr>
<tr>
<td>Pct Util</td>
<td>20.2</td>
</tr>
<tr>
<td>Max. Pct Util</td>
<td>20.2</td>
</tr>
<tr>
<td>Physical Volumes</td>
<td>3</td>
</tr>
<tr>
<td>Buffer Pool Pages</td>
<td>65,280</td>
</tr>
<tr>
<td>Total Buffer Requests</td>
<td>37,804</td>
</tr>
<tr>
<td>Cache Hit Pct.</td>
<td>99.89</td>
</tr>
<tr>
<td>Cache Wait Pct.</td>
<td>0.00</td>
</tr>
<tr>
<td>Backup in Progress?</td>
<td>No</td>
</tr>
<tr>
<td>Type of Backup In Progress:</td>
<td></td>
</tr>
<tr>
<td>Increments Since Last Full</td>
<td>2</td>
</tr>
<tr>
<td>Changed Since Last Backup (MB)</td>
<td>113.02</td>
</tr>
<tr>
<td>Percentage Changed</td>
<td>27.64</td>
</tr>
<tr>
<td>Last Complete Backup Date/Time</td>
<td>02/21/2006 17:12:20</td>
</tr>
<tr>
<td>Estimate of Recoverable Space (MB)</td>
<td>0</td>
</tr>
</tbody>
</table>

Increasing the `BUFPOOLSIZE` parameter can improve the performance of many Tivoli Storage Manager server functions, such as multi-client backup, storage pool migration and backup, expiration processing, and move data. If the cache hit percentage is lower than 98%, increase the `BUFPOOLSIZE` value in the server options file. For most servers, we recommend starting with a value of 32768, which equals 8192 database pages. If you have enough memory, increase in 1MB increments. A cache hit percentage greater than 98% indicates that the proper `BUFPOOLSIZE` has been reached. However, continuing to raise `BUFPOOLSIZE` beyond that level may still be helpful. While increasing `BUFPOOLSIZE`, take care not to cause paging in the virtual memory system. Monitor system memory usage to check for any increased paging after changing the `BUFPOOLSIZE`.

**Tip:** Tivoli Storage Manager can use the parameter `SELF/TUNEBUFPOOLSIZE YES` in the server options file to activate self-tuning. When you activate this option, the server will check the cache hit ratio each time inventory expiration is run. If the value is less than 98%, then it will increase the `BUFPOOLSIZE` by a predictable factor related to the actual cache hit ratio achieved. An upper limit for `BUFPOOLSIZE` with self-tuning is imposed of 10% of the real memory for AIX, HP UX, Solaris, Linux, and Windows, and 50% of the region size in zOS. If you still need a larger `BUFPOOLSIZE` and it is acceptable in your environment, you will have to set the value manually.
MIRRORWRITE
This specifies how mirrored volumes are accessed when the server writes pages to the recovery log or database during normal processing. A value of sequential specifies that the server writes to the mirrored volume one after another. Server performance decreases because a successful I/O must occur before the next write can occur. A value of parallel specifies that the server writes to all mirrored volumes in parallel. This mode allows all mirrors to obtain the new page at approximately the same time.

**Note:** If a system outage occurs at exactly the instant that each mirror is partially complete in writing its page, a partial write to each mirror could result. See DBPAGESHADOW option below to prevent this.

When using mirrored database volumes in sequential mode, using a disk system with write caching ability can improve database performance. When writing in sequential mode, one database volume write must complete before the mirror is written to. A disk system with write cache allows the mirror to be written to almost instantaneously, nearly doubling the amount of write activity possible. Many disk systems can do this; however it may need to be specifically enabled - check your disk vendor's documentation for details.

DBPAGESHADOW
This specifies whether database page shadowing is enabled. If database page shadowing is enabled, Tivoli Storage Manager mirrors every write to a database page. This mirror actually is represented by a shadow file that contains these written mirrors. DBPAGESHADOW YES eliminates the requirement to set MIRRORWRITE SEQUENTIAL to prevent exposure to partial page writes. It is recommended to keep the default of YES.

Database reorganization
Over time, database volumes can become fragmented. You can restore the efficiency of the database and improve database performance by reorganizing the database using database unload and reload processing. By reloading the database, you compress and reorganize it. This process is described in detail in Chapter 14., “Advanced operations” on page 437.

15.3.2 Transactions
This section covers server options which influence the performance and behavior of data movement within the server.
MOVEBATCHSIZE and MOVESIZETHRESH

The MOVEBATCHSIZE and MOVESIZETHRESH options help tune the performance of the server processes that involve the movement of data between storage media. These processes include storage pool backup and restore, migration, reclamation, and move data.

These options specify the number of files and the quantity of data that are to be moved and grouped together in a batch, within the same server transaction.

The number of client files moved for each server database transaction during a server storage pool backup or restore, migration, reclamation, or move data operation will be determined by the number and size of the files in the batch. If the number of files in the batch equals the MOVEBATCHSIZE before the cumulative size of the files becomes greater than the MOVESIZETHRESH, then the MOVEBATCHSIZE is used to determine the number of files moved or copied in the transaction. If the cumulative size of files being gathered for a move or copy operation exceeds the MOVEBATCHSIZE value before the number of files becomes equivalent to the MOVEBATCHSIZE, then the MOVESIZETHRESH value is used to determine the number of files moved or copied in the transaction.

If the MOVEBATCHSIZE or MOVESIZETHRESH parameters are increased from the default values, the server will require more recovery log space - up to two or more times larger than a recovery log when the defaults are used. Also, the server requires more time to initialize at startup. The impact of a larger recovery log size will be felt while running the server with the logmode set to NORMAL (the default value). If you choose to increase these values for performance reasons, be sure to monitor recovery log usage during the first few storage pool backup/restore, migration, reclamation, or move data executions to ensure sufficient recovery log space is available.

TXNGROUPMAX

The option TXNGROUPMAX specifies the number of files that are transferred as a group between a client and the server between transaction commit points. Client backup, archive, restore, and retrieve performance may improve by using a larger value for this option.

TXNGROUPMAX is used in conjunction with the client TXNBYTELIMIT option. See “TXNBYTELIMIT” on page 488 for a more detailed description of the transaction process and the side effects on the recovery log.
**Recovery log**

If you use the TXNGROUPMAX and TXNBYTELIMIT parameters, remember that larger transactions require more recovery log space. The Tivoli Storage Manager server can require more time when re-starting, to process the log entries. Again, see “TXNBYTELIMIT” on page 488 for more information on the transaction process and the side effects on the recovery log.

**15.3.3  Communication**

This section covers server options to influence the performance and behavior of communication protocols between client and server.

**MAXSESSION**

The MAXSESSION parameter specifies the maximum number of simultaneous client sessions that can connect with the Tivoli Storage Manager server. The default value is 25 client sessions, and the minimum value is two. The maximum value is limited only by available virtual memory or communication resources. This parameter specifies the maximum number of simultaneous client sessions that can connect to the Tivoli Storage Manager server. By limiting the number of clients, server performance can be improved, but the availability of Tivoli Storage Manager services to the clients is reduced.

Since Tivoli Storage Manager clients use multi-threading, you should consider the total number of concurrent nodes, times the number of concurrent sessions that the server must handle. If you need 10 concurrent nodes to perform backup operations and each of them has a multi-threading capability of (resource utilization) of 4, then you must set maxsession to at least 40 (10 x 4).

**MAXSCHEDSESSIONS**

The MAXSCHEDSESSIONS parameter specifies the number of sessions that the server can use for processing scheduled operations. It is specified as a percentage of the total number of server sessions available (the MAXSESSION
parameter). You should set this to less than 100, otherwise it could lead to a situation where all the available sessions are being used for running client scheduled backups and a critical restore cannot run because there are no spare session slots.

Use the `query status` command to display the current `MAXSCHEDSESSIONS` value, and change it to another value with the `set maxschedsessions` command.

**TCPWINDOWSIZE**

This option specifies the size of the TCP sliding window in kilobytes. The `TCPWINDOWSIZE` option overrides the operating system's TCP send and receive spaces. In AIX for instance, these parameters are named `tcp_sendspace` and `tcp_recvspace`. The `TCPWINDOWSIZE` option specifies the size of the TCP sliding window for all clients and all but MVS servers. A larger window size can improve communication performance, but uses more memory. It enables multiple frames to be sent before an acknowledgment is obtained from the receiver. If long transmission delays are being observed, increasing the `TCPWINDOWSIZE` may improve throughput.

The size of the TCP/IP buffer is used when sending or receiving data. The window size used in a session is the smaller of the server and client window sizes. Larger window sizes use additional memory but may improve performance.

The general recommendation is to set `TCPWINDOWSIZE` to 64 (except Windows which is 63). Clients now default to 63. In an SP2 environment with a high speed switch set the `TCPWINDOWSIZE` to a value between 128 - 640, and when using Gigabit Ethernet with Jumbo Frames – 9000 MTU set the `TCPWINDOWSIZE` to 128.

**Tip:** On AIX, the network option `rfc1323` must be set on to have TCPWindow sizes larger than 64K-1.

**TCPBUFSIZE**

The `TCPBUFSIZE` option specifies the size of the internal TCP communication buffer, that is used to transfer data between the client node and the server. A large buffer can improve communication performance, but requires more memory.

The default setting of `TCPBUFSIZE` to 32 on client and server, which is the recommended value.
TCPNODELAY
The TCPNODELAY option, when set to Yes, allows data packets less than the MTU size to be sent out immediately. It is recommended to stay with the default setting of YES.

15.3.4 General parameters
This parameters can affect system performance and can be manually tuned according to customer requirements.

**Note:** The following parameters must be set in the server options file, and require a restart of the Tivoli Storage Manager server to take effect.

**EXPINTERVAL**
The Tivoli Storage Manager server runs automatic inventory expiration to remove unneeded client backup and archive file copies from the server. The EXPINTERVAL option specifies the interval in hours between automatic expiries.

Backup and archive copy groups specify the criteria that make copies of files eligible for deletion from data storage. However, even when a file becomes eligible for deletion, the file is only marked for deletion in the server database. It is not physically deleted from the database and storage pools until expiration processing occurs. If expiration processing does not occur periodically, storage pool space is not reclaimed from expired client files, and the Tivoli Storage Manager server requires increased disk storage space.

Expiration processing is very CPU intensive. If possible, it should be run when other Tivoli Storage Manager processes are not occurring. To enable this, either schedule expiration once per day, or use the `setopt expinterval 0` command and manually start the process with the expire inventory command at the server.

**Tip:** If SELFTUNEbufpoolsize is set to YES, expire inventory processing will also trigger the buffer pool performance monitoring algorithm to check if a performance improvement could be gained (based on previous server execution and available real memory).

**THROUGHPUT thresholds**
Use the `THROUGHPUTTIMETHRESHOLD` and `THROUGHPUTDATATHRESHOLD` to control how Tivoli Storage Manager handles slow performing client sessions. Slow performing sessions may pin your recovery log and result in slower overall server performance. These options allow you to specify thresholds which must be met by client sessions in order to be considered productive and avoid cancellation.
The *THROUGHPUTDATATHRESHOLD* is specified in kilobytes per second, and specifies the throughput that a client session must reach to prevent being cancelled after the time threshold is reached.

The *THROUGHPUTTIMETHRESHOLD* is specified in minutes, and is added to the media wait time, to determine the total client session time. It specifies the time threshold for a session after which it may be cancelled for low throughput.

If the server detects that the client data transfer rate is below the specified threshold, the session is considered to be eligible for termination, after the time threshold is reached.

**COLLOCATION**

The speed at which you can restore the files, among other parameters, also depends on how many tape drives are available on the server, and whether you are using collocation to keep file spaces assigned to as few volumes as possible.

With tape capacities becoming larger and larger, collocation by groups of nodes is now supported. Groups of nodes can be defined, and the server can then collocate data based on these groups. Collocation by group can yield the following benefits:

- Reduce unused tape capacity by allowing more collocated data on individual tapes.
- Minimize mounts of target volumes.
- Minimize database scanning and reduce tape passes for sequential-to-sequential transfer

For newly defined storage pools, the default storage pool collocation setting is now *group*.

You can have the server collocate client data when the data is initially stored in server storage. If you have a storage hierarchy, you can also have the data collocated when the server migrates the data from the initial storage pool to the next storage pool in the storage hierarchy.

### 15.4 Client node

In this section we focus on some tuning parameters on the Tivoli Storage Manager client to obtain maximum performance when using Tivoli Storage Manager. These parameters can be changed or added to the client options file.
15.4.1 Transactions

This section covers the Tivoli Storage Manager client options that influence the performance and behavior of data movement on and onto the server.

**TXNBYTELIMIT**

Specifies the batch size, in kilobytes, for Tivoli Storage Manager server transactions. *TXNBYTELIMIT* is used together with *TXNGROUPMAX*. This option reduces the number of server transactions by increasing the amount of data within any one transaction. Therefore, the amount of overhead during backup, restore, archive, and retrieve caused by database commits is reduced.

**Note:** This option can also be defined and adjusted by the server as required during self-tuning operations.

A *transaction* is the unit of work exchanged between the client and server. Because the client program can transfer more than one file or directory between the client and server before it commits the data to server storage, a transaction can contain more than one object. This is called a *transaction group*. This option allows you to control the amount of data sent between the client and server before the server commits the data and changes to the server database, thus changing the speed with which the client performs work.

The amount of data sent within a single transaction applies when files are batched together during backup or when receiving files from the server during a restore procedure. The administrator can limit the number of files or directories contained within a group transaction using the *TXNGROUPMAX* option; the actual size of a transaction can be less than your limit. Once this number is reached, the client commits the transaction to the server even if the transaction byte limit is not reached.

If you increase this parameter, consider that:

- More data per transaction will increase server recovery log requirements. Check log and log pool space to ensure that there is enough space, and remember that a larger log may increase server startup time.
- More data per transaction may result in more data being retransmitted if a retry occurs. During a retry, all objects belonging to the current transaction need to be retransmitted, which can decrease performance.

**Tip:** Check your client log files for retransmission attempts during backups. They can occur, for example, when a file grows because client compression is enabled and the *compressalways* option being set to no.
The benefits of changing this parameter are subject to configuration and workload characteristics. In particular, this parameter benefits tape storage pool backup more than disk storage pool backup, especially if the workload consists of many small files.

When setting the size of transactions, consider setting a smaller size if you are experiencing many resends due to files changing during backup when using static, shared static, or shared dynamic. This applies both to static and shared, because when a client detects that a file has changed during backup and decides not to send that file, it still has to re-send the other files in the transaction.

**RESOURCEUTILIZATION**

The `RESOURCEUTILIZATION` client option regulates the level of resources (that is, number of concurrent sessions) the Tivoli Storage Manager client and server can use during processing.

Tivoli Storage Manager clients are automatically multi-session capable and this function is transparent to the end user. However the `RESOURCEUTILIZATION` parameter allows the user to customize the function.

This option increases or decreases the ability of the Tivoli Storage Manager client to create multiple sessions. The value of `RESOURCEUTILIZATION` does not represent the amount of sessions created by the client - it specifies the level of resources the Tivoli Storage Manager server and client can use during backup or archive processing. During backup or archive, the higher the value, the more sessions the client can start if it deems necessary.

The parameter can range from 1 to 10. When the option is not set, which is the default, only two sessions are created to the server - one session is opened for querying the server and the other for transferring file data.

If you set the `RESOURCEUTILIZATION` option to enable multiple client/server sessions and are backing up direct to tape, you must also update the server option `MAXNUMP`, for client node maximum mount points allowed.

The following factors can affect the throughput of multiple sessions:

- The server’s ability to handle multiple client sessions. Is there sufficient memory, multiple storage volumes, and CPU cycles to increase backup throughput?
- The client’s ability to drive multiple sessions (sufficient CPU, memory, etc.).
- The configuration of the client storage subsystem. File systems that are striped across multiple disks, using either software striping or RAID-5, can better handle an increase in random read requests than a single drive file.
system. A file system on a single drive may not see performance improvement if it attempts to handle many random concurrent read requests.

- Sufficient bandwidth in the network to support the increased traffic.

These are some potentially undesirable aspects of running multiple sessions:

- The client could produce multiple accounting records.
- The server may not start enough concurrent sessions. To avoid this, the server `MAXSESSIONS` parameter must be reviewed and possibly changed.
- A query node command may not summarize client activity.

### 15.4.2 Communication

This section covers client options to influence the performance and behavior of communication protocols between client and server.

**DISKBUFFSIZE**

The `DISKBUFFSIZE` option specifies the maximum disk I/O buffer size (in kilobytes) that the client may use when reading files. Optimal backup, archive, or HSM migration client performance may be achieved if the value for this option is equal to or smaller than the amount of file read ahead provided by the client file system. A larger buffer will require more memory and may not improve performance. This option replaces the formerly available `LARGECOMMBUFFERS` option. It is recommended to keep the default value unless otherwise advised by IBM support.

**TCPBUFFSIZE**

The `TCPBUFFSIZE` option specifies the size of the internal TCP communication buffer that is used to transfer data between the client node and the server. A large buffer can improve communication performance, but requires more memory.

**TCPWINDOWSIZE**

The `TCPWINDOWSIZE` option specifies the size of the TCP/IP sliding window in kilobytes. This option overrides the operating system's TCP send and receive spaces. It specifies the size of the TCP sliding window for all clients, and all but MVS servers. A larger window size can improve communication performance, but uses more memory. It enables multiple frames to be sent before an acknowledgment is obtained from the receiver. If long transmission delays are being observed, increasing the `TCPWINDOWSIZE` may improve throughput.
TCPNODELAY
The TCPNODELAY option, when set to Yes, allows data packets less than the MTU size to be sent out immediately. It is recommended to set the value to yes.

15.4.3 General parameters
This parameters can affect system performance and can be manually tuned according to customer requirements.

COMPRESSION
The COMPRESSION option compresses files before they are sent to the Tivoli Storage Manager server. Compressing files reduces the amount of data storage required to store backup versions and archive copies of your files. It can, however, affect Tivoli Storage Manager throughput because of the CPU cycles required to compress the file.

Client data compression will save storage space, network capacity, and server cycles. However, compression may decrease throughput. If compression is on, backups can be significantly slower, depending on client processor speed, than if it were disabled. Compression may be beneficial for a fast processor on a slow network, but probably not for a slow processor on a fast network.

By default, files continue compressing even if the operation is causing the file size to increase. This can be the case if you are backing up already compressed files, such as ZIP archives. To prevent continued compression if the filesize grows, and to send the file again without compression, use the COMPRESSALWAYS option set to no. When set to no, the current transaction will get rolled back and the objects for the transactions need to get retransmitted. You might want to edit your include/exclude list to exclude precompressed options from compression using the exclude.compression option.

The client COMPRESSION option is only in effect if your Tivoli Storage Manager administrator specifies that your client node may choose its own compression. When a node is registered, using the register node command, there is a COMPRESSION parameter which allows the server to enforce compression, enforce non-compression, or allow the client to choose for itself. The default value is that the client can choose by setting the COMPRESSION value in the client options file. If the administrator wants to force a client to use compression, regardless of the contents of the client options file, then use the command update node with the parameter compression=yes.

General rules for using Tivoli Storage Manager compression:
- If you are backing up directly to tape, and the tape drive supports its own compaction, use the tape drive compaction, not Tivoli Storage Manager
compression. If you have already compressed the data at the client-level, then the tape drive compaction will not be able to reduce the data further.

► Do not use Tivoli Storage Manager compression if a client currently has built-in file compression support, like the Tivoli Storage Manager client for NetWare. Tivoli Storage Manager compression on these clients will not yield additional reduction in the amount of data backed up to the server.

► If you are using compressed file systems, for example NTFS compression on a Windows system, the Tivoli Storage Manager client reads the uncompressed data stream regardless of the compression state of that file in the file system. This means that file is uncompressed during the read and, if it is compressable data, gets compressed again by the client during the backup. This decompression/compression overhead may decrease backup performance. During the same file is restored, the client will decompress the file data received from the server and write the uncompressed data to the file system where it will get compressed by the file system driver again.

**COMPRESSALWAYS**

The *COMPRESSALWAYS* option controls what occurs when a file grows during compression. You can continue compressing, or send the object again as is if it grows during compression. This option is used with the *COMPRESSION* option.

**DIRMC**

This option used to have a big impact on restore performance in earlier versions of Tivoli Storage Manager, when during the restore process first the directories and then the files were restored. It was therefore an advantage to have directory information cached so that it was permanently on disk, and best practices design was to create small storage pools specifically for directories. The DIRMC directive in the client options file was used to bind directories to a management class pointing to this storage pool. Restore processing has changed since then: during the process directories will be created with default attributes and the correct attributes and ACL information is applied once the data is read from the media. Therefore the original reason to cache directories on disk no longer applies.

Nevertheless, the DIRMC option is still useful. If you do not specify this option to associate a management class with directories, the client, during backup, uses the management class in the active policy set of your policy domain with the longest retention period, which could well point to a storage pool on tape. This might result in unwanted mount requests during a backup. Therefore, in the design described in this Redbook, we have used a separate storage pool and management class for directories and recommend using the DIRMC option.
**QUIET**

The *QUIET* option keeps messages from being written to the screen during backups. By default, Tivoli Storage Manager displays information about each file it backs up. To prevent this, use the *QUIET* option - messages and summary information are still written to the log files.

There are two main benefits of using the *QUIET* option:

- For tape backup, the first transaction group of data is always resent. To avoid this, use the *QUIET* option to reduce retransmissions at the client.
- If you are using the client scheduler to schedule backups, using the *QUIET* option dramatically reduces disk I/O overhead to the schedule log and improves Tivoli Storage Manager throughput.

### 15.5 System design for performance

In this section we discuss some areas of hardware based design considerations when setting up a Tivoli Storage Manager server system.

#### 15.5.1 PCI busses

Most pSeries machines have multiple PCI busses. As an example, when backing up to tape over a LAN it is not desirable to have the network adaptor and the tape (SCSI, fibre) adaptor on the same bus. Spreading the PCI adapters across different busses based on predicted usage will provide the most efficient layout.

#### 15.5.2 Tape busses (SCSI, Fibre)

Placing too many tape devices on a bus can cause contention issues. For HVD SCSI tape devices, no more than two devices should be placed on a single bus. For Fibre Channel tape devices, consider the throughput of the tape device and the HBA. For example, if you are using 3rd generation LTO drives with rated performance of 80MB/second, and your backup data streams are able to push the drives to close to this limit, you might choose to put one or two drives per 2Gbps HBA. Don’t forget to consider the effect of compression.

It is often difficult to achieve the rated speed of high speed adaptors such as Gigabit Ethernet and Fibre Channel, no matter what the application. Do not plan on achieving full rated speed with these cards.
15.5.3 Disk topology

It is desirable to have a single Tivoli Storage Manager volume per disk, be it database, log or storage pool. This provides the least contention, allowing each volume to act independently. This is often difficult as disk sizes get larger and RAID is insisted upon. It takes discipline to dedicate a 72 GB disk to a small 6GB log volume, for example. Use of virtualization technologies such as the IBM TotalStorage® SAN Volume Controller can assist here, since virtual disks can be made of any size.

In the case of RAID, there is little choice but to have multiple Tivoli Storage Manager volumes per logical disk. This is an inbuilt downside to RAID. Instead of each disk acting independently, they must all work in unison, limiting performance.

When using JBOD, placing two storage pool volumes on a single disk will not result in a degradation, and may provide an improvement in performance. This is due to the fact that Tivoli Storage Manager writes synchronously to storage pool volumes and providing the disk with other work to do increases aggregate performance.

15.5.4 System memory

The largest use of memory in a Tivoli Storage Manager server is the database buffer pool. A large buffer pool can improve database performance because fewer disk I/O is necessary. You should provide enough real memory for an optimal buffer pool. The buffer pool is adjusted using the \texttt{BUFPOOLSIZE} option, described in 15.3.1, “Server database and recovery log” on page 480. Set this option to between 1/8 and 1/2 of real memory.

15.5.5 Network

If possible, use dedicated networks for backup (LAN or SAN) so that other network traffic is not sharing the same wire as backup data.

Gigabit technology supports jumbo frames (9000 bytes) which should be used whenever Gigabit Ethernet hardware is implemented. Unfortunately not every Gigabit hardware component implements jumbo frames. Using this feature is only practical when all elements, server, switch and client, are capable of it.

15.5.6 Tape devices

Calculation of your daily throughput for backup and archive data as well as the amount of data being sent directly to tape should lead to a minimum number of tapes that should be in place to sustain your data flow. Remember to size the
number of tape devices to serve the data flow during the *peak* backup window, not on an daily average basis.

If you have to schedule certain server operations like migration, reclamation or storage pool backup during the backup window, make sure that there are enough tape drives available to support these additional operations. Even if these server operations are typically scheduled outside the normal backup window, you should allow a number of tape drives serving unscheduled restore or retrieve operations.

### 15.6 Special performance tips

This section describes some tuning tips for special areas that may depend on a certain operating system.

#### 15.6.1 LAN-free tuning

When using, LAN-free backup and restore, `TCPNODELAY` must be set to YES (the default) on the Storage Agent and server.

#### 15.6.2 LTO/DLT tape tuning

Due to the high latency of the `write filemarks` command, LTO and DLT tape devices benefit from making Tivoli Storage Manager transactions as large as possible. Setting server `TXNGROUPMAX` greater than 512 files and client `TXNBYTELIMIT` to the maximum of 2097152 bytes can reduce the number of transactions, enhancing performance. It is important to understand that these settings can effect the server's recovery log utilization, and will increase the amount of time between transaction commits. At Tivoli Storage Manager V5.2 and higher, the maximum setting for `TXNGROUPMAX` value has been increased from 256 to 65000. The double-up and test rule should be followed for these parameters.

#### 15.6.3 File system volumes versus raw logical volumes

As a rule of thumb, the general recommendation is to put Tivoli Storage Manager server volumes on *raw logical volumes* (RLV) in a UNIX environment. In addition to the read/write performance, RLV volumes do not fragment and the creation is very fast. Support for RLV's is available on all UNIX Tivoli Storage Manager platforms, with the exception of Linux. RLVs are not supported for sequential access storage pools (device class of type file).
Tests on AIX have shown little difference in performance between using Tivoli Storage Manager storage pool volumes on JFS2 file systems using direct I/O and raw logical volumes. The same is true for tests on Solaris systems using VxFS filesystems with the QuickIO option being enabled.

**Note:** On AIX, be aware that only storage pool volumes attempt to utilize the AIXDIRECTIO option, not database or log volumes.

If you decide to place your server volumes on a file system, be aware of fragmentation in the file system, especially if you create a lot of volumes at the same time. Also, creating such volumes can take some time as the whole file is written during initialization.

### 15.6.4 AIX virtual memory system tuning

AIX is very aggressive in caching file system data. In many cases this is highly desirable. In the case of Tivoli Storage Manager, file system caching provides no benefit since the data is not likely to be in cache when it is needed (for migration or restore.) This is due to the large volume of data Tivoli Storage Manager processes, which is typically much greater than available memory.

AIX will often page out application memory (including Tivoli Storage Manager) in favor of file system cache data. This is undesirable since it often causes the Tivoli Storage Manager database buffer pool to be paged out to disk, negating much of the benefit of the buffer pool. This can cause misleading database cache hit statistics since Tivoli Storage Manager believes it has that data in memory, when in fact it has much of that data on disk in paging space. The symptoms for this behavior are high paging rates as seen by the `vmstat` command. This can be avoided by tuning AIX such that it will not favor file system cache over application memory. This is accomplished by using the `vmtune` command provided in the bos.adt.samples AIX fileset.

By default, AIX will use up to 80% of memory as a file system cache. For machines dedicated to Tivoli Storage Manager this should be lowered. A good starting point is 50%. This parameter is called maxperm. This may be done by running the `vmtune` command shown in Example 15-18 (pre AIX V5.2) and the `vmo` command in Example 15-19 (AIX V5.2 and later)

**Example 15-18** Tuning pre 5.2 AIX file system cache usage

```
/usr/samples/kernel/vmtune -P50
```
Example 15-19  Tuning AIX 5.2 and newer file system cache usage

vmo -o maxperm%=50

For detailed explanation of the vmo tunables, please see *VMM page replacement tuning* under

If, after a period of time, paging still occurs this may be lowered further. This behavior can also be avoided by using raw logical volumes for the disk storage pools. AIX will not attempt to cache data residing on a raw logical volume and will then be less likely to need to page out application memory. Raw logical volumes are also more efficient (in terms of CPU utilization) since AIX does not spend time attempting to cache this data. If a Tivoli Storage Manager server has high CPU utilization, better performance might be obtained by using raw logical volumes.

Often system paging is interpreted as a lack of memory. With Tivoli Storage Manager, this does not happen often, and paging can (and should) usually be eliminated with the tuning above. AIX clients can also benefit from altering the maxperm parameter. During backup, files are read into cache that are not likely to be read again.

As before, this can cause application memory to be paged out, causing the main application of that machine to suffer during backup. Lowering maxperm can help with this. Beware of the effects of tuning maxperm on the client application - the performance of the main application may depend on file system cache in some instances (like a file server.) In this case it may be desirable to just alter maxperm before and after a Tivoli Storage Manager backup, or not at all.

Another tunable parameter is maxpgahead, which controls the AIX read-ahead algorithms. Read-ahead is desirable on the client during backup, and on the Tivoli Storage Manager server during storage pool migration from disk.

Setting maxpgahead to the maximum of 256 is recommended. When tuning maxpgahead you must also adjust the maxfree parameter to allow room for this data. The maxfree parameter should equal minfree+maxpgahead (or higher), as shown in Example 15-20.

Example 15-20  Tuning pre AIX 5.2 read-ahead algorithms

/usr/samples/kernel/vmtune -R256 -f120 -F376

The vmtune settings do not survive system reboot - place them in a script run by /etc/inittab on startup.
On AIX 5.2 and newer, the `vmtune` command is replaced by `vmo` and `ioo` commands. See

Example 15-21  Tuning AIX 5.2 and newer read-ahead algorithms

```
vmo -o maxfree=376
vmo -o minfree=120
ioo -o maxpgahead=256
ioo -o j2_maxPageReadAhead=256
```

For more information on the commands, see the AIX documentation or man pages for vmtune, vmo and ioo.

### 15.6.5 Use NTFS partitions for the server

In a Microsoft Windows environment, place the Tivoli Storage Manager server recovery log, database, and disk storage pool volumes on partitions formatted using NTFS. NTFS has the following advantages:

- It offers support for larger disk partitions than FAT.
- It has better data recovery.
- It has better file security.
- Formatting Tivoli Storage Manager storage pool volumes on NTFS partitions is much faster than on FAT partitions.

**Warning:** NTFS file compression must not be used on disk volumes that are used by the Tivoli Storage Manager server, because of the potential for performance degradation.
15.6.6 Journal based incremental backup

Using journal based incremental backup (JBB) can provide substantially faster incremental backups of file systems with a large number of files with small daily change rates. Configuration of the journal options is done in the tsmjbbd.ini file in the client install directory. See the file for supported settings and configurable parameters. To show you the difference between a classic incremental and JBB type of backup, we created a file system with more than 240,000 objects and collected an instrumentation trace for an incremental backup when only a single file has been changed. The statistics for the backup without JBB are shown in Example 15-22.

Example 15-22  Incremental backup, no journal


Instrumentation class: Client detail
Completion status: Success

 annonces

Detailed Instrumentation statistics for

Thread: 1029  Elapsed time 406.568 sec

<table>
<thead>
<tr>
<th>Section</th>
<th>Actual (sec)</th>
<th>Average (msec)</th>
<th>Frequency used</th>
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<tr>
<td>Other</td>
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Detailed Instrumentation statistics for
Thread: 515  **Elapsed time**  406.433 sec
Section  Actual (sec)  Average(msec)  Frequency used

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<td>Solve Tree</td>
<td>0.000</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>Compute</td>
<td>0.000</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>BeginTxn Verb</td>
<td>0.000</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>Transaction</td>
<td>0.000</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>File I/O</td>
<td>0.000</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>Compression</td>
<td>0.000</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>Encryption</td>
<td>0.000</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>CRC</td>
<td>0.000</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>Delta</td>
<td>0.000</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>Data Verb</td>
<td>0.000</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>Confirm Verb</td>
<td>0.000</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>EndTxn Verb</td>
<td>0.000</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>Sleep</td>
<td>0.000</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>Thread Wait</td>
<td>0.040</td>
<td>39.7</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>97.981</td>
<td>0.0</td>
<td>0</td>
</tr>
</tbody>
</table>

Session established with server LOCHNESS_SERVER1: Windows
   Server Version 5, Release 3, Level 2.2
   Server date/time: 02/23/06 16:39:37 Last access: 02/23/06 16:32:12

Total number of objects inspected: 242,421
Total number of objects backed up: 2
Total number of objects updated: 0
Total number of journal objects: 0
Total number of objects rebound: 0
Total number of objects deleted: 0
Total number of objects expired: 0
Total number of objects failed: 0
Total number of bytes transferred: 87.33 KB
LanFree data bytes: 0 B
Server-Free data bytes: 0 B
Data transfer time: 0.00 sec
Network data transfer rate: 16,750.46 KB/sec
Aggregate data transfer rate: 0.21 KB/sec
Total number of bytes pre-compress: 89,411
Total number of bytes post-compress: 89,411
Objects compressed by: 0%
**Elapsed processing time:** 00:06:46
Average file size: 43.65 KB
So out of the total time of 406 seconds it takes 308 seconds to process the 35332 directories and find out that only two objects have changed. In addition, the server is queried for the objects available, resulting in search and transfer of 82MB worth of inventory information as shown with producer session 134 in Example 15-23. Not only do we have to collect the information from the server, we need to transfer it through the network to make it available for the client session to check for changed objects.

**Example 15-23   TSM server query session information.**

```
  tsm: LOCHNESS_SERVER1> q se

  Sess Comm.  Sess  Wait  Bytes  Bytes  Platform  Client Name
  Number    Method State  Time  Sent  Recvd    Type
  ------    ------ ------ ----- ----- -------- --------
    121      Tcp/Ip  Run   0 s   8.4 K   456 Admin  WinNT  ADMIN
    134      Tcp/Ip  IdleW 1 s  82.0 M   1.8 K  Node  AIX      BANDA
```

Now we run the same operation, but with JBB enabled. The statistics are shown in Example 15-24.

**Example 15-24   Journal based backup statistics**

```
Session established with server LOCHNESS_SERVER1: Windows
  Server Version 5, Release 3, Level 2.2
  Server date/time: 02/23/06  17:12:31  Last access: 02/23/06  17:11:38

Incremental backup of volume '/home'
Querying Journal for '/home'
Processing 1 Journal entries for '/home'
Successful incremental backup of '/home'

Total number of objects inspected:       1
Total number of objects backed up:       1
Total number of objects updated:         0
Total number of objects rebound:         0
Total number of objects deleted:         0
Total number of objects expired:         0
Total number of objects failed:          0
Total number of bytes transferred:       88.03 KB
Data transfer time:                     0.00 sec
Network data transfer rate:             17,737.50 KB/sec
Aggregate data transfer rate:           43.80 KB/sec
Objects compressed by:                  0%
Elapsed processing time:                00:00:02
```
Please keep in mind that this is only a single small test in our lab, but it should be sufficient to explain the major advantages of journaling to you.

We recommend that you leave the journal database size set to unlimited. Limiting the journal database size could potentially cause the journal to become invalid, and then Tivoli Storage Manager would resort to a full incremental backup. Of course, the journal size will depend on how many distinct files and directories are updated or deleted between backups, and hence on how much activity the file system sees. Very active file systems will need more space for the journal database than inactive file systems. We also recommend placing the journal database on a disk with at least 1 GB of free space. If free disk space is limited, consider performing backups more frequently than once per day, as this will also limit the journal database size.

15.7 Summary

When all is said and done with regard to performance, one thing should be clear: this job is never complete! As your client workload changes, your network configuration will evolve, the amount of managed data will increase, databases and their specialized client requirements will change, and hardware will get faster. All of these factors combine to move bottlenecks around your environment in an endless game of cat and mouse.

Figure 15-2, while by far not complete, should give you a good starting point when reviewing your Tivoli Storage Manager tunables.
If you document all your changes, making one change then re-testing, you will build yourself a smooth path to a continually top performing solution. However, if you are less structured in your approach, and do not keep good documentation, then frustrating times might be waiting just around the corner. If your experiences become overwhelming, you might require the assistance of a very experienced Subject Matter Expert. All of the authors have spent time working through some of the challenges created by careless “haphazard” approaches, and we’re hoping you will follow the careful structured path.

Happy tuning!
Advanced topics

In this part of the book, we discuss more advanced topics, such as LAN-free backups, and using NDMP and the Network Appliance file server to achieve file level restore. Also included is the Disaster Recovery Manager, bare metal machine recovery, Tivoli Data Protection complimentary products, and finally, how to upgrade your IBM Tivoli Storage Manager server and clients.
Leveraging SAN environments

We are now entering into the advanced topics for this guide.

In this chapter, we describe how to exploit your SAN environment to perform LAN-free client operations. We cover in detail requirements and procedures to set up LAN-free backup to tape using advanced IBM Tivoli Storage Manager features, such as library sharing, server to server communication, SAN device discovery and more.

We show you how to install and configure the Storage Agent component, which is a prerequisite for LAN-free operations and how to deploy the Storage Agent into your IBM Tivoli Storage Manager architecture.

Finally, we show you how to determine whether a client operations such as backups and restores were made via LAN-free or not and which important considerations you should made before deploying LAN-free feature to your data protection procedures.

More information on LAN-free environments, especially on various library sharing scenarios and on LAN-Free backups to disk is in Get More Out of Your SAN with IBM Tivoli Storage Manager, SG24-6687.
16.1 LAN-free prerequisites

Before deploying LAN-free data movement in your environment, you should carefully plan the system configuration, since this provides a smooth transition through system setup into production. As part of your planning, you need to identify the following:

- Which devices will be used for LAN-free data movement.
- Which clients will use LAN-free data movement.
- Which server will manage your client data.
- Which library will be shared among the server and clients.
- Compatibility of server and Storage Agent code, as well as compatibility of server and Storage Agent and the shared library drives.

**Note:** Only Storage Agents versions 5.2.3, 5.2.4 (and later) and 5.3 (and later) are supported by Tivoli Storage Manager V5.3.

Basically, the LAN-free environment consists of a Tivoli Storage Manager server; and client machines with both the backup-archive and Tivoli Storage Manager for SAN clients installed. Tivoli Storage Manager for SAN is referred to as the Storage Agent. The Storage Agent, sometimes described as a small Tivoli Storage Manager server, is responsible for performing LAN-free operation upon client requests. Last but not least, both server and Storage Agent need access to a shared tape library (or disk system) connected to the SAN.

Using a Storage Area Network (SAN) as a data transmission media for Tivoli Storage Manager client backup or restore operations requires several conditions and requirements to be met:

- The SAN configuration must be supported by Tivoli Storage Manager, from a hardware and software perspective
- TCP/IP is required for communication between the Tivoli Storage Manager server, the client, and the Storage Agent.
- You need sufficient licenses for LAN-free operations, that is licenses of Tivoli Storage Manager for SAN.
- A Tivoli Storage Manager backup-archive client or a Tivoli Storage Manager Data Protection application client must be installed on a client system

As shown in Figure 16-1 on page 509, our LAN-free lab environment consists of a client DIOMEDE running Microsoft Windows 2003 and a Tivoli Storage Manager server V5.3.2, ATLANTIC, running on AIX 5.3. Both systems are connected via LAN and SAN. We also need a shared tape library connected to
the SAN - this is an IBM TotalStorage 3582 Tape Library (IBM 3582) with 2 LTO2 drives and Control Path Failover (CPF) feature enabled.

**Note:** CPF is an optional feature of the IBM 3582, that provides automatic control path failover to a preconfigured redundant control path if an HBA or control path drive fails, without aborting the current operation in progress. CPF is supported under AIX, Linux, Solaris, HP-UX, and Windows.

**Figure 16-1  SAN lab environment**

**Note:** The Tivoli Storage Manager server and Storage Agents may run on different platforms, e.g. server on AIX and Storage Agents run on Solaris and Windows client machines.

Apart from properly setting up the SAN itself, including configuring the switches; and cabling and zoning the devices participating in the SAN environment, you
should install the supported Fibre Channel Host Bus Adapters (HBA) in the client machines, including the HBAs device drivers and firmwares.

In the following sections we discuss LAN-free client data transfer using Tivoli Storage Manager and the Storage Agent. In particular, we cover these topics:

- Setup and configuring Tivoli Storage Manager server for LAN-free
- Configuring devices on client machine for LAN-free
- Setup and configuring the Storage Agent on client machine
- Customizing the client for LAN-free
- Operations and considerations when using LAN-free data transfer

For more information on operating Tivoli Storage Manager in SAN environments, see *Get More Out of Your SAN with IBM Tivoli Storage Manager*, SG24-6687.

### 16.2 Server setup for LAN-free

Before setting up the server for LAN-free operations, the Tivoli Storage Manager server itself must be installed and running. The machine hosting the server instance needs to be connected to the SAN.

The instructions in this section assume that you can detect and use your SAN-attached library devices, and that all SAN devices and components have current microcode and firmware levels installed.

Once the hardware, firmware, and operating systems are prepared, the Tivoli Storage Manager configuration is virtually identical, regardless of the platform used. Here we describe configuring the Tivoli Storage Manager server on an AIX 5L platform.

In a Tivoli Storage Manager SAN environment, where the library is shared between several hosts, the Tivoli Storage Manager server is referred to as the library manager. The library manager owns and controls the library device and processes all requests from the library clients, such as mounting and dismounting volumes.

In our case, the library clients are Storage Agents. Library clients request shared library resources, such as a drive or media, from the library manager, but use them independently of the library manager.

In this library-sharing environment, the most important relationship is the one between the server and the Storage Agent - or library manager and library client. Establishing communication between library manager and library clients is called server-to-server communication in Tivoli Storage Manager terminology.
We prepare our server instance for server-to-server communication, setting up the server name, which must be unique across the whole Tivoli Storage Manager environment. Further, each server name has an associated password, that will be used during the server-to-server authentication process. Note, that the server name is independent of DNS name or TCPSERVERADDRESS as specified on the clients - it is just an identifying string for a server in a Tivoli Storage Manager server-to-server communication.

Also note, in some server-to-server configurations you may allow cross defining among servers, which facilitates defining server-to-server communication. Cross defining does not apply to Storage Agent definitions, so we do not cover it here.

Finally, make sure that the Tivoli Storage Manager server’s high-level address (IP address) and low-level address (port) are set. We leave the port number for server-to-server communication on default value 1500, see Example 16-1.

Example 16-1  Prepare the server instance for server-to-server communication

```bash
  tsm: ATLANTIC> set servername atlantic
  ANR2094I Server name set to ATLANTIC.

  tsm: ATLANTIC> set serverpassword xxxxx
  ANR2131I Server password set.

  tsm: ATLANTIC> set serverhladdress atlantic.itsosj.sanjose.ibm.com

  tsm: ATLANTIC> set serverlladdress 1500
  ANR2133I Server lladdress set to 1500.
```

You may review your settings with the `query status` command, as shown in Example 16-2.

Example 16-2  Server status output

```bash
  tsm: ATLANTIC> query status
  Storage Management Server for AIX-RS/6000 - Version 5, Release 3, Level 2.2

  Server Name: ATLANTIC
  Server host name or IP address: atlantic.itsosj.sanjose.ibm.com
  Server TCP/IP port number: 1500
  Crossdefine: On
  Server Password Set: Yes
```
16.2.1 Define library, drives and associated paths on the server

As we said, the library must be shared between server and Storage Agents for LAN-free operations. Therefore, in contrast to a typical library definition, you must enable the library for SAN sharing using `shared=yes` parameter, otherwise the library clients will not be able to communicate with the drives.

Additionally, Tivoli Storage Manager V5.3 and later supports an option when defining the library, `resetdrives`. This is mainly used in cluster failover configurations, since its purpose is to reset SCSI reservations on defined drives during the server instance startup. However, it can also be helpful in non-clustered solutions, so we set the `resetdrives` value to yes, as in Example 16-3.

Example 16-3  Library and drive definition

```
tsm: ATLANTIC> define library 3582_shared libtype=scsi shared=yes resetdrives=yes autolabel=yes serial=autodetect
ANR8400I Library 3582_SHARED defined.

sm: ATLANTIC> define path atlantic 3582_SHARED srctype=server \ cont> desttype=library autodetect=yes device=/dev/smc0
ANR1720I A path from ATLANTIC to 3582_SHARED has been defined.

sm: ATLANTIC> define drive 3582_shared dr00 serial=autodetect \ cont> element=autodetect cleanfrequency=none
ANR8404I Drive DR00 defined in library 3582_SHARED.

sm: ATLANTIC> define drive 3582_shared dr01 serial=autodetect \ cont> element=autodetect cleanfrequency=none
ANR8404I Drive DR01 defined in library 3582_SHARED.

sm: ATLANTIC> define path atlantic dr00 srctype=server desttype=drive \ cont> library=3582_shared device=/dev/rmt0 online=yes
ANR1720I A path from ATLANTIC to 3582_SHARED DR00 has been defined.

sm: ATLANTIC> define path atlantic dr01 srctype=server desttype=drive \ library=3582_shared \ cont> device=/dev/rmt1 online=yes
ANR1720I A path from ATLANTIC to 3582_SHARED DR01 has been defined.
```

Tip: LTO drives have an internal self cleaning mechanism, which cleans a drive anytime a tape is to be loaded. Therefore, you do not need to set the cleaning frequency in the drive definition.
16.2.2 Define the device class

In Example 16-4, we define a device class for the IBM 3582 with the appropriate tape format. Note, that we set the tape retention time to 5 minutes only, to ensure that tape volumes are dismounted as soon as they are no longer required for the operation in progress. Thus, when a library manager or client requires a mount point in the future, it does not need to wait for the idle tape to be dismounted first.

Example 16-4 Define the device class for the shared library

```
   tsm: ATLANTIC>define devclass LTO2C devtype=LTO library=3582_SHARED \   cont> format=ULTRIUM2C mountretention=5 mountlimit=DRIVES
   ANR2203I Device class LTO2C defined
```

**Note:** In a mixed server and Storage Agent version environment, you should choose a recording format supported by both server and Storage Agent. For example, if your drives support more than one recording format, (i.e LTO3 drives supports writes using both LTO2 and LTO3 format), and your server is running version V5.3.2 (which supports LTO3), but Storage Agents are on 5.2.3 (which supports only LTO2), you must choose either LTO2 format, or upgrade your Storage Agent to a version that supports LTO3.

For the complete syntax of the `define devclass` command for other storage devices supported by IBM Tivoli Storage Manager, refer to the *IBM Tivoli Storage Manager Administrator’s Reference*.

16.2.3 Creating primary sequential storage pool for LAN-free

Now define a storage pool using the device class we just created, which will be used by the LAN-free clients as their data destination. In Example 16-5, we define a primary sequential storage pool called TAPEDATA_LF.

Example 16-5 Define a primary sequential storage pool for LAN-free

```
   tsm: ATLANTIC>define stgp tapedata_lf lto2c description="Lan-free storage pool"\   cont> collocate=no maxscratch=99
   ANR2200I Storage pool TAPEDATA_LF defined (device class LTO2C).
```

16.2.4 Defining policy

The last step is to define a management class with associated copy group in the policy domain that uses the LAN-free storage pool. We then validate and activate the policy set to make the management class available for clients registered to the domain, see Example 16-6. For more explanation on policy implementation, see Chapter 7, “Data storage policies” on page 257.
Example 16-6  Prepare policy components for the LAN-free clients

tsm: ATLANTIC> define mgmtclass server server lanfree migdestination=NONE
ANR1520I Management class LANFREE defined in policy domain SERVER, set SERVER.

tsm: ATLANTIC> define copygroup server server lanfree type=backup verexist=3 verbdel=1 retextra=100 retonly=100 destination=TAPEDATA_LF
ANR1530I Backup copy group STANDARD defined in policy domain SERVER, set SERVER, management class LANFREE.

tsm: ATLANTIC> validate policy server server
ANR1515I Policy set SERVER validated in domain SERVER (ready for activation).

tsm: ATLANTIC> activate policy server server

Do you wish to proceed? (Yes (Y)/No (N)) y
ANR1514I Policy set SERVER activated in policy domain SERVER.

tsm: ATLANTIC> query copygroup server active lanfree f=d

Policy Domain Name: SERVER
Policy Set Name: ACTIVE
Mgmt Class Name: LANFREE
Copy Group Name: STANDARD
Copy Group Type: Backup
Versions Data Exists: 3
Versions Data Deleted: 1
Retain Extra Versions: 100
Retain Only Version: 100
Copy Mode: Modified
Copy Serialization: Shared Static
Copy Frequency: 0
Copy Destination: TAPEDATA_LF

Table of Contents (TOC) Destination:
Last Update by (administrator): ADMIN
Last Update Date/Time: 02/23/2006 14:45:26
Managing profile:
Changes Pending: No

Now we can register our client DIOMEDE to the policy domain SERVER. Note, that although the dataread and datawrite parameters are set to their default values, (any for both), we set it explicitly in the example to show you how you can control the transfer path used by the client. You may set the transmission to either LAN, or LANFREE or both (any). Specifying any means, that the LAN-free path will be tried at first, and if unavailable, data will be moved via the LAN.

Additionally, you may want to allow your client to allocate more than one tape drive for concurrent tape I/O operation, by specifying the MAXNUMMP
parameter during node registration. Our library has only two drives, so the maximum in our case is \( \text{maxnummp}=2 \).

**Example 16-7  Register node with data path and maxnummp specification**

```
$ tsm: ATLANTIC> register node diomede diomede datawritepath=any datareadpath=any maxnummp=2
ANR2060I Node DIOMEDE registered in policy domain STANDARD.
ANR2099I Administrative userid DIOMEDE defined for OWNER access to node DIOMEDE.
```

### 16.2.5 LAN-free validation

Now validate the available management classes and their associated destination storage pools for LAN-free capability. Example 16-8 shows there is one storage pool capable of LAN-free transfer - see the LAN-free capable column.

**Example 16-8  Validate management classes and storage pools for LAN-free**

```
$ tsm: ATLANTIC> validate lanfree diomede sta_diomede
ANR0387I Evaluating node DIOMEDE using storage agent STA_DIOMEDE for LAN-free data movement.

<table>
<thead>
<tr>
<th>Node Name</th>
<th>Storage Agent</th>
<th>Operation Mgmt Class</th>
<th>Destination Name</th>
<th>LAN-free capable?</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIOMEDE</td>
<td>STA_DIOMEDE</td>
<td>BACKUP DATA</td>
<td>DISKDATA</td>
<td>No</td>
<td>Destination storage pool is DISK.</td>
</tr>
<tr>
<td>DIOMEDE</td>
<td>STA_DIOMEDE</td>
<td>BACKUP DIRECTORY</td>
<td>DISKDIRS</td>
<td>No</td>
<td>No available online paths.</td>
</tr>
<tr>
<td>DIOMEDE</td>
<td>STA_DIOMEDE</td>
<td>BACKUP IMAGE</td>
<td>DISKDATA</td>
<td>No</td>
<td>Destination storage pool is DISK.</td>
</tr>
<tr>
<td>DIOMEDE</td>
<td>STA_DIOMEDE</td>
<td>BACKUP LANFREE</td>
<td>TAPEDATA_LF</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>DIOMEDE</td>
<td>STA_DIOMEDE</td>
<td>BACKUP SPECIAL</td>
<td>DISKDATA</td>
<td>No</td>
<td>Destination storage pool is DISK.</td>
</tr>
<tr>
<td>DIOMEDE</td>
<td>STA_DIOMEDE</td>
<td>ARCHIVE DATA</td>
<td>DISKDATA</td>
<td>No</td>
<td>Destination storage pool is DISK.</td>
</tr>
</tbody>
</table>

ANR1706I Ping for server 'STA_DIOMEDE' was able to establish a connection.
ANR0388I Node DIOMEDE using storage agent STA_DIOMEDE has 1 storage pools capable of LAN-free data movement and 5 storage pools not capable of LAN-free data movement.
16.3 Storage Agent setup

Here we describe how to install and configure the Storage Agent on a Windows 2003 machine, including installing the IBM 3582 device drivers for the shared library.

The Storage Agent is an interface between a client and a server - it does not itself initiate the backup or restore operation, since this is a backup-archive client responsibility. Therefore, you should already have the backup-archive client installed, on your machine, as described in 4.2, “Code installation” on page 97. Later we will show the client customization steps to enable LAN-free transfer during client operations.

We recommend performing normal LAN-based backup and restore tests on the client node before installing and configuring the Storage Agent. By doing so, you can verify the basic connectivity and operation of the Tivoli Storage Manager client and server.

If you already have a library defined on your server, make sure that the parameter shared is set to yes.

To configure the Storage Agent:

1. Identify shared library and drives in the client operating system
2. Install device drivers for the library and tape drives
3. Install the Storage Agent software.
4. Configure the Storage Agent and set it as a service.
5. Obtain device information.
6. Define the Storage Agent and device paths.
7. Customizing the client options file to enable LAN-free.

**Note:** Remember you cannot install the Storage Agent on a machine that is an Tivoli Storage Manager server.

16.3.1 Device drivers for shared devices

First we must properly set up our shared library and tape devices in the client operating system. In other words, you need to provide the operating system with device drivers it would use to operate the devices on its own.

Since we have an LTO library, we have to use IBM tape device drivers. For non-IBM devices, you might choose either 3rd party device drivers or use the Tivoli Storage Manager device drivers included in the Storage Agent package. The supported devices and required device drivers are on the Tivoli Storage Manager Web site:

Figure 16-2 shows that we have two unidentified medium changers (libraries) and two tape drives. We have two libraries, because our library has Control Path Failover feature enabled, thus each drive may take control of the robotics.

![Windows device manager](image)

**Figure 16-2  Windows device manager**

Now we may supply the correct device drivers. Note, that since V 6.0.8.2 of the IBM Tape device drivers, the installation method has changed. With support for CPF in the Windows device driver, you must either follow the instructions in the readme file or run the install.exe binary, which performs all the necessary steps to install device drivers. We ran the install.exe to install the device driver for both the library and medium changer.

**Note:** We strongly recommend you disable the Windows Removable Storage Manager (RSM) component so that it will not conflict with the device drivers. Disable the RSM component by selecting RSM from the Windows services available and updating its startup type to disabled.

After the installation, our devices are now correctly identified as IBM 3582 LTO Library and IBM ULT3580-TD2 SCSI Sequential Device, see Figure 16-3
Important: If your environment includes an IBM LTO Ultrium tape drive and your Storage Agent will be installed on Windows 2000, you must verify and possibly change the host-bus-adapter (HBA) setting. For most HBAs, this value is located in the MAXIMUMSGLIST registry setting, see Figure 16-4. Tivoli Storage Manager requires that the MAXIMUMSGLIST value on the Storage Agent be equal to or greater than HEX 41 (decimal 65) or a data integrity error may occur. To verify or change the current registry setting, perform the following operations:

1. Edit the registry, using regedit.

2. Click HKEY_LOCAL_MACHINE → System → Current Control Set → Services → (Vendor HBA name) → Parameters → Device.

3. Change the setting’s hex value to 41. Close the registry editor and continue with Storage Agent installation and configuration procedure. Repeat the process for all Windows 2000 Storage Agents in the environment.
Later, you may run the `dsmmaxsg` utility included with the Storage Agent package to increase the maximum transfer length for HBAs and, consequently, the block size used for writing or reading data from a certain types of tape drives, such as LTO, 3592, and more. For detail see *IBM Tivoli Storage Manager for SAN Storage Agent User’s Guide*, GC32-0785.

### 16.3.2 Storage Agent software installation

Here we describe how to install the Windows Storage agent. For UNIX, see *IBM Tivoli Storage Manager for Storage Area Network UNIX Storage Agent User’s Guide*, GC32-0771.

1. Figure 16-5 on page 520 shows the Storage Agent installation menu which launches when you run install.exe or mount the CD. Depending on your library type, you may need to install both packages, that is TSM Storage Agent code and TSM Device Driver. The Device Drivers package is needed for non IBM tape libraries. For demonstration purposes, we install both items. Note a reboot is required after installation so it is recommended to follow the sequence of the items in the menu.
2. Click **TSM Storage Agent** - a wizard will launch. Click **Next**.

3. Enter customer information and choose access rights to the Storage Agent application as shown in Figure 16-6.
4. Choose the type of installation. In Figure 16-7, we chose complete installation. You may choose **Custom** installation to select Storage Agent code installation, or console plugin installation or both, which is the default. Our recommendation is to choose **Complete** installation to make sure that all components and its prerequisites are installed.

![Figure 16-7 Windows Storage Agent setup type](image)

5. On the next screen, you have the option to go back and review your inputs to the installation wizard, or continue. If you are satisfied with your choices, begin the installation by clicking **Install**.

6. When installation is finished, a completion window is displayed. Click **Finish** to return to the installation menu.

Now you may continue with TSM Device Driver installation. Since the installation process is straightforward and practically the same as Storage Agent installation, we do not cover it here. When the device driver is successfully installed, you are prompted to reboot your machine to apply changes.

**Note:** On Windows 2000 machines, enable the device driver using `tmscsi /enable` command, which is located in the Storage Agent installation directory.
16.3.3 Configuring the Storage Agent

In order for the Storage Agent to communicate with the server instance, server-to-server communication is required. In 16.2, “Server setup for LAN-free” on page 510, we prepared our Tivoli Storage Manager server for this communication by setting up server name, password, address and port of the server instance.

Register Storage Agent on Tivoli Storage Manager server

Now we need to define the Storage Agent on the server. This is similar to the server-to-server configuration - you define a unique Storage Agent name, a password, communication path (IP address or DNS name) to the Storage Agent, and the IP port the agent listens on, see Example 16-9.

Example 16-9   Defining Storage Agent on the server for server-to-server communication

```
tsm: ATLANTIC>define server sta_diomede serverpassword=sta_diomede532 \
cont> hladdress=diomede.itsosj.sanjose.ibm.com lladdress=1502 \
cont> description="Storage Agent on Diomede"
ANR1660I Server STA_DIOMEDE defined successfully.
```

Customize Storage Agent configuration file

The next step is to edit the Storage Agent configuration file. This is analogous to the server options file, and is called dsmsta.opt, located in the installation path. There are numerous options you may set; however for the basic setup you need only the `devconfig` and `tcpport` options, see Example 16-10. Since the `devconfig` option is by default set to `devconfig.txt` we only need to change the default TCPPORT for the Storage Agent to the value defined in Example 16-9, that is 1502, and then we can proceed with the Storage Agent service setup.

Example 16-10   Option file dsmsta.opt

```
<table>
<thead>
<tr>
<th>Option</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEVCONFIG</td>
<td>devconfig.txt</td>
</tr>
<tr>
<td>TCPPORT</td>
<td>1502</td>
</tr>
</tbody>
</table>
```
Unlike other supported platforms, the Storage Agent package on Windows provides two ways to initialize the Storage Agent - command line or using a GUI wizard. We describe both ways, however the wizard is a preferred method, since typing commands may be error prone and, this is important, the wizard automatically configures the Storage Agent as a service in Windows.

**Storage Agent initialization using GUI wizard**

1. If you selected a Complete Storage Agent installation, an MMC console plugin is provided for the Storage Agent initialization. To start it, select **Start → Programs → Tivoli Storage Manager → Management Console**. If the Storage Agent is not configured yet, the initialization wizard starts immediately, as in Figure 16-8. Or you can start it manually by double clicking **Storage Agent Initialization** on the right hand side of the window.

![Storage Agent Initialization Wizard](image)

**Figure 16-8  Storage Agent initialization wizard**

2. On Figure 16-9, enter the Storage Agent configuration values, which we have specified in the Storage Agent definition in the Tivoli Storage Manager server (Example 16-9 on page 522). Specifically, provide the Storage Agent name and password and TCP/IP address.
3. On Figure 16-10, enter the Tivoli Storage Manager server details - the server name, password, server IP address and port number - to match the definitions given in Example 16-1 on page 511.
4. In Figure 16-11, set the Storage Agent service behavior. We recommend automatically starting the service on reboot, and if you require the service to run under a specific account, give the account details.
5. On the final screen, click Back to review the entries, or complete the initialization by clicking Finish. Provided your account password was correct, the initialization wizard subsequently configures a service in Windows and starts it, as shown in Figure 16-12 on page 527.
6. If the service started successfully, two sessions are opened to the Tivoli Storage Manager server. One session is for Storage Agent itself, the other is for event logging to the Tivoli Storage Manager server, as shown in Example 16-11.

**Example 16-11  Storage Agent sessions on the server**

```
tsm: ATLANTIC> query session

<table>
<thead>
<tr>
<th>Sess Comm.</th>
<th>Sess</th>
<th>Wait</th>
<th>Bytes</th>
<th>Bytes Sess</th>
<th>Platform</th>
<th>Client Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>Method</td>
<td>State</td>
<td>Time</td>
<td>Sent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>----------</td>
<td>------</td>
<td>-------</td>
<td>------------</td>
<td>----------</td>
<td>-------------</td>
</tr>
<tr>
<td>178</td>
<td>Tcp/Ip</td>
<td>Run</td>
<td>0 S</td>
<td>1.1 K</td>
<td>Admin</td>
<td>AIX</td>
</tr>
<tr>
<td>179</td>
<td>Tcp/Ip</td>
<td>IdleW</td>
<td>5 S</td>
<td>1.5 K</td>
<td>Server</td>
<td>Windows</td>
</tr>
<tr>
<td>180</td>
<td>Tcp/Ip</td>
<td>IdleW</td>
<td>5 S</td>
<td>253</td>
<td>Server</td>
<td>Windows</td>
</tr>
</tbody>
</table>
```

Although it may seem that communication is correctly established, you should verify it using the `ping server` command. This checks not only that the defined Storage Agent is reachable on the specified address, but also that the Storage Agent is listening on the specified port as well. Example 16-12 shows that connection to our Storage Agent was successfully tested.
Example 16-12  Verifying the connection from the server to the Storage Agent

```plaintext
tsm: ATLANTIC> ping server sta_diomede
ANR1706I Ping for server 'STA_DIOMEDE' was able to establish a connection.
```

**Storage Agent initialization using command line**

You can alternatively initialize the Storage Agent, using the `dsmsta setstorageserver` command, as shown in Example 16-13. Again, specify the Storage Agent name, password, IP address, and port number followed by the Tivoli Storage Manager server connection details.

Example 16-13  Storage agent initialization using command line

```plaintext
C:\Program Files\Tivoli\TSM\storageagent> dsmsta -k "StorageAgent1" 
setstorageserver myname=sta_diomede mypassword=sta_diomede532 
myhladdress=DIOMEDE.ITSO.SANJOSE.IBM.COM servername=ATLANTIC 
serverpassword=atlantic532 hladdress=ATLANTIC.ITSO.SANJOSE.IBM.COM
lladdress=1500
ANR0900I Processing options file C:\Program Files\Tivoli\TSM\storageagent\dsms-
ta.opt.
ANR7800I DSMSERV generated at 10:12:40 on Dec 9 2005.
```

Tivoli Storage Manager for Windows
Version 5, Release 3, Level 2.2

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ANR4726I The ICC support module has been loaded.
ANR1432I Updating device configuration information to defined files.
ANR1433I Device configuration information successfully written to devconfig.txt.
ANR2119I The SERVERNAME option has been changed in the options file.
ANR0467I The SETSTORAGESERVER command completed successfully.

The initialization procedure creates the lines shown in Example 16-14 in the device configuration file for the Storage Agent, pointed to by the `devconfig` option in `dsmsta.opt` file. In our case, `devconfig` points to `devconfig.txt` file.

Example 16-14  Device configuration file for the Storage Agent

```plaintext
C:\Program Files\Tivoli\TSM\storageagent> more devconfig.txt
SET STANAME STA_DIOMEDE
SET STAPASSWORD 21e38f499c8a4e26b1dbalc8c2cb8d882f
```
You may then start the Storage Agent using the `dsmsta` command in the foreground to verify that the Storage Agent successfully starts and connects to the server, as shown in Example 16-15.

---

**Example 16-15   Storage Agent startup on the foreground**

```text
C:\Program Files\Tivoli\TSM\storageagent> dsmsta
ANR09001 Processing options file C:\Program Files\Tivoli\TSM\storageagent\dsms-ta.opt.
ANR78001 DSMSERV generated at 10:12:40 on Dec 9 2005.

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ANR4726I The ICC support module has been loaded.
ANR8260I Named Pipes driver ready for connection with clients.
ANR8273I Shared memory driver ready for connection with clients on port 1.
ANR8200I TCP/IP driver ready for connection with clients on port 1500.
ANR0408I Session 1 started for server ATLANTIC (AIX-RS/6000) (Tcp/Ip) for storage agent.
ANR0993I Server initialization complete.
ANR0916I TIVOLI STORAGE MANAGER distributed by Tivoli is now ready for use.
ANR0408I Session 2 started for server ATLANTIC (AIX-RS/6000) (Tcp/Ip) for event logging.
TSM:STA_DIOMEDE>
```

---

**Setting up Storage Agent service using command line**

Example 16-16 shows how to define a Storage Agent service using the command line. It is based on the assumption, that you defined your Storage Agent using the syntax in Example 16-13 on page 528, since the same service name is needed here. Note, that you must also provide your Windows administrator account and password.

---

**Example 16-16   Storage Agent service installation using command line**

```text
C:\Program Files\Tivoli\TSM\storageagent> install "TSM StorageAgent1"
"C:\Program Files\Tivoli\TSM\storageagent\dstasvc.exe" Administrator Password
```
16.3.4 Device configuration on the Storage Agent

Now we proceed to the device configuration part of the overall LAN-free configuration. The Storage Agent, in order to be able to use drives in the shared library, must have defined paths to these drives on the server.

We recommend you define paths to all available drives, even if you only want the Storage Agent to use some of them. In this case, limit the number of available mount points in the device class using the \textit{MOUNTLIMIT} parameter, rather than defining a subset of the paths. Thus, you increase the chance that the Storage Agent can get a mount point if needed.

To configure the devices, you need to identify which drives are seen by the Storage Agent system. The \texttt{tsmdlst} utility in the Storage Agent installation directory provides this function.

Using \texttt{tsmdlst}, you can easily display information for devices attached to your Storage Agent. Apart from the device name, it displays SCSI ID, LUN, Bus, Port and device identifier information, which typically includes microcode level information. In SAN environments, \texttt{tsmdlst} lists any HBAs along with any corresponding device driver information. For SAN devices, the serial number (SSN) and World Wide Name (WWN) are also displayed if they can be detected.

Example 16-17 shows the output of the \texttt{tsmdlst} command on our DIOMEDE Storage Agent. We trimmed the description field of the command output to fit the example in the page without wrapping.

\begin{example}

\textbf{Example 16-17  Device listing as seen by the Windows machine using tsmdlst utility}

\begin{verbatim}
C:\Program Files\Tivoli\TSM\storageagent>\texttt{tsmdlst /detail}

Tivoli Storage Manager -- Device List Utility

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Computer Name:        DIOMEDE
TSM Device Driver:    ADSMScsi - Not Running

One HBA was detected.
\end{verbatim}
\end{example}
<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model</th>
<th>Driver</th>
<th>Version</th>
<th>Firmware</th>
</tr>
</thead>
<tbody>
<tr>
<td>QLogic Corporation</td>
<td>2312</td>
<td>ql2312.sys</td>
<td>8.1.5.60 (W2K IP)</td>
<td>3.01.10</td>
</tr>
</tbody>
</table>

**Device Type:** TapePeripheral  
**TSM Device Name:** mt0.0.0.2  
**TSM Device Type:** LTO  
**ID:** 0  
**LUN:** 0  
**Bus:** 0  
**Port:** 2  
**Serial Number:** -  
**World Wide Name:** 0000000000000000  
**Device Identifier:** IBM ULT3580-TD2 53Y2  
**Supported Generic Tape:** Yes  
**Variable Blocks:** Yes  
**Filemarks:** Yes  
**Relative Blocks:** Yes  
**Reverse Position:** Yes

**Device Type:** MediumChangerPeripheral  
**TSM Device Name:** lb0.1.0.2  
**TSM Device Type:** LIBRARY  
**ID:** 0  
**LUN:** 1  
**Bus:** 0  
**Port:** 2  
**Serial Number:** -  
**World Wide Name:** -  
**Device Identifier:** IBM ULT3582-TL 307B

**Device Type:** TapePeripheral  
**TSM Device Name:** mt1.0.0.2  
**TSM Device Type:** LTO  
**ID:** 1  
**LUN:** 0  
**Bus:** 0  
**Port:** 2  
**Serial Number:** -  
**World Wide Name:** -  
**Device Identifier:** IBM ULT3580-TD2 53Y2  
**Supported Generic Tape:** Yes  
**Variable Blocks:** Yes  
**Filemarks:** Yes  
**Relative Blocks:** Yes  
**Reverse Position:** Yes

**Device Type:** MediumChangerPeripheral  
**TSM Device Name:** lb1.1.0.2
As you can see, the provided information is quite comprehensive. Two library and two tape drives were detected, along with the HBA. The output did not however display serial number or WWN identifier. This is because we are using the IBM tape device drivers, rather than the Tivoli Storage Manager native device drivers. To get this information, we add the /xinquiry parameter, see Example 16-18.

Example 16-18  Device listing for devices using IBM Tape device drivers

C:\Program Files\Tivoli\TSM\storageagent>tsmdlst /xinquiry

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Computer Name:      DIOMEDE
TSM Device Driver:  ADSMscsi - Not Running

One HBA was detected.

Manufacturer    Model    Driver    Version            Firmware
---------------------------------------------------------------
QLogic Corporation  2312     ql2312.sys  8.1.5.60 (W2K IP)  3.01.10

Looking for devices...

<table>
<thead>
<tr>
<th>TSM Name</th>
<th>ID</th>
<th>LUN</th>
<th>Bus</th>
<th>Port</th>
<th>SSN</th>
<th>WWN</th>
<th>TSM</th>
</tr>
</thead>
<tbody>
<tr>
<td>mt0.0.0.2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1110177214</td>
<td>500308C140067006</td>
<td>LTO</td>
</tr>
<tr>
<td>mt1.0.0.2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1110176223</td>
<td>500308C140067003</td>
<td>LTO</td>
</tr>
</tbody>
</table>

Completed in: 0 days, 0 hours, 0 minutes, 1 seconds.
Defining paths between Storage Agent and shared drives

Now we must match the tape drives with those ones defined on the Tivoli Storage Manager server. We are using different operating systems - AIX for the server and Windows 2003 for the Storage Agent. Therefore the operating system device names for tape drives differ and we must match them according to their serial number and WWN ids, which are always unique. Example 16-19 shows the serial number and WWNs of the tape drives on the AIX Tivoli Storage Manager server.

Example 16-19  Device identification on AIX 5L

```
root@Atlantic /: lsattr -El rmt0 | grep ww_name
ww_name  0x500308c140467006 World Wide Port Name

root@Atlantic /: lscfg -vl rmt0 | grep Serial
Serial Number...............1110177214

root@Atlantic /: lsattr -El rmt1 | grep ww_name
ww_name  0x500308c140467003 World Wide Port Name

root@Atlantic /: lscfg -vl rmt1 | grep Serial
Serial Number...............1110176223
```

By matching up the WWN and serial numbers from Example 16-18 and Example 16-19, we see that rmt0 device on AIX is mt0.0.0.2 on Windows machine and rmt1 matches mt1.0.0.2. These devices match the dr00 and dr01 drive and path definitions already made on the server, in Example 16-3 on page 512. We may now define appropriate paths between the Storage Agent and the shared tape drives.

In Example 16-20, we define the required paths.

Example 16-20  Storage agent path definition to the shared tape drives.

```
 tsm: ATLANTIC>define path sta_diomede dr00 srctype=server desttype=drive \  cont> library=3582_shared device=mt0.0.0.2
ANR1720I A path from STA_DIOMEDE to 3582_SHARED DR00 has been defined.

 tsm: ATLANTIC>define path sta_diomede dr01 srctype=server desttype=drive \  cont> library=3582_shared device=mt1.0.0.2
ANR1720I A path from STA_DIOMEDE to 3582_SHARED DR01 has been defined.
```

We review our settings using query path command, which reveals all defined paths, as shown in Example 16-21.
Example 16-21  Defined path summary using query path command

<table>
<thead>
<tr>
<th>Source Name</th>
<th>Source Type</th>
<th>Destination Name</th>
<th>Destination Type</th>
<th>On-Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATLANTIC</td>
<td>SERVER</td>
<td>3582_SHARED</td>
<td>LIBRARY</td>
<td>Yes</td>
</tr>
<tr>
<td>ATLANTIC</td>
<td>SERVER</td>
<td>DR00</td>
<td>DRIVE</td>
<td>Yes</td>
</tr>
<tr>
<td>ATLANTIC</td>
<td>SERVER</td>
<td>DR01</td>
<td>DRIVE</td>
<td>Yes</td>
</tr>
<tr>
<td>STA_DIOMEDE</td>
<td>SERVER</td>
<td>DR00</td>
<td>DRIVE</td>
<td>Yes</td>
</tr>
<tr>
<td>STA_DIOMEDE</td>
<td>SERVER</td>
<td>DR01</td>
<td>DRIVE</td>
<td>Yes</td>
</tr>
</tbody>
</table>

16.4 SAN device discovery support

With Tivoli Storage Manager V5.3 and higher, the server and Storage Agent option sandiscovery, if specified, means that the server will perform SAN discovery during both server initialization and if the device path has changed.

Essentially, if the SAN device identification has been changed due to SAN environmental changes, such as device, cabling changes, or bus resets, the server or Storage Agent will discover these changes during server or Storage Agent startup or when accessing the paths during operations with the drives and will perform the necessary changes to the path definition, based on the drive serial number. Thus, the path will not go offline, instead it stays online and available for the operation.

On Windows platforms, this option is set by default. On other platforms enable SAN discovery using SANDISCOVERY on option in the server options file dsmserv.opt (or in dsmsta.opt for Storage Agents). You can also dynamically set the option using the administrative CLI, as in Example 16-22.

Example 16-22  Dynamically setting SANDISCOVERY option

<table>
<thead>
<tr>
<th>Server Option</th>
<th>Option Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>SANdiscovery</td>
<td>On</td>
</tr>
</tbody>
</table>

Do you wish to proceed? (Yes (Y)/No (N)) y
ANR2119I The SANDISCOVERY option has been changed in the options file.

Do you wish to proceed? (Yes (Y)/No (N)) y
Note: The ability to accurately define SAN devices on the server and Storage Agent in AIX relies on functionality built into the operating system. In particular, fileset devices.common.IBM.fc.hba-api provides a 32-bit and 64-bit API for use by Tivoli Storage Manager.

If the server or Storage Agent cannot load the library or the library is missing, it will issue message ANR8226E. If the library is not at the minimum required level, it will issue message ANR8227E. With any of these messages, the QUERY SAN command will show no information and SAN discovery will not be performed.

With the SAN discovery feature enabled, you may review the SAN attached devices using the `query san` command as seen in the Example 16-23.

**Example 16-23  Query SAN command output on the server**

```
Example 16-23   Query SAN command output on the server

<table>
<thead>
<tr>
<th>Device</th>
<th>Vendor</th>
<th>Product</th>
<th>Serial Number</th>
<th>Device Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRIVE</td>
<td>IBM</td>
<td>ULT3580-TD2</td>
<td>1110177214</td>
<td>/dev/rmt0</td>
</tr>
<tr>
<td>LIBRARY</td>
<td>IBM</td>
<td>ULT3582-TL</td>
<td>0000013108231000</td>
<td>/dev/smc0</td>
</tr>
<tr>
<td>DRIVE</td>
<td>IBM</td>
<td>ULT3580-TD2</td>
<td>1110176223</td>
<td>/dev/rmt1</td>
</tr>
<tr>
<td>LIBRARY</td>
<td>IBM</td>
<td>ULT3582-TL</td>
<td>0000013108231000</td>
<td>/dev/smc1</td>
</tr>
</tbody>
</table>
```

### 16.4.1 Recovering from offline paths

Starting with Storage Agent V5.3.2, the `tmsdlist` utility can also help keep Tivoli Storage Manager path statements up-to-date for IBM tape devices. This can be especially useful when working with versions of the server that do not include the Accurate SAN Mapping feature. For example, if a pre-Version 5.3 Tivoli Storage Manager server is installed on AIX and path statements need to be set up for a Windows based Storage Agent, `tmsdlist` can be used to display the required information and also generate a macro that can be used to synchronize paths when devices change in the SAN and to update the offline paths.

Below, we show how to update paths from the Storage Agent machine if a path goes offline. Provided that the cause has been ascertained and resolved, such as a damaged fiber, you may update the path in two steps, as follows:

1. Generate path file, which includes tape drive identification.
2. Apply the path file to make the offline paths online again.
We changed one of our Storage Agent paths to the offline state, see Example 16-24.

**Example 16-24  Offline path**

```plaintext
tsm: ATLANTIC->query path
```

<table>
<thead>
<tr>
<th>Source Name</th>
<th>Source Type</th>
<th>Destination Name</th>
<th>Destination Type</th>
<th>On-Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATLANTIC</td>
<td>SERVER</td>
<td>3582_SHARED</td>
<td>LIBRARY</td>
<td>Yes</td>
</tr>
<tr>
<td>ATLANTIC</td>
<td>SERVER</td>
<td>DR00</td>
<td>DRIVE</td>
<td>Yes</td>
</tr>
<tr>
<td>ATLANTIC</td>
<td>SERVER</td>
<td>DR01</td>
<td>DRIVE</td>
<td>Yes</td>
</tr>
<tr>
<td>STA_DIOMEDE</td>
<td>SERVER</td>
<td>DR00</td>
<td>DRIVE</td>
<td>No</td>
</tr>
<tr>
<td>STA_DIOMEDE</td>
<td>SERVER</td>
<td>DR01</td>
<td>DRIVE</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Example 16-25 shows a path file generation on the Storage Agent. Essentially, the file contains the tape drive names, their unique identification numbers, such as serial and WWN numbers. The output is then saved to the C:\Program Files\Tivoli\TSM\Console\tsmdlst_pathfile.txt file.

**Example 16-25  Path file generation using tsmdlst**

```plaintext
C:\Program Files\Tivoli\TSM\storageagent>tsmdlst /xinquiry /genpathfile
```

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Computer Name: DIOMEDE
TSM Device Driver: ADSMScsi - Not Running

One HBA was detected.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model</th>
<th>Driver</th>
<th>Version</th>
<th>Firmware</th>
</tr>
</thead>
<tbody>
<tr>
<td>QLogic Corporation</td>
<td>2312</td>
<td>ql2312.sys</td>
<td>8.1.5.60 (W2K IP)</td>
<td>3.01.10</td>
</tr>
</tbody>
</table>

Looking for devices...

<table>
<thead>
<tr>
<th>TSM Name</th>
<th>ID</th>
<th>LUN</th>
<th>Bus</th>
<th>Port</th>
<th>SSN</th>
<th>WWN</th>
</tr>
</thead>
<tbody>
<tr>
<td>mt0.0.0.2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1110177214</td>
<td>500308C140067006</td>
</tr>
<tr>
<td>mt1.0.0.2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1110176223</td>
<td>500308C140067003</td>
</tr>
</tbody>
</table>
Pathfile was written out as C:\PROGRA~1\Tivoli\TSM\Console\tsmdlst_pathfile.txt

Completed in: 0 days, 0 hours, 0 minutes, 1 seconds.

Afterwards, we use the path file to update all offline paths remotely on the server from the Storage Agent machine, see Example 16-26.

**Example 16-26  Offline path update using tsmdlst utility on the Storage Agent machine**

C:\Program Files\Tivoli\TSM\storageagent>tsmdlst -genmacropathoffline
-exemacropathoffline -id=admin -pass=admin -tcps=atlantic -tcp=1500
-server=atlantic -stagent=sta_diomede

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Computer Name:      DIOMEDE
TSM Device Driver:  ADSMScsi - Not Running

One HBA was detected.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model</th>
<th>Driver</th>
<th>Version</th>
<th>Firmware</th>
</tr>
</thead>
<tbody>
<tr>
<td>QLogic Corporation</td>
<td>2312</td>
<td>ql2312.sys</td>
<td>8.1.5.60 (W2K IP)</td>
<td>3.01.10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TSM Name</th>
<th>ID</th>
<th>LUN</th>
<th>Bus</th>
<th>Port</th>
<th>SSN</th>
<th>WWN</th>
</tr>
</thead>
<tbody>
<tr>
<td>mt0.0.0.2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>-</td>
<td>0000000000000000000000</td>
</tr>
<tr>
<td>lb0.1.0.2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>mt1.0.0.2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>lb1.1.0.2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Obtained information for 2 paths from TSM server.
Obtained information for 2 drives from TSM server.
Obtained information for 2 devices from
C:\PROGRA~1\Tivoli\TSM\Console\tsmdlst_pathfile.txt

Executed macro: C:\PROGRA~1\Tivoli\TSM\Console\tsmdlst_path_offline.mac, results:
IBM Tivoli Storage Manager
16.5 Client LAN-free customization

We assume that you have already configured the client options file, dsm.opt for Windows clients, and dsm.sys for UNIX clients to connect to the Tivoli Storage Manager server and that your client can backup or restore your data via LAN.

In order to utilize the LAN-free path for client operations, you need to further customize the client options file, in order to specify the communication method, the Storage Agent address and the port on which the Storage Agent listens for requests.

Depending on the platform and Storage Agent configuration, you may use different communication methods between client and Storage Agent, as follows:

- TCP/IP
- shared memory
- named pipes

Our Storage Agent is configured for TCP/IP communication only, if you want to use other methods, you must enable them in the Storage Agent configuration file, dsmsta.opt.

We added the following options to our client options file, dsm.opt, on the Storage Agent, DIOMEDE, see Example 16-27.

**Example 16-27 Client customization for LAN-free**

<table>
<thead>
<tr>
<th>Option</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENABLELANFREE</td>
<td>YES</td>
</tr>
<tr>
<td>LANFREECOMMMETHOD</td>
<td>TCPIP</td>
</tr>
</tbody>
</table>
These options specify that the client will use the Storage Agent to access SAN-attached devices when the path is available, during backup, restore, archive and retrieve processing.

With TCP/IP as a configured communication method, a client can use a Storage Agent which is running on a different machine, as well. Data traffic will be via LAN from the client to the Storage Agent and via SAN from the Storage Agent to the final storage device.

**Note:** For Data Protection clients, such as Data Protection for SQL, you must ensure that the API client is installed on the same machine as the Data Protection module. Then, add the options specified in Example 16-27 to the API client options file, referenced to by DSM_CONFIG system variable, to enable the LAN-free path.

For detailed prerequisites on using LAN-free with API clients, see *IBM Tivoli Storage Manager for SAN Storage Agent User’s Guide* for your platform.

As well as the necessary communication parameters, you may need to bind client data to a LAN-free capable management class. Use an *include* statement in the client options file, as follows:

```
INCLUDE  c:\console\...\*       LANFREE
```

With this statement, our client binds all objects in the C:\console subdirectory to our management class LANFREE, which is the only management class having a storage pool capable of LAN-free in our environment, see Example 16-8 on page 515. Unless other *include* statement exists, all other objects residing on our DIOMEDE machine will be bound to the default management class, which is not LAN-free capable.

For more information on binding objects see Chapter 7, “Data storage policies” on page 257.

### 16.6 Performing LAN-free operations

If all necessary components participating in the LAN-free path, such as the Storage Agent, server-to-server configuration, storage pools, paths, client options and more are correctly configured and set, the client operations are automatically performed using the LAN-free path.
In Figure 16-13, we make an incremental backup of the c:\console directory and since we have the console directory bound to a LAN-free capable management class, it is done via SAN instead of LAN, as shown in Figure 16-14 on page 540.
As you can see in Figure 16-14, the positive LanFree Data Bytes value confirms, that the backup was done via SAN. The difference between Bytes Transferred and LanFree data Bytes value is because the LAN path is used for storing metadata in the server database, and thus the total value for transferred data will always be slightly greater than the LanFree Bytes value.

In Example 16-28, we show statistics as produced by the command line backup-archive client for another incremental backup operation. Again, you can easily distinguish how much data was transferred via SAN from the LanFree data bytes statistic value.

**Example 16-28  Command line client summary statistics**

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of objects inspected</td>
<td>762</td>
</tr>
<tr>
<td>Total number of objects backed up</td>
<td>538</td>
</tr>
<tr>
<td>Total number of objects updated</td>
<td>0</td>
</tr>
<tr>
<td>Total number of objects rebound</td>
<td>0</td>
</tr>
<tr>
<td>Total number of objects deleted</td>
<td>0</td>
</tr>
<tr>
<td>Total number of objects expired</td>
<td>0</td>
</tr>
<tr>
<td>Total number of objects failed</td>
<td>0</td>
</tr>
<tr>
<td>Total number of subfile objects</td>
<td>0</td>
</tr>
<tr>
<td>Total number of bytes transferred</td>
<td>932.57 MB</td>
</tr>
<tr>
<td>LanFree data bytes</td>
<td>929.32 MB</td>
</tr>
<tr>
<td>Data transfer time</td>
<td>14.36 sec</td>
</tr>
<tr>
<td>Network data transfer rate</td>
<td>66,478.35 KB/sec</td>
</tr>
<tr>
<td>Aggregate data transfer rate</td>
<td>6,978.46 KB/sec</td>
</tr>
<tr>
<td>Objects compressed by</td>
<td>0%</td>
</tr>
<tr>
<td>Subfile objects reduced by</td>
<td>0%</td>
</tr>
<tr>
<td>Elapsed processing time</td>
<td>00:02:16</td>
</tr>
<tr>
<td>ANSI1074W The operation was stopped by the user.</td>
<td></td>
</tr>
</tbody>
</table>

### 16.6.1 Determining whether the data movement is LAN-free

Monitor the administrative CLI query session output against the node that is running the LAN-free backup. Review the bytes sent and bytes received.

In out test, Example 16-29, when LAN-free data movement was occurring, a query session on the Storage Agent shows about 683 MBs received so far from the DIOMEDE node, displayed in the Bytes Recvd column.

**Example 16-29  LAN-free session statistics on Storage Agent**

```
 tsm: ATLANTIC>sta_diomede: query session
 ANR1699I Resolved STA_DIOMEDE to 1 server(s) - issuing command QUERY SESSION against server(s).
 ANR1687I Output for command 'QUERY SESSION ' issued against server STA_DIOMEDE follows:
```
The output on the Tivoli Storage Manager server shows a very small number of bytes of metadata received for the same node. This confirms that data movement is LAN-free, see Example 16-30.

Example 16-30 Client session statistics on server

```
tsm: ATLANTIC>query session
```

Further, you can monitor the Tivoli Storage Manager server console for new sessions. If you see a message, that a session proxied by a Storage Agent for a node was established, this confirms a LAN-free operation, see Example 16-31.

Example 16-31 IBM Tivoli Storage Manager console output

```
root@Atlantic /usr/include: dsmadmc -id=admin -pa=admin -consolemode
IBM Tivoli Storage Manager
Command Line Administrative Interface - Version 5, Release 3, Level 2.0
(c) Copyright by IBM Corporation and other(s) 1990, 2005. All Rights Reserved.

Session established with server ATLANTIC: AIX-RS/6000
   Server Version 5, Release 3, Level 2.2
   Server date/time: 02/27/2006 08:44:34  Last access: 02/27/2006 08:41:49

ANR0406I Session 332 started for node DIOMEDE (WinNT) (Tcp/Ip diomede.itsosj.sanjose.ibm.com(3384)).
```
Alternatively, you may use the following command to figure out whether the data movement was LAN-free.

```
query actlog search=storage_agent_name msgno=8337
```

Last but not least, from the Tivoli Storage Manager client, the detailed status report after each client operation also shows you the amount of LAN-free data transferred. If the client operation failed to use the LAN-free path then the **LAN-free Data Bytes** information is grayed out in the GUI status window or the value for respective statistic item is zero in backup-archive CLI.

### 16.6.2 LAN-free data transfer considerations

Tivoli Storage Manager LAN-free data transfer provides an effective means to off-load backup-archive data traffic from your LAN to the SAN. LAN-free data transfer improves performance especially when backing up large files, typically larger than 50 MB.

Therefore, it is recommended to use LAN-free transfer to back up large databases and file system images because there is a significant performance
improvement. This also allows you to fully utilize your LAN for other application and communication processing.

On the other hand, there are instances where LAN data transfer may be faster than LAN-free data transfer, particularly when backing up many small-size files. Traditional incremental backups where only a small amount of the data has changed, usually perform better over the LAN than LAN-free, since this type of operation usually does not allow a tape drive to operate at streaming speeds.

To ensure better performance, you need to consider the following items:

- The hardware speeds of the LAN based hardware versus the SAN based hardware
- The topology configured, and whether bandwidth is shared or dedicated
- The average size of the files being transferred

### 16.7 Summary

This chapter has demonstrated the configuration of LAN-free feature in a Tivoli Storage Manager environment. We have provided implementation details and explained how this technology might be deployed. In the next chapter we will show how to configure Tivoli Storage Manager to use a server-free communication path.
Server-free data movement

In this chapter we describe an IBM Tivoli Storage Manager server-free backup environment. Data is copied directly from the IBM Tivoli Storage Manager SAN attached IBM Tivoli Storage Manager client disk to the SAN attached tape drive via an additional Data Mover component that is included in the IBM 3583 tape library.
17.1 Server-free: What is it, and why use it?

Server-free data movement provides a way to back up and restore large volumes of data between client-owned disks and storage devices in a method that reduces overhead on the Tivoli Storage Manager server and Tivoli Storage Manager Client, and that minimizes data transfer on the LAN.

Tivoli Storage Manager allows clients to directly back up and restore file system images between disk storage and tape devices accessible over a Storage Area Network (SAN). An outboard data mover, such as IBM SAN Data Gateway, handles the server-free data movement on behalf of the Tivoli Storage Manager server. The data mover must be able to execute the SCSI-3 extended copy command.

Server-free data movers must have addressability to all the devices involved, which include disk and tape drives. Unlike traditional LAN and LAN-free backups and restore, data passes through neither the client nor the server. Instead, the data mover handles the data. In this way, backup and restore operation do not require resources from client or server processors or from LAN.

Figure 17-1 shows how data is actually transferred on a Storage Area Network during server-free backup/restore.
Operations for server-free backup/restore are done in the following order:

1. Tivoli Storage Manager client initiates backup or restore request.
2. Tivoli Storage Manager Server issues a mount request to the library.
3. The data mover initiates a copy operation.
4. The data is copied between the disk and the tape library.

Server-free operations transfer only volume images, not standard, file-level data. If the client cannot perform a server-free backup or restore, the operation first fails over to LAN-free operation. If a LAN-free operation cannot be performed, the client attempts a LAN-based backup or restore. Server-free operation can restore LAN-free or LAN-based volume image backups (the image data should be stored in storage pools with a data format of NONBLOCK). Currently, server-free image backup is supported for Windows 2000 clients only. Image backup of both raw volumes and volumes that contain NTFS file systems are supported. Tivoli Storage Manager supports both online and offline image backup using server-free data movement.
Tivoli Storage Manager client allows server-free backup and restore of volume images between different volume layouts, with the exception of software based RAID-5 volumes and software-striped volumes. When restoring a software based mirror volume (RAID-1), Tivoli Storage Manager restores to the primary copy only and uses the operating system to resynchronize the stale mirrors. The client supports volume layouts such as striped and mirrored only on Windows 2000 dynamic disks.

Server-free data movement has the following advantages:

- It reduces Tivoli Storage Manager client and/or server CPU utilization. With data movement operations being performed by an outboard copy engine, the client and/or server CPU will not be utilized for data movement and will thus be available for other applications.
- It eliminates data movement on the LAN. Implementation of the SCSI-3 extended copy command will cause the data to be transferred directly between devices over the SAN or SCSI bus.
- It improves performance for data movement operations. Direct transfer between devices through a high speed Fibre Channel should perform better than our current mode that utilizes a slower network connection with multiple buffer copy operations in the client and server processors.
- It improves scalability. The Tivoli Storage Manager server will be able to handle more concurrent client connections and server operations because it will not be copying data. The Tivoli Storage Manager client processor will likewise be able to handle more application load because cycles will not be needed to read and send data buffers to the server.

### 17.2 Server-free setup requirements

The SAN should be already configured in order to perform server-free data movement. The hardware specifications provided below only depict one successful implementation of server-free data movements. There can be other possible hardware that can be used to set up server-free data movement.

Our test environment used the following configuration. Note some of the hardware/software/device drivers are not at the latest level; however the setup and operation procedure for the server-to-server function has not changed
substantially. To see a list of the latest hardware/software/HBA/device driver levels, see

**Hardware:**
- Tivoli Storage Manager Server:
  - IBM xSeries® server
  - Windows 2000 Advanced Server Service Pack 3
  - 2 x Qlogic 2200 HBA (Device Driver: 8.0.8)
- Tivoli Storage Manager client:
  - IBM xSeries server
  - Windows 2000 Advanced Server Service Pack 3
  - 2 x Qlogic 2200 HBA (Device Driver: 8.0.8)
- Disk Subsystem:
  - IBM FASTT500 Raid controller with /2 EXP 500 disk enclosures
- Fabric:
  - 2*IBM 2109 S08 + 1 * IBM 2109 S16 cascaded
  - IBM SAN Fibre Channel Switch 2109 Model S08 (Kernel: 5.4, Fabric OS: v2.6.0c).
- Library:
  - IBM Ultrium 3583 with 6 LTO drives and integrated SAN Data Gateway (pathlight 5000). (Windows 2000 Device Driver: 5.0.4.5)
  - Datamover Firmware: 4.200.5
  - LTO Drive Firmware: 25D4
  - Library Firmware: 2.80

**Software:**
- Server and Client operating system
  - Windows 2000 Advanced Server Service Pack 3
- Software
  - Disk subsystem manager
    - IBM FASTT Storage Manager v7.1or above
- SAN gateway management
  - IBM StorWatch Specialist v2.7 or above.

**Note:** The Tivoli Storage Manager Server will need two HBAs, one for connecting to the San disk and other for the 3583 LTO Tape library. We tried configuring a single HBA for disks and tape, but this doesn’t work very well with Windows 2000.

**Tip:** A second HBA on Tivoli Storage Manager client is only necessary if you want to do both server-free and LAN-free operations on the client machine.
17.3 Configuration steps: Overview

Here is an overview of the steps you should follow to successfully configure server-free data movement:

1. Set up the Storage Area Network.
2. Set up FAStT 500.
3. Set up IBM 3583. Make sure the tape library has the correct firmware level.
4. Install HBAs on the client and server machines. Install the correct device driver and API for the HBAs. Refer to the requirements section for the level of drivers and API.
5. Connect the client and server machines to the Fibre Switches.
6. Create zones as described in the setup section.
7. Install device drivers for IBM 3583 on the server machine.
8. Install the FAStT storage Manager on one of the machines to manage FAStT 500 Box.
9. Enable SAN Data Gateway (data mover).
10. Set up Tivoli Storage Manager Server.
11. Set up Tivoli Storage Manager Client.

17.4 Setting up server-free data movement

Configuration for server-free data movement requires the steps described below. We assume that you have knowledge on how to setup zoning and update firmware for various SAN devices.

17.4.1 SAN configuration

The SAN should be configured correctly. We won't show you how to set up the SAN, but we will provide you with a view of the SAN after the setup.

Figure 17-2 shows the SANk setup you will need in order to perform a server-free data movement. Before moving to the next step, using StorWatch specialist, make sure that you can see the tape drives. Using FAStT storage manager, make sure that you can see the disks. Also, check for the latest available firmware for the IBM 3583; update the drive, RMU, and library firmware.
17.4.2 SAN zoning

Zoning allows you to partition your SAN into logical groupings of devices that can access each other. Using zoning, you can arrange fabric-connected devices into logical groups, or zones, over the physical configuration of the fabric. Zones can vary in size depending on the number of fabric-connected devices. Figure 17-3 shows the zoning for our server-free backup.
Table 17-1 provides a description of the zone members.

**Table 17-1  Server-free zoning**

<table>
<thead>
<tr>
<th>Zone</th>
<th>Members</th>
</tr>
</thead>
<tbody>
<tr>
<td>ServTape</td>
<td>3583, Tivoli Storage Manager Server HBA1</td>
</tr>
<tr>
<td>ServDisk</td>
<td>FASTT 500, Tivoli Storage Manager Server HBA2</td>
</tr>
<tr>
<td>CliDisk</td>
<td>Tivoli Storage Manager Client HBA1, FASTT 500</td>
</tr>
<tr>
<td>SDG_Disk</td>
<td>3583 (data mover), FASTT 500</td>
</tr>
</tbody>
</table>

The following list describes the zones:

- **ServTape**: This zone enables server to access the tape media.
- **ServDisk**: This zone enables the server to be able to see the disks in order to perform server-free data movement. The server should be able to see the disks in order to perform a *define disk* command on the server.
- **CliDisk**: The client accesses the disk directly on the Storage Area Network.
- **SDG_Disk**: This zone allows SAN Data Gateway to access the disk directly and copy the data directly from disks to tape and vice-versa.
For more information on zoning, refer to the *IBM SAN Fibre switch 2109 Model S08 Guide* for managing and implementing zones in a Storage Area Network.

Figure 17-4 shows our SAN configuration overview using the IBM StorWatch software. Your administration interface will be different, depending on the type of SAN gateway used.

![StorWatch SAN configuration overview](image)

**Figure 17-4** StorWatch SAN configuration overview

### 17.4.3 Setting up the SAN Data Gateway (data mover)

In order to perform the extended copy command from the data mover built into the IBM 3583, we need to enable the data mover, as described in the following steps (if you have already done this, just proceed to the second to last step):

1. On Windows, connect a null modem cable from the serial port on the top of the gateway to a free serial port on the Windows workstation.

2. Open HyperTerminal and create a profile for the Gateway using:
   - Bits/seconds: 19200
   - Data Bits: 8
   - Parity: None

**Note:** We have used soft zoning in this scenario.
– Stop Bits: 1
– Flow Control: XON/XOFF

3. Reset the box by typing initializeBox.

4. Enable the Command and control interface: enableCC.

5. Next rebuild the SCSI Mapping DB to get all the drive LUNs to show up in order by issuing mapRebuildDatabase.

6. Next compress the DB to remove inactive devices: mapCompressDatabase.

7. Set the FC Connection to Point-to-Point protocol fcConnTypeGet (this displays the current setting).
   – 0 - loop
   – 1 - point-to-point
   – 2 - loop preferred
   – 3 - point-to-point preferred

8. Issue command, fcConnTypeSet 1,1 — this will set port 1 to point-to-point (2,1 will set port 2).

9. Next set the port mode to public target and initiator: fcPortModeSet 1,19 (port 1 mode 19).

10. Set Host type for the machine that will control the library (very important if you are switching this library from a different host type). Using hostTypeShow will tell you the current settings. Use setHostX,OSName where, X = the port (0 will set all ports, 1 will set port 1, and 2 will set port 2) and “OSName” is either:
   – AIX
   – AS400
   – HP-UX
   – NETWARE
   – gateway
   – generic
   – SOLARIS
   – Unisys
   – nt (default)

11. Then enable the IP port: ethEnable

12. Set the IP Address: ethAddrSet "192.168.0.212","255.255.255.0"

13. Set the Gateway gateAddrSet "192.168.0.1"

14. Now issue the following command to enable the Data Mover agents.
    sncFeatureEnable "License Key String"
The License Key String is a unique key provided with the device. However, if the license key was factory-installed, you can use “enable” instead of the actual license key string. For example:

- First: `SncFeatureEnable "BVRZC-G79DN"`
- Value = 0 = 0x0
- Second: `SncFeatureEnable "enable"
- Value = 0 = 0x0
- Datamover license is valid.

15. Reboot the gateway: `reboot`

### 17.4.4 Configuring Tivoli Storage Manager server

To configure the Tivoli Storage Manager server for server-free data movement, follow these steps:

1. Install the Ultrium device drivers (current level). Make sure that the server system can recognize the tape drives and medium changer.

2. Set the processing options on server:
   ```
   set registration open
   ```

3. Set server communication options:
   ```
   set servername waikiki
   set serverpass tsm52level0
   ```

4. Register administrators, grant authority:
   ```
   register admin waikikiadmin waikikiadmin
   grant auth waikikiadmin cl=system
   ```

5. Define Disk storage volumes:
   ```
   define vol archivepool I:\tsmserv\data\arch01.dsm
   ```
   (continue until all volumes are defined)

6. Define 3583 LTO tape library:
   ```
   define library TAPE_LIB libtype=scsci shared=yes
   ```

7. Define path from server to library:
   ```
   define path waikiki 3583_svt SRCT=server destt=library
device=\\Changer0 online=yes
   ```
   The device name can be obtained using the `query san` command on the server. Example 17-1 shows how to find the device name, in italics.
Example 17-1  SAN query

TSM:WAIKIKI> q san
ANR2017I Administrator SERVER_CONSOLE issued command:

<table>
<thead>
<tr>
<th>Device</th>
<th>Vendor</th>
<th>Product</th>
<th>Serial</th>
<th>Device</th>
</tr>
</thead>
<tbody>
<tr>
<td>GATEWAY</td>
<td>IBM</td>
<td>Gateway</td>
<td>610677</td>
<td>Module</td>
</tr>
<tr>
<td>DRIVE</td>
<td>IBM</td>
<td>ULT3580-TD1</td>
<td>6811154801</td>
<td>Tape0</td>
</tr>
<tr>
<td>DRIVE</td>
<td>IBM</td>
<td>ULT3580-TD1</td>
<td>6811155213</td>
<td>Tape1</td>
</tr>
<tr>
<td>DRIVE</td>
<td>IBM</td>
<td>ULT3580-TD1</td>
<td>6811154684</td>
<td>Tape2</td>
</tr>
<tr>
<td>DRIVE</td>
<td>IBM</td>
<td>ULT3580-TD1</td>
<td>6811155177</td>
<td>Tape3</td>
</tr>
<tr>
<td>DRIVE</td>
<td>IBM</td>
<td>ULT3580-TD1</td>
<td>6811155203</td>
<td>Tape4</td>
</tr>
<tr>
<td>DRIVE</td>
<td>IBM</td>
<td>ULT3580-TD1</td>
<td>6811154087</td>
<td>Tape5</td>
</tr>
<tr>
<td>LIBRARY</td>
<td>IBM</td>
<td>ULT3583-TL</td>
<td>IBM7815216</td>
<td>Changer0</td>
</tr>
<tr>
<td>DISK</td>
<td>IBM</td>
<td>3552</td>
<td>1T03510567</td>
<td>Xport</td>
</tr>
</tbody>
</table>

8. Define all the drives for the tape library:

```plaintext
define drive 3583_svt drivea element=256 wwn=20010060451729B6
serial=6811154801
```

or

```plaintext
define drive 3583_svt drivea element=autodetect wwn=autodetect
serial=autodetect
```

We only show how to define one drive. You can define others using the same procedure; the element number will increment by 1 for every new drive. You can also use the Tivoli Storage Manager server autodetect feature to detect the WWN, element number, and serial numbers.

Example 17-2 shows how to get the WWN and serial number for drives in the library.

Example 17-2  Retrieve WWN and serial numbers

TSM:WAIKIKI>
q san type=drive f=d
ANR2017I Administrator SERVER_CONSOLE issued command: QUERY SAN type=drive f=d

Device Type: DRIVE
Vendor: IBM
Product: ULT3580-TD1
Serial Number: 6811154801
Device: Tape0
Data Mover: No
Node WWN: 10000060451729B6
Port WWN: 20010060451729B6
LUN: 2
SCSI Port: 4
SCSI Bus: 0
SCSI Target: 0
9. Define paths from server to drives:

   define path waikiki drivea SRCT=server destt=drive libr=3583_svt
device=\.:Tape0 online=yes

   Device information can be found from q san command, please see the example above.

10. Define device class and storage pool going to the LTO tape library.

   define devclass 3583_svt devtype=LTO library=3583_svt
   define stgpool tapepool 3583_svt maxscratch=100 dataformat=nonblock

   **Note:** The dataformat must be nonblock for server-free data movement.

11. Define the data mover integrated into the tape library (3583 LTO).

   DEFINE DATAMOVER sandg1 wwn=20010060451729B6 dataformat=nonblock
   serial=610667 type=scsi

   The world wide name and serial number for the data mover can be found from the `q san` command. There is another parameter called “IBM Tivoli Storage Manager copythreads” when defining the data mover. The parameter, copythreads, specifies the number of concurrent copy operations that the data mover can support. If other programs or servers will be using the extended copy capabilities of the data mover device, you may want to specify fewer than the maximum number of concurrent copy commands supported by the device for this parameter.

   **Note:** The QLogic API for the HBA on the Tivoli Storage Manager server should be at level v1.27.06.

**Example 17-3  SAN query for the data mover**

TSM:WAIIKI>q san f=d
ANR2017I Administrator SERVER_CONSOLE issued command: QUERY SAN f=d

   Device Type: GATEWAY
       Vendor: IBM
       Product: Gateway Module
Serial Number: 610677
   Device:
   Data Mover: Yes
       Node WWN: 10000060451729B6
       Port WWN: 20010060451729B6
       LUN: 0IBM Tivoli Storage Manager
   SCSI Port: 4
   SCSI Bus: 0
12. Define SAN disks for the client bordeaux.

   reg node bordeaux bordeaux archdel=yes backdel=yes do=basvt1_sf
   define disk bordeaux Harddisk2 wwn=200800A0B80C00D3
   serial=1T03510567

   Issue dsmc query diskinfo to get the disk name (that is, Harddisk2). See Example 17-4 for details.

   **Important:** The disk name is case-sensitive

---

**Example 17-4   WWN for the disk**

TSM:WAIKIKI> q san type=disk f=d
ANR2017I Administrator SERVER_CONSOLE issued command: QUERY SAN type=disk f=d
   Device Type: DISK
   Vendor: IBM
   Product: 3552
   Serial Number: 1T03510567
   Device:
   Data Mover: No
   Node WWN: 201A00A0B80C00D2
   Port WWN: 201A00A0B80C00D3
   LUN: 0
   SCSI Port: 5
   SCSI Bus: 0
   SCSI Target: 0

13. Define paths from the datamover to the tape drives

   define path sandg1 drivea srct=datamover destt=drive libr=3583_svt

   Define path for all the drives in the same fashion.

13. Define paths from the datamover to the disks

   define path sandg1 Harddisk4 srct=datamover destt=disk node=bordeaux

---

**17.4.5 Configuring the Tivoli Storage Manager Client**

Follow these steps to configure the Tivoli Storage Manager client for server-free data movement:

1. Install the Logical Volume Snapshot Agent (LVSA), so that you can perform online image backup. We showed how to do this in 4.5.6, “Configuring Open File Support” on page 158
2. Make sure that you can see the SAN disk from the client Device manager.

3. Make sure that the node name is the same as defined for the disks on the Tivoli Storage Manager server.

4. Make sure that the server-free client node is assigned to the correct policy domain. The policy domain must directly backup directly to the tape.

5. Edit `dsm.opt` to add line `enableserverfree=yes`. You can also specify other parameters for server-free data movement like `snapshotcachelocation` and `snapshotcachesize`. These will come in pictures during online image backup processing.

6. The last step is to specify a backup command like this:

   ```
   dsmc backup image <drive name for the san attached disk> <options>
   - Options = can be found in the Tivoli Storage Manager client help.
   - Example:
     - dsmc backup image D:
     - dsmc restore image D: E: -noprompt
   ```

### 17.5 Running server-free backup and restore

The screen captures in this section show how the server-free backup works, once it is set up.

Figure 17-5 shows a server-free client backup in process.
Next we check the Tivoli Storage Manager server status, as shown in Figure 17-6.

![Server-free backup server status query](image)

Figure 17-6  Server-free backup server status query.

After finishing the backup successfully, we can restore from the client, as shown in Figure 17-7.

![Tivoli Storage Manager server-free client restore in process](image)

Figure 17-7  Tivoli Storage Manager server-free client restore in process

### 17.6 Summary

We have shown how to configure and run a server-free client backup. In the next chapter we will show how to configure Tivoli Storage Manager for use with NDMP and NAS devices.
Network Data Management Protocol (NDMP)

This chapter is about planning, configuring, and managing a backup environment that protects your Network Attached Storage (NAS) file server by using Network Data Management Protocol (NDMP). Tivoli Storage Manager Extended Edition includes support for the use of NDMP to back up and recover NAS file servers.
18.1 NDMP terminology

The key goals of NDMP include interoperability, contemporary functionality, and extensibility. This section is useful for understand the general NDMP terms.

**NDMP**

**NDMP client**
The application that controls the NDMP server.

**NDMP host**
The host that executes the NDMP server application. Data is backed up from the NDMP host to either a local tape drive or to a backup device on a remote NDMP host.

**NDMP server**
The virtual state machine on the NDMP host that is controlled using the NDMP protocol. There is one of these for each connection to the NDMP host. This term is used independent of implementation.

18.1.1 Tivoli Storage Manager and NDMP

Tivoli Storage Manager Extended Edition uses Network Data Management Protocol (NDMP) to perform high-performance, scalable backups and restores. The backups and restores minimize network traffic and transfer data outboard of the Tivoli Storage Manager client and server. Tivoli Storage Manager enables data backup and restore on Network Attached Storage (NAS) devices that support Network Data Management Protocol (NDMP) Version 3.0.

NDMP defines a mechanism and protocol for controlling backup, recovery, and other transfers of data between primary and secondary storage. The NDMP architecture separates the Data Servers (NAS) and Tape Servers (Tivoli Storage Manager), participating in archival or recovery operations. NDMP also provides low-level control of tape devices and SCSI media changers.

18.1.2 NDMP backup for NAS

A full or differential backups can be performed at a directory or file system level, including snapshots that are stored as either file systems or subdirectories. Restores can be performed of an entire file system or selected files and
directories within the file system. Multiple backup and restore operations can be performed in parallel.

Currently, NDMP for full or differential backups can be performed at a directory or file system level, including snapshots that are stored as either file systems or subdirectories to a Tivoli Storage Manager server running on AIX, Sun Solaris, HP-UX, Linux, or Windows. This uses NDMP to back up a full file system image and to restore an entire file system image. After a full backup image has been created, subsequent backups can be differential images. A differential image consists of all of the files that have changed since the previous full image backup.

The restore of a differential image automatically restores the differential image after the appropriate full image has been restored. Backup and restore operations can be scheduled using the administrative command scheduler. During backup and restore operations, data flows directly between the tape drive and the Network Attached Storage (NAS) appliance.

In Figure 7-5 shows the topology for Tivoli Storage Manager NDMP operations.

![Diagram showing NDMP operations and Tivoli Storage Manager interactions.](image)

**Figure 18-1** NDMP operations and Tivoli Storage Manager interactions.
18.1.3 NDMP support

NDMP operations can be performed using SCSI or ACSLS tape libraries. Additionally, 349X tape libraries may be used with some NAS devices. NDMP for NAS backup works with either a SCSI-attached tape device local to the NAS appliance, or with a SAN-attached SCSI or ACSLS device that can be shared with the Tivoli Storage Manager server. Drives must be supported by both the NAS appliance and the NAS operating system. Drives can be dedicated to NDMP operations from a single NAS file server or can be shared.

Table 18-1 shows Tivoli Storage Manager devices on Network Attached Storage (NAS) that support NDMP.

<table>
<thead>
<tr>
<th>Device</th>
<th>Capacity</th>
<th>AIX</th>
<th>HP-UX</th>
<th>SUN</th>
<th>WINDOWS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any EMC Celerra File Server running Dart 5.1.9.3 or higher. If running Dart OS Version 5.4, must be at level 5.4.15 or higher</td>
<td>N/A</td>
<td>5.2.0</td>
<td>5.2.0</td>
<td>5.2.0</td>
<td>5.2.0</td>
</tr>
<tr>
<td>Any Network Appliance File Server running Data ONTAP version 6.1.1 or higher</td>
<td>N/A</td>
<td>Base</td>
<td>5.1.1</td>
<td>Base</td>
<td>Base</td>
</tr>
<tr>
<td>Any Ready for IBM Tivoli Software certified NAS file server See Additional Device Support below for more information</td>
<td>N/A</td>
<td>5.2.2</td>
<td>5.2.2</td>
<td>5.2.2</td>
<td>5.2.2</td>
</tr>
<tr>
<td>IBM System Storage N Series File Server</td>
<td>N/A</td>
<td>5.2.7</td>
<td>5.2.7</td>
<td>5.2.7</td>
<td>5.2.7</td>
</tr>
<tr>
<td>Network Appliance NearStore appliances via NDMP, requires Data ONTAP 6.1.1 or higher. This device can also be used as a Tivoli Storage Manager storage pool device via the sequential device class.</td>
<td>N/A</td>
<td>Base</td>
<td>5.1.1</td>
<td>Base</td>
<td>Base</td>
</tr>
</tbody>
</table>

Refer to the Tivoli Storage Manager device support Web page and your NAS vendor's documentation for complete latest NDMP device support.

18.1.4  Multiple NAS appliances

Multiple NAS appliance can share tape resources can be shared if they have Fibre Channel (FC) access to the drive and if backups are performed via the same Tivoli Storage Manager server. Depending on the configuration, drives can be shared with LAN-free backup/restore operations. NDMP operations for backup of NAS file servers have been enhanced to support the following functions:

- Directory-level backup of NAS data, which enables the division of a file system backup operation among several NDMP backup operations as well as several tape drives. This enhancement will reduce backup and restore times.
- NDMP directory level backup enables Tivoli Storage Manager to back up user-created snapshots that are stored as subdirectories, specifically Network Appliance snapshots.
- The NDMP controlled backups/restores can be performed in Full file system image and differential file system image.
- Backup to local tape devices without LAN network data movement
- NDMP isolates backup software from hardware/software changes on NAS appliances.

If you have a large NAS file system, initiating a backup at a directory level reduces backup and restore times and provides more flexibility in configuring your NAS backups. By defining virtual file spaces, a file system backup can be partitioned among several NDMP backup operations and multiple tape drives. You can also use different backup schedules to back up subtrees of a file system.

The virtual file space name cannot be identical to any file system on the NAS node. If a file system is created on the NAS device with the same name as a virtual file system, a name conflict will occur on the Tivoli Storage Manager server when the new file space is backed up.

**Note:** Virtual file space mappings are supported only for NAS nodes. For more information about virtual file space mapping commands, see the *Tivoli Storage Manager Administrator's Reference*.

18.2  Configuration diagram for NDMP

In Figure 18-2 we show our lab configuration for these tests.
Figure 18-2   NDMP test lab configuration
18.3 Configuring for Network Appliance and NDMP

In this section we describe how to physically connect the Network Appliance NAS server to the tape drive, which resides in the library, and ensure that the NetApp configures the tape drive. Figure 18-3 shows the NetApp GUI interface.

![NetApp Web GUI](image)

*Figure 18-3  NetApp Web GUI*
Figure 18-4 shows the NetApp filer view.

Next are the steps to configure NDMP on our Tivoli Storage Manager server called Clyde.

1. Define the library called 3583lib with type=SCSI.
2. Define a device class for the tape drives as shown in Example 18-1.

Example 18-1  Defining the device class

```bash
tsm: CLYDE_W2K> define devclass NAS_LT0 devtype=nas library=3593lib
```
Figure 18-5 shows the query of the device class definition.

3. Define a storage pool for NAS storage media as shown in Example 18-2. The results are shown in Figure 18-6.

**Example 18-2  Define a storage pool for the NAS device**

```
tsm: CLYDE_W2K> define stgpool NAS_POOL NAS_LTO dataformat=NetAppdump
```
4. Configure the IBM Tivoli Storage Manager policy domain for managing NAS backups, as shown in Example 18-3. The results shown in Figure 18-7.

Example 18-3  Defining a STANDARD_NAS policy domain

tsm: CLYDE_W2K> define domain STANDARD_NAS
Figure 18-7 Query domain for STANDARD_NAS policy domain

5. Define the policy set, as shown in Example 18-4.

Example 18-4 Defining the STANDARD_NAS policyset

```bash
tsm: CLYDE_W2K> define policyset STANDARD_NAS standard
```

6. Define the management class for the NAS, as shown in Example 18-5.

Example 18-5 Defining the mgmtclass for STANDARD_NAS

```bash
tsm: CLYDE_W2K> define mgmtclass STANDARD_NAS STANDARD_NAS STANDARD_NAS STANDARD_NAS
```

7. Assign the default management class for the STANDARD_NAS domain, as shown in Example 18-6.

Example 18-6 Assigning the default management class

```bash
tsm: CLYDE_W2K> assign defmgmtclass STANDARD_NAS STANDARD_NAS STANDARD_NAS STANDARD_NAS
```

8. Define a backup copy group in the default management class, as shown in Example 18-7.
Example 18-7  Define a backup copy group in the default mgmt class

```bash
tsm: CLYDE_W2K> define copygroup STANDARD_NAS STANDARD_NAS STANDARD_NAS
destination=NAS_POOL tocdestination=DISKPOOL
```

The results from these steps can be seen in Figure 18-8.

![Operation Results](image)

**Figure 18-8** Query the copygroup for STANDARD_NAS

9. Activate the policy set as shown in Figure 18-8.

**Example 18-8  Activate the policyset**

```bash
tsm: CLYDE_W2K> activate policyset STANDARD_NAS standard
```

10. Register a NAS file server node on the Tivoli Storage Manager server as shown in Example 18-9. The results can be seen in Figure 18-9.

**Example 18-9  Registering the NetApp node**

```bash
tsm: CLYDE_W2K> register node NetApp NetApp_psswd domain=STANDARD_NAS type=nas
```
11. Define a data mover for the NAS file server as shown in Example 18-10, and view the results in Figure 18-10.

Example 18-10  Defining a datamover

```
 tsm: CLYDE_W2K> define datamover NetApp type=nas hladdress=9.1.38.150
 lladdress=10000 userid=root password=admin dataformat=NetAppdump
```
Defining a datamover for NAS

12. Define a path from the Tivoli Storage Manager server to the NAS attached tape drive as shown in Example 18-11. The results are shown in Figure 18-11.

Example 18-11 Define path to the NetApp drive

```
tsm: CLYDE_W2K> define path NetApp drive0 srctype=datamover desttype=drive library=3583lib device=/dev/rst0a
```
13. Finally, label and check in the tapes.

### 18.4 NDMP full backup and selective file restore test

This test specifically targets the NDMP feature of individual file restore (selective), as opposed to full image backup and restore.
NDMP backups and restores can be invoked on a host which is configured with the Tivoli Storage Manager Web client. Point your browser's URL address to a Tivoli Storage Manager client address and port number, and you will then see the window shown in Figure 18-12.

Figure 18-12  Initial client Web interface
The permissions for the logging into the Tivoli Storage Manager client must be at administrator level for both the client you're logging into to, and you need administrator rights for the Network Appliance server. We logged in as the admin user ID. As shown in Figure 18-13, the NDMP fileset option is visible. If you did not have sufficient permissions, this would not be seen.

Figure 18-13  Backup and restore client which shows the NetApp filesets
Figure 18-14 shows the NetApp client expanded to reveal the /vol/vol0 file system.

Figure 18-14 The NetApp client file system vol0 is visible
Next, we select a FULL backup, and check the vol0 file system to back up, as shown in Figure 18-15. Finally, we click the **Backup** button to start the backup.

![Figure 18-15  Selecting the file system to perform a full backup on](image)

Now the backup is running, and this can be seen in a few ways. One method is through the Tivoli Storage Manager server Clyde, as shown in Figure 18-16.
Figure 18-16 Query process run on Clyde showing the backup happening.

An output volume has been mounted by Clyde requesting the mount across the SAN into the tape library. The tape is loaded into the tape drive which is defined for only NetApp’s use, as it is physically and directly attached. The query mount command run on Clyde will also show the output volume is mounted, as in Figure 18-17.

Figure 18-17 Query mount displays the volume mounted for the NDMP backup.
The query session that is run on the Tivoli Storage Manager server Clyde is illustrated in Figure 18-18. This shows that Clyde is also the client (which it is), however, it is really representing the Network Appliance file server.

![Query session on Clyde showing the two client sessions running](image)

*Figure 18-18  Query session on Clyde showing the two client sessions running*

The full backup results are posted, as shown in Figure 18-19.

![NDMP full backup results are posted](image)

*Figure 18-19  The NDMP full backup results are posted*
In Figure 18-20, the successful completion window appears.

![Backup completed window](image)

Figure 18-20 Backup completed window

Figure 18-21 shows the server’s actlog output for the completed backup session.

![Server actlog session](image)

Figure 18-21 Server’s actlog session for the completed NDMP full backup
Figure 18-22 shows a file system listing on the AIX system Brazil, which has NFS mounted the NetApp filesystem. This shows the directories and files which were backed up.

![Figure 18-22: Extended file listing on Brazil showing the data being backed](image)

**18.4.1 Individual file restore**

Figure 18-23 shows the preparation for the restore test. This is what we did:

- Removed the file Dan/74p4832.tgz
- Removed the file Fred/KEYBOARD.TXT
- Added the file Aezil/Aezil.test
- Added the file Ross/Ross.test
- Produced a recursive listing to show the changes
Now, as shown in Figure 18-24, we choose the restore option from the Web client, which brings up the restore window. We expand the NetApp client and select one of the deleted files, Dan/74p4832.tgz.

Figure 18-23  File changes done to set up the restore test
Figure 18-24  One of the deleted files has been selected for restore

Figure 18-25 shows we have selected the restore into the original location.

Figure 18-25  Restore to panel
Figure 18-26 shows the Tivoli Storage Manager server Clyde running the restore process, and waiting for the tape mount.

Figure 18-26  Tape mount request on Clyde due to the restore

Figure 18-27 shows the Tivoli Storage Manager server Clyde now has the tape mounted and the NDMP restore has begun.
Chapter 18. Network Data Management Protocol (NDMP)

Operation Results

ANR8330I NAS volume AFA929 is mounted R/W in drive DRIVE0 (rst0a), status: IN USE.
ANR8334I 1 matches found.

Figure 18-27  Tape mount is shown on server Clyde

Figure 18-28 shows the client restore status.

Figure 18-28  Client restore status
Figure 18-29 shows the restore has completed.

![Figure 18-29   Restore completed popup](image)

Figure 18-30 shows the detailed status report from the client GUI perspective.

![Figure 18-30   Client side restore status report](image)
Figure 18-31 shows the server actlog output for the restore.

Figure 18-31  Server Clyde's actlog output for the restore summary

Figure 18-32 shows the AIX extended listing with the file restored. If you compare this information, before and after, you will see that the file has been restored with all its original attributes.
Figure 18-32  AIX extended listing showing the file restored with original attributes
18.5 NDMP full backup and image restore

We will now demonstrate the behavior of an image restore based on a full backup. We will perform the full backup, review the environment, change the environment and then restore the full image, then a final review and summary.

Figure 18-33 shows the client screen for our full backup.
In Figure 18-34 we show the environment which is being backed up.

```
root@brazil > ls -lR *
Aezil:
total 0
-rw-r--r-- 1 65534 system 0 Apr 29 15:32 Aezil.test
Dan:
total 56994
-rwx------ 1 65534 65534 988973 Apr 15 10:39 74p4832.tgz
-rwx------ 1 65534 65534 28110720 Apr 15 10:26 kernel-source-2.4.18-10.1366.rpm
Fred:
total 472
-rwxrwxrwx 1 65534 65534 235344 Apr 09 15:21 TSM 5.2.PDF
Ross:
total 0
-rw-r--r-- 1 65534 system 0 Apr 29 15:32 Ross.test
root@brazil >
```

*Figure 18-34  Environment on Brazil which has NFS mounted the NAS file system*

Figure 18-35 shows that the backup has successfully completed.

*Figure 18-35  Client popup which shows the backup has completed*
We now start the client restore panel, and select the restore options button to ensure that we will restore an image only, as shown in Figure 18-36.

![Figure 18-36  Restore options panel](image)
Figure 18-37 now shows the changes to the environment we have made. We have deleted some files and folders, and created one new folder with a zero-byte file inside.

```
root@brazil > rm -r *
rm: Remove Den/kernel-source-2.4.18-10.i386.rpm? y
rm: Remove Den/74p4932.tgz? y
rm: 0653-609 Cannot remove Fred.
Operation not permitted.
root@brazil > ls -lr *
total 0
root@brazil > pwd
/netapp
root@brazil > ls -l
total 8
drwxrwxrwx  2 65535  65535  4096 Apr 30 16:14 Fred
root@brazil > mkdir Folder_1
root@brazil > touch Folder_1/newfile.test
root@brazil > ls -lr *
Folder_1:
total 0
-rw-r--r--  1 65534  system  0 Apr 30 16:16 newfile.test
```

**Figure 18-37  Changes to the file system before the image restore**
Figure 18-38 shows the selection of the image restore, which we now start.

![Client restore screen showing the selection of the image restore](image)

Figure 18-38  Client restore screen showing the selection of the image restore

Figure 18-39 shows that the restore has completed successfully.

![Successful restore status screen](image)

Figure 18-39  Successful restore status screen
Finally, we demonstrate the results of the image restore in Figure 18-40. Notice that all the removed folders and files are restored with their original attributes. In addition, the new folder and new file are left untouched.

![Image of command line output]

Figure 18-40 Final environment view of the file system after the restore is complete

### 18.6 Summary

We have shown the configuration of our NDMP environment using the Network Appliance file server, and demonstrated both image backup and restore, and image backup and selective file restore. In the next chapter we will discuss the Disaster Recovery Manager feature, which is now included in the Tivoli Storage Manager Enterprise Edition package.
In this chapter we present an example of how to set up and test some Disaster Recovery Manager (DRM) functions. The example presented here was adapted from the redbook, *Disaster Recovery Strategies with Tivoli Storage Management*, SG24-6844, and has been updated to reflect current levels.

Due to the complexity of disaster recovery, our implementation guide is not intended to supply you with all the knowledge required to effectively design, implement, and manage your DRM solution. To achieve a better perspective and understanding, we encourage you to read the aforementioned Redbook.
19.1 Example of a DRM implementation

This section contains a practical example of using Disaster Recovery Manager. In our lab we have a Windows 2003 Tivoli Storage Manager server, LOCHNESS, connected to a SAN-attached IBM 3582 Tape Library. The Tivoli Storage Manager server is called LOCHNESS_Server1. The storage pool setup is the same as our example solution in Chapter 6, “Data storage” on page 205.

In our scenario, we set up DRM on LOCHNESS, backed up all the necessary data, and restored the Tivoli Storage Manager server onto another Windows 2003 system called CASEY. The result was that the Tivoli Storage Manager server named LOCHNESS_Server1 was run on the machine called CASEY as shown in Figure 19-1. Our situation most closely matches a disaster recovery with a cold standby machine.

Here is a summary of the steps we performed:

- Tivoli Storage Manager server settings
  - DRM setup:
    - Register DRM (Extended Edition) license
    - Define copy storage pools (if not already done)

![Diagram of DRM lab setup](image-url)
• Configure DRM settings
• Create instructions files

– Daily operations:
• Back up the primary storage pools to the copy storage pools (usually scheduled).
• Back up the Tivoli Storage Manager database (usually scheduled).
• Move DR media states.
• Remove the volumes from library.
• Run PREPARE.
• Transport DR media offsite.
• Return empty media from offsite.

► Restore operations on backup server:
– Install operating system and Tivoli Storage Manager server software
– Restore server using DRM scripts

19.2 DRM setup

Before using DRM, we need to perform some basic configuration tasks.

19.2.1 Register DRM license

To use DRM, it must first be licensed in Tivoli Storage Manager. DRM is now included with the Tivoli Storage Manager Extended Edition. To license DRM, use register license with the file tsmee.lic. Example 19-1 shows the procedure.

Example 19-1 Registering Tivoli Storage Manager Extended Edition

tsm: LOCHNESS_SERVER1> q lic

Last License Audit: 02/27/2006 00:00:09
...
  Is IBM System Storage Archive Manager in use ?: No
  Is IBM System Storage Archive Manager licensed ?: No
  Is Tivoli Storage Manager Basic Edition in use: Yes
  Is Tivoli Storage Manager Basic Edition licensed: Yes
  Is Tivoli Storage Manager Extended Edition in use: No
  Is Tivoli Storage Manager Extended Edition licensed: No
  Server License Compliance: Valid

tsm: LOCHNESS_SERVER1> register license file=tsmee.lic
ANR2852I Current license information:
ANR2828I Server is licensed to support Tivoli Storage Manager Basic Edition.
ANR2853I New license information:
ANR2828I Server is licensed to support Tivoli Storage Manager Basic Edition.
ANR2828I Server is licensed to support Tivoli Storage Manager Extended Edition.

```
tsm: LOCHNESS_SERVER1> q lic

Last License Audit: 02/27/2006 00:00:09
...
  Is IBM System Storage Archive Manager in use ?: No
  Is IBM System Storage Archive Manager licensed ?: No
  Is Tivoli Storage Manager Basic Edition in use: Yes
  Is Tivoli Storage Manager Basic Edition licensed: Yes
  Is Tivoli Storage Manager Extended Edition in use: No
  Is Tivoli Storage Manager Extended Edition licensed: Yes
  Server License Compliance: Valid
```

Note that the Extended Edition is now licensed but not, as yet, in use. Note also that there is no specific entry for DRM.

### 19.2.2 Create a copy storage pool

To transport tapes to an off-site location using the DRM, you must make backups of your primary storage pools. In 6.3, “Storage pools” on page 219, we created the copy storage pools shown in Table 19-1.

#### Table 19-1  Storage pools

<table>
<thead>
<tr>
<th>Primary storage pool</th>
<th>Copy storage pool</th>
</tr>
</thead>
<tbody>
<tr>
<td>DISKDATA</td>
<td>OFFDATA</td>
</tr>
<tr>
<td>TAPEDATA</td>
<td>OFFDATA</td>
</tr>
<tr>
<td>DISKDIRS</td>
<td>OFFDIRS</td>
</tr>
</tbody>
</table>

Example 19-2 shows using the `define stgpool` command to create the copy storage pool OFFDATA using the device class defined for the LTO tape library. Note the value of `REUsedelay=6`. This is important for ensuring recovery integrity. See Step 8 on page 604 for more information on how this relates to the database backup series expiration value.

**Example 19-2  Creation of copy storage pool**

```
tsm: LOCHNESS_SERVER1> define stgpool offdata lto2-dc pooltype=copy reclaim=100 maxscratch=10000 reusedelay=6 collocate=no
ANR2200I Storage pool OFFDATA defined (device class LTO2-DC).
```

Query `stgpool` displays the details of the new pool, as shown in Figure 19-3.
Example 19-3  Query stgpool command output

```
storage: LOCHNESS_SERVER1> q stg offdata f=d

Storage Pool Name: OFFDATA
Storage Pool Type: Copy
Device Class Name: LTO2-DC
Estimated Capacity: 0.0 M
Space Trigger Util:
  Pct Util: 0.0
  Pct Migr:
  Pct Logical: 0.0
  High Mig Pct:
  Low Mig Pct:
Migration Delay:
Migration Continue:
Migration Processes:
Reclamation Processes: 1
Next Storage Pool:
Reclaim Storage Pool:
Maximum Size Threshold:
  Access: Read/Write
  Description:
  Overflow Location:
  Cache Migrated Files?:
  Collocate?: No
  Reclamation Threshold: 100
  Offsite Reclamation Limit: No Limit
Maximum Scratch Volumes Allowed: 10,000
Number of Scratch Volumes Used: 0
Delay Period for Volume Reuse: 6Day(s)
Migration in Progress?:
  Amount Migrated (MB):
  Elapsed Migration Time (seconds):
Reclamation in Progress?: No
Last Update by (administrator): ADMIN
  Last Update Date/Time: 02/27/2006 15:25:52
Storage Pool Data Format: Native
Copy Storage Pool(s):
  Continue Copy on Error?:
    CRC Data: No
    Reclamation Type: Threshold
```

19.2.3 DRM settings

Now we will configure the DRM settings. Most of the DRM basic settings are set using SET commands.
1. First, we need to specify a directory where the DR plans will be stored, and a prefix that will name each file. To set the prefix we use the `set drmplanprefix` command. You should specify the plan prefix with an absolute directory path followed by your chosen file name prefix. Using the form shown in Example 19-4, our DR plans generated by DRM will be stored in the directory `C:\TSMDATA\DRM\PLANS\` and each file will be prefixed by the string `LOCHNESS-DR_`. If you do not set the directory and prefix, plans are created in the server's default path (the directory where the instance of the Tivoli Storage Manager server is running from) with a file name consisting only of the date and time the plan was created. Enclose the prefix in quotes if it contains metacharacters or spaces.

**Example 19-4  Setting the DRM plan prefix**

```
tsm: LOCHNESS_SERVER1> set drmplanprefix "c:\tsmdata\drm\plans\lochness-dr"
ANR67001 SET DRMPLANPREFIX command completed successfully.
```

2. Next we set the prefix for where site specific recovery instructions will be stored. The DRM `prepare` command will look for the instructions files in this directory if it is set. We set the instructions directory using `set drminstrprefix`. You should specify the instructions prefix with an absolute path. Using the syntax shown in Example 19-5 on page 603, the recovery instruction files should be located in the directory `C:\TSMDATA\DRM\INSTRUCTIONS\`. The prefix does not need to be specified — if you do not set the directory, instructions are search for in the server’s default path (the directory where the instance of the Tivoli Storage Manager server is running from).

The recovery instruction files are user-created and should contain any site-specific instructions related to the DR process. You can create the files using any plain text editor. Be sure to include any information which is relevant to your installation. Instructions files will be automatically included in the DR plan. The standard names for the instruction plans are:

- **RECOVERY.INSTRUCTIONS.GENERAL**: Contains general information such as the name of the system administrator, backup administrators and operators names, contact details, security guards, passwords and so on.

- **RECOVERY.INSTRUCTIONS.OFFSITE**: Contains information about the offsite vault location and courier service, including name, phone number, e-mail, fax, after-hours pager, and so on. Also contains the procedure for retrieving tapes from the vault including pass phrases and your customer number/details.

- **RECOVERY.INSTRUCTIONS.INSTALL**: Contains installation instructions for the Tivoli Storage Manager server, and site-specific details such as passwords, hardware/software requirements, fix levels, where media are located and so on.
- **RECOVERY.INSTRUCTIONS.DATABASE**: Contains instructions to recreate the Tivoli Storage Manager server database and recovery log volumes. A good idea is to keep up-to-date directory listings of the volumes (for example, `ls` on UNIX platforms, `dir` on Windows) in this file.

- **RECOVERY.INSTRUCTIONS.STGPOOL**: Contains instructions to recreate the Tivoli Storage Manager server primary storage pool volumes. It is a good idea to keep up-to-date directory listings of the volumes (for example, `ls` on UNIX/Linux, `dir` on Windows) in this file.

**Example 19-5 Setting the DRM instructions files prefix**

```plaintext
set drminstrprefix "c:\tsmdata\drm\instructions\"  
```

3. Next, we will specify a character that will be appended to the end of the replacement volumes names in the recovery plan file. The character is set using `set drmplanvpostfix`. Use of this special character allows you to easily search the recovery plan so that you can changes the names at recovery time. In Example 19-6, we use the default character of `@`.

**Example 19-6 Setting the DRM replacement volumes postfix**

```plaintext
set drmplanvpostfix @  
```

4. Now, we use `set drmchecklabel` to specify whether Tivoli Storage Manager will mount and read the labels of tape media when they are checked out using the `move drmedia` command. The default value is YES. We will set it to NO in Example 19-7.

**Example 19-7 Setting DRMCHECKLABEL**

```plaintext
set drmchecklabel no  
```

5. Now we need to indicate which primary storage pools will be managed by DRM, using `set drmprimstgpool`. The primary storage pools we set here will be recoverable by DRM after a disaster. In Example 19-8, we specify our storage pools DISKDATA, DISKDIRS and TAPEDATA to be managed by DRM.

**Example 19-8 Setting primary storage pools managed by DRM**

```plaintext
set drmprimstgpool diskdata,diskdirs,tapedata  
```

6. Similarly, we use `set drmcopystgpool` to indicate one or more copy storage pools to be managed by DRM. The copy pools configured here will be used to
recover the primary storage pools after a disaster. The move drmedia and query drmedia commands will only process volumes in the copy storage pools listed here by default (unless explicitly over-ridden with the COPYSTGPOOL parameter). In Example 19-9 we specify that our copy storage pools OFFDATA and OFFDIRS are to be managed by DRM.

**Example 19-9  Setting copy storage pools managed by DRM**

```
tsm: LOCHNESS_SERVER1> set drmcopystgpool offdata,offdirs
ANR6700I SET DRMCOPYSTGPOOL command completed successfully.
```

7. Next, use set drmcouriername to define the name of your courier company. If not set, the courier name will default to “COURIER”. Any meaningful string can be inserted here, enclosing the string in quotes if spaces or special characters are included in the name (Example 19-10).

**Example 19-10  Setting the DRM courier name**

```
tsm: LOCHNESS_SERVER1> set drmcouriername “Rocket Couriers”
ANR6700I SET DRMCOURIERNAME command completed successfully.
```

8. Now, we specify the number of days before a database backup series expires using set drmdbbackupexpiredays. This parameter applies to both database snapshots and full-plus-incremental database backup series. The age of the last volume in the series must exceed the expiration value defined here to be eligible for expiration. The most recent backup series of either type is never deleted. Therefore, a value of 6 will keep database backups for one week.

In Example 19-11, we specify an expiration value of 6 days. To ensure that the database can be restored to an earlier level and database references to files in the storage pool are still valid, the number of days specified by this setting and the number of days specified by the REUsedelay parameter in the copy storage pool definitions should be the same.

**Example 19-11  Setting database backup expiry period**

```
tsm: LOCHNESS_SERVER1> set drmdbbackupexpiredays 6
ANR6700I SET DRMDBBACKUPEXPIREDAYS command completed successfully.
```

9. The set drmfileprocess command (shown in Example 19-12) indicates whether the move drmedia and query drmedia commands should process database backup volumes and copy storage pool volumes that have been defined with the FILE device class. The default value is NO.

**Example 19-12  Setting processing for FILE device class volumes**

```
tsm: LOCHNESS_SERVER1> set drmfileprocess no
ANR6700I SET DRMFILEPROCESS command completed successfully.
```
10. Next, specify the location where media will be stored while it is waiting to be sent to the offsite location, using `set drmnotmountablename`. The location name is used by the `move drmedia` command to set the location of volumes that are in transition to the NOTMOUNTABLE state. The default value is NOTMOUNTABLE.

**Example 19-13  Setting the NOTMOUNTABLE location**

```
tsm: LOCHNESS_SERVER1> set drmnotmountablename "East dock"
ANR67001 SET DRMNOTMOUNTABLENAME command completed successfully.
```

11. If you are using Tivoli Storage Manager server-to-server communication and intend to store recovery plans on another server, use `set drmrpfexpiredays` to set the expiry period. When plans are stored on another Tivoli Storage Manager server, they are automatically expired after `drmrpfexpiredays` days. The most recent files are never deleted. Example 19-14 shows changing this value from the default of 60 days to 6 days.

**Example 19-14  Setting remote plan file expiry period**

```
tsm: LOCHNESS_SERVER1> set drmrpfexpiredays 6
ANR67001 SET DRMRPFEXPIREDAYS command completed successfully.
```

12. Identify the vault name with `set drmvaultname`, as shown in Example 19-15. You can specify any string, or leave the default value of VAULT.

**Example 19-15  Setting the vault name**

```
tsm: LOCHNESS_SERVER1> set drmvaultname "Rocket Vault"
ANR67001 SET DRMVAULTNAME command completed successfully.
```

### 19.2.4 Verifying the settings

You can display and check settings of the DRM parameters with the `query drmstatus` command, as shown in Example 19-16.

**Example 19-16  Querying DRM status**

```
tsm: LOCHNESS_SERVER1> q drmst
```

```
Recovery Plan Prefix: C:\TSMDATA\DRM\PLANS\LOCHNESS-DR
Plan Instructions Prefix: C:\TSMDATA\DRM\INSTRUCTIONS\nReplacement Volume Postfix: @
Primary Storage Pools: DISKDATA DISKDIRS TAPEDATA
Copy Storage Pools: OFFDATA OFFDIRS
Not Mountable Location Name: East dock
Courier Name: Rocket Couriers
Vault Site Name: Rocket Vault
```
### 19.3 Daily operations

After setup, DRM will now manage your tape movements and generate a recovery plan for you. As we discussed in Chapter 12, “Scheduling” on page 359, a number of operations are scheduled to happen after the client backups are complete. For disaster recovery, we are concerned with the first of those schedules, backing up the primary storage pool and database. The list below details the procedures required for DRM operations on a daily basis:

1. Back up the primary storage pools to copy storage pools
2. Back up the Tivoli Storage Manager database
3. Perform DR tape movement commands
4. Generate recovery plan
5. Physically transport media and plan offsite

We will now discuss each step in detail.

Throughout this section, we refer to the possible states in which a piece of DR media could be. DR media are volumes used for storage pool and database backup. The states and their life cycle is shown in Figure 19-2. DR media states are changed using `move drmedia`.
Table 19-2 lists the valid DR media states and their meanings.

<table>
<thead>
<tr>
<th>DR media state</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOUNTABLE</td>
<td>Volume is in a tape library onsite and is accessible by the server.</td>
</tr>
<tr>
<td>NOTMOUNTABLE</td>
<td>Volume is not in a tape library but remains onsite. It is not accessible by the server.</td>
</tr>
<tr>
<td>COURIER</td>
<td>Volume is in transit to the offsite vault location.</td>
</tr>
<tr>
<td>VAULT</td>
<td>Volume is offsite at the vault.</td>
</tr>
<tr>
<td>VAULTRETRIEVE</td>
<td>Volume is offsite at the vault and contains no valid data. It is ready for transport back onsite.</td>
</tr>
<tr>
<td>COURIERRETRIEVE</td>
<td>Volume is in transit from the vault to onsite.</td>
</tr>
<tr>
<td>ONSITERETRIEVE</td>
<td>Volume has been returned onsite and can be loaded into a library for reuse.</td>
</tr>
</tbody>
</table>

Note that a volume does not have to move through all states. You can skip states, as long as it is clearly understood which states your media are in at any given
time. For example, you do not have to transit a M0untable tape through NOTM0untable and COUrier before it can be in the VAULT state. You can transit a M0untable tape directly to VAULT if you wish. Likewise, a VAULTRetriev0 tape can transit directly to ONSITERetrieve if desired.

19.3.1 Backup primary storage pools to copy storage pool

The first step in the tape offsiting process is to back up the primary storage pools. As discussed above, the storage pool backups are usually (and should be) run by a schedule overnight. We show examples of manually backing up the primary storage pools below.

In our example solution, the clients back up to the primary storage pool, DISKDATA, which migrates to the pool TAPEDATA. We must back up both of the storage pools to our copy storage pool, OFFDATA. We use the backup stgpool command, as shown in Example 19-17. We also backup the primary storage pool DISKDIRS to our copy storage pool OFFDIRS. The example shows a number of queries that you can use to view the status of the jobs as they run.

Note that when we run the first backup stgpool operation on the pool DISKDATA, there is no data to backup. This indicates that the pool has already been completely migrated to TAPEDATA, leaving it empty.

Example 19-17 Primary storage pool backup

```bash
tsm: LOCHNESS_SERVER1> backup stg diskdata offdata maxprocess=1 wait=no
ANR2111W BACKUP STGPOOL: There is no data to process for DISKDATA.
ANS8001I Return code 11.

tsm: LOCHNESS_SERVER1> backup stg tapedata offdata maxprocess=1 wait=no
ANS8003I Process number 2 started.

tsm: LOCHNESS_SERVER1> q pr
```

<table>
<thead>
<tr>
<th>Process Number</th>
<th>Process Description</th>
<th>Status</th>
</tr>
</thead>
</table>

```bash
tsm: LOCHNESS_SERVER1> q mount
ANR8330I LTO volume 028AKK is mounted R/W in drive DR01 (mt1.0.0.2), status: IN USE.
ANR8330I LTO volume 032AKK is mounted R/W in drive DR00 (mt0.0.0.2), status: |
```
IN USE.

ANR8334I 2 matches found.

tsm: LOCHNESS_SERVER1> **backup stg diskdirs offdirs maxprocess=1 wait=no**

ANS8003I Process number 6 started.

tsm: LOCHNESS_SERVER1> **q pr**

<table>
<thead>
<tr>
<th>Process Number</th>
<th>Process Description</th>
<th>Status</th>
</tr>
</thead>
</table>

tsm: LOCHNESS_SERVER1> **q actlog**

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>02/28/2006 11:19:23</td>
<td>ANR2017I Administrator ADMIN issued command: BACKUP STGPOOL tapedata offdata maxprocess=1 wait=no (SESSION: 3)</td>
</tr>
<tr>
<td>02/28/2006 11:19:23</td>
<td>ANR2110I BACKUP STGPOOL started as process 2. (SESSION: 3, PROCESS: 2)</td>
</tr>
<tr>
<td>02/28/2006 11:19:23</td>
<td>ANR1210I Backup of primary storage pool TAPEDATA to copy storage pool OFFDATA started as process 2. (SESSION: 3, PROCESS: 2)</td>
</tr>
<tr>
<td>02/28/2006 11:19:23</td>
<td>ANR1228I Removable volume 028AKK is required for storage pool backup. (SESSION: 3, PROCESS: 2)</td>
</tr>
<tr>
<td>02/28/2006 11:19:32</td>
<td>ANR2017I Administrator ADMIN issued command: QUERY MOUNT (SESSION: 3)</td>
</tr>
<tr>
<td>02/28/2006 11:20:26</td>
<td>ANR1340I Scratch volume 032AKK is now defined in storage pool OFFDATA. (SESSION: 3, PROCESS: 2)</td>
</tr>
<tr>
<td>02/28/2006 11:20:26</td>
<td>ANR8337I LTO volume 028AKK mounted in drive DRO1 (mt1.0.0.2). (SESSION: 3, PROCESS: 2)</td>
</tr>
<tr>
<td>02/28/2006 11:20:29</td>
<td>ANR0513I Process 2 opened output volume 032AKK. (SESSION: 3, PROCESS: 2)</td>
</tr>
<tr>
<td>02/28/2006 11:20:29</td>
<td>ANR0512I Process 2 opened input volume 028AKK. (SESSION: 3, PROCESS: 2)</td>
</tr>
<tr>
<td>02/28/2006 11:31:48</td>
<td>ANR0986I Process 2 for BACKUP STORAGE POOL running in the BACKGROUND processed 99594 items for a total of</td>
</tr>
</tbody>
</table>
19.3.2 Backup of Tivoli Storage Manager database

After successfully backing up all primary storage pools, we can back up the Tivoli Storage Manager database. Using `backup db` as shown in Example 19-18, we see the output from running the command in the foreground (\texttt{wait=yes}) and the activity log entries. The database backup is written to volume 037AKK.

\begin{example}
\textbf{Example 19-18  Backup of Tivoli Storage Manager database}

\begin{verbatim}
tsm: LOCHNESS_SERVER1> backup db devc=lto2-dc type=full wait=yes
\end{verbatim}
\end{example}
ANR4554I Backed up 64896 of 129915 database pages.
ANR4554I Backed up 129792 of 129915 database pages.
ANR4550I Full database backup (process 7) complete, 129915 pages copied.

```
q actlog
```

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>02/28/2006 13:36:53</td>
<td>ANR8337I LTO volume 037AKK mounted in drive DR01 (mt1.0.0.2). (SESSION: 13, PROCESS: 7)</td>
</tr>
</tbody>
</table>

---

### 19.3.3 Querying DR media

When you are ready to move the DR media offsite, you can check the status of the tapes using `query drmedia`. `Query drmedia` lists all DR volumes, including those that should be moved offsite.

Example 19-19 on page 612 shows the output of the `query libvolume` and `query drmedia` commands. Specifying the state as MOUNTABLE ensures that only DR media in the library will be displayed.
Example 19-19  Querying DR media

```
ibm: LOCHNESS_SERVER1> q libvol
```

<table>
<thead>
<tr>
<th>Library Name</th>
<th>Volume Name</th>
<th>Status</th>
<th>Owner</th>
<th>Last Use</th>
<th>Home Element</th>
<th>Device Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>3582LIB</td>
<td>029AKK</td>
<td>Private</td>
<td></td>
<td>Data</td>
<td>4,103</td>
<td>LTO</td>
</tr>
<tr>
<td>3582LIB</td>
<td>030AKK</td>
<td>Private</td>
<td></td>
<td>Data</td>
<td>4,106</td>
<td>LTO</td>
</tr>
<tr>
<td>3582LIB</td>
<td>031AKK</td>
<td>Private</td>
<td></td>
<td>Data</td>
<td>4,107</td>
<td>LTO</td>
</tr>
<tr>
<td>3582LIB</td>
<td>032AKK</td>
<td>Private</td>
<td></td>
<td>Data</td>
<td>4,100</td>
<td>LTO</td>
</tr>
<tr>
<td>3582LIB</td>
<td>033AKK</td>
<td>Private DbBackup</td>
<td>4,105</td>
<td>LTO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3582LIB</td>
<td>034AKK</td>
<td>Private DbBackup</td>
<td>4,098</td>
<td>LTO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3582LIB</td>
<td>036AKK</td>
<td>Private</td>
<td></td>
<td>Data</td>
<td>4,101</td>
<td>LTO</td>
</tr>
<tr>
<td>3582LIB</td>
<td>037AKK</td>
<td>Private</td>
<td></td>
<td>Data</td>
<td>4,113</td>
<td>LTO</td>
</tr>
</tbody>
</table>

```
tsm: LOCHNESS_SERVER1> q drmedia wherestate=mountable
```

<table>
<thead>
<tr>
<th>Volume Name</th>
<th>State</th>
<th>Last Update Date/Time</th>
<th>Automated LibName</th>
</tr>
</thead>
<tbody>
<tr>
<td>032AKK</td>
<td>Mountable</td>
<td>02/28/2006 11:31:48</td>
<td>3582LIB</td>
</tr>
<tr>
<td>036AKK</td>
<td>Mountable</td>
<td>02/28/2006 13:31:24</td>
<td>3582LIB</td>
</tr>
<tr>
<td>037AKK</td>
<td>Mountable</td>
<td>02/28/2006 13:36:20</td>
<td>3582LIB</td>
</tr>
<tr>
<td>034AKK</td>
<td>Mountable</td>
<td>02/28/2006 12:35:34</td>
<td>3582LIB</td>
</tr>
<tr>
<td>033AKK</td>
<td>Mountable</td>
<td>02/28/2006 12:31:36</td>
<td>3582LIB</td>
</tr>
</tbody>
</table>

The example shows how to tell which volumes are database backups. The query libvol output lists the database backups as 033AKK, 034AKK and 037AKK. Therefore, the other DR media are copy pool tapes (032AKK and 036AKK).

Before moving media offsite, we should check if any of the volumes are still mounted using `query mount`. If any are mounted, we dismount them with the `dismount volume` command, as shown in Example 19-20.

Example 19-20  Dismounting a mounted volume

```
ibm: LOCHNESS_SERVER1> query mount
ANR8329I LTO volume 037AKK is mounted R/W in drive DR01 (mt1.0.0.2), status: IDLE.

ibm: LOCHNESS_SERVER1> dismount volume 037AKK
ANR8499I Command accepted.
```

```
tsm: LOCHNESS_SERVER1> q actlog
```

02/28/2006 14:15:24 ANR8336I Verifying label of LTO volume 037AKK in drive DR01 (mt1.0.0.2).
19.3.4 Send disaster recovery media off-site

Now we can initiate a move of the DR media we have just identified to the offsite location, using **move drmedia**. By default, move drmedia moves full/incremental database backup volumes and copy storage pool volumes (as specified by the **set drmcopydstgpool** command in Step 6 on page 603). The command output in Example 19-21 shows how the **REMove=Yes** option automatically ejects media from the library.

*Example 19-21  Moving DR media to the vault*

```
tsm: LOCHNESS_SERVER1>move drmedia * wherestate=mountable tostate=vault
remove=yes
ANR0609I MOVE DRMEDIA started as process 8.
ANS8003I Process number 8 started.

% tsm: LOCHNESS_SERVER1>q actlog

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>02/28/2006 14:29:12</td>
<td>ANR2017I Administrator ADMIN issued command: MOVE DRMEDIA * wherestate=mountable tostate=vault remove=yes (SESSION: 13)</td>
</tr>
<tr>
<td>02/28/2006 14:29:12</td>
<td>ANR0609I MOVE DRMEDIA started as process 8. (SESSION: 13, PROCESS: 8)</td>
</tr>
<tr>
<td>02/28/2006 14:29:12</td>
<td>ANR0610I MOVE DRMEDIA started by ADMIN as process 8. (SESSION: 13, PROCESS: 8)</td>
</tr>
<tr>
<td>02/28/2006 14:29:34</td>
<td>ANR8322I 001: Remove LTO volume 032AKK from entry/exit port of library 3582LIB; issue 'REPLY' along with the request ID when ready. (SESSION: 13, PROCESS: 8)</td>
</tr>
<tr>
<td>02/28/2006 14:32:09</td>
<td>ANR2017I Administrator ADMIN issued command: REPLY 001 (SESSION: 27)</td>
</tr>
<tr>
<td>02/28/2006 14:32:09</td>
<td>ANR8499I Command accepted. (SESSION: 27)</td>
</tr>
<tr>
<td>02/28/2006 14:32:09</td>
<td>ANR0405I Session 27 ended for administrator ADMIN (WinNT). (SESSION: 27)</td>
</tr>
<tr>
<td>02/28/2006 14:32:09</td>
<td>ANR6683I MOVE DRMEDIA: Volume 032AKK was moved from</td>
</tr>
</tbody>
</table>
```
The example shows that the **move drmedia** command with the **REMove=Yes** option spawns a **checkout libvolume** for each volume, requiring an individual reply for each volume. If you have a small library with only a single slot entry/exit port, like our IBM 3582, you may wish to use **REMove=No** and manually export the tapes from the library's front panel.

Notice also that each volume was moved from the **MOUNTABLE** state directly to the **VAULT** state, bypassing the interim states.

We can check the media status once again with **query drmedia**, as shown in Example 19-22 (note that only three of our five volumes are displayed).

**Example 19-22  Querying DR media with format=detailed**

```plaintext
tsm: LOCHNESS_SERVER1>q drmedia f=d

Volume Name: 032AKK
  State: Vault
  Last Update Date/Time: 02/28/2006 14:32:09
  Location: Rocket Vault
  Volume Type: CopyStgPool
  Copy Storage Pool Name: OFFDATA
  Automated LibName:

Volume Name: 036AKK
  State: Vault
  Last Update Date/Time: 02/28/2006 14:32:40
  Location: Rocket Vault
  Volume Type: CopyStgPool
```
Copy Storage Pool Name: OFFDIRS
Automated LibName:

Volume Name: 037AKK
State: Vault
Last Update Date/Time: 02/28/2006 14:33:23
Location: Rocket Vault
Volume Type: DBBackup
Copy Storage Pool Name:
Automated LibName:

Figure 19-3 shows the process we have used to back up the storage pools and database, and send the media offsite.

19.3.5 Generate the recovery plan

Now we are ready to generate the Disaster Recovery Plan, as shown in Figure 19-4.
We generate the recovery plan using the **prepare** command, as shown in Example 19-23.

**Example 19-23  Prepare a recovery plan**

```plaintext
tsm: LOCHNESS_SERVER1> prepare
ANS8003I Process number 9 started.

 tsm: LOCHNESS_SERVER1> q actlog

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>02/28/2006 15:00:53</td>
<td>ANR2017I Administrator ADMIN issued command: PREPARE (SESSION: 13)</td>
</tr>
<tr>
<td>02/28/2006 15:00:53</td>
<td>ANR0984I Process 10 for PREPARE started in the BACKGROUND at 15:00:53. (SESSION: 13, PROCESS: 10)</td>
</tr>
<tr>
<td>02/28/2006 15:00:53</td>
<td>ANR9678W C:\Program Files\Tivoli\tsm\Server\dsmserv used for server executable. A server is currently running as a service. (SESSION: 13, PROCESS: 10)</td>
</tr>
<tr>
<td>02/28/2006 15:00:53</td>
<td>ANR6900I PREPARE: The recovery plan file C:\TSMDATA\DRM\PLANS\LOCHNESS-DR.20060228.150053 was created. (SESSION: 13, PROCESS: 10)</td>
</tr>
<tr>
<td>02/28/2006 15:00:53</td>
<td>ANR0985I Process 10 for PREPARE running in the BACKGROUND completed with completion state SUCCESS at 15:00:53.</td>
</tr>
</tbody>
</table>
```
The plan is now stored in a file in the local directory with a prefix as defined in `set drmplanprefix`, as shown in Step 1 on page 602. The file created is named `C:\TSMDATA\DRM\PLANS\LOCHNESS-DR.20060228.150053`. As you can see from the time stamps on the activity log entries, the digits appended to the file name match the date and time on which the plan was created.

We recommend for safety, that you create multiple copies of the recovery plan, and store them in different locations. If you are have more than one Tivoli Storage Manager server and are using server-to-server communication, you can create a remote copy of the plan. By specifying a `DEVclass` on the `prepare` command line, the local server will send the plan to the remote server specified in `DEVclass`. The `DEVclass` can only be of type `SERVER`.

Another way to create a remote copy is to override the default directory location by specifying an alternative (typically on a network drive) location with the `PLANPrefix` option on the `prepare` command line. The plan(s) created can also be FTP'd to another site, and printed for emergency retrieval. Use whatever redundancy is necessary to maintain confidence that a copy of the plan will be accessible in the event of a disaster. A copy of the recovery plan should also be stored on removable media and transported to the vault location with the daily DR media.

### 19.3.6 Returning expired volumes

Part of your daily operations will also include moving tapes back on-site. Those that have expired can be returned to a library for use as scratch tapes. Volumes can be expired if they are EMPTY copy storage pool volumes or EXPIRED volumes from a database backup series. DRM automatically changes the state of such volumes to `VAULTRetrieve`. You can generate a list of DR media to be returned using the command:

```
QUERY DRMmedia * WHERE STATE = vaultretrieve
```

Send this list to the vault administrators so that they can gather the tapes for return to the primary location. When you are notified that the volumes have been given to the courier, you can change the state in DRM using:

```
MOVE DRMmedia * WHERE STATE = vaultretrieve
```

The media state is changed from `VAULTRetrieve` to `COURIERRetrieve`. When the courier has delivered the volumes to the primary location, change their state to `ONSITERetrieve` with the command:

```
MOVE DRMmedia * WHERE STATE = courierretrieve
```
After changing the state to **ONSITERetrieve** the media no longer show when you query drmedia.

Returned media can then be inserted into the library for reuse, with `checkin libvol` command. Note that you can also specify options to the `move drmedia` command for DR media in the **COURIERRetrieve** state to automatically generate a macro of `checkin libvol` commands. Refer to the Tivoli Storage Manager Administrator's Reference for more details.

### 19.4 Server restore setup

If a disaster happens, you can easily use the DRM generated plans and offsite media to restore the Tivoli Storage Manager server. Here is a summary of the process:

1. Obtain the latest disaster recovery plan.
2. Locate a suitable replacement machine.
3. Install the operating system and Tivoli Storage Manager on to the replacement machine.
4. Break the file into its various parts. You may need to update some parts before running the various macros and scripts.
5. Obtain the backup volumes from the vault.
6. Review the `RECOVERY.SCRIPT.DISASTER.RECOVERY.MODE` and `RECOVERY.SCRIPT.NORMAL.MODE` files (created when splitting the DR plan into its parts), because they are important for restoring the server to a point where clients can be recovered.

An overview of the Tivoli Storage Manager server restore process is shown in Figure 19-5 on page 619. A number of these steps can be performed in parallel, for example, you can call your courier to obtain the offsite volumes while you are installing the replacement hardware.
19.4.1 Obtain the latest DR Plan

The latest plan should be retrieved from the courier or from any other location, according to your company's policy, where it has been stored. Double-check that it is the latest version of the plan by referring to the line near the top of the file; for example, you might see this information:

Created by DRM PREPARE on 02/28/2006 15:32:16

The DR plan is created as a single file that is organized in stanzas.

The plan should be copied back to the same directory as it was stored on the original Tivoli Storage Manager server when it was created. See 19.5.2 “Install the operating system and the server” on page 620.

19.4.2 Find a replacement server and storage

The RECOVERY.INSTRUCTIONS.INSTALL stanza specifies local information on hardware required. The RECOVERY.DEVICES.REQUIRED stanza specifies the device type needed to read the backups. The SERVER.REQUIREMENTS stanza specifies the disk space required.
19.4.3 Install the operating system and the server

Install the operating system and Tivoli Storage Manager server software on the replacement server. If your tape library uses a vendor-supplied driver (as opposed to the inbuilt TSMSCSI driver), you have to install it before starting Tivoli Storage Manager server recovery. Ensure that your operating system can communicate with the replacement library and drives.

Media names for recovery and their locations are specified in the RECOVERY.INSTRUCTIONS.INSTALL stanza and the MACHINE.RECOVERY.MEDIA.REQUIRED stanza. Ensure that the environment is the same as when the DR plan was created. The environment includes:

- The directory structure and location of the Tivoli Storage Manager server executables, enrollment certificates, administrative command line client, and disk formatting utility.
- The directory structure for the Tivoli Storage Manager server instance-specific files and the database, log, and storage pool volumes.
- The directory structure where the server deposits DR plans. The plan will be split into its component parts in the next step.

19.5 Break out the disaster recovery plan

The DR plan is created as a single file that is organized in stanzas. Some of the stanzas contain macros or scripts for execution on the server to automate recovery. To obtain the macros and scripts, the plan needs to be broken out into its components.

You can either use a text editor to manually divide the recovery plan into its components, or use sample scripts shipped with Tivoli Storage Manager. For Windows, a VB Script, planexpl.vbs, is shipped. For UNIX and Linux, a sample awk script, planexpl.awk.smp is shipped. You should keep a copy of the appropriate script offsite along with the recovery plan. We also recommend that you familiarize yourself with executing the scripts, as the plan will be large, and performing a manual breakout will be time-consuming.

If you elect to manually break the plan into its components, each stanza starts with the keyword "begin" and ends with the keyword "end". You should create a file name with the same name as the stanza. The file should contain all lines between and including the begin and end keywords. Example 19-24 shows the contents of the SERVER.REQUIREMENTS stanza. Your file should have that name, and all of the contents shown in the example.
Example 19-24  DR plan stanza

begin SERVER.REQUIREMENTS

Database Requirements Summary:

    Available Space (MB): 2,024
    Assigned Capacity (MB): 2,024
    Pct. Utilization: 25.1
    Maximum Pct. Utilization: 25.1
    Physical Volumes: 3

Recovery Log Requirements Summary:

    Available Space (MB): 1,712
    Assigned Capacity (MB): 1,712
    Pct. Utilization: 0.0
    Maximum Pct. Utilization: 55.9
    Physical Volumes: 7

Server Installation Directory: C:\Program Files\Tivoli\tsm\

end SERVER.REQUIREMENTS

To use the sample script to break out a disaster recovery plan on Windows, use the syntax shown in Example 19-25.

Example 19-25  Break out a DR plan on Windows

C:\tsmdata\drm\plans> cscript planexpl.vbs recoveryplanfilename

For AIX, the syntax is shown in Example 19-26.

Example 19-26  Break out a DR plan on AIX

root@Atlantic /tsm/drm/plans: awk -f planexpl.awk recoveryplanfilename

For Sun Solaris, the syntax is shown in Example 19-27.

Example 19-27  Break out a DR plan on Solaris

root@Sol /tsm/drm/plans > nawk -f planexpl.awk recoveryplanfilename

Example 19-28 shows the command output from breaking out the DR plan on the replacement server. You can see that a number of files are created.

Example 19-28  Breaking out a DR plan on Windows

C:\tsmdata\drm\plans> cscript planexpl.vbs lochness-dr.20060228.153216
Planfile: lochness-dr.20060228.153216
set planprefix to C:\TSMDATA\DRM\PLANS\LOCHNESS-DR.
Creating file C:\TSMDATA\DRM\PLANS\LOCHNESS-DR.SERVER.REQUIREMENTS
Creating file C:\TSMDATA\DRM\PLANS\LOCHNESS-DR.RECOVERY.VOLUMES.REQUIRED
Creating file C:\TSMDATA\DRM\PLANS\LOCHNESS-DR.RECOVERY.DEVICES.REQUIRED
Creating file C:\TSMDATA\DRM\PLANS\LOCHNESS-DR.RECOVERY.SCRIPT.DISASTER.RECOVERY.MODE.CMD
Creating file C:\TSMDATA\DRM\PLANS\LOCHNESS-DR.RECOVERY.SCRIPT.NORMAL.MODE.CMD
Creating file C:\TSMDATA\DRM\PLANS\LOCHNESS-DR.RECOVERY.SCRIPT.NORMAL.MODE.CMD
Creating file C:\TSMDATA\DRM\PLANS\LOCHNESS-DR.LOG.VOLUMES
Creating file C:\TSMDATA\DRM\PLANS\LOCHNESS-DR.DB.VOLUMES
Creating file C:\TSMDATA\DRM\PLANS\LOCHNESS-DR.LOGANDDB.VOLUMES.INSTALL.CMD
Creating file C:\TSMDATA\DRM\PLANS\LOCHNESS-DR.LICENSE.REGISTRATION.MAC
Creating file C:\TSMDATA\DRM\PLANS\LOCHNESS-DR.COPYSTGPOOL.VOLUMES.AVAILABLE.MAC
Creating file C:\TSMDATA\DRM\PLANS\LOCHNESS-DR.COPYSTGPOOL.VOLUMES.DESTROYED.MAC
Creating file C:\TSMDATA\DRM\PLANS\LOCHNESS-DR.PRIMARY.VOLUMES.DESTROYED.MAC
Creating file C:\TSMDATA\DRM\PLANS\LOCHNESS-DR.PRIMARY.VOLUMES.REPLACEMENT.CREATE.CMD
Creating file C:\TSMDATA\DRM\PLANS\LOCHNESS-DR.STGPOOLS.RESTORE.MAC
Creating file C:\TSMDATA\DRM\PLANS\LOCHNESS-DR.VOLUME.HISTORY.FILE
Creating file C:\TSMDATA\DRM\PLANS\LOCHNESS-DR.DEVICE.CONFIGURATION.FILE
Creating file C:\TSMDATA\DRM\PLANS\LOCHNESS-DR.DSMSERV.OPT.FILE
Creating file C:\TSMDATA\DRM\PLANS\LOCHNESS-DR.LICENSE.INFORMATION

If executed, the RECOVERY.SCRIPT.DISASTER.RECOVERY.MODE batch program will delete the following log and db volumes if they exist and then reallocate them. During a normal disaster recovery scenario this is not a problem since you are going to restore data to them from the db backup.

C:\TSMDATA\RLP\L7373650.LOG
C:\TSMDATA\RLP\L8960750.LOG
C:\TSMDATA\RLP\LOG_01.DSM
C:\TSMDATA\SERVER1\LOG1.DSM
C:\TSMDATA\DBP\DBV_01.DSM
C:\TSMDATA\SERVER1\DB1.DSM

19.5.1 Obtain the recovery volumes

A list of the offsite volumes required for recovery is in the stanza
RECOVERY.VOLUMES.REQUIRED (and now also in the file
LOCHNESS-DR.RECOVERY.VOLUMES.REQUIRED). The stanza is shown in Example 19-29 on page 623. Use this list to alert the vault administrator that you need these tapes retrieved as soon as possible.

Example 19-29 Recovery volumes required

begin RECOVERY.VOLUMES.REQUIRED

Volumes required for data base restore

Location = Rocket Vault
Device Class = LTO2-DC
Volume Name = 037AKK

Volumes required for storage pool restore

Location = Rocket Vault
Copy Storage Pool = OFFDATA
Device Class = LTO2-DC
Volume Name = 032AKK

Copy Storage Pool = OFFDIRS
Device Class = LTO2-DC
Volume Name = 036AKK

end RECOVERY.VOLUMES.REQUIRED

We can see that volume 037AKK is required for database restore, while 032AKK and 036AKK are required for storage pool restoration. You can confirm the currency of the volumes by looking at the volume history section of the recovery plan (VOLUME.HISTORY.FILE stanza).

19.5.2 Review the Tivoli Storage Manager macros

You should review the macros contained in the recovery plan. It is possible that the volumes you have available may not be exactly the ones that the DR plan macros are expecting. For any number of reasons, volumes may still be in transit, or not yet picked up, and may have been destroyed in the disaster. Whatever the case, you need to examine and update the entries in the COPYSTGPOOL.VOLUMES.DESTROYED and COPYSTGPOOL.VOLUMES.AVAILABLE files, to reflect the current situation.

If all primary volumes were destroyed, no changes are required to the PRIMARY.VOLUMES.DESTROYED script and Tivoli Storage Manager macro files.
In PRIMARY.VOLUMES.REPLACEMENT.CREATE.CMD, we need to specify replacement volumes for the primary disk storage volumes. In Example 19-30, the primary storage pool volumes were originally located in C:\TSMDATA\STG\DISKDATA. The replacement volumes will be created in the same directory, with the "@" character appended (as specified with set drmplanvpostfix). If you wish to change the location of the volumes, ensure that you create dsmfmt entries for all storage pool volumes.

Example 19-30  Contents of PRIMARY.VOLUMES.REPLACEMENT.CREATE.CMD

@echo off

rem Purpose: Create replacement volumes for primary storage pools that
rem use device class DISK.
rem Recovery administrator: Edit this section for your replacement
rem volume names. New name must be unique, i.e. different from any
rem original or other new name.

rem Set the TSM management console directory.
pushd "C:\Program Files\Tivoli\tsm\Console"

echo Replace C:\TSMDATA\STG\DISKDATA\DDVOL_01.DSM DISK 2,048.0M in DISKDATA
dsmfmt -data "C:\TSMDATA\STG\DISKDATA\DDVOL_01.DSM@" 2048

echo Replace C:\TSMDATA\STG\DISKDATA\DDVOL_02.DSM DISK 2,048.0M in DISKDATA
dsmfmt -data "C:\TSMDATA\STG\DISKDATA\DDVOL_02.DSM@" 2048

echo Replace C:\TSMDATA\STG\DISKDATA\DDVOL_03.DSM DISK 2,048.0M in DISKDATA
dsmfmt -data "C:\TSMDATA\STG\DISKDATA\DDVOL_03.DSM@" 2048

echo Replace C:\TSMDATA\STG\DISKDATA\DDVOL_04.DSM DISK 2,048.0M in DISKDATA
dsmfmt -data "C:\TSMDATA\STG\DISKDATA\DDVOL_04.DSM@" 2048

echo Replace C:\TSMDATA\STG\DISKDATA\DDVOL_05.DSM DISK 2,048.0M in DISKDATA
dsmfmt -data "C:\TSMDATA\STG\DISKDATA\DDVOL_05.DSM@" 2048

echo Replace C:\TSMDATA\STG\DISKDATA\DDVOL_06.DSM DISK 2,048.0M in DISKDATA
dsmfmt -data "C:\TSMDATA\STG\DISKDATA\DDVOL_06.DSM@" 2048

rem Restore the previous working directory.
popd

In the file PRIMARY.VOLUMES.REPLACEMENT.MAC, we need to define replacement volumes for destroyed primary storage pool volumes, as shown in Example 19-31. Again, edit the file to suit your replacement machine.
19.5.3 Review the device configuration

Review the device configuration file to ensure that the hardware configuration at the recovery site is the same or equivalent to the original site. Any differences (for example, device special file names) must be updated in the device configuration file. Table 19-3 shows the device configuration for the original and replacement machines. We can see that, as is commonly the case with Windows, different SCSI addresses were assigned to the devices on the replacement server, compared to the original server.

Table 19-3 Review of the Tivoli Storage Manager device configuration

<table>
<thead>
<tr>
<th>Tivoli Storage Manager server on LOCHNESS</th>
<th>Tivoli Storage Manager server on CASEY</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM 3582 LTO tape library</td>
<td>IBM TS3310 LTO tape library</td>
</tr>
<tr>
<td>Medium changer address lb0.1.0.2</td>
<td>Medium changer address lb0.2.0.3</td>
</tr>
</tbody>
</table>
Although the IBM TS3310 is an automated library, we have to manually place the database backup volumes into the library, since there is no Tivoli Storage Manager server to check them in. We must then update the configuration information to identify the elements within the library where the volumes are located. The server is then able to locate the required database backup volumes during the recovery.

In Example 19-32 we added a line to the device configuration file, `DEVICE_CONFIGURATION.FILE`, with the location of tape volume 037AKK, and the actual element address 0016. Element address 16 corresponds to I/O station slot 1 in the 3310 library. For information on the element addresses for your particular devices, consult your tape library vendor documentation and the Tivoli Web site on device support:

```
```

We also updated the inventory to reflect the locations of the other two DR volumes, 032AKK and 036AKK (slots 17 and 18 respectively). We changed the `DEFINE` statements for the library and paths to reflect the actual new device special files for the library and tape drives, and changed the serial number to auto detection.

**Example 19-32  Contents of DEVICE_CONFIGURATION.FILE**

```
/* Device Configuration */

...  
SET SERVERNAME LOCHNESS_SERVER1  
SET SERVERPASSWORD 211f78779242c164e8bf552d1d4be3365a  
DEFINE LIBRARY 3310LIB LIBTYPE=SCSI SHARED=NO AUTOLABEL=YES RESETDRIVE=NO  
DEFINE DRIVE 3310LIB DR00 ELEMENT=257 ONLINE=Yes SERIAL=AUTODETECT  
DEFINE DRIVE 3310LIB DR01 ELEMENT=256 ONLINE=Yes SERIAL=AUTODETECT  
/* LIBRARYINVENTORY SCSI 3310LIB 020AKK 4096 101*/  
/* LIBRARYINVENTORY SCSI 3310LIB 021AKK 4097 101*/  
/* LIBRARYINVENTORY SCSI 3310LIB 022AKK 4117 101*/  
/* LIBRARYINVENTORY SCSI 3310LIB 023AKK 4099 101*/  
/* LIBRARYINVENTORY SCSI 3310LIB 026AKK 4102 101*/  
/* LIBRARYINVENTORY SCSI 3310LIB 027AKK 4116 101*/  
/* LIBRARYINVENTORY SCSI 3310LIB 028AKK 4104 101*/  
/* LIBRARYINVENTORY SCSI 3310LIB 029AKK 4103 101*/  
/* LIBRARYINVENTORY SCSI 3310LIB 030AKK 4106 101*/  
/* LIBRARYINVENTORY SCSI 3310LIB 031AKK 4107 101*/
```
Chapter 19. Disaster Recovery Manager

19.5.4 Start the restore Tivoli Storage Manager server scripts

To restore the Tivoli Storage Manager server to a point where clients can be recovered from copy storage pools, you need to invoke the script file, `RECOVERY.SCRIPT.DISASTER.RECOVERY.MODE`. Enter the script file name at the command prompt and follow with administrator name and password as parameters. The script formats volumes for the database and recovery log, then restores the database using the volume in the tape library. The output is shown in Example 19-33.

Example 19-33  Invoke `RECOVERY.SCRIPT.DISASTER.RECOVERY.MODE`

```
C:TSMDATA\DRM\plans>LOCHNESS-DR.RECOVERY.SCRIPT.DISASTER.RECOVERY.MODE.CMD
admin admin
  1 file(s) copied.
  1 file(s) copied.
  1 file(s) copied.
ANR09001 Processing options file c:\program files\tivoli\tsm\server1\dsmserv.opt.
ANR78001 DSMSERV generated at 09:43:13 on Dec  9 2005.

Tivoli Storage Manager for Windows
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Allocated space for C:\TSMDATA\SERVER1\DB1.DSM: 1049624576 bytes.
Allocated space for C:\TSMDATA\DBP\DBV_01.DSM: 1074790400 bytes.
Allocated space for C:\TSMDATA\DBP\DBV_01.DSM: 1074790400 bytes.
ANR03001 Recovery log format started; assigned capacity 1712 megabytes.
```
ANR0301I Recovery log format in progress; 4 megabytes of 1712.
ANR0301I Recovery log format in progress; 8 megabytes of 1712.
...
...
ANR0301I Recovery log format in progress; 1708 megabytes of 1712.
ANR0301I Recovery log format in progress; 1712 megabytes of 1712.
ANR0302I Recovery log formatting took 43294 milliseconds.
ANR0303I Format rate: 10121.75 pages/second.
ANR0304I Page service time: 0.09 ms.
ANR0305I Recovery log format complete.
ANR0306I Recovery log volume mount in progress.
ANR0353I Recovery log analysis pass in progress.
ANR0354I Recovery log redo pass in progress.
ANR0355I Recovery log undo pass in progress.
ANR0352I Transaction recovery complete.
ANR0992I Server installation complete.

ANR0900I Processing options file c:\program files\tivoli\tsm\server1\dsmserv.opt.
ANR7800I DSMSERV generated at 09:43:13 on Dec 9 2005.

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ANR8200I TCP/IP driver ready for connection with clients on port 1500.
ANR0200I Recovery log assigned capacity is 1712 megabytes.
ANR0201I Database assigned capacity is 2024 megabytes.
ANR4600I Processing volume history file C:\PROGRAM FILES\TIVOLI\TSM\SERVER1\VOLHIST.OUT.
ANR4620I Database backup series 2 operation 0 device class LTO2-DC.
ANR4622I Volume 1: 037AKK.
ANR8337I LTO volume 037AKK mounted in drive DR01 (mt2.0.0.3).
ANR1363I Input volume 037AKK opened (sequence number 1).
ANR4646I Database capacity required for restore is 1024 megabytes.
ANR4649I Reducing database assigned capacity to 1024 megabytes.
ANR4638I Restore of backup series 2 operation 0 in progress.
ANR4639I Restored 36888 of 129761 database pages.
ANR4639I Restored 88876 of 129761 database pages.
ANR4640I Restored 129761 pages from backup series 2 operation 0.
ANR0306I Recovery log volume mount in progress.
ANR4641I Sequential media log redo pass in progress.
ANR4642I Sequential media log undo pass in progress.
ANR1364I Input volume 037AKK closed.
ANR4644I A full backup will be required for the next database backup operation.
ANR8468I LTO volume 037AKK dismounted from drive DR01 (mt02.0.0.3) in library 3310LIB.

Wait for the server to start. Ensure that the Administrative command line client option file is set up to communicate with this server, then press enter to continue recovery script execution.
Press any key to continue...

After pressing a key to continue, a second command window is opened and starts the Tivoli Storage Manager server, as shown in Example 19-34.

Example 19-34  Starting server after database recovery

ANR0900I Processing options file c:\program files\tivoli\tsm\server1\dsmserv.opt.
ANR7800I DSMSERV generated at 09:43:13 on Dec 9 2005.

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ANR4726I The ICC support module has been loaded.
ANR0990I Server restart-recovery in progress.
ANR02001 Recovery log assigned capacity is 1712 megabytes.
ANR02011 Database assigned capacity is 1024 megabytes.
ANR0306I Recovery log volume mount in progress.
ANR0287W Contents of the page shadow file dbpgshdw.bdt are not valid.
ANR0285I Database page shadowing started using file dbpgshdw.bdt.
ANR0353I Recovery log analysis pass in progress.
ANR0354I Recovery log redo pass in progress.
ANR0355I Recovery log undo pass in progress.
ANR0352I Transaction recovery complete.
ANR1635I The server machine GUID, 5d.6f.87.21.95.0b.11.da.82.63.00.0d.60.49.6a-.62, has initialized.
ANR2100I Activity log process has started.
ANR4726I The NAS-NDMP support module has been loaded.
ANR4726I The Centera support module has been loaded.
ANR4726I The ServerFree support module has been loaded.
ANR9969E Unable to open volume C:\TSM\DATA\STG\DISKDATA\DDVOL_01.DSM. The most likely reason is that another TSM server is running and has the volume allocated.
ANR1311E Vary-on failed for disk volume C:\TSM\DATA\STG\DISKDATA\DDVOL_01.DSM - unable to access disk device.
ANR9969E Unable to open volume C:\TSM\DATA\STG\DISKDATA\DDVOL_02.DSM. The most likely reason is that another TSM server is running and has the volume allocated.
ANR1311E Vary-on failed for disk volume C:\TSM\DATA\STG\DISKDATA\DDVOL_02.DSM - unable to access disk device.
ANR9969E Unable to open volume C:\TSM\DATA\STG\DISKDATA\DDVOL_06.DSM. The most likely reason is that another TSM server is running and has the volume allocated.
ANR1311E Vary-on failed for disk volume C:\TSM\DATA\STG\DISKDATA\DDVOL_06.DSM - unable to access disk device.
ANR9969E Unable to open volume C:\TSM\DATA\STG\DISKDATA\DDVOL_04.DSM. The most likely reason is that another TSM server is running and has the volume allocated.
ANR1311E Vary-on failed for disk volume C:\TSM\DATA\STG\DISKDATA\DDVOL_04.DSM - unable to access disk device.
ANR9969E Unable to open volume C:\TSM\DATA\STG\DISKDATA\DDVOL_03.DSM. The most likely reason is that another TSM server is running and has the volume allocated.
ANR1311E Vary-on failed for disk volume C:\TSM\DATA\STG\DISKDATA\DDVOL_03.DSM - unable to access disk device.
ANR9969E Unable to open volume C:\TSM\DATA\STG\DISKDATA\DDVOL_05.DSM. The most likely reason is that another TSM server is running and has the volume allocated.
ANR1311E Vary-on failed for disk volume C:\TSM\DATA\STG\DISKDATA\DDVOL_05.DSM - unable to access disk device.
ANR2803I License manager started.
ANR2828I Server is licensed to support Tivoli Storage Manager Basic Edition.
ANR2828I Server is licensed to support Tivoli Storage Manager Extended Edition.
ANR8260I Named Pipes driver ready for connection with clients.
ANR1305I Disk volume C:\TSM\DATA\STG\DISKDATA\DDVOL_01.DSM varied online.
ANR2560I Schedule manager started.
ANR8200I TCP/IP driver ready for connection with clients on port 1500.
ANR8280I HTTP driver ready for connection with clients on port 1580.
ANR4747W The web administrative interface is no longer supported. Begin using the Integrated Solutions Console instead.
ANR8840E Unable to open device lb0.1.0.2 with error -1.
ANR8440E Initialization failed for SCSI library 3582LIB; will retry in 2 minute(s).

ANR0993I Server initialization complete.
TSM:LOCHNESS_SERVER1>
ANR0407I Session 2 started for administrator ADMIN (WinNT)
The scripts have finished successfully, the Tivoli Storage Manager database was restored, and the Tivoli Storage Manager server starts. In our case, the library and drive paths were altered in `DEVICE_CONFIGURATION.FILE`, which causes the `ANR8840E` errors. To correct the problem, we simply update the library and drives paths directly at the server prompt in the command window as shown in Example 19-35.

**Example 19-35  Updating library and drive paths**

```bash
TSM:LOCHNESS_SERVER1> update path lochness_server1 3310lib srct=server dest=libr devi=lb0.2.0.3 online=yes
ANR2017I Administrator SERVER_CONSOLE issued command: UPDATE PATH LOCHNESS_SERVER1 3310LIB SRCTYPE=SERVER DESTTYPE=LIBRARY DEVICE=lb0.2.0.3 ONLINE=YES
ANR1722I A path from LOCHNESS_SERVER1 to LB0.1.0.2 has been updated.

TSM:LOCHNESS_SERVER1> update path lochness_server1 dr00 srct=server dest=drive libr=3310lib devi=mt0.0.0.3 online=yes
ANR2017I Administrator SERVER_CONSOLE issued command: UPDATE PATH LOCHNESS_SERVER1 DR00 SRCTYPE=SERVER DESTTYPE=DRIVE LIBRARY=3310LIB DEVICE=mt0.0.0.3 ONLINE=YES
ANR1722I A path from LOCHNESS_SERVER1 to 3310LIB DR00 has been updated.

TSM:LOCHNESS_SERVER1> update path lochness_server1 dr01 srct=server dest=drive libr=3310lib devi=mt2.0.0.3 online=yes
ANR2017I Administrator SERVER_CONSOLE issued command: UPDATE PATH LOCHNESS_SERVER1 DR01 SRCTYPE=SERVER DESTTYPE=DRIVE LIBRARY=3310LIB DEVICE=mt2.0.0.3 ONLINE=YES
ANR1722I A path from LOCHNESS_SERVER1 to 3310LIB DR01 has been updated.
```

Once the device configuration is set correctly, you can mount copy storage pool volumes upon request, check in the volumes in advance, or manually place the volumes in the library. You should ensure inventory consistency by issuing `audit library`.

After the library audit is complete, the Tivoli Storage Manager server is ready to provide restore services for clients using the copy storage pool volumes directly. If you plan to stay for some time on the replacement Tivoli Storage Manager machine, you should recreate the primary storage pools and their volumes to enable backups to continue. You can restore storage pools and volumes using the script `RECOVERY.SCRIPT.NORMAL.MODE.CMD`.
19.5.5 Restore primary storage pools

To restore primary storage pools from copy storage pools, execute the script file, RECOVERY.SCRIPT.NORMAL.MODE. If client machines are damaged, you may want to delay this action until after all clients are recovered.

**Note:** This action is optional because Tivoli Storage Manager can access the copy storage pool volumes directly to restore client data. Using the copy pool volumes, you can minimize client recovery time, because server primary storage pools do not have to be restored first.

Enter the script file name at the command prompt passing the administrator name and password as arguments. The script creates replacement primary storage pool volumes, defines them to Tivoli Storage Manager, and restores them from the copy storage pool volumes. Example 19-36 shows the invocation of the script and the output from the first phase, which formats the new volumes (example for one volume only is shown).

*Example 19-36  Invoking RECOVERY.SCRIPT.NORMAL.MODE*

C:\TSMDATA\DRM\plans>LOCHNESS-DR.RECOVERY.SCRIPT.NORMAL.MODE.CMD admin admin
Replace C:\TSMDATA\STG\DISKDATA\DDVOL_01.DSM DISK 2,048.0M in DISKDATA
TIVOLI STORAGE MANAGER by Tivoli

Tivoli Storage Manager (C)
All rights reserved.
U.S. Government Users Restricted Rights - Use, duplication
or disclosure restricted by GSA ADP Schedule Contract with IBM Corporation.
Licensed Materials - Property of IBM.
IBM Product ID 5608-ISM, 5608-ISX
Allocated space for C:\TSMDATA\STG\DISKDATA\DDVOL_01.DSM: 2147483648 bytes.
...

The second phase is to define the volumes to the Tivoli Storage Manager server, as shown in Example 19-37 (example for one volume only is shown).

*Example 19-37  Phase 2, defining volumes to the Tivoli Storage Manager server*

IBM Tivoli Storage Manager
Command Line Administrative Interface - Version 5, Release 3, Level 2.0
(c) Copyright by IBM Corporation and other(s) 1990, 2005. All Rights Reserved.

Session established with server LOCHNESS_SERVER1: Windows
Server Version 5, Release 3, Level 2.2
Server date/time: 03/01/2006 11:44:32  Last access: 03/01/2006 11:35:06
ANS8000I Server command: 'def vol DISKDATA
C:\TSMDATA\STG\DISKDATA\DDVOL_02.DSM@ acc=READW'
ANR2206I Volume C:\TSMDATA\STG\DISKDATA\DDVOL_02.DSM@ defined in storage pool
DISKDATA (device class DISK).

ANS8002I Highest return code was 0.

Activity log entries:
03/01/2006 11:35:16 ANR2017I Administrator ADMIN issued command: DEFINE VOLUME
DISKDATA C:\TSMDATA\STG\DISKDATA\DDVOL_02.DSM@ acc=READW
(SESSION: 4)
03/01/2006 11:35:16 ANR2206I Volume C:\TSMDATA\STG\DISKDATA\DDVOL_01.DSM@
defined in storage pool DISKDATA (device class DISK).
(SESSION: 4)
03/01/2006 11:35:16 ANR1305I Disk volume C:\TSMDATA\STG\DISKDATA\DDVOL_01.DSM@
varied online. (SESSION: 4)

The third phase is to restore each storage pool, as shown in Example 19-38. The
example shows DISKDATA being restored.

Example 19-38  Phase 3, restoring primary storage pools

IBM Tivoli Storage Manager
Command Line Administrative Interface - Version 5, Release 3, Level 2.0
(c) Copyright by IBM Corporation and other(s) 1990, 2005. All Rights Reserved.

Session established with server LOCHNESS_SERVER1: Windows
   Server Version 5, Release 3, Level 2.2
   Server date/time: 03/01/2006 11:44:32  Last access: 03/01/2006 11:35:06

ANS8000I Server command: 'restore stgp DISKDATA'

Activity log entries:
03/01/2006 11:35:23 ANR2017I Administrator ADMIN issued command: RESTORE
STGPOOL DISKDATA
03/01/2006 11:35:23 ANR0984I Process 9 for RESTORE STORAGE POOL started in the
BACKGROUND at 11:35:23.
03/01/2006 11:35:23 ANR1230I Restore of primary storage pool DISKDATA
started as process 9.
03/01/2006 11:35:23 ANR2110I RESTORE STGPOOL started as process 9.
03/01/2006 11:44:32 ANR0986I Process 9 for RESTORE STORAGE POOL running in the
BACKGROUND processed 5427 items for a total of
376,963,072 bytes with a completion state of SUCCESS at
11:44:32.
03/01/2006 11:44:32 ANR1238I Restore of primary storage pool DISKDATA has
ended. Files Restored: 5427, Bytes Restored: 376963072,
Unreadable Files: 0, Unreadable Bytes: 0.
Alternatively, you can use the recovery script as a guide and manually run each step.

If you wish to view the output of the commands run during the server restoration process, the results are logged in the following files:

- `LOGANDDB.VOLUMES.INSTALL.LOG`
- `LICENSE.REGISTRATION.LOG`
- `COPYSTGPOOL.VOLUMES.AVAILABLE.LOG`
- `PRIMARY.VOLUMES.DESTROYED.LOG`
- `COPYSTGPOOL.VOLUMES.DESTROYED.LOG`
- `PRIMARY.VOLUMES.REPLACEMENT.CREATE.LOG`
- `PRIMARY.VOLUMES.REPLACEMENT.LOG`
- `STGPOOLS.RESTORE.LOG`

19.5.6 Summary of example disaster recovery plan

Using Tivoli Storage Manager Disaster Recovery Manager, we were able to quickly restore our Tivoli Storage Manager server named `LOCHNESS_Server1` on a replacement set of hardware. The offsite backup of the Tivoli Storage Manager database and the copy storage pool volumes provided the necessary data.

Once your replacement server is up and running, you should use DRM procedures to return the retrieved vault recovery volumes so they are available in the event of another disaster. You can now resume normal backup and disaster protection operations.

19.6 Summary

As we mentioned on the first page of this chapter, our example and the associated explanations are not sufficient to supply the reader with enough understanding of disaster recovery to properly design and implement a solution. There are some excellent books on disaster recovery available. However, the redbook, *Disaster Recovery Strategies with Tivoli Storage Management*, SG24-6844, is certainly one of the “must read” choices.

Implementing the Disaster Recovery Manager without a full understanding of the product, and a business commitment to its ongoing care and feeding, may lead to misconfiguration or undesirable results at a point when it is most needed.

Our next topic, bare machine recovery, is similar, and we will discuss AIX and Windows system recovery.
Chapter 20. Bare machine recovery

Bare machine recovery

In this chapter we describe Bare Machine Recovery (BMR) setup and processes for Windows and AIX systems. IBM Tivoli Storage Manager is designed to back up and recover application data.

Recovering the operating system environment was not this product's goal. That said, as vendor technology improves from an operating system Disaster Recovery perspective, there are new features within the IBM Tivoli Storage Manager to leverage these enhancements.
20.1 Windows bare machine recovery

Tivoli Storage Manager provides integration with documented Windows APIs for backup of system objects/system state. This allows for a complete bare machine recovery in combination with the boot/system partition and other data partitions.

However, to restore your system, you need to have previously gathered and saved certain machine-specific characteristics, such as network and disk partition information. Therefore, we discuss the methods for collecting this information using operating system utilities and storing this information within DRM. We then provide detailed instructions for recovery of Windows 2000 client, step-by-step, in conjunction with Tivoli Storage Manager.

Again, you should read Deploying the Tivoli Storage Manager Client in a Windows 2000 Environment, SG24-6141, for a comprehensive review of Windows 2000 and Bare Machine Recovery. It discusses addition considerations for restoring an Active Directory, Domain Controllers, and DFS.

20.1.1 Collecting client machine information for disaster recovery

Collecting and recording information about your client systems will greatly help your ability to restore a Windows machine after a disaster to a pre-disaster state. There are several add-on tools, utilities and features built into Windows that can assist you with information collection, including msinfo32, srvinfo (found in the Windows Resource Kit), diskmap, the Disk Management interface, ipconfig, or writing your own Windows Management Instrumentation application (see the Windows 2000 SDK for more information about WMI). The information that should be collected for the client system should include:

- Hard drive partition information, for example, number and type of partitions, disk size, drive letters, amount of data used per volume, boot partition, and system directory
- System hostname
- TCP/IP networking information, for example, IP address, subnet mask, default gateway, DNS information
- Windows Service Pack levels

Scripts or batch files can be used to automate the collection of client information for users not skilled in these kinds of system level commands. Client system information should then be stored offsite for potential use during a Disaster Recovery procedure. Client system information can be imported into DRM (via scripts discussed in 20.1.3, “Storing system information for DRM access” on page 639), or DRM administrators can be given access to system information collected into a text file and backed up by the Tivoli Storage Manager backup-archive client.
The msinfo32 command

The msinfo32 command is a feature of Windows that enables you to collect detailed system hardware and configuration data that can be used for problem determination. This same information can be useful for Disaster Recovery purposes since it documents the original system’s configuration. Just storing msinfo32 information does not prepare you for Disaster Recovery; you still need a predetermined and rehearsed strategy. However, having this information can be one more weapon in your Disaster Recovery arsenal.

The msinfo32 command has both a GUI and command line interface. In this section we focus on the command line interface, since it can be scheduled for periodic execution using mechanisms like the Tivoli Storage Manager Backup/Archive Client scheduler, scripts, or batch files. Generally, msinfo32 will provide most of the required information listed above and is installed by default with Windows. It can be run by entering this at the command-line:

```
C:\Program Files\Common Files\Microsoft Shared\MSInfo\msinfo32.exe
```

You can use msinfo32 to display configuration information interactively via the GUI interface, or generate a text file report via GUI or command line batch invocation. The text file is organized in categories and subcategories stanzas which are delimited with [category] and [subcategory] headings. There are many categories and subcategories of information in the report including Hardware Resources, IRQs, Memory, Drivers, and Environment Variables.

To run msinfo32 and collect it in a report, execute the following commands as shown in Example 20-1.

```
Example 20-1   How to run msinfo32

cd \Program Files\Common Files\Microsoft Shared\MSInfo

<prompt>msinfo32 /report msinfo32.txt /categories +all
```

A portion of the output for our BMR client machine follows in Example 20-2—notice the first [System Information] stanza.

```
Example 20-2   Example of msinfo32 report output

System Information report written at: 02/24/06 10:49:27
System Name: TRIPLEEIGHT
[System Summary]

ItemValue
OS NameMicrosoft Windows XP Professional
Version5.1.2600 Service Pack 2 Build 2600
OS ManufacturerMicrosoft Corporation
```
You probably should save the whole report, but if there are sections you are sure
would not be useful you may want to delete them. If you type msinfo32 /?
you can see various invocation options. If the /categories option did not seem to have
the granularity you desired, a script can be used to extract selected information.

Note: Note, running msinfo32 and generating a report may take some time. In
our case it took about a half minute to generate the report.

On our test client system, we created a batch file to automatically save system
information to a text file and then back it up to the Tivoli Storage Manager server.
We created an icon on our desktop with a link to this batch file which can be used
to back up system information once changes have been made to the system.
The sample batch file is shown in Example 20-3.

Example 20-3  Batch file for saving machine information

@echo off
echo.
echo SAVING MACHINE INFORMATION FOR DISASTER RECOVERY
echo.
c:\Progra~1\Common~1\Micros~1\MSInfo\msinfo32 /report
c:\Progra~1\Tivoli\TSM\config\msinfo32.txt /categories +all
cd c:\Progra~1\Tivoli\TSM\baclient
20.1.2 Collect partition and logical volume information with diskmap

The diskmap utility is a command-line disk mapping tool that allows users to view the partition and logical volume structures of the disks. It displays a map of the disk and produces a report about the disk's configuration. It provides information about the disk characteristics and a description of each partition and logical volume on the disk.

An example of using diskmap and the output from our main system volume is given in Example 20-4.

Example 20-4   Example diskmap output

```
C:\Program Files\Resource Kit>diskmap /d0
Cylinders  HeadsPerCylinder SectorsPerHead BytesPerSector MediaType
7752       240             63            512      12
TrackSize = 32256, CylinderSize = 7741440, DiskSize = 60011642880 (57231MB)
Signature = 0x64656469
* StartingOffset PartitionLength StartingSector PartitionNumber
  32256       60011610624             63               1

MBR:

<table>
<thead>
<tr>
<th>Starting Cylinder Head Sector</th>
<th>Ending Cylinder Head Sector</th>
<th>System ID</th>
<th>Relative Sector</th>
<th>Total Sectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>*</td>
<td>0</td>
<td>1</td>
<td>1023 239 63</td>
<td>0x07 63</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0x00 0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0x00 0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0x00 0</td>
</tr>
</tbody>
</table>
Once there is a backup copy of the `msinfo32` report for this machine in the Tivoli Storage Manager server, you probably want to allow other users, such as the members of your Disaster Recovery team, to access it. This assumes that they have Tivoli Storage Manager backup-archive client node IDs registered for them. In Example 20-5, the Tivoli Storage Manager backup-archive client command line (the GUI can also be used) is used to permit a Tivoli Storage Manager Client Node ID called DRTEAM to access the msinfo32.txt file backed up from the directory `c:\program files\common files\microsoft shared\msinfo`.

**Example 20-5  Setting client system information report access**

```
dsmc set acc backup "c:\program files\Tivoli\TSM\config\msinfo32.txt" DRTEAM
```

Assuming you have authorized it, a Tivoli Storage Manager backup-archive client user on another node could restore your `msinfo32` report to a temporary directory on their machine so that it can be referred to an alternative location while the destroyed machine is rebuilt.

### 20.1.4 Inserting client machine information into DRM

Client machine information can be inserted in DRM for potential use later during disaster recovery. The Tivoli Storage Manager **INSERT MACHINE** command allows an administrator to store machine characteristics and/or recovery instructions in DRM. Using this method the data can easily be queried and updated by an administrator, without requiring access to storage pool volumes, and the information can potentially be a part of a Tivoli Disaster Recovery Manager **PREPARE** recovery plan file.

We outline below how machine information can be inserted into DRM. We assume that the client machine is already defined as a DRM client machine (using the **DEFINE MACHINE** command). You can use the administrative command line or the Administration Center to insert the clients machine information into DRM. Figure 20-1 shows how to use the Administration Center to insert client machine information.
Alternatively, you can insert machine information using the command line as shown in Example 20-6.

**Example 20-6 Using the command line to insert machine information**

```
insert machine tripleeight 1 char="MACHINE OWNER: ITSO SAN JOSE LAB"
```

### 20.1.5 Using machchar.vbs to insert machine reports into DRM

Since the `INSERT MACHINE` command allows for adding one line of information at a time we can use a script or macro to easily add many lines of information at a time in DRM. Scripts are provided with Tivoli Storage Manager and can be found in the directory `C:\Program Files\tivoli\tsm\server`,

A script called `machchar.vbs` takes a text file and create a Tivoli Storage Manager macro file of `INSERT MACHINE` commands. This macro can then be run by the Tivoli Storage Manager administrator to load a DRM MACHINE table with the information. Example 20-7 uses the machchar.vbs script and the machine information report (`msinfo32.txt`) to create a macro (`msinfo32.mac`) that inserts multiple lines of client information automatically. A VBScript is run from the Windows command line as shown.

**Example 20-7 Running machchar.vbs to start machine information collection**

```
C:\Program Files\Tivoli\TSM\server> cscript machchar.vbs
```

Microsoft (R) Windows Script Host Version 5.6
Copyright (C) Microsoft Corporation 1996-2001. All rights reserved.
usage: cscript machchar.vbs machinename inputmachinefilename outputmacrofilename

eexample: cscript machchar.vbs mch1 c:\client1\clientinfo.txt
c:\client1\clientinfo.mac

C:\Program Files\Tivoli\TSM\server>cscript machchar.vbs tripleeight "c:\progra~1\tivoli\tsm\config\msinfo32.txt"
"c:\progra~1\tivoli\tsm\config\msinfo32.mac"

Microsoft (R) Windows Script Host Version 5.6
Copyright (C) Microsoft Corporation 1996-2001. All rights reserved.

Creating TSM macro file: c:\progra~1\tivoli\tsm\config\msinfo32.mac

Now, from the administrative CLI, run this command (Example 20-8).

Example 20-8   Running the macro to insert machine date Into DRM

macro “c:\Program Files\Common Files\Microsoft Shared\MSInfo\msinfo32bat.mac”

To view machine characteristics added to DRM, use the QUERY MACHINE
command as shown in Example 20-9.

Example 20-9   Querying DRM for Client Machine Information

query machine tripleeight f=d

Machine information stored by DRM can also be included in the DRM plan file.
This is the detailed disaster recovery file that is generated by the DRM PREPARE
command. In order to include a machines system information or recovery
instruction in the DRM plan file the defined system must be marked as
adsmserver=yes on the UPDATE MACHINE command. Example 20-10 shows the
command line to add our server to the DRM plan file.

Example 20-10   Incorporating machine information in the DRM Plan file

update machine tripleeight adsmserver=yes

The Recovery Plan File is arranged in stanzas. After running the PREPARE
commands, we would see the following stanzas in the Recovery Plan File related
to our system, TRIPLEEIGHT as shown in Example 20-11. Provided the plan file
has been appropriately protected, this information will be available after a
disaster so that it can be used to recover the client system.

Example 20-11   Machine information seen in DRM Plan file
begin MACHINE.CHARACTERISTICS

Purpose: Hardware and software characteristics of machine TRIPLEEIGHT.

begin MACHINE.CHARACTERISTICS

Purpose: Hardware and software characteristics of machine TRIPLEEIGHT.

System Information report written at: 02/24/06 11:45:03
System Name: TRIPLEEIGHT

[System Summary]

ItemValue
OS NameMicrosoft Windows XP Professional
Version5.1.2600 Service Pack 2 Build 2600
OS ManufacturerMicrosoft Corporation
System NameTRIPLEEIGHT
System ManufacturerIBM
System Model2373TG5
System TypeX86-based PC
Processorx86 Family 6 Model 9 Stepping 5 GenuineIntel ~1694 Mhz
BIOS Version/DateIBM 1RETDNW (3.19 ), 13.10.2005
SMBIOS Version2.33
Windows DirectoryC:\WINDOWS
System DirectoryC:\WINDOWS\system32
Boot Device\Device\HarddiskVolume1
LocaleGermany
Hardware Abstraction LayerVersion = "5.1.2600.2180 (xpsp_sp2_rtm.040803-2158)"
User NameTRIPLEEIGHT\npott
Time ZonePacific Standard Time
Total Physical Memory1.024,00 MB
Available Physical Memory181,29 MB
Total Virtual Memory2,00 GB
Available Virtual Memory1,91 GB
Page File Space2,40 GB
Page File C:\pagefile.sys

[Hardware Resources]
end MACHINE.CHARACTERISTICS

*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*
20.1.6 Windows systems additional information

In the previous sections we described how to identify and back up important system configuration information on Windows platforms to prepare for the case of a disaster recovery. The complete procedure documentation, from backup preparation to the restore itself, is beyond the scope of this book. In addition, there are different ways to approach this: for example you can plan to use the ASR recovery procedure, the Windows Preinstallation Environment recovery, or, for example, use complementary products like Cristie Bare Machine Recovery.

The following are relevant resources with regards to Disaster Recovery, and Bare Machine Recovery strategies within a Windows environment:

- The basic concepts we explain in *IBM Tivoli Storage Management Concepts*, SG24-4877:

- *Deploying the Tivoli Storage Manager Client in a Windows 2000 Environment*, SG24-6141:

- *Disaster Recovery Strategies with Tivoli Storage Management*, SG24-6844:

- *Summary BMR Procedures for Windows NT and Windows 2000 with IBM Tivoli Storage Manager, TIPS0102*:


- *Tivoli Storage Manager Recovery Techniques Using Windows Preinstallation Environment (Windows PE)*:


20.2 Using SysBack for bare machine recovery

In this section we explain how to use IBM Tivoli Storage Manager for System Backup and Recovery (also known as SysBack) for AIX. SysBack is a comprehensive system backup, restore, and reinstallation tool for AIX. It is
simple to use and highly effective in partitioned or non-partitioned environments, as well as in a cluster environment composed of multiple pSeries systems.

We discuss the following concepts:

- An introduction to SysBack
- Partition backup and reinstallation (system recovery)
- Cloning backup images between partitions or stand-alone systems
- SysBack bare machine recovery with Tivoli Storage Manager environments
- Additional information regarding SysBack

SysBack has many features that give you the flexibility to administer partitioning-capable pSeries servers in a partitioned environment. This section covers several of the most beneficial features:

- **Remote backup, restore, and installation capabilities:** SysBack provides the ability to back up a system or partition to any other system or partition on the network running AIX. This feature enables you to have one or more partitions act as backup servers. With remote backup and restore capabilities, you no longer have to be concerned with having a backup device assigned to any given partition.

  In addition to remote backup and restore capabilities, SysBack enables you to install your backup images over the network. This functionality is facilitated by the network boot feature. SysBack can provide its own network boot resources or a wrapper around an existing NIM configuration.

  In contrast, mksysb can run remotely, but only to disk. Backups to a tape, CD, or DVD require a locally attached device. In order to perform a network install of a mksysb, you must also configure and use a NIM environment.

- **Multiple supported media formats:** SysBack can back up to, restore from, or install from, all of the following media formats either locally or remotely across the network:
  
  - **Tape:** SysBack’s generic approach to tape control allows it to work with virtually any tape device, IBM or OEM, on the market.
  
  - **File on disk:** SysBack allows you to back up your system to the file system or directory of your choice. When using a single system or partition to act as a backup server to other systems or partitions, you can configure the product to separate your backups by host name.
  
  - **Recordable CD or DVD devices:** SysBack supports any recordable CD or DVD devices to which AIX can write a mksysb image.

  **Note:** See /usr/lpp/bos.sysmgmt/README.oem_cdwriters for the tested CD/DVD recordable devices.
- **Backup and recovery of non-rootvg volume groups:** SysBack not only will back up your rootvg volume group, but also will optionally back up your non-rootvg volume groups. This backup may be done as a part of your Full System backup, all in a single backup process, or it may be backed up separately. You can choose to restore, or not restore, this non-rootvg data during an install from a SysBack backup.

In contrast to mksysb, any non-rootvg data that you would like to be backed up requires a separate backup and cannot be restored as a part of the mksysb install process.

- **Raw logical volume support:** SysBack backs up raw logical volumes by default. You can also optionally exclude them from backups.

In contrast, mksysb does not back up raw logical volumes.

- **Optional coexistence with Network Install Manager (NIM):** If you are a current NIM user, SysBack can utilize your exiting NIM environment for the network boot capabilities.

- **Special boot utilities:** These are for partitions functioning as SP nodes or IBM @server Cluster 1600 systems. For customers whose partitions function as a part of an SP complex or an IBM @server Cluster 1600, SysBack has specific boot and install utilities to interact with Parallel System Support Program (PSSP).

- **Quick, easy setup and use:** SysBack is SMIT menu driven and also enables complete command line interaction. The most basic, initial configuration to perform a system backup takes a matter of moments. Other features can be configured as desired and are also quickly enabled.

### 20.2.1 An introduction to SysBack

For those who are not already SysBack users, this section briefly highlights the features of the product.

#### Backup options

SysBack provides five levels of backup granularity. In order of the most system comprehensive to the least, they are as follows:

- **Full system (installation image):** This is the only backup type that can be used to completely reinstall a system or partition. It is similar in function to mksysb, but also includes raw logical volumes, and optionally, non-rootvg data. In addition, any subset of this backup can be individually recreated or restored. For example, an individual volume group, individual file systems or logical volumes, or specific files or directories can be recovered from this backup type.
This is also the only type of backup that can be sent to CD or DVD in addition to a tape or a file on disk.

- **Volume group**: This backup type backs up any active volume group on the system or partition. From this backup, you can recreate the LVM structure of a volume group and all of its file systems and logical volumes, as well as restore the data within them. Although this backup type allows you to back up the root volume group, it is not recommended to do so, because you would not be able to reinstall a system or partition from a volume group backup of rootvg. Also, many of the LVM structures cannot be recreated on a running system or partition.

- **File system**: This backup type backs up specified file systems. From this backup type, you can recreate the LVM structure of the file system and restore its data.

- **Logical volume**: This backup type backs up specified raw logical volumes. From this backup type, you can recreate the LVM structure of the logical volume or restore its data, or both. Although it is possible to do so, it is highly recommended that you do not use this backup option for logical volumes that have mount points.

- **File and directory**: This backup type backs up specified files and directories.

### Incremental backups
All of the previously described backup types, except the full system (installation image) backup, can also be performed as standard UNIX type incremental backups (for example, Level 0 - 9).

### Pull backups (also known as central managed backups)
The standard SysBack backup is considered a push backup, because the data is pushed from the client to the server. All backup types can also be pulled from the client by a server.

**Note:** The references to server and client refer specifically to the SysBack definitions only. A SysBack server may, or may not be, any other type of application server, file server, NFS server, and so on in your environment. In addition, the same machine or partition can be both a SysBack server and client.

Pulling the backups from clients enables you to use a single machine or partition to act as a central backup server. You can script, schedule, and thereby automate all backups for an entire environment from a single location.
There are 2-way and 3-way pull backups. A 2-way pull backup is when the same machine or partition initiates the client backup and stores the backup to media. Figure 20-2 illustrates the flow of a 2-way pull backup.

Figure 20-2 Two-way pull backup
A 3-way pull backup is when one machine or partition initiates the client backup, another machine or partition stores the backup data, and a third machine is the backup client. Figure 20-3 illustrates the flow of a 3-way pull backup.

**Offline Mirror Backup function**
SysBack provides a function to split AIX mirrors and back up the inactive copies. This enables database users to have minimal downtime, because it is only required to halt the database while the mirrors are being split. After the backup completes, SysBack automatically resynchronizes the stale partitions while the database is active.
Figure 20-4 depicts the relationship between mirrored copies after the Offline Mirror Backup feature splits them.

![Diagram showing Mirroring Before and After the Offline Mirror Backup Split]

**Stacking backup images**

SysBack provides the ability to stack multiple backups on a single tape. Figure 20-5 shows the image sequence on tape for a stack full system (installation image) backup.
Recreating LVM structures and restoring data
SysBack provides the ability to do the following operations:

- Restore data only
- Recreate LVM structures only
- Recreate LVM structures and restore data all in the same process

You can restore and recreate either an entire backup image, or any subset of data on a backup. For example, considering a volume group backup, you can:

- Restore the entire volume group and data
- Recreate only the volume group LVM structures
- Restore one or more individual file systems
- Recreate only the LVM structure of one or more file systems
- Restore one or more individual logical volumes
- Recreate only the LVM structure of one or more logical volumes
- Restore individual files or directories

20.2.2 System installation options
SysBack provides the following installation options from a full system (installation image) backup:

- **Full system installation**: This process reinstalls the system by recreating the rootvg volume group, and optionally, any non-rootvg volume groups.
- **Recovery installation**: This process restores the system on the / (root) and /usr file systems after booting into maintenance mode. It is most useful in situations where you need to back out software installations or changes without impacting your other rootvg file systems.

Both of these installation types can be either prompted or unprompted:

- **Prompted**: This is the default SysBack installation method. The system or partition is booted from SysBack media to the SysBack Installation and Maintenance Main Menu. You can then change or customize any installation option before initiating the installation process.

- **Unprompted**: By pre-configuring certain tasks required for an installation, such as defining the console and terminal type, you can initiate an installation that requires no human intervention. In this situation, you will not be prompted to complete any customization through the SysBack Installation and Maintenance Main Menu.

**Customizing an installation**

During a prompted installation, all of the following tasks can be customized through the SysBack Installation and Maintenance Main Menu options:

- Change between the 32-bit and 64-bit kernels
- Change between JFS and JFS2
- Turn mirroring on or off and set the number of copies
- Specify to recreate, ignore, or delete non-rootvg volume groups on the backup
- Specify whether or not to restore files as non-sparse
- Change any volume group attributes
- Designate a disk as a hot spare
- Change file system attributes or specify a file system to be ignored on restore
- Change logical volume attributes or specify a logical volume to be ignored on restore

These customization options can also be pre-configured and passed to an unprompted installation by creating a customized volume group information file.

### 20.2.3 Network boot

SysBack provides network boot capabilities to facilitate the installation of a machine or partition that does not have a locally attached bootable removable media device, such as a tape or CD/DVD device.

After a machine or partition has been successfully network booted, you can reinstall the system through a supported media device located on another machine or partition.
SysBack provides the ability to boot a machine or partition from another system of the same, or different, architecture. For example, a Common Hardware Reference Platform (CHRP) system can boot from an RSPC system. However, it should be noted that there are some additional configuration tasks required for cross-architecture booting.

**Note:** AIX 5L Version 5.2 no longer supports the MCA or RSPC architectures.

There are two types of SysBack network boots:

- Classic network boot
- NIM resource network boot

The classic network boot method relies on the / (root) and the /usr file systems of the boot server for creating the network boot image. The boot server also fulfills other processing requirements for the client during the boot and installation process. Figure 20-6 illustrates the relationships between systems or partitions using the classic network boot method.

![Classic network boot relationships](image_url)

The NIM resource network boot method provides a mechanism for you to use existing NIM SPOT and lppsource resources in combination with SysBack boot and installation operations. The NIM resource network boot method relies on an existing NIM SPOT to create the network boot image and an existing NIM lppsource to provide the device support that the client may need to configure attached hardware.
Figure 20-7 illustrates the relationships between systems or partitions using the NIM resource network boot method.

For customers whose partitions function as a part of an RS/6000® SP complex or an IBM server Cluster 1600, SysBack has specific boot and install utilities to interact with PSSP. For these utilities, SysBack utilizes existing NIM resources that are a default part of the SP or cluster configuration in order to provide a server-initiated network boot and install through the control workstation. SysBack also executes the required PSSP functions to bring the partition back into the SP or cluster environment after system installation.

### 20.2.4 Multivolume backup and tape device support

SysBack interfaces with the tape drive units through generic SCSI commands used by all drives. SysBack does not directly interface to a tape library robot or auto-changer mechanism and, therefore, does not control its movement.

By design, SysBack simply ejects the tape when the end of volume is reached and waits for the next volume to be loaded. For a stand-alone tape drive, human intervention is required to load the next tape. However, if the unit is a tape
autoloader that has a mode of operation called *automatic* or *sequential*, then placing the autoloader in this mode allows SysBack and the hardware to take care of all the tape changes automatically without human intervention.

The hardware design of an autoloader’s sequential mode will automatically load the next sequential volume when the tape is ejected from the drive. This behavior eliminates the need of an application, such as SysBack, to control the robot arm. This behavior is true across all tape autoloaders that have an automatic or sequential mode of operation.

However, if the unit is a tape library where the tape loading occurs through commands issued to the robot, then SysBack can still work with the library provided that you create a simple script to handle the robot functions.

Therefore, in essence, SysBack can work with any model library from any vendor. However, depending on the functionality of the library, you may or may not have to write a small script to control the robot functions for SysBack.

**20.2.5 Partition backup, recovery, and cloning**

SysBack can be used to back up and reinstall the same partition, or to clone that partition image to another system or partition. You can also clone an image of a stand-alone system to a partition.

The following examples demonstrate local and remote backups, partition recovery, and cloning. Other variations and options related to these procedures exist. Therefore, refer to the *IBM Tivoli Storage Manager for System Backup and Recovery Installation and User’s Guide*, along with product readme files, for more detailed information about any or all of these tasks. The manual is available at:


The readme files are available in: /usr/lpp/sysback after the product has been installed, as well as on the product media.

**20.2.6 Partition backup and reinstallation (system recovery)**

This section demonstrates the basic tasks required to do the following operations:

- Perform a system backup to a device assigned to the partition:
  - Perform a basic boot and reinstall from that tape.

- Perform a system backup to a remote device assigned to another partition:
  - Perform a network boot.
Perform the reinstallation remotely across the network from tape.

All commands require execution by the root user.

**Using a media device assigned to the partition**

Local backups are backups that are performed to a device that is physically attached to the machine, and in this case, the partition. This type of backup is the easiest to implement. Figure 20-8 illustrates the relationship of a partition to a tape device for a local backup.

![Figure 20-8  Local backup to tape](image)

**Sample backup to tape**

To execute a full system (installation image) backup of a partition to be used only to reinstall this partition or another partition on this machine and to back up datavg in addition to rootvg, pointing the backup to the /dev/rmt0 device, issue the following command:

```bash
# /usr/sbin/sysback -f /dev/rmt0 datavg
```

**Note:** There are several other options available for the `/usr/sbin/sysback` command. Refer to Appendix A. “Commands,” in the *IBM Tivoli Storage Manager for System Backup and Recovery Installation and User’s Guide* for more detailed information, available at:


**Sample boot and install from tape**

To sample boot and install from tape, do the following operations:

1. Place the backup tape in the drive and activate your partition to begin booting.

   **Note:** If your boot device is not set to the tape drive, first boot into SMS and set the boot device.
2. The partition boots to the SysBack Installation and Maintenance Main Menu.

3. Using the menus, make any needed changes to the LVM information. When finished, select the Install the System with Current Settings option.

4. The install proceeds without any further intervention. Once completed, the system login prompt opens.

**Using a media device assigned to a remote partition**

Remote backups are backups sent across the network to a remote machine or partition. This backup type is easily accomplished after completing a quick, simple, one time Remote Services configuration.

For the purposes of this example, let us assume the following scenario:

- SysBack is installed on both partitions.
- The host name of the partition to be backed up is pluto.
- The host name of the remote partition that has a tape drive assigned to it is mars.

**Note:** The following references to server and client refer specifically to the SysBack definitions only. A SysBack server may be, or may not be, any other type of application server, NFS server, and so on in your environment.

Because it is not possible to boot a partition from a tape device assigned to another partition, a network boot of the partition is required. After the partition has been booted over the network, you can simply direct SysBack to restore from the remote tape device.

In order to perform a SysBack network boot, you must complete a one-time configuration procedure.
Figure 20-9 illustrates the relationship between partitions for a remote backup and network boot.

**Figure 20-9  Remote backup to tape and network boot of partition**

**Onetime Remote Services configuration**
Log in to the mars partition (server) and issue the following commands:

1. Issue the `/usr/sbin/cfgremsvs` command to configure Remote Services on this partition.
2. Issue the `/usr/sbin/cfgremaccess -h pluto -u all -f all` command to define pluto’s access to this partition and its tape drive resources.

Log in to the pluto partition (client) and execute the following commands:

1. Issue the `/usr/sbin/cfgremsvs` command to configure Remote Services on this partition.
2. Issue the `/usr/sbin/cfgremserver -a -h mars` command to define mars as the backup server.

**Sample backup to tape**
In order to execute a full system (installation image) backup of the pluto partition (client) to be used only to reinstall this partition or another partition in this machine and to back up the datavg in addition to rootvg, pointing the backup to the `/dev/rmt0` device located in the mars partition (server), log in to pluto and issue the following command:

```
# /usr/sbin/sysback -h mars -f /dev/rmt0 datavg
```

**Note:** There are several other configurable options available for the `/usr/sbin/sysback` command. Refer to Appendix A. “Commands,” in the *IBM Tivoli Storage Manager for System Backup and Recovery Installation and User’s Guide* for more detailed information, available at:

**Onetime network boot configuration**

To do a onetime network boot configuration, log in to mars partition (server) and execute the `/usr/sbin/mksbnetboot -h pluto -d your_network_type -T chrp -k mp -S server_ip -g client_gateway -s client_subnet` command in order to define pluto as a network boot client and to build the required boot image.

**Note:** The values allowed for the variable your_network_type are Ethernet or token ring. If your client and server are on the same subnet (the client does not require a gateway to get to the server), specify the server address again for the client_gateway variable.

**Sample network boot**

In order to network boot the pluto partition (client) from the mars partition (server), do the following operations:

1. Boot the pluto partition to the SMS menu.
2. Select **Multiboot**.
3. Select **Select Install Device**.
4. Select the desired network interface to use for the network boot process.
5. Type X two times to return to the main SMS menu.
6. Select **Remote Initial Program Load**.
7. Select **IP parameters**.
8. Input the same server IP address, client IP address, client gateway, and client subnet mask values that were used in the SysBack network boot configuration.

**Note:** If your client and server are on the same subnet (the client does not require a gateway to get to the server), specify the server address again for the client_gateway variable.

9. Type X to return to the Remote Initial Program Load menu.
10. Select **Adapter Parameters**.
11. Set any attributes appropriate to you network interface and network environment.
12. Type X to return to the Remote Initial Program Load menu.
13. Select **Test Ping**.
14. Input the appropriate IP information to ping the mars partition.
15. Type X two times to return to the main SMS menu.
16. Type X to exit SMS and start the network boot process.

The partition boots to the **SysBack Installation and Maintenance Main Menu**.

**Sample install from remote tape**
After your partition has booted to the **SysBack Installation and Maintenance Main Menu**, and if you want to install over the same network interface from which you booted, execute only steps 5 to 10 below.

However, if you want to install from a different network interface, you must change to it and configure the desired network interface, as follows.

To install from a remote tape, do the following steps:

1. Select **Change Installation Device**.
2. Select the desired network interface.
3. Enter the client IP address, server IP address, client gateway, and subnet mask in order to use this interface.

   **Note:** If your client and server are on the same subnet (the client does not require a gateway to get to the server), specify the server address again for the `client_gateway` variable.

4. Press Esc to return to the main menu.
5. Select **Change Volume Group & Logical Volume Information**.
6. Select the appropriate tape device on the remote system from the Select Source for Volume Group Data menu.
7. Tape processing occurs to position the tape to the correct location.
8. Press Esc to return to the main menu.
9. Select **Install the System with Current Settings** to begin the installation.
10. The install proceeds without any further intervention. Once completed, the system login prompt opens.

### 20.2.7 Cloning backup images between partitions

**Cloning** refers to creating a backup image of one machine or partition and installing a different machine or partition with that same image.

This section demonstrates the basic tasks required to do the following operations:

- Identify resources that may need to be supported for the cloning process.
Perform a system backup to a device assigned to the partition:
  - Perform a basic boot and install using a DVD backup made from another partition.

Perform a system backup to a remote device assigned to another partition:
  - Perform a network boot.
  - Perform a basic installation remotely across the network using a DVD backup made from another partition.

**Note:** There are other variations to prepare for needed support or to enable support at the time of install. However, these examples can be complicated and relate to very specific scenarios. The processes described here are the most direct and the least complicated.

**Resource identification**

When cloning, it is important to remember that an image from the source machine or partition must have all of the needed device driver filesets and kernel filesets installed to support the hardware of the new machine or partition.

In a partitioned environment, the need to identify the required device driver and kernel filesets is greatly reduced.

**Device driver filesets**

The essential device drivers needed to support each partition are the same across all of the partitions, because each partition exists on the same physical machine. Examples of essential device drivers might be filesets to support SCSI disk drives or the I/O bus.

However, each partition can have additional I/O slots assigned to it beyond the minimal requirements for defining a partition. These I/O slots may have adapter cards used to attach external devices. Various types of Ethernet adapters, or even differential SCSI adapters used to attach tape libraries, are examples of how these I/O slot allocations can be used. Each I/O component has an associated device driver.

In order to clone an image of one partition to another, it is recommended that you identify any resource existing on the destination partition, which does not exist on the source partition. Once identified, you should install the required device drivers to support those resources identified on to the source partition.

In a partitioned environment, there will be few, if any, resources to identify. Furthermore, because these resources would be optionally assigned I/O slots, these resources are not likely to keep the cloning operation from completing. In this scenario, missing device drivers could simply be installed on the destination
partition as needed to configure an adapter card after the cloning operation has completed.

**Note:** It is recommended that you reboot the operating system after installing device drivers to ensure that they are properly initialized into the running kernel. Doing this ensures that the needed support is included in the boot image that is created when you perform the backup.

**Kernel support filesets**
In a partitioned environment, there are only two choices of kernel support filesets available at the time of this publication:

- **bos.mp:** This fileset is required when running the 32-bit kernel.
- **bos.mp64:** This fileset is required when running the 64-bit kernel.

On partitioning-capable pSeries server models, the default action when installing AIX 5L V5.x is to install both kernel filesets.

Provided that you would like to run the same kernel after the cloning procedure as was running on the partition that created the backup, there are no additional tasks required. However, should you want to run a different kernel and would like to use SysBack to switch the kernel for you during the cloning procedure, you must install both filesets on the source partition before creating the backup.

**Using a media device assigned to the same partition**
Local backups are backups that are performed to a device that is physically attached to the machine, and in this case, the partition. This type of backup is the easiest to implement. Figure 20-10 illustrates the relationship between partitions and their respective backup devices for a cloning operation.

![Figure 20-10  Local backup to CD/DVD and using that image for a new partition](image)
Sample backup to DVD

Make sure that you have evaluated any additional hardware resources that will exist on the destination partition and install the needed device drivers to support them before performing the backup.

To execute a full system (installation image) backup of this partition to be used only to reinstall this partition or another partition on this machine, pointing the backup to the /dev/cd1 device, which uses 2.6 GB media, issue the following command:

```
# /usr/sbin/mksbcd -T “D” -t I -f /dev/cd1 -Z 2662
```

Starting with SysBack Version 5.6.5.0, you can create backups using the UDF structure on DVD media when using AIX 5.2 and higher (as opposed to ISO9660). Issue the following command to use the UDF format:

```
# /usr/sbin/mksbcd -T “D” -t U -f /dev/cd1 -Z 2662
```

**Note:** A backup to CD/DVD has additional configuration requirements. There are also many additional flags, options, and potential considerations of the /usr/sbin/mksbcd command. See the /usr/lpp/sysback/README.udf.dvdc.txt file for details about using this feature.

Sample boot and install from DVD

To boot and install from a DVD, do the following operations:

1. Place the DVD backup in the drive and activate your partition to begin booting.

   **Note:** If your boot device is not set to the DVD drive, first boot into SMS and set the boot device.

2. The partition boots to the **SysBack Installation and Maintenance Main Menu**.

3. Using the menus, make any needed changes to the LVM information. When finished, select the **Install the System with Current Settings** option.
4. The install proceeds without any further intervention. Once completed, the system log in prompt appears.

**Using a media device assigned to a remote partition**

Remote backups are backups sent across the network to a remote machine or partition. This backup type is easily accomplished after completing a quick, simple, onetime Remote Services configuration.

For the purposes of this example, let us assume the following scenario:

- SysBack is installed on both partitions.
- The host name of the partition to be backed up is pluto:
  - This image is used to install a new partition.
  - The new partition network boots from this partition. Therefore, this partition is a boot server to the new partition.
  - This partition also is a backup client to mars.

**Note:** It is possible for a system or partition to be both a SysBack server and a client.

- The host name of the remote partition that has a DVD drive assigned to it is mars.
  - This is the partition from which the new partition is installed. Therefore, this partition is the install server to the new partition.
  - This partition is a backup server to pluto.

**Note:** The following indications to server and client refer specifically to the SysBack definitions only. A SysBack server may, or may not be, any other type of application server, NFS server, and so on in your environment.
Because it is not possible to boot a partition from a DVD device assigned to another partition, a network boot of the new partition is required. After the partition has been booted over the network, you may simply direct SysBack to restore from the remote DVD device. In order to perform a SysBack network boot, you must complete a onetime configuration procedure.

Figure 20-11 illustrates the relationships between the partitions for this example.

---

**Onetime Remote Services configuration**

To configure backup services between pluto (backup client) and mars (backup server), do the following operations:

1. Log in to the mars partition (backup server) and execute the following commands:
   a. Issue the `/usr/sbin/cfgremsvs` command to configure Remote Services on this partition.
   b. Issue the `/usr/sbin/cfgremaccess -h pluto -u all -f all` command to define pluto’s access to this partition and its tape drive resources.

2. Log in to the pluto partition (backup client) and execute the following commands:
   a. Issue the `/usr/sbin/cfgremsvs` command to configure Remote Services on this partition.
   b. Issue the `/usr/sbin/cfgremserver -a -h mars` command to define mars as the backup server.
To configure Remote Services install between mars (install server) and the new partition (install client), do the following operations:

1. Log in to the mars partition (install server), and execute the following commands:
   a. Issue the `/usr/sbin/cfgremsvs` command to configure Remote Services on this partition.

   **Note:** If you are working through this example in order and have already issued the above command, it need only be issued one time.

   b. Issue the `/usr/sbin/cfgremaccess -h new_partition_hostname -u all -f all` command to define the new partition’s access to this partition and its DVD resources.

   **Note:** This command assumes that the IP and host name of the new partition have been defined in your network environment.

### Sample backup to DVD

Make sure that you have evaluated any additional hardware resources that will exist on the destination partition and install the needed device drivers to support them before performing the backup.

To execute a full system (installation image) backup of this partition to be used only to reinstall this partition or another partition on this machine, pointing the backup to the `/dev/cd1` device, which uses 2.6 GB media, issue the following command:

```
# /usr/sbin/mksbcd -T "D" -t I -h mars -f /dev/cd1 -Z 2662
```

Starting with Sysback V5.6.5.0, you can create backups with the UDF on DVD media when using AIX V5.2 and higher. Issue the following command to use UDF format:

```
# /usr/sbin/mksbcd -T "D" -t U -h mars -f /dev/cd1 -Z 2662
```

**Note:** A backup to CD/DVD has additional configuration requirements. There are also many additional flags, options, and potential considerations of the `/usr/sbin/mksbcd` command. For details about using this feature, refer to the `/usr/lpp/sysback/README.udf.dvdc.txt` file.

### Onetime network boot configuration

To do a one-time network boot configuration, log in to pluto (boot server to the new partition) and execute the command `/usr/sbin/mksbnetboot -h`
new_partition_hostname -d your_network_type -T chrp -k mp -S server_ip
-g client_gateway -s client_subnet in order to define pluto as a network boot
client and to build the required boot image.

**Note:** The values allowed for the variable *your_network_type* are Ethernet or
token ring. If your client and server are on the same subnet (the client does
not require a gateway to get to the server), input the server address again for
the *client_gateway* variable. This command also assumes that the IP and host
name of the new partition have been defined in your network environment.

**Sample network boot**

To network boot the new partition (network boot client) from the pluto partition
(network boot server), do the following operations:

1. Boot the new partition to the SMS menu.
2. Select Multiboot.
3. Select Select Install Device.
4. Select the desired network interface to use for the network boot process.
5. Type X two times to return to the main SMS menu.
7. Select IP parameters.
8. Input the same server IP address, client IP address, client gateway, and client
subnet mask values that were used in the SysBack network boot
configuration.

**Note:** If your client and server are on the same subnet (the client does not
require a gateway to get to the server), specify the server address again for
the *client_gateway* variable.

9. Type X to return to the Remote Initial Program Load menu.
10. Select Adapter Parameters.
11. Set any attributes appropriate to your network interface and network
environment.
12. Type X to return to the Remote Initial Program Load menu.
13. Select Test Ping.
14. Input the appropriate IP information to ping the pluto partition.
15. Type X two times to return to the main SMS menu.
16. Type X to exit SMS and start the network boot process.
The partition boots to the **SysBack Installation and Maintenance Main Menu**.

**Sample install from remote tape**

After your partition has booted to the **SysBack Installation and Maintenance Main Menu**, you must change the installation device to point to mars (install server) using the following steps:

1. Select **Change Installation Device**.
2. Select the desired network interface.
3. Enter the client and server IP addresses, client gateway, and subnet mask for mars.

   **Note:** If your client and server are on the same subnet (the client does not require a gateway to get to the server), specify the server address again for the client_gateway variable.
4. Press Esc to return to the main menu.
5. Select **Change Volume Group & Logical Volume Information**.
6. Select the appropriate DVD device on the remote system from the Select Source for Volume Group Data menu.

   **Note:** This new partition may not have as many disk drives assigned to it as the source partition. The disk drives also may be of a different size. You may want to enable mirroring in this partition when it did not exist on the source partition. These changes, and many more, can be used to customize this installation. For more information about how to change LVM information, refer to Chapter 11, “Changing the Volume Group, Logical Volume, and File system Attributes,” in the **IBM Tivoli Storage Manager for System Backup and Recovery Installation and User’s Guide**, available at:


7. Press Esc to return to the main menu.

   **Note:** If you want to keep the same host name and network information as was defined on pluto in this new partition (for example, this new partition replaces pluto), you do not need to execute steps 8-12 below. Simply go to step 13.

8. Select **Utilities**.
9. Select **Post Install Configuration Options**.
10. Select **Remove Network Settings After Install**.
11. Type `y` at the prompt, Do you wish to remove the network settings?
12. Press Esc three times to return to the **SysBack Installation and Maintenance Main Menu**.
13. Select the **Install the System with Current Settings** option to begin the installation.
14. The installation proceeds without any further intervention. Once completed, the system login prompt opens.

You have now cloned (installed) the system backup image of pluto to the new partition.

### 20.2.8 Cloning from a stand-alone system to a partition

Using the same procedures as described in 20.2.7, “Cloning backup images between partitions” on page 660, you can also clone a backup image from a stand-alone system to a partition. This is useful in situations where your partition is replacing another machine.

To clone a backup image from a stand-alone system to a partition, do the following operations:

1. Identity the device driver filesets required by your partition and install them to your stand-alone system.
2. Identify the kernel fileset required by your partition and install it to your stand-alone system.
3. Ensure that you are running at least the minimum required level of AIX on the stand-alone system as is required by the partition.
4. Execute any Remote Services configuration required if performing a remote backup or install.
5. Execute any network boot configuration required if performing a network boot of the partition.
6. Execute the backup of the stand-alone system.
7. Install the backup image of the stand-alone system to the partition.

Figure 20-12 shows that the same network backup and network boot capabilities exist between a stand-alone system and a partition as exists solely between partitions.
20.2.9 License information

To license your Tivoli Storage Manager for System Backup and Recovery (SysBack) software, install the:

- tivoli.tsm.client.sysback.license.rte
- tivoli.tsm.client.sysback.license.cert

filesets included on your product media in addition to the installation of the base tivoli.tsm.client.sysback.rte fileset.

Special licensing measures apply for customers using SysBack versions 5.1 - 5.4. There are no license filesets for this version of SysBack. For detailed information related to licensing your product, refer to your product README file located at: /usr/lpp/sysback/README.txt or other documentation that accompanied your order.

20.2.10 Documentation

SysBack product documentation is available in the following ways:

- Product manual
- Readme file

The manual

The IBM Tivoli Storage Manager for System Backup and Recovery Installation and User’s Guide is available in hardcopy and softcopy forms. Hardcopy
versions of the order must be individually ordered. Softcopy versions are located at:


**The readme file**

SysBack documents the latest features and fixes since the last publication of the *User’s Guide* in its readme files. After the product is installed, the readme file is located in the `/usr/lpp/sysback` directory.

### 20.3 Integrating SysBack with Tivoli Storage Manager

SysBack V5.6 and later allows for the storage of backup objects into a Tivoli Storage Manager server. Backups to a Tivoli Storage Manager server may be manipulated like any other SysBack backup. They may be listed, verified, restored, and used for system reinstallation.

Combining the SysBack backup, restore, and network boot / install functions with a Tivoli Storage Manager server provides bare machine recovery capability for Tivoli Storage Manager configurations. SysBack will back up and recover a system’s volume group, logical volume, and file system information. Optionally, SysBack will back up any non-rootvg data specified.

#### 20.3.1 Prerequisites, limitations and exclusions

To install Tivoli Storage Manager for System Backup and Recovery, also know as, SysBack, you must have the prerequisite software installed on your system.

**Hardware requirements**

SysBack supports the following hardware:

- IBM Eserver pSeries and RS/6000 systems, including RS/6000 SP environments, and systems capable of the logical partitioning of AIX
- Eserver pSeries Cluster 1600 systems using the PSSP option

**Software requirements**

The following software is required to use SysBack:

- AIX 5L V5.1, V5.2, or V5.3. Starting with Version 5.6.7.0, full functionality is provided for AIX V5.3 - you can backup and restore all AIX V5.3 data to tape, TSM server, CD/DVD or files on disk. This includes extended ACLS and NFS4 extended attributes. See the *README* file for more information.
If you will be using the **TSM Integration** feature, you will also need:
- A previously configured Tivoli Storage Manager server must be at V5.2.0 or higher.
- The 32-bit Tivoli Storage Manager API client must be installed and at V5.2.0 or higher.
- The Tivoli Storage Manager node name used for SysBack backups must be registered on the Tivoli Storage Manager server and configured to use the `passwordaccess generate` option.

**Note:** This feature is not available in SysBack versions less than 5.6

The **bos.sysmgt.sysbr** fileset.

**Note:** You should update your `bos.sysmgt.sysbr` fileset to 5.1.0.10. Otherwise, when booting from tape, CD, or DVD and attempt to make the root file systems (/, /usr, /var,/ tmp) JFS2 type, you will receive the error that files from `/sbin/helpers/jfs2` are missing. For example:

```
/sbin/helpers/jfs2/mkfs or /sbin/helpers/jfs2/logform.
```

This is because these files were not included in `/usr/lpp/bosinst/tape/tapefile1` until 5.1.0.10 of `bos.sysmgt.sysbr` and are required for this scenario.

If you will be using the **Remote Services** functions of SysBack, install the following items:
- **bos.rte.net**
- **bos.net.tcp.client**

If you will be using the **Classic Network Boot** functions for the Network Installs, install **bos.net.nfs.client**.

If you will be using the **NIM Resource Network Boot** functions for Network Installs, the NIM environment and resources must first be installed and configured in the desired locations for SysBack to use these resources. For information on installing and configuring NIM, see the book, *Network Installation Management Guide and Reference*

If you will be using SysBack on SP or Cluster 1600 systems, you must be using PSSP level 3.4 or 3.5.

**Note:** At this time, SysBack does not include support for Eserver pSeries Cluster1600 systems using the CSM option available in AIX 5.2.
When AIX is installed, the following are installed automatically with the system and may not be removed in order for SysBack to function properly:

- `bos.rte.bosinst`
- `bos.rte.archive`
- `bos.rte.libnetsvc` (when using Network Install functions)

**Limitations and exclusions applying to interaction**

- You must exclude Tivoli Storage Manager HSM managed file systems from all SysBack backup processes (via an exclude list). You must use the Tivoli Storage Manager backup / archive client to back up these file systems instead. At restore time, SysBack may be used to rebuild the underlying file system structure for the HSM managed file system, but the actual file data and HSM stub file data should be restored via the Tivoli Storage Manager backup / archive client.

- There can be notable functional differences and limitations in MBCS environments. Please refer to Appendix B. Functional Requirements & Limitations for DBCS and BiDi Environments in the *Installation and User's Guide* for a detailed listing of impacted functionality. LAN-free backups are not supported.

- COMMMethod TCPIP is the only supported Tivoli Storage Manager communication method.

- GPFS file systems are not supported.

**Note:** The Tivoli Storage Manager Backup-Archive Client can backup GPFS file systems.

- VERITAS file systems are not supported.

- AFS® and DFS file system structures can not be recreated from backups. If the root user has the appropriate AFS or DFS permissions, then SysBack can back up the data.

**Note:** The Tivoli Storage Manager Backup-Archive Client can backup of AFS and DFS file systems.

- Compression should not be set from within the SysBack backup commands when the backup destination is a Tivoli Storage Manager server. Compression of data is controlled through Tivoli Storage Manager configuration options.
- Files, directories, file systems, or logical volumes that you would like excluded from backup processing must be defined in the SysBack exclude list. Tivoli Storage Manager exclude processing does not apply to this backup process.

- If you are using SysBack's incremental backup function, and the destination is a Tivoli Storage Manager server, you must ensure that you have an adequate number of versions exist specified to avoid inadvertently expiring off members of a full incremental backup set.

Currently, there is no tracking that ties an individual incremental backup to the rest of the incremental backups in a series.

For example, if you specify to keep 3 backups versions in your Tivoli Storage Manager copy group, but do a level 0 backup, and then level 4 backups every Friday, by the end of the month your level 0 will have been versioned off by Tivoli Storage Manager.

### 20.3.2 Basic setup and configuration tasks

In order to perform backup, list, verify, query, or restore operations with a Tivoli Storage Manager server, you must perform the following configuration tasks:

- **Register a Tivoli Storage Manager node:** Before you can perform any communications with a Tivoli Storage Manager server, you must first register a Tivoli Storage Manager node and define a password. The password will be initialized when the Tivoli Storage Manager virtual device is created. If your password is already initialized, such as when you are using the same node name as your Tivoli Storage Manager Backup / Archive Client, it will be necessary for you to provide that password when creating the virtual device definition.

- **Install the API client:** You must install V5.2.0 (or later) Tivoli Storage Manager 32-bit API client for use with SysBack operations.

- **Configure the Tivoli Storage Manager options file:** Operations between SysBack and Tivoli Storage Manager require at least this minimum information in the `dsm.sys` file:

  ```
  Servername lasher_main
  NODename lasher
  COMMMethod TCPIP
  TCPPort 1500
  TCPServeraddress tsmserver.your.domain.com
  PASSWORDAccess generate
  ```

- **Set Tivoli Storage Manager environment variables:** The Tivoli Storage Manager API client provides the following environment variables:
– **DSMI\_CONFIG**: The fully qualified name for the client options file usually named dsm.opt. Setting this variable is not supported with SysBack — it will always set this variable to `/usr/lpp/sysback/tsm/dsm.opt.tsmXX` where X represents the Tivoli Storage Manager virtual device number.

– **DSMI\_DIR**: The path that contains the dsm.sys, dsmtca, and the en\_US subdirectory. Setting this variable is not supported with SysBack. SysBack will always look to the default API installation directory of `/usr/tivoli/tsm/client/api/bin` to locate these items in order to allow the bare machine recovery functions.

– **DSMI\_LOG**: The path that points to the API error log. You may configure this variable to designate the location and filename of the API error log. If this variable is not set, the API error log for SysBack operations will be located in `/usr/lpp/sysback/sbtsmerror.log`.

**Note**: This does not log the output of the SysBack command processing. This only logs the information for the API communications between the SysBack command processing and the Tivoli Storage Manager server.

► **Create a Tivoli Storage Manager virtual device**: The steps for doing this are discussed in 20.3.3, “Creating a Tivoli Storage Manager virtual device” on page 675.

► **Additional configuration for bare machine recovery**: In order to perform a Bare Machine Recovery from a SysBack backup stored in a Tivoli Storage Manager server, you must execute the following configuration tasks:

– Configure operations for the backup, list, verify, query, and restore tasks as explained previously.

– Configure a SysBack Network Boot Client

– Configure the Tivoli Storage Manager Network Install Client Defaults

### 20.3.3 Creating a Tivoli Storage Manager virtual device

To access the Tivoli Storage Manager Virtual Device configuration menus:

1. Log in as the root user.
2. Type `smitty sysback` and press Enter.
3. Navigate **TSM ➔ TSM Virtual Device Configuration ➔ Add a TSM Virtual Device** and press Enter.
4. Highlight the desired TSM server name stanza when prompted at the Select a TSM Server dialogue as shown in Example 20-12 and press Enter.
Example 20-12  Server selection menu

TSM Virtual Device Configuration

Move cursor to desired item and press Enter.

Add a TSM Virtual Device
Change an Existing TSM Virtual Device
List TSM Virtual Devices
Remove a TSM Virtual Device

+--------------------------------------------------------------------------+
|                           Select a TSM Server                            |
|                                                                          |
| Move cursor to desired item and press Enter.                             |
|                                                                          |
|   Atlantic                                                               |
|   lochness                                                               |
|                                                                          |
| Esc+1=Help              Esc+2=Refresh           Esc+3=Cancel             |
| Esc+8=Image             Esc+0=Exit              Enter=Do                 |
| Es| /=Find                  n=Find Next                                      |
| Es+--------------------------------------------------------------------------+

Note: The list of IBM Tivoli Storage Manager server name stanzas is generated from the contents of the file /usr/tivoli/tsm/client/api/bin/dsm.sys.

Once you have selected a server name, you have to enter the password you used during the register node command as shown in Example 20-13.

Example 20-13  Add TSM virtual device menu

Add a TSM Virtual Device

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

[Entry Fields]

TSM Server Name                     Atlantic
Client Node Password                [password]
5. Enter the password that corresponds to the node name defined in this server stanza in the **Password** field.

You should be aware of the following information related to the password field:

a. If this is the first connection to the Tivoli Storage Manager server for this node name, the password will be encrypted and stored in `/etc/security/adsm` or as specified with the PASSWORDDIR option in the `dsm.sys` file.

b. If connections to the Tivoli Storage Manager server have previously been established by this, or any other Tivoli Storage Manager client using this node name, you must enter the password that was previously stored in `/etc/security/adsm` or where specified with the PASSWORDDIR option in the `dsm.sys` file. If you do not know this password, you have two options:

i. Specify the password to the administrative id created for this node name which has OWNER access.

ii. Log in to the Tivoli Storage Manager server and issue the command: `update node nodename newpassword` before attempting to create the TSM Virtual Device.

**Note:** For more information regarding the `update node` command, refer to *IBM Tivoli Storage Manager for AIX: Administrator's Reference*, GC32-0769.

Figure 20-14 shows that a virtual device called *tsm0* has been created.

**Example 20-14 Virtual device tsm0 created**

<table>
<thead>
<tr>
<th>COMMAND STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Command: OK</td>
</tr>
<tr>
<td>stdout: yes</td>
</tr>
<tr>
<td>stderr: no</td>
</tr>
</tbody>
</table>

Before command completion, additional instructions may appear below.

Device tsm0 for TSM server lochness has been added.
20.3.4 Configuring network boot options for BMR

In order to perform a Tivoli Storage Manager bare machine recovery, the install client must initiate a network boot in order to access the SysBack System Installation & Maintenance Main Menus.

Network boot configuration procedures are performed like any other SysBack network boot configuration. All of the same requirements apply with the following additional requirements:

- When performing a SysBack Classic Network Boot, the Tivoli Storage Manager 32-bit API client and the tivoli.tivguid (prerequisite of the API client) filesets must be installed on to the network boot server.
- When performing a SysBack NIM Resource Network Boot, the Tivoli Storage Manager 32-bit API client and tivoli.tivguid (prerequisite of the API client) filesets must be installed in to the NIM SPOT.

**Note:** There is no SysBack utility available for installing the Tivoli Storage Manager filesets into the NIM SPOT. You must install them yourself using standard NIM commands.

Optionally, you may choose to pre-configure the TSM Network Install Client Defaults to avoid the manual entry of these values in the SysBack Installation & Maintenance Main Menus.

**Note:** You must configure the SysBack Network Boot Client for this system before setting this install defaults.

To access the TSM Network Install Client Defaults Menu:

1. Log in as the root user.
2. Type `smitty sysback` and press Enter.
3. Select **TSM Configuration**  →  **Network Boot/Install Configuration**  →  **Classic Network Boot**  →  **Set TSM Network Install Client Defaults** and press **Enter**.

4. Highlight the desired network boot client when prompted in the **Select a Client Name** dialog as shown in Example 20-15 and press **Enter**.

**Example 20-15  Network boot client selection**

<table>
<thead>
<tr>
<th>Classic Network Boot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Move cursor to desired item and press Enter.</td>
</tr>
<tr>
<td>Add or Change a Network Boot Client</td>
</tr>
<tr>
<td>Rebuild Network Boot Image</td>
</tr>
<tr>
<td>Set Network Install Client Defaults</td>
</tr>
<tr>
<td>Set TSM Network Install Client Defaults</td>
</tr>
<tr>
<td>Remove a Network Boot/Install Client</td>
</tr>
</tbody>
</table>

---

**Example 20-16** shows the options set for the node we configured in the lab.

**Example 20-16  Set TSM network install client defaults.**

<table>
<thead>
<tr>
<th>Set TSM Network Install Client Defaults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type or select values in entry fields.</td>
</tr>
<tr>
<td>Press Enter AFTER making all desired changes.</td>
</tr>
</tbody>
</table>
5. Press Enter to set the defaults.

### 20.3.5 Recovery and system reinstallation from a server

Performing a system installation, or bare machine recovery, using a backup stored in a Tivoli Storage Manager server, is done just like any other SysBack system installation, with the following exceptions:

- You must network boot the system to the **Installation and Maintenance Main Menu**. Tape, CD, or DVD device boots are not supported.

- The installation device will be a Tivoli Storage Manager virtual device rather than a tape, CD, DVD, or another network install server.

Once you have successfully executed a network boot, Example 20-17 shows the menu that will be displayed:

*Example 20-17  SysBack installation and maintenance menu*

```
+----------------------------------------------------------+
|IBM Tivoli Storage Manager for System Backup and Recovery |
+----------------------------------------------------------+
+--------------------------------+                      
| Installation & Maintenance     |
| M A I N M E N U                 |
+--------------------------------+                      
```
To verify or change the network information required to connect to a Tivoli Storage Manager server for retrieval of the SysBack backup image, select Change Installation Device to display the menu as shown Example 20-18.

Example 20-18 Change installation device menu

```
+----------------------------------------------------------+
|             Change Installation Device                    |
+----------------------------------------------------------+
| Device Description Location                              |
| /dev/rmt0 5.0 GB 8mm Tape Drive 04-C0-00-5,0              |
| /dev/ent0 10/100 Mbps Ethernet PCI Adapter II 04-B0       |
| /dev/ent1 IBM 10/100/1000 Base-T Ethernet PCI Adapter 04-04|
| => tsm0 TSM Virtual Device (ent1) 04-04                  |
+----------------------------------------------------------+
| Select one network device or one or more tape devices.   |
| The "=>" symbol indicates current choice(s).             |
+----------------------------------------------------------+
| Use ARROW or Tab keys to move, ENTER to select or deselect, ESC when done. |
+----------------------------------------------------------+
```

Select the tsmdev device to verify or change the network interface associated with this restore process. The menu in Example 20-19 will be displayed.

Example 20-19 Change network interface menu

```
+----------------------------------------------------------+
|             Change Network Interface                      |
+----------------------------------------------------------+
| Device Description Location                              |
| /dev/ent0 10/100 Mbps Ethernet PCI Adapter II 04-B0       |
| ==>/dev/ent1 IBM 10/100/1000 Base-T Ethernet PCI Adapter 04-04|
+----------------------------------------------------------+
| Select one network device or one or more tape devices.   |
| The "=>" symbol indicates current choice(s).             |
+----------------------------------------------------------+
| Use ARROW or Tab keys to move, ENTER to select or deselect, ESC when done. |
+----------------------------------------------------------+```
Select the desired network interface and press Enter to verify or change the network settings associated with this restore process. The screen shown in Example 20-20 will be displayed.

Example 20-20  Change IBM Tivoli Storage Manager network settings menu

+-----------------------------------------------------------------------------+
| Change TSM Network Settings                                                 |
+-----------------------------------------------------------------------------+
| Client IP Address       | 9.43.86.49   |
| Client Node Name        | atlantic    |
| TSM Admin ID            | admin       |
| Server IP Address       | 9.43.86.84   |
| Gateway IP Address      | 9.43.86.88   |
| Subnet Mask             | 255.255.254.0 |
| Port Number             | 1500        |
| Password:               | password    |
| Network Adapter:        | ent1 [inactive] |
+-----------------------------------------------------------------------------+

Enter the TSM server port number that corresponds to the desired TSM server connection for this installation.

Use ARROWS or Tab to move or INS/DEL to edit. Press ESC to return.

Verify or edit the values in each field as required for this restore process.

Once you have configured the installation device settings as desired, you will need to query the Tivoli Storage Manager server and select the backup object to restore. The easiest way to achieve this is to access the Change Volume Group & Logical Volume Information menu. Selecting this menu after setting your tsmdev installation device settings will cause SysBack to query the correct Tivoli Storage Manager server to obtain a list of backup objects available for restore. This is shown in Example 20-21.

Example 20-21  Query the server and select the backup to restore

+-----------------------------------------------------------------------------+
| IBM Tivoli Storage Manage for System Backup and Recovery                    |
+-----------------------------------------------------------------------------+
<table>
<thead>
<tr>
<th>Backup ID</th>
<th>Active</th>
<th>Management Class</th>
<th>Backup Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>=&gt; 0.1345</td>
<td>Yes</td>
<td>SystemBackupClass</td>
<td>01/19/06 11:56:00</td>
</tr>
<tr>
<td>0.1214</td>
<td>No</td>
<td>SystemBackupClass</td>
<td>01/18/06 13:10:05</td>
</tr>
<tr>
<td>0.1010</td>
<td>No</td>
<td>OldBackupClass</td>
<td>01/15/06 09:54:25</td>
</tr>
</tbody>
</table>
+-----------------------------------------------------------------------------+

Select the backup ID to use from the above list.
Once you have selected the backup object to restore, you are ready to customize any other installation attributes as desired. If you do not need to make any changes, simply begin the install.
Data Protection configuration on the server

IBM Tivoli Storage Manager provides support for online backup of applications through the use of complementary products such as IBM Tivoli Storage Manager for Applications, IBM Tivoli Storage Manager for Databases, IBM Tivoli Storage Manager for Enterprise Resource Planning, IBM Tivoli Storage Manager for Copy Services, IBM Tivoli Storage Manager for Advanced Copy Services, and IBM Tivoli Storage Manager for Mail.

In this chapter we describe the configuration steps on the Tivoli Storage Manager server. For more information on the installation and configuration of these complementary products on the client side, refer to the Installation and User’s Guide for each product. The redbook, IBM Tivoli Storage Management Concepts, SG24-4877, also provides an overview of each of the data protection modules.
21.1 Basic assumptions

It assumes that a Tivoli Storage Manager server is already installed and configured for backup and restore. If this is a brand new installation, you will need to perform Tivoli Storage Manager server configuration first.

**Note:** It is expected that the commands described in this chapter are familiar to the Tivoli Storage Manager administrator; otherwise, refer to Part I of this book or the *Administrator's Guide*.

Generally, when using data protection modules, there are two major tasks that have to be performed on the Tivoli Storage Manager server:

- Define policy requirements
- Register the node

21.2 Policy creation requirements

Tivoli Storage Manager policies are used to specify how files are backed up, archived, migrated from client node storage and managed in server storage.

Because the policy requirements for data protection backups are different from the desired settings for regular Tivoli Storage Manager backup clients, a different management class must be defined with Tivoli Storage Manager for managing data protection backups.

You have two options to do this:

- Define a management class in an existing policy domain
- Define a new policy domain

21.2.1 Defining a management class in an existing policy domain

This management class will be used for backup by the data protection module.

Example 21-1 creates a TDP_CLASS management class within an existing policy domain and policy set both called STANDARD. It also creates the backup and archive copygroups containing the actual backup version and retention requirements.

*Example 21-1 Define TDP management class and copygroups*

```bash
tsm: ATLANTIC> define mgmtclass STANDARD STANDARD TDP_CLASS
ANR1520I Management class TDP_CLASS defined in policy domain STANDARD, set STANDARD.
```
Chapter 21. Data Protection configuration on the server

21.2.2 Defining a new policy domain

Rather than define a separate management class in an existing policy domain, you can also define a new policy domain where the default management class has the required settings. This method allows the default management class to be utilized for the data protection backups. There is no concern over an include statement not being recognized during the backup process. We recommend setting up the management class for the data protection clients in this way.

Example 21-4 shows how to define a new policy domain.
Example 21-4  Create data protection policy requirements

```
tsm: ATLANTIC> define domain TDP_DOMAIN
ANR1500I Policy domain TDP_DOMAIN defined.

tsm: ATLANTIC> define policyset TDP_DOMAIN STANDARD
ANR1510I Policy set STANDARD defined in policy domain TDP_DOMAIN.

tsm: ATLANTIC> define mgmtclass TDP_DOMAIN STANDARD STANDARD
ANR1520I Management class STANDARD defined in policy domain TDP_DOMAIN, set
STANDARD.

tsm: ATLANTIC> define copygroup TDP_DOMAIN STANDARD STANDARD
    type=backup verexists=30 verdeleted=1 retextra=30 retonly=90 dest=tapepool
ANR1530I Backup copy group STANDARD defined in policy domain TDP_DOMAIN, set
STANDARD, management class STANDARD.

tsm: ATLANTIC> define copygroup TDP_DOMAIN STANDARD STANDARD
    type=archive retver=365 destination=tapepool
ANR1535I Archive copy group STANDARD defined in policy domain TDP_DOMAIN, set
STANDARD, management class STANDARD.

tsm: ATLANTIC> assign defmgmtclass TDP_DOMAIN STANDARD STANDARD
ANR1538I Default management class set to STANDARD for policy domain TDP_DOMAIN, set
STANDARD.

tsm: ATLANTIC> activate policyset TDP_DOMAIN STANDARD
Do you wish to proceed? (Yes (Y)/No (N)) y
ANR1514I Policy set STANDARD activated in policy domain TDP_DOMAIN.
```

21.2.3 Backup and archive copygroup considerations

Backup and archive copygroup usage varies among the data protection modules. Here are some backup and archive copygroup requirements for each application.

Some data protection modules do not send any archive objects to the Tivoli Storage Manager server, so you do not need to worry about this. You may wish to have an archive copy group to prevent warning messages on the Tivoli Storage Manager server.

The archive feature of the Tivoli Storage Manager backup-archive client can be used to perform operating system and file level backups of the application files. With archives, you can group files together to expire at the same time. If you choose to do this, pay attention to the archive copygroup that you are using. The archive copygroup will determine how long the objects will exist before expiring.
There are also specific backup retention and version requirements for specific data protection modules.

Table 21-1 summarizes the backup and archive copygroup requirements for each data protection module.

Table 21-1  *Data protection backup and archive copygroup requirements*

<table>
<thead>
<tr>
<th>Data Protection module</th>
<th>Backup copy group requirements</th>
<th>Archive copy group requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Protection for WebSphere Application Server</td>
<td>You can set <code>verdeleted</code>, <code>verexist</code>, <code>retonly</code>, and <code>retextra</code> parameters according to your retention requirements</td>
<td>Not required</td>
</tr>
<tr>
<td>Data Protection for Informix (or inbuilt Informix backup support)</td>
<td>You can set <code>verdeleted</code>, <code>verexist</code>, <code>retonly</code>, and <code>retextra</code> parameters according to your retention requirements</td>
<td>Not required</td>
</tr>
<tr>
<td>Data Protection for Microsoft SQL</td>
<td>For SQL database objects, you can set <code>verdeleted</code>, <code>verexist</code>, <code>retonly</code>, and <code>retextra</code> parameters according to your retention requirements. For log and set objects which are always uniquely named, set the <code>retonly</code> parameter to control expiration. When selecting the <code>retonly</code> value for log backups, ensure that it is at least as long as the value for the backup objects the logs are associated with. Data objects and their associated meta objects should have the same version limits and retention values. You may want to consider storing meta objects in a disk-storage pool so that media mount is not necessary when doing data protection for SQL queries. Alternatively, you can use the same management class if you rarely need the meta objects.</td>
<td>Not required</td>
</tr>
<tr>
<td>Data Protection for Oracle</td>
<td>Since backup objects inserted into the Tivoli Storage Manager backup storage pool have unique file names, they never expire on the Tivoli Storage Manager server. The following options must be set to handle this case: <code>verdeleted=0</code> <code>retonly=0</code></td>
<td>Not required</td>
</tr>
<tr>
<td>Data Protection module</td>
<td>Backup copy group requirements</td>
<td>Archive copy group requirements</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------------------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>Data Protection for Lotus Domino</td>
<td>You can set <code>verdeleted</code>, <code>verexist</code>, <code>retonly</code>, and <code>retextra</code> parameters according to your retention requirements. Regular use of the <code>inactivatelog</code> command inactivates the archived transaction log files when all databases that would require that file for a complete recovery are inactive. Therefore, be sure to set the retention period for inactive transaction log files to be equal to or greater than that of the database backup objects.</td>
<td>Not required</td>
</tr>
<tr>
<td>Data Protection for MS Exchange</td>
<td>For exchange server database backup objects, you can set <code>verdeleted</code>, <code>verexist</code>, <code>retonly</code>, and <code>retextra</code> parameters according to your retention requirements. However, note that incremental backups always have unique names. Therefore, they will only expire due to <code>retonly</code> limits. When setting the <code>retonly</code> parameter for incremental backups, the value must be as long as the value set for the full backup objects to which the incremental backups are associated. You can use the same management class for incremental and full backup objects to be sure an adequate value is used.</td>
<td>Not required</td>
</tr>
<tr>
<td>Data Protection for ESS (Oracle/DB2) Data Protection for DS and SVC (Oracle/DB2)</td>
<td>Set the following values so that deleted backups are immediately removed from server storage: <code>verdeleted=0</code> <code>retonly=0</code></td>
<td>Not required</td>
</tr>
</tbody>
</table>
21.3 Register node

Before a Tivoli Storage Manager client can use the storage services of a Tivoli Storage Manager server, it must first authenticate to the Tivoli Storage Manager server using a nodename and password. A node is created by the Tivoli Storage Manager Administrator using the `register node` command. 8.2.3, “Working with client nodes” on page 280 shows how to create client nodes.

When the node is registered, it has five key parameters: `nodename`, `password`, `domain`, `maxnummp`, and `backdelete`. The Tivoli Storage Manager backup-archive client defaults the nodename to the hostname of the machine.

We strongly recommend registering a dedicated node for each Data Protection backup client, that is separate from the node that is used with the backup-archive client. If you have a separate policy domain for data protection backups, this is required, since a node can only belong to one domain. The password you specify will be used for authenticating the client API to the Tivoli Storage Manager server the first time a Data Protection session is invoked.

<table>
<thead>
<tr>
<th>Data Protection module</th>
<th>Backup copy group requirements</th>
<th>Archive copy group requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Protection for mySAP (DB2 or Oracle)</td>
<td>Not required</td>
<td>You need to define a management class for SAP system data, data files, offline redo logs and copies of offline redo logs. Data Protection for mySAP uses its own <code>version control</code> mechanism for managing mySAP database backups. To do this, Data Protection for mySAP backs up all data only to management classes for which an archive copy group has been defined. In addition, to prevent backed up files in Tivoli Storage Manager being deleted because of their expiration date, the parameter <code>retver</code> should be set to unlimited (9999).</td>
</tr>
</tbody>
</table>
The node that is used to back up Oracle or MS SQL database objects to Tivoli Storage Manager must be able to manually delete the backup objects. To do so, specify `BACKDELETE=YES` when registering the node. You can also update a node that has this value set to `NO` and set it to `YES` with the `update node` command.

The `MAXNUMMP` option restricts the number of tape mounts that a client can initiate. In order for the Tivoli Storage Manager client to use multiple sessions when sending backups to tape, the parameter `MAXNUMMP` must be equal to or greater than the number of sessions involved in the backup.

The `MAXNUMMP` option must not be set to a value greater than the actual number of physical drives defined to the Tivoli Storage Manager server. If the Data Protection module cannot acquire enough tape mounts, either because this value is set lower than the number of sessions, or because sufficient tape drives are not available, the backups may fail, or have to wait for one session to finish.

## 21.4 Server configuration considerations

The following are some recommendations for additional configuration on the Tivoli Storage Manager server to improve data protection backups and restores.

---

**Note for Tivoli Storage Manager for Databases, Data Protection for Oracle:** The administrator must run the `tdpoconf` utility program to set the password before using Data Protection for Oracle.

**Note for Informix:** The password specified in the `register node` command will be used with the `tdpipswd` program.

**Note for Tivoli Storage Manager for ERP, Data Protection for mySAP:** Tivoli Data Protection for mySAP has several password handling options. See the *Installation and User’s Guide* for more information about the options and their implications.

**Note for Data Protection for WebSphere Application Server:** When Data Protection for WebSphere Application Server is called to perform a backup or restore, it always uses the Tivoli Storage Manager API archive and retrieve functions. Tivoli Data Protection for WebSphere Application Server does not use the Tivoli Storage Manager API backup and restore functions.
Refer to the Data Protection module *Installation and User’s Guide* for more information.

**Tip: Informix:** To back up large Informix databases, edit the dsmserv.opt and increase `commttimeout` to about 300 and `idletimeout` to 30.

**Tip: Tivoli Storage Manager for Databases, Data Protection for MS SQL:**
- The `collocate` parameter for the storage pool assigned to the Data Protection for the MS SQL client node should be set to `filespace` to ensure that individual data stripes stay on separate removable volumes. The default value is `no`. Not doing so may require more operations to make the data for each stripe of a restore simultaneously accessible.
- The `txngroupmax` option in the dsmserv.opt file must be at least one more than the maximum number of stripes to be used for backup or restore operations regardless of media. The default value is 40.

**Tip: Tivoli Storage Manager for Mail, Data Protection for Lotus Domino:**
- To optimize the recover process, use collocation for the file space containing the transaction log files if they are stored on sequential media on the Tivoli Storage Manager server. The transaction log files are stored in a separate file space from the database files on the Tivoli Storage Manager server.

**Tip: Tivoli Storage Manager for Mail, Data Protection for MS Exchange**
- The `txngroupmax` parameter must have a value of 12 or greater.
- A single restore can require a full backup, a differential backup and/or multiple incremental backups. It is recommended to use collocation if these backups are stored on removable media. Use a collocation by file space if you plan to restore multiple storage groups in parallel. This is recommended because all data for any one storage group is required within one Storage Manager Server filespace.

**Tip: Tivoli Storage Manager for Advanced Copy Services**
- Increase the value of the `commttimeout` option in the dsmserv.opt file to 600 seconds to prevent a time-out from occurring during large database backups.
Tivoli Storage Manager upgrade considerations

In this chapter we cover some upgrade procedures for IBM Tivoli Storage Manager environment. We describe both general considerations and specifics of upgrade procedures on AIX and Windows platforms.
22.1 General upgrade considerations

When you move from one version of Tivoli Storage Manager to another, you are not just upgrading the server instance. The whole Tivoli Storage Manager environment consists of numerous components, such as tape devices, clients and storage agents, that might be affected by the server upgrade. Therefore, we will explain various consequences of the server migration to the rest of the environment and considerations you should take before upgrading the server.

Since the upgrade may involve hardware migration as well, we provide general techniques how to migrate from one tape technology to another one and what steps are needed to migrate data between libraries.

We show here a specific instance of upgrading to Tivoli Storage Manager V5.3.2; however in general, similar principles apply. Always carefully read any README files or flashes related to the version which you are upgrading to, as well as the Installation Guide manual, for any specific considerations.

22.1.1 Server

Generally, you can upgrade to Tivoli Storage Manager server V5.3.2 from any previous version. The amount of time needed to upgrade from V5.2 to 5.3.x is negligible, and the change in database size is also negligible. Versions older than V5.2 will take longer to upgrade and may cause an increase in database size. Essentially, the older the version relative to the new version, the longer the upgrade process will take. Therefore in general we recommend trying to stay as current as possible with product releases.

When upgrading multiple servers participating in library sharing to v5.3.x, the server acting as library manager must be upgraded first to maintain compatibility among the servers acting as library clients or storage agents. When upgrading multiple servers participating in server-to-server communication to V5.3.x, all servers must be upgraded at the same time.

Database

Before upgrading, perform a full backup of your database and save your Tivoli Storage Manager executables. If you need to revert to a previous release, you will have to restore from that database backup.

For AIX, Solaris, Linux, Windows, and HP-UX servers, the Tivoli Storage Manager database is automatically upgraded during the installation of the Tivoli Storage Manager V5.3.x server. After this database upgrade, you can no longer run a previous version of the server with the database, so to revert to a previous version, you would have to restore the corresponding database.
Bear in mind that if you upgrade to Tivoli Storage Manager 5.3.x from any previous release and you have Windows clients which backup their system objects, you should take specific actions to clean up the orphaned system object entries in the database. For details see the IBM Support Web site at:


**FILE volumes and Paths to FILE devices**

When the V5.3 server starts, existing FILE volumes in a FILLING state are marked as full. In V5.2.x and earlier servers, the server accepted a PATH definition for a local FILE Library and FILE drives, although it was not used in any way. Such definitions are not accepted by a V5.3 server and are rejected. This could be problematic if these definitions are contained in a devconfig file, and must be removed manually.

**Password length**

When the server database is upgraded to V5.3.0, the encryption level of stored passwords is converted from DES 56-bit to AES 128-bit. During the conversion, decrypted passwords are checked against the server minimum password length setting. If a password is shorter than the minimum length, an invalid password error message is issued and the database upgrade fails.

Passwords shorter than the minimum length can exist if the server's minimum password length setting has been changed. Changing the setting does not affect existing passwords. The new password length is only enforced when passwords are first registered or updated. Any previously created or expired passwords that do not meet the current length requirement are considered invalid during the database upgrade.

If there is any possibility that shorter passwords are stored in the server database, use the following upgrade procedure:

1. Temporarily set the minimum password length to zero (0). To change the minimum password length, you can use either the Administration Center or the SET MINPWLENGTH command.
2. Back up the current server database.
3. Install the new version of Tivoli Storage Manager.
4. Reset the minimum password length to the desired value.

**Transition version of administrative Web interface**

The Administrative Web interface has been replaced with a completely new Web-based interface called Administration Center. Together with the Integrated Solution Console (ISC) that provides a framework for Administration Center, you can administer all Tivoli Storage Manager V5.3 and higher servers from a single
point. Administration Center is independent of the Tivoli Storage Manager instance - it may run on the same system as a server, or on a separate system entirely. Since the Administration Center does not support previous versions of the Tivoli Storage Manager, (prior to V5.2), you are still required to administer those using the old administrative Web interface. The old administrative Web interface will not be enhanced or have defect support.

**Discontinued server platforms support**

The following Tivoli Storage Manager server operating systems supported in V5.2 were not migrated to V5.3 and are not supported in V5.3:

- OS/390 V2R10 and z/OS V1R1, V1R2, and V1R3
- z/VM® (you may want to migrate your IBM Tivoli Storage Manager z/VM servers to Linux)
- HP-UX 11.0
- Red Hat Enterprise Linux Server 2.1
- SLES 7
- OS/400 PASE

### 22.1.2 Clients and Data Protection modules

As part of a migration plan from Tivoli Storage Manager V5.2 to V5.3.x, the clients and servers may be upgraded at different times. However, to help prevent disruption to the your backup and archive activities during the migration, note the following:

- V5.2 clients can perform backup, restore, archive, and retrieve functions to a Tivoli Storage Manager V5.3 server.
- V5.3 clients can perform backup, restore, archive, and retrieve functions to a Tivoli Storage Manager V5.2 server, including V3.1-level functions to a Tivoli Storage Manager V3.1 server on VM.
- V5.2 HSM clients can perform migrate and recall functions to a Tivoli Storage Manager V5.3 server.
- V5.3 HSM clients can perform migrate and recall functions to a Tivoli Storage Manager V5.2 server.
- Data that was backed up from a V5.3 client to a Tivoli Storage Manager server can be restored using a V5.2 client, except for files backed up using 128-bit encryption.
- Data that was backed up from a V5.1 or V5.2 client to a Tivoli Storage Manager server can be restored using a Tivoli Storage Manager V5.3 client.
- V5.2 and V5.3 command line administrative clients can administer Tivoli Storage Manager V5.2 and V5.3 servers, and the V3.1 VM server.
- The Motif native GUI on UNIX clients was not migrated to V5.3. The Java GUI client should be used instead.
Error log behavior change

Beginning with V5.3, client applications will not run without a writable log. If you start `dsmadmc` or `dsmc` as non-root, and if the option `ERRORLOGNAME` in `dsm.sys` points to a file that is not writable by non-root users, error message ANS1398E is displayed and the session does not start.

The following new rules apply (using `dsmerror.log` as an example, but all logs are treated equally). The different error logs for the backup-archive client are explained in “Environment variables” on page 108 under `DSM_LOG`:

1. If the log does not exist, it will be created as follows (with default permissions):
   - With the name and in the directory specified in the `ERRORLOGNAME` option.
   - If the `ERRORLOGNAME` option is absent, the log will be created with the name `dsmerror.log` in the directory specified in the `DSM_LOG` environment variable, if present.
   - Otherwise, the log will be created with the name `dsmerror.log` in the current working directory.
   - Because default permissions are used, a log created by the root user might not be writable by any other user. If this is the case, the root user must set the proper permissions or ACLs to allow free use of the Tivoli Storage Manager application by all users who need to use it.

2. If the log is successfully created, an error-free session will leave a zero-length (empty) log file.

3. The client does not attempt to create logs in the root directory. ANS1398E is displayed when the method in rule 1 directs the log file to be created in the root directory.

4. If a log file exists and can be located using the method in rule 1, it will be used (and it can be in the root directory if you choose). Furthermore, whatever permissions you give that log file will be preserved by Tivoli Storage Manager.

It is recommended that you create your log file before running the client, to make sure all eligible users have write access to that log. Use the `ERRORLOGNAME` option or the `DSM_LOG` environment variable to designate your predefined log file.

Further, certain background Tivoli Storage Manager applications might fail to start due to errors writing to `dsmerror.log`. When these errors occur, a number of errors are recorded in the Windows event log (the System log on other platforms). An example is an error indicating that `dsmerror.log` could not be written to, as shown in Example 22-1 on page 700.
Example 22-1   Scheduler service fails to start due to errors writing to dsmerror.log

C:\Program Files\Tivoli\Tsm\baclient>net start “TSM Sched”
The TSM Sched service is starting.
The TSM Sched service could not be started.
A service specific error occurred: 12.

Additional setup steps are required for non-root users to run Tivoli Storage Manager applications or Tivoli Storage Manager for Data Protection applications. You will receive the ANS1398E error if you attempt to run Tivoli Storage Manager applications using an error log which has already been generated by root that is left with default permissions. For data protection clients, you might only receive a Tivoli Storage Manager API error.

Here is one method for setting up dsmerror.log for use by non-root users:

1. Set ERRORLOGNAME in dsm.sys. For example, enter errorlogname /var/msgs/tsm/dsmerror.log.

2. Generate a starter dsmerror.log by issuing dsmc query session command.

3. Modify the permissions on dsmerror.log to allow writing by all users, for example by entering chmod 666 /var/msgs/tsm/dsmerror.log command.

Discontinued client platforms support
The following clients or client operating system levels were not migrated to V5.3. The V5.2 clients that support these operating systems can be used with the V5.3 Tivoli Storage Manager servers.

- Macintosh 10.1, 10.2
- Linux IA64
- HP-UX 11.0
- Linux Red Hat Advanced Server 2.1
- SLES 7
- NetWare 6.0
- Solaris 7
- OS/400 V5R1 (API client)
- OS/390 V2R10 and z/OS V1R1, V1R2, and V1R3
- SGI
- Tru64 UNIX
- Windows NT®
- AIX AFS/DFS

The V5.2 clients can be downloaded from the Tivoli Storage Manager support Web page at:

http://www.ibm.com/support/search.wss?tc=SSGSG7&rs=663&rank=8&dc=D400&d tm
Data Protection for Informix
The Data Protection for Informix component of Tivoli Storage Manager for Databases, which is supported in V5.2, was not migrated to V5.3 and is not supported in V5.3. The latest release of IBM Informix Dynamic Server (IDS), is automatically enabled to back up to Tivoli Storage Manager and does not require Tivoli Storage Manager for Databases. If you are using previous versions of IDS and want the Data Protection for Informix component, you can only obtain it by separately purchasing Tivoli Storage Manager for Databases V5.2.

22.1.3 Storage Agent

Only Storage Agents V5.2.3, 5.2.4 (and later), and 5.3.x are supported by Tivoli Storage Manager V5.3.x. Before moving to V5.3, you must ensure your Storage Agents are upgraded to one of these levels.

Note that Storage Agents at the Version 5.2.x level can not access shared FILE volumes (using SANergy®) on 5.3.x servers using LAN-free protocols. Requests by 5.2.x Storage Agents are automatically re-directed to the server and handled using LAN protocols.

Discontinued Storage Agent platforms
The following Tivoli Storage Manager Storage Agent operating systems, supported in V5.2, were not migrated to V5.3 and are not supported in V5.3:
- HP-UX 11.0
- Red Hat Enterprise Linux Server 2.1
- SLES 7

22.2 Server upgrade best practices

When planning to upgrade your server, we recommended to have a standby machine where the upgrade procedure and additional steps may be thoroughly tested and reviewed before rolling the upgrade procedure on the production server.

22.2.1 Server quiesce

Before upgrading the server, the server instance should be as idle as possible. Consider the following:

1. Perform the scheduled upgrade during a period of little of no activity if possible.
2. Change the migration thresholds on the disk pools so as to move all the data to the tape pools before starting the upgrade.
3. Make a copy or your server options file, dsmserv.opt
4. Disable central scheduler (add DISABLESCHEDS YES to dsmserv.opt)
5. Cancel all remaining processes and sessions (issue disable sessions command)
6. Add to the dsmserv.opt file EXPINTERVAL 0 which keeps expiration from running at start up.
7. Add to the dsmserv.opt file NOMIGRRECL option which keeps both migration and reclamation from running on the server at startup. Note, this is an undocumented command.
8. After you complete the upgrade, you can merge the original server options file to the current version, since some default options may have changed.

### 22.2.2 Backing up important components

Now, when the server is idle, you may proceed with the preparation steps, as follows:

1. Backup your primary disk and sequential storage pools.
2. Backup your server database.
3. Backup device configuration file (devconfig).
5. Make a copy of the dsmserv.dsk file(s) and keep in safe place, since it contains database and recovery log volumes’ file names and locations.
6. Make a copy of the dsmserv.opt file(s) and keep in safe place, it contains all your server instance options. Note if you already made the recommended changes to the server options file as described in the previous section, you should already have saved a copy of the file.
7. Halt your server instance.

### 22.2.3 Upgrading the server

Once the server instance is halted, you may perform the upgrade. This procedure differs among platforms, since each supported operating system has its native way to install software packages.

Nevertheless, one common approach applies to all platforms. When upgrading the server we distinguish between applying maintenance (base) and patch (fix) packages.
The base level code must applied first, then the patch level may be installed. Hence, if you intend to upgrade your server from version 5.2.7.0 to 5.3.2.2, you must first upgrade to the base level, that is to 5.3.2.0, and subsequently apply the 5.3.2.2 patch.

Then, after applying the base level, we recommend to start your server instance in foreground to see whether a database upgrade is required. If so, upgrade the database using `dsmserv upgrade` command and then go on with applying the appropriate patch to your server.

### 22.2.4 Testing new updates

After successfully upgrading your server instance, you should test the upgraded server instance as follows:

1. Start your server instance in foreground and watch for any suspicious behavior and messages during startup in the console window
2. Disable client sessions immediately after server startup
3. Verify license status
4. If device drivers were upgraded/installed as well, redefine paths
5. Test your library and tape drives, Once drives/paths are defined and on-line, test with the `move data` command to verify volumes can be mounted (in the correct drive) and can be read and written. Move data on a volume with a small amount of data.
6. Review any changed default server options, as well as new options and test them in your environment.

If your upgrade is successful and you are not experiencing any difficulties, you should backup your database along with other important files before re-enabling production mode.

### 22.2.5 Enable production mode

If your upgraded server instance seems to be in order, you may take the server out of idle state by following:

1. Remove `nomigrrecl` and `disablescheds` options and change `expinterval` to desired value, in the dsmserv.opt file.
2. Raise the migration thresholds of your storage pools to the desired value.
3. Restart your server instance
4. Run client tests - try backing up and restoring an object or filespace.
Following these outlined recommendations should make your upgrade procedure uncomplicated and safer, since you have your database along with other supporting files backed up. Should an upgrade procedure fail, you are able to bring your server instance back to the original level using these backed components.

We will now show some sample server upgrade procedures.

### 22.3 Performing server upgrades

In this section we discuss specific steps for upgrading Tivoli Storage Manager server V5.2 running on Windows 2003 and AIX 5.3 to the latest version available at the time of writing the book, that is 5.3.2.2. For more information, refer to the IBM Tivoli Storage Manager Installation Guide manual for your server platform.

Bear in mind that whenever you are about to upgrade your Tivoli Storage Manager server, then prior to migration, you need to back up the following items:

1. The IBM Tivoli Storage Manager database (*backup db*)
2. The volume history file (*backup volhist*)
3. The device configuration file (*backup devconfig*)
4. The dsmserv.opt file
5. The dsmserv.dsk file

You should also consider that the later versions contain more features and might therefore require additional database space. We recommend that you increase your database size by 5% prior to migration and reduce it after the migration when the database space has stabilized.

Make sure that the current storage devices you are using are supported by the new Tivoli Storage Manager version. Refer to the device support section of the Tivoli Storage Manager Web site at:


### 22.3.1 Migration on Windows

The objective of the test is to migrate Tivoli Storage Manager server V5.2.7.0 to V5.3.2.2. Before upgrading our server, we checked V5.3 server specific requirements and support on the Web site:

We used a Windows 2003 server with an IBM 3582 LTO library. Figure 22-1 on page 705 shows the setup in our test environment.

Generally, you can install a new Tivoli Storage Manager server version over a previous version of the server. This is called a **migrate install**. This means, you do not need to uninstall the previous server before applying a new one, since this is done automatically by the migration procedure.

When you upgrade multiple servers participating in library sharing to V5.3, the servers acting as library manager must be upgraded first to maintain compatibility among the servers acting as library clients or Storage Agents. When you upgrade multiple servers participating in server-to-server communication to V5.3, all servers must be upgraded at the same time.

**Migration procedure**

As a general rule, follow the recommendations in 22.1, “General upgrade considerations” on page 696, that is, quiesce the server instance and then backup the database and supporting files.
Apart from those, you should consider cleaning up the database by running the **expire inventory** command. Also, if your server is currently at a release earlier than V5.2, there might be additional steps you should take in preparation for upgrading to V5.3, such as expiration of system object filespaces. If you do not back up Windows clients or do not back up **system objects** on the Windows client, you are not affected by this problem. For details on these steps, see following IBM Web site:


**Note:** When migrating to Tivoli Storage Manager V5.3, the time necessary to install the packages can be considerable, depending on the number of Windows clients registered. The more Windows clients registered, the longer it will take to install the package.

Once you finished the preparation phase, you may start the migration running the Tivoli Storage Manager setup wizard. Keep in mind that base level (that is 5.3.2) must be installed first and then you may apply the patch (5.3.2.2).

Also note that installation will be stopped and error message in Figure 22-2 will display if a running server or Storage Agent process is detected. All active servers must be halted before installation can proceed.

![IBM Tivoli Storage Manager Server 5.3.2.0 Installer Info](image)

A previous version of the IBM Tivoli Storage Manager Server or Storage Agent is currently running. Please stop this service before continuing.

**Figure 22-2  Migration failure due to running server process**

Generally, you should upgrade your server environment using following sequence:

- Server
- Server Licenses
- Language Packs, if needed
- Device Driver, if needed (requires reboot)
Your database is automatically upgraded during migration, see Figure 22-3.

![Figure 22-3 Automatic server instance upgrade during migration](image)

Licensing has changed in V5.3. Although the server still reports the number of various clients in use, you no longer have to explicitly register licenses per client type. Instead, you have three licenses files available:

- `tsmbasic.lic` for Basic Edition of the server
- `tsmee.lic` for Extended edition of the server
- `dataret.lic` for IBM System Storage Archive Manager

The installation wizard will automatically perform conversion to the required license status, since it removes the license files first and subsequently installs new license package. You can see the server license status in the bottom of server console output, as shown in Example 22-2 on page 708.

Note that, if you upgraded the Tivoli Storage Manager Device Driver as well, the installation wizard requires reboot of the machine, see Figure 22-4 on page 708.
After you have all packages installed and the machine is rebooted, start the server instance in foreground, as shown in Example 22-2. If everything seems to be in order and you are not getting any errors, halt the server by entering `halt` command on the console prompt and continue applying the 5.3.2.2 patch.

Example 22-2  Server startup on the foreground

```
C:\Program Files\Tivoli\TSM\server>dsmserv
ANR0900I Processing options file c:\program files\tivoli\tsm\server1\dsmserv.opt.
ANR7800I DSMSERV generated at 11:34:40 on Sep 27 2005.

Tivoli Storage Manager for Windows
Version 5, Release 3, Level 2.0

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ANR4726I The ICC support module has been loaded.
ANR0990I Server restart-recovery in progress.
ANR0200I Recovery log assigned capacity is 200 megabytes.
ANR0201I Database assigned capacity is 4096 megabytes.
ANR0306I Recovery log volume mount in progress.
ANR0285I Database page shadowing started using file dbpgshdw.bdt.
ANR0353I Recovery log analysis pass in progress.
ANR0354I Recovery log redo pass in progress.
ANR0355I Recovery log undo pass in progress.
ANR0352I Transaction recovery complete.
ANR1635I The server machine GUID, 57.47.aa.41.98.e8.11.da.81.34.00.0d.60.49.4c-.39, has initialized.
ANR2100I Activity log process has started.
ANR4726I The NAS-NDMP support module has been loaded.
```
Applying the patch level, in our case 5.3.2.2, is straightforward and practically the same process as the installation of base level. The only difference is that patches lacks license and language packs, so you need to upgrade only your server and device driver code.

During upgrade, the installation wizard performs necessary updates to the server code, as shown in Figure 22-5.
Following a successful server upgrade you may patch the Tivoli Storage Manager Device Drivers, if used. However, this requires another reboot of the machine.

Again, after the server upgrade, you should follow the recommendations described in section 22.2.4, “Testing new updates” on page 703. That essentially means starting the server, either in foreground or background, observing the server console output for any unusual messages and errors, redefining your paths if devices have changed during device drivers update. Last but not least you should test that your drives can read and write data by moving a volume’s data.

If your verification tests do not reveal any problems, you may enable your server for production by following steps in section 22.2.5, “Enable production mode” on page 703.

Finally, you should backup your storage pools and database and create a new disaster recovery plan file. Refer to the IBM Tivoli Storage Manager for Windows Administrator’s Guide, GC32-0782 for more information.

22.3.2 Migration on AIX 5L

Our environment, as illustrated in Figure 22-6 on page 711, consists of an AIX 5.3 system called BANDA connected together with an IBM 3582 library to the SAN. The objective of the test is to describe the migration of Tivoli Storage Manager from V5.2.2.0 to V5.3.2.2.

The minimum supported version of AIX 5L by Tivoli Storage Manager V5.3 is AIX 5.1. You can install Tivoli Storage Manager V5.3 over a previous version without uninstalling it first.

The installation procedure uninstalls the old filesets on its own, then applies new filesets.

However, If you are running the 32-bit version of Tivoli Storage Manager V5.2 in a 64-bit AIX kernel environment, you must uninstall your current version and then install the appropriate Tivoli Storage Manager V5.3 packages for the 64-bit kernel environment.

The same approach applies to the reverse case. If you are running the 64-bit version of Tivoli Storage Manager V5.2 in a 32-bit AIX kernel environment, you must uninstall your current version and then install the appropriate Tivoli Storage Manager V5.3 packages for the 32-bit kernel environment.

For an overview of which packages to install in different environments, see Table 22-1 on page 712.
In any case, we recommend you to thoroughly check software and hardware requirements for Tivoli Storage Manager V5.3 on the IBM Web site:


**Note:** If installing Tivoli Storage Manager V5.3 on AIX V5.1, you must first upgrade the C++ Runtime for AIX to V6 (xC.rte.6.0.0.0 and later). This fileset is installed by default on AIX 5.2 and higher.
Table 22-1  Software to Install for different AIX environments

<table>
<thead>
<tr>
<th>Environment</th>
<th>Software Packages to Install</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>tivoli.tsm.devices.acsls - STK Silo support (optional)</td>
</tr>
<tr>
<td></td>
<td>tivoli.tsm.devices.aix5.rte - Device support</td>
</tr>
<tr>
<td></td>
<td>tivoli.tsm.server.com - Server samples and diagnostic utilities</td>
</tr>
<tr>
<td></td>
<td><strong>tivoli.tsm.server.rte</strong> - Server runtime</td>
</tr>
<tr>
<td></td>
<td>tivoli.tsm.msg.en_US.server - Message Library and Help</td>
</tr>
<tr>
<td></td>
<td>tivoli.tsm.msg.en_US.devices - SMIT menu catalogs</td>
</tr>
<tr>
<td></td>
<td><strong>tivoli.tsm.license.rte</strong> - License enablement module</td>
</tr>
<tr>
<td></td>
<td>tivoli.tsm.license.cert - License certificates</td>
</tr>
<tr>
<td></td>
<td>tivoli.tsm.server.webcon - redirecting webmod to AdminCenter</td>
</tr>
<tr>
<td>64-bit AIX kernel</td>
<td>tivoli.tsm.devices.acsls - STK Silo support (optional)</td>
</tr>
<tr>
<td></td>
<td>tivoli.tsm.devices.aix5.rte - Device support</td>
</tr>
<tr>
<td></td>
<td>tivoli.tsm.server.com - Server samples and diagnostic utilities</td>
</tr>
<tr>
<td></td>
<td><strong>tivoli.tsm.server.aix5.rte64</strong> - Server Runtime</td>
</tr>
<tr>
<td></td>
<td>tivoli.tsm.msg.en_US.server - Message Library and Help</td>
</tr>
<tr>
<td></td>
<td>tivoli.tsm.msg.en_US.devices - SMIT menu catalogs</td>
</tr>
<tr>
<td></td>
<td><strong>tivoli.tsm.license.aix5.rte64</strong> - License enablement module</td>
</tr>
<tr>
<td></td>
<td>tivoli.tsm.license.cert - License certificates</td>
</tr>
<tr>
<td></td>
<td>tivoli.tsm.server.webcon - redirecting webmod to AdminCenter</td>
</tr>
<tr>
<td>If running server in</td>
<td>tivoli.tsm.msg.&lt;your-language&gt;.server - Message Library and Help</td>
</tr>
<tr>
<td>a language other</td>
<td></td>
</tr>
<tr>
<td>than US English</td>
<td>tivoli.tsm.msg.&lt;your-language&gt;.devices - SMIT menu catalogs</td>
</tr>
</tbody>
</table>

The database is automatically upgraded during a migrate installation. However, if you are running additional Tivoli Storage Manager server instances server on the same system, you have to perform a manual database upgrade for each instance using `dsm servant db` command.

If you are using Tivoli Storage Manager server in an HACMP cluster and want to migrate to V5.3 from any previous version, you will need to convert to the new startserver script. Device resets are no longer performed by the startserver script. They are now done by the server during initialization of the library. If the `resetdrives` parameter is set to `yes` for a library, then the reset will be performed on the library manager for the library and all drives defined to it. If a library is defined as `shared`, the `resetdrives` parameter automatically defaults to `yes` for the library. Otherwise, you can run the `update library` command with `resetdrives=yes`. More information on HACMP with Tivoli Storage Manager is in the chapter “High availability clustering” in *IBM Tivoli Storage Management Concepts*, SG24-4877.
Migration procedure

We will show the procedure to upgrade a Tivoli Storage Manager server V5.2.2.0 to V5.3.2.2 on AIX Version 5.3. As described earlier, migration is a two-step process. First we must install the base level (5.3.2) and then the fix level (5.3.2.2).

Example 22-3 shows the currently installed Tivoli Storage Manager filesets on Banda before the upgrade. Since we have the 64-bit AIX kernel, we are using 64-bit server filesets. If we had been using the 32-bit filesets in our 64-bit AIX kernel, we would have to uninstall those and install new appropriate filesets as described in Table 22-1 on page 712.

Example 22-3  IBM Tivoli Storage Manager version 5.2.2.0 filesets on BANDA

```
root@banda> lslpp -L | grep -i tivoli
tivoli.tsm.devices.aix5.rte
  5.2.2.0  C  F  IBM Tivoli Storage Manager

tivoli.tsm.license.aix5.rte64
  5.2.2.0  C  F  IBM Tivoli Storage Manager

tivoli.tsm.license.cert
  5.2.2.0  C  F  IBM Tivoli Storage Manager

tivoli.tsm.loc.server.ela
  5.2.2.0  C  F  IBM Tivoli Storage Manager

tivoli.tsm.msg.en_US.devices
  5.2.2.0  C  F  IBM Tivoli Storage Manager

tivoli.tsm.msg.en_US.webhelp
  5.2.2.0  C  F  IBM Tivoli Storage Manager

Web

tivoli.tsm.server.aix5.rte64
  5.2.2.0  C  F  IBM Tivoli Storage Manager

tivoli.tsm.server.com
  5.2.2.0  C  F  IBM Tivoli Storage Manager

tivoli.tsm.server.webadmin
  5.2.2.0  C  F  IBM Tivoli Storage Manager
```

Before you begin with the actual server migration, follow the outlined steps in 22.2, "Server upgrade best practices" on page 701, particularly those related to quiescing your server instance and backing up all necessary components of your server.

Apart from those, you should know that the Tivoli Storage Manager device definitions might not be preserved after migration. Therefore, after the installation you may have to redefine Tivoli Storage Manager devices. We recommend you record your current device definitions to a text file before you begin the installation as shown below:

```
lsdev -Cs fcp > definitions.fcp
lsdev -Cs scsi > definitions.scsi
```
Also note, that a migrate installation will not normally create a new database, recovery log, and storage pool volumes. However, if dsmserv.dsk is not in the /usr/tivoli/tsm/server/bin directory, the installation creates the following volumes in the /usr/tivoli/tsm/server/bin directory:

- Database volume (db.dsm)
- Recovery log volume (log.dsm)
- Storage pool volumes (backup.dsm, archive.dsm, and spcmgmt.dsm)

To use your existing database, recovery log, and storage pool volumes, ensure that a copy of the dsmserv.dsk file is in /usr/tivoli/tsm/server/bin and the file system is mounted before you do a migrate installation. You must not move the database, recovery log, and storage pool volumes.

Once you have finished all recommended steps, you must stop all your running Tivoli Storage Manager server instances, either using the administrative CLI `halt`, or operating system `kill` command. We ensured that our server instance is not running as shown in the Example 22-4.

**Example 22-4  Server instance is not running**

```
# ps -ef | grep dsmserv
   root 426034 434374   0 09:06:43 pts/7  0:00 grep dsmserv
```

Provided that you have your installation media ready, you may begin with the migration procedure. Start SMIT and select **Software Install and Maintenance → Install and Update Software → Install and Update from ALL Available Software**.

Specify the INPUT device/directory, select SOFTWARE to Install - Select the appropriate filesets to install for your configuration (see Table 22-1 on page 712, Set “COMMIT software updates?” to Yes, “SAVE replaced files?” to No, and “Accept new LICENSE agreements?” to Yes.

**Note:** You cannot reject a fileset once installed, you will have to uninstall it if needed.

Following a successful fileset installation using SMIT, you get SMIT output as shown in Example 22-5 on page 715.
Example 22-5  SMIT installation summary report

<table>
<thead>
<tr>
<th>Name</th>
<th>Level</th>
<th>Part</th>
<th>Event</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>tivoli.tsm.server.com</td>
<td>5.3.2.0</td>
<td>USR</td>
<td>APPLY</td>
<td>SUCCESS</td>
</tr>
<tr>
<td>tivoli.tsm.server.com</td>
<td>5.3.2.0</td>
<td>ROOT</td>
<td>APPLY</td>
<td>SUCCESS</td>
</tr>
<tr>
<td>tivoli.tsm.server.aix5.rte6</td>
<td>5.3.2.0</td>
<td>USR</td>
<td>APPLY</td>
<td>SUCCESS</td>
</tr>
<tr>
<td>tivoli.tsm.server.aix5.rte6</td>
<td>5.3.2.0</td>
<td>ROOT</td>
<td>APPLY</td>
<td>SUCCESS</td>
</tr>
<tr>
<td>tivoli.tsm.loc.server.ela</td>
<td>5.3.2.0</td>
<td>USR</td>
<td>APPLY</td>
<td>SUCCESS</td>
</tr>
<tr>
<td>tivoli.tsm.license.cert</td>
<td>5.3.2.0</td>
<td>USR</td>
<td>APPLY</td>
<td>SUCCESS</td>
</tr>
<tr>
<td>tivoli.tsm.license.aix5.rte</td>
<td>5.3.2.0</td>
<td>USR</td>
<td>APPLY</td>
<td>SUCCESS</td>
</tr>
<tr>
<td>tivoli.tsm.devices.acsls</td>
<td>5.3.2.0</td>
<td>USR</td>
<td>APPLY</td>
<td>SUCCESS</td>
</tr>
<tr>
<td>tivoli.tsm.devices.acsls</td>
<td>5.3.2.0</td>
<td>ROOT</td>
<td>APPLY</td>
<td>SUCCESS</td>
</tr>
<tr>
<td>tivoli.tsm.server.webcon</td>
<td>5.3.2.0</td>
<td>USR</td>
<td>APPLY</td>
<td>SUCCESS</td>
</tr>
<tr>
<td>tivoli.tsm.devices.aix5.rte</td>
<td>5.3.2.0</td>
<td>USR</td>
<td>APPLY</td>
<td>SUCCESS</td>
</tr>
<tr>
<td>tivoli.tsm.devices.aix5.rte</td>
<td>5.3.2.0</td>
<td>ROOT</td>
<td>APPLY</td>
<td>SUCCESS</td>
</tr>
<tr>
<td>tivoli.tsm.msg.en_US.device</td>
<td>5.3.2.0</td>
<td>USR</td>
<td>APPLY</td>
<td>SUCCESS</td>
</tr>
<tr>
<td>tivoli.tsm.msg.en_US.server</td>
<td>5.3.2.0</td>
<td>USR</td>
<td>APPLY</td>
<td>SUCCESS</td>
</tr>
</tbody>
</table>

After your new filesets are applied, verify that any previous version filesets are removed, as shown in Example 22-6, and that you have only 5.3 filesets installed.

Example 22-6  Listing of installed base level server filesets

```
root@banda> lslpp -L | grep -i tivoli
  tivoli.tsm.devices.acsls   5.3.2.0    C     F    IBM Tivoli Storage Manager
  tivoli.tsm.devices.aix5.rte 5.3.2.0    C     F    IBM Tivoli Storage Manager
  tivoli.tsm.license.acsls   5.3.2.0    C     F    IBM Tivoli Storage Manager
  tivoli.tsm.license.aix5.rte64 5.3.2.0    C     F    IBM Tivoli Storage Manager 64
  tivoli.tsm.license.cert    5.3.2.0    C     F    IBM Tivoli Storage Manager
  tivoli.tsm.loc.server.ela  5.3.2.0    C     F    IBM Tivoli Storage Manager
  tivoli.tsm.msg.en_US.devices 5.3.2.0    C     F    IBM Tivoli Storage Manager
  tivoli.tsm.msg.en_US.server 5.3.2.0    C     F    IBM Tivoli Storage Manager
```

Now you may start the server instance on the foreground to check whether database upgrade was performed or if are required to do it manually using `dsmcrsv upgradedb` command. In most cases, database upgrade should be performed as part of the migration automatically.
After verifying the server, you need to halt the server again and proceed with the applying the fix level to your base level server.

In contrast to base level installation, you do not need to run SMIT installation using *Install and update from ALL available software* option. Instead, just type `smitty update_all` on the shell prompt and follow the SMIT screens to apply your patch filesets.

When your installation is finished, you may review the installed filesets level using `lslpp -L` command, as shown on Example 22-7 below.

**Example 22-7  Listing of server filesets after applying the patch level**

```
root@banda> lslpp -L | grep -i tivoli
  tivoli.tsm.devices.acsls   5.3.2.2    C     F    IBM Tivoli Storage Manager
  tivoli.tsm.devices.aix5.rte 5.3.2.2    C     F    IBM Tivoli Storage Manager
  tivoli.tsm.license.aix5.rte64 5.3.2.0    C     F    IBM Tivoli Storage Manager 64
  tivoli.tsm.license.cert  5.3.2.0    C     F    IBM Tivoli Storage Manager
  tivoli.tsm.loc.server.ela  5.3.2.0    C     F    IBM Tivoli Storage Manager
  tivoli.tsm.msg.en_US.devices 5.3.2.2    C     F    IBM Tivoli Storage Manager
  tivoli.tsm.msg.en_US.server 5.3.2.2    C     F    IBM Tivoli Storage Manager
  tivoli.tsm.server.aix5.rte64 5.3.2.2    C     F    IBM Tivoli Storage Manager 64
  tivoli.tsm.server.com  5.3.2.2    C     F    IBM Tivoli Storage Manager
  tivoli.tsm.server.webcon  5.3.2.2    C     F    IBM Tivoli Storage Manager Web
```

Note that license filesets are not upgraded to the V5.3.2.2 since they were not part of the fix packages and they do not need explicit update.

Now you should follow the steps described in 22.2.4, “Testing new updates” on page 703. If the migration was successful, enable your server for production on as described in 22.2.5, “Enable production mode” on page 703.

In Example 22-8 we show startup of our upgraded server instance. As you can see, the server is properly licensed and the migration was successful.

**Example 22-8  Upgraded server startup on the foreground**

```
root@banda> ./dsmerv

Tivoli Storage Manager for AIX-RS/6000
Version 5, Release 3, Level 2.2
```
22.4 Performing client upgrades

In this section we discuss the steps for upgrading clients to V5.3.2 on AIX and Windows platforms. For more information, refer to the *IBM Tivoli Storage Manager Backup-Archive Client Installation and User's manual* for your platform.

In contrast to server upgrade process, you can directly install the desired version of the client, there is no need to install base level first and then patch level.
You may want to keep a separate copy of your client options files: dsm.opt for Windows, dsm.opt and dsm.sys for UNIX/Linux before migration. In any case, these files will not be overwritten during the upgrade, as long as they exist in the installation directory.

For client hardware and software requirements and supported file systems see the Tivoli Storage Manager client support Web site at:

http://www.ibm.com/support/search.wss?rs=663&tc=SSGSG7&atrn=Keywords&atrv=ClientRequirements

### 22.4.1 Windows

Tivoli Storage Manager supports a wide variety of Windows server and workstation operating systems. For detailed requirements see the web site:


Essentially, you may directly install desired client level over any previous client version. The InstallShield Wizard removes the previous client code and installs new version.

Before you start with the migration, stop any client related processes, such client scheduler, or Web client.

The upgrade will not replace existing client files, such as dsm.opt, dsmerror.log, dsmsched.log and dsmwebcl.log. Depending on the features chosen to be installed, the InstallShield Wizard may ask to reboot the machine after the installation is finished. This is the case, when you specify to install or upgrade Image Backup and Open File Support client components.

After the upgrade is done, you may start the backup-archive client GUI or CLI interface to check whether the installation was successful and subsequently restart client services, such as web client and scheduler.

### 22.4.2 AIX 5L client upgrade

Below we describe procedure to upgrade the client from V5.2.2.9 to 5.3.2.0.

Tivoli Storage Manager V5.3 backup-archive client code requires at least AIX V 5.1 installed. Detailed requirements for installing client on AIX 5L can be found at:

Essentially, before you attempt to migrate your client version, ensure there are no client processes running on the system, such as client scheduler, web client or that no user is performing any operation using backup-archive client, as shown in Example 22-9.

Example 22-9  Check client processes

root@banda> ps -ef | grep dsmc
   root 430112 434374   0 14:49:28 pts/7  0:00 grep dsmc

Client packaging has changed since V5.2. There are now two separate backup-archive client packages, called Client for JFS and Client for JFS2, depending on the AIX file system type you are using.

The Tivoli Storage Manager Client for JFS2 is not compatible with the Tivoli Storage Manager Client for JFS or GPFS. You first need to remove the Tivoli Storage Manager Client for JFS or GPFS before you install the Tivoli Storage Manager Client for JFS2.

Our Banda machine has 32-bit 5.2.2 client filesets installed, as shown in Example 22-10.

Example 22-10  Client V5.2.2 filesets

root@banda> lslpp -L | grep -i tivoli | grep -iE "client|books"
  tivoli.tsm.books.en_US.client.htm
  tivoli.tsm.books.en_US.client.pdf
  tivoli.tsm.client.api.32bit
  tivoli.tsm.client.ba.32bit.base
  tivoli.tsm.client.ba.32bit.common
  tivoli.tsm.client.ba.32bit.image
  tivoli.tsm.client.ba.32bit.nas
  tivoli.tsm.client.ba.32bit.web

If you try to install JFS2 client over the old JFS client, your installation will fail, as illustrated in the Example 22-11

Example 22-11  Client installation failure when installing JFS2 over JFS client

Performing Pre-Installation tasks for the TSM API Client.
#*****************************************************************************#
  tivoli.tsm.client.api.jfs2 and tivoli.tsm.client.api.32bit
  can not be installed together. You must choose which one to
  install. Aborting installation of fileset:
  tivoli.tsm.client.api.jfs2.
#*****************************************************************************#
instal: Failed while executing the tivoli.tsm.client.api.jfs2.pre_i script.
Therefore, we must uninstall them first following SMIT menus, **Software Installation and Maintenance → Software Maintenance and Utilities → Remove Installed Software.**

When you supply fileset names, software uninstallation occurs. Note that client uninstall will not remove client configuration files.

Once the filesets are removed, you may proceed with the installation of the new client version filesets using following SMIT menus: **Software Installation and Maintenance → Install and Update Software → Install and Update from ALL Available Software.**

Supply the device or directory name from which the filesets are to be installed, and choose which filesets to install.

We installed the following filesets:

tivoli.tsm.client.ba.jfs2
tivoli.tsm.client.api.jfs2
tivoli.tsm.books.en_US.client.htm

The tivoli.tsm.client.ba.jfs2 fileset contains the following packages:

tivoli.tsm.client.ba.jfs2.base
tivoli.tsm.client.ba.jfs2.common
tivoli.tsm.client.ba.jfs2.image
tivoli.tsm.client.ba.jfs2.nas
tivoli.tsm.client.ba.jfs2.web

When the installation is done, restart the client processes such as client scheduler or web client. In Example 22-12 on page 720, we started the client CLI to verify the installation was correct and successful.

*Example 22-12   Upgraded version of the AIX client*

root@banda> dsmc
IBM Tivoli Storage Manager
Command Line Backup/Archive Client Interface
   Client Version 5, Release 3, Level 2.0
   Client date/time: 03/01/06   14:42:33
(c) Copyright by IBM Corporation and other(s) 1990, 2005. All Rights Reserved.

Node Name: BANDA
Session established with server LOCHNESS_SERVER1: Windows
   Server Version 5, Release 3, Level 2.2
   Server date/time: 03/01/06   14:38:17  Last access: 03/01/06   14:06:34
22.5 Storage Agent upgrade

Generally, Storage Agent upgrade is a similar process to the server upgrade. However, since Storage Agent does not have its own database, or license files, the migration is easier and faster. Further, you do not need to apply base level first and then fix level, you can directly upgrade to the desired Storage Agent version.

Before you start with migration, stop all running Storage Agent services.

22.5.1 AIX Storage Agent migration

Migration installation will occur if you try to install Storage Agent over your previous version. You do not have to uninstall your previous version. When the upgrade is finished, your prior version will disappear.

After the migration, Tivoli Storage Manager device definitions might not be preserved. Therefore, you may need to redefine the Tivoli Storage Manager devices after the installation. Before you begin the installation, record your current device definitions using following commands:

```bash
lsdev -Cs fcp > definitions.fcp
lsdev -Cs scsi > definitions.scsi
```

**Note:** You do not have to record definitions for IBM(R) 3494, 3570, 3575, 358x or 3590. These devices use IBM-supplied drivers, not the Tivoli Storage Manager device drivers.

22.5.2 Windows 2003 Storage Agent migration

The upgrade procedure is the same as an AIX Storage Agent migration. You may install directly the desired version over a previous one.

Ensure, that all your Storage Agent services are stopped before you attempt to begin the migration. Also note, that if you use Tivoli Storage Manager Device drivers for your SAN tape devices, the installation wizard will ask you to restart the machine at the end of the migration procedure.

When rebooted, your Storage Agent service should be up and running.
22.6 Library migration

If you are introducing new tape technology into your environment, you will want to effectively migrate your data from old library to the new one, with minimal disruption. Or you may want to migrate data from one storage pool, whose data is stored on old generation tapes to the new storage pool defined on the new generation.

Since storage pool hierarchy is fundamental to Tivoli Storage Manager, incorporating new storage technologies is quite an easy task.

Essentially, the solution is built on two concepts:

- each storage pool must have a device class
- each storage pool's data may migrate to another storage pool

Therefore, if you want to migrate data between libraries, do not think on the library level. Rather, consider that your library consists of one or more storage pools using one or more device classes.

Hence, data can be migrated from one library to another by setting up chains of storage pools, where on one side are storage pools in the library that are to be migrated and on the other side are storage pools data are migrated to.

Consider the following scenario:

You have two libraries, LIB_A with LTO1 tape drives and a new library, LIB_B with LTO3 drives. In library LIB_A, you have two storage pools called archive_tape and backup_tape. In library LIB_B you have other storage pools called archiveLTO3 and backupLTO3.

You want your clients to backup to the new library from now on and you want to migrate all your existing data from all volumes in the old library LIB_A (that is from LTO1 volumes) to the new library LIB_B (that is to LTO3).

You may accomplish this task as follows:

- Define your library LIB_B along with the drives and respective paths
- Define new device class for your new library LIB_B
- Define new storage pools in library LIB_B called archiveLTO3 and backupLTO3
- Change the destination value in your copygroups’ options to the new storage pools, that is archiveLTO3 and backupLTO3
- Activate the changed policy
- Change your old storage pools nextstgpool option to point to the respective storage pools in the new library, that is to archiveLTO3 and backupLTO3
Once defined, you may trigger the migration by lowering the migration threshold (highmig and lowmig) on your old storage pools, archive_tape and backup_tape. Since the migration from one library to another is a time consuming process, you may control the migration by changing these values as desired

Once all data is migrated, you may delete the old storage pool definition

Analogous to tape library migration, you may set the migration on a single storage pool, whose data resides on old generation of tapes to another, new one.
Appendixes

In this part of the book we provide the following supplementary information:

- Appendix A, “Planning and sizing worksheets” on page 727
- Appendix B, “Redbook support material — macros and scripts” on page 733
Planning and sizing worksheets

In this appendix are the worksheets that we introduced and recommended in Chapter 1, “Implementation checklists” on page 3.

The redbook support material is available in soft copy on the Internet from the redbooks Web server. Point your Web browser to:

ftp://www.redbooks.ibm.com/redbooks/SG245416

Alternatively, you can get to the same Web page at:


Select Additional Materials and click the suggested link.
## Worksheets grouped in tables

**Table 22-2  Client requirements worksheet**

<table>
<thead>
<tr>
<th>Category</th>
<th>Client 1</th>
<th>Client 2</th>
<th>Client 3</th>
<th>Client 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Client name</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contact information</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating system</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total storage available (GB)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total storage used (GB)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GB changed per backup</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of files backed up</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data compression</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Backup window times</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Backup number of hours</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Required recovery time</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IBM Tivoli Storage Manager recovery time</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GB copied per archive</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of files archived</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of archives kept</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Archive frequency</td>
<td></td>
<td></td>
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</tr>
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<td>Archive window times</td>
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</tr>
<tr>
<td>Archive number of hours</td>
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<td></td>
</tr>
<tr>
<td>Number of image backups</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Image backup frequency</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of backup sets</td>
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<td></td>
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</tr>
<tr>
<td>Policy domain</td>
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<td></td>
</tr>
<tr>
<td>Client option set</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
### Table 22-3  Storage policy requirements worksheet

<table>
<thead>
<tr>
<th>Category</th>
<th>Example 1</th>
<th>Example 2</th>
<th>Example 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group name</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of backup versions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Backup file retention period</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of deleted versions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Last deleted file version retention period</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Archive retention period</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Offsite copies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Onsite collocation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Offsite collocation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Image backup retention</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Backupset retention</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 22-4  Database worksheet

<table>
<thead>
<tr>
<th>Database volume</th>
<th>Filename (Primary)</th>
<th>Size (MB)</th>
<th>Filename (Copy)</th>
<th>Size (MB)</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

### Table 22-5  Recovery log worksheet

<table>
<thead>
<tr>
<th>Log Volume</th>
<th>Filename (Primary)</th>
<th>Size (MB)</th>
<th>Filename (Copy)</th>
<th>Size (MB)</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>Total</td>
</tr>
</tbody>
</table>
### Table 22-6  Device configuration and volume history worksheet

<table>
<thead>
<tr>
<th>Category</th>
<th>Size (MB)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td>Total</td>
<td></td>
</tr>
</tbody>
</table>

### Table 22-7  Total IBM Tivoli Storage Manager disk required worksheet

<table>
<thead>
<tr>
<th>Category</th>
<th>Size (MB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM Tivoli Storage Manager software (dependent on platform)</td>
<td></td>
</tr>
<tr>
<td>IBM Tivoli Storage Manager database</td>
<td></td>
</tr>
<tr>
<td>IBM Tivoli Storage Manager recovery log</td>
<td></td>
</tr>
<tr>
<td>IBM Tivoli Storage Manager primary storage pools</td>
<td></td>
</tr>
<tr>
<td>Device configuration table and volume history table</td>
<td></td>
</tr>
<tr>
<td>Other (RAID, Operating system)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
</tr>
</tbody>
</table>

### Table 22-8  Tape drive configuration worksheet

<table>
<thead>
<tr>
<th>Category</th>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

### Table 22-9  Administrator IDs worksheet

<table>
<thead>
<tr>
<th>Category</th>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of database volumes</td>
<td></td>
</tr>
<tr>
<td>Number of scratch tapes</td>
<td></td>
</tr>
<tr>
<td>Number of backupset tape volumes</td>
<td></td>
</tr>
<tr>
<td>Total tape volumes required</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Functions</th>
<th>IBM Tivoli Storage Manager ID</th>
<th>Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
Redbook support material — macros and scripts

This appendix contains listings of support material for this redbook. See section 1.1.1, “Our redbook support material” on page 5 for considerations regarding this material.

The redbook support material is available in soft copy on the Internet from the redbooks Web server. Point your Web browser to:

ftp://www.redbooks.ibm.com/redbooks/SG245416

Alternatively, you can get to the same Web page at:

http://www.redbooks.ibm.com

Select Additional Materials and click the suggested link (or follow the instructions given, since the Web pages change frequently!), and then select SG245416.
B.1 Macros

We have provided macros to help you implement your Tivoli Storage Manager environment. The names and values within those macros reflect the recommendations for our redbook environment. You may change them to suit your environment as required.

B.1.1 Define administrators

Example 22-13 shows a Tivoli Storage Manager macro that contains the administrative commands to define our administrators.

```bash
/*================================================================*/
/* Redbook Macro - Define Administrators (macadmins)          */
/* Getting Started with Tivoli Storage Manager - Implementation */
/* SG24-5416                                                 */
/*                                                          */
/* These scripts are supplied to help you implement a        */
/* Tivoli Storage Manager                                    */
/* environment. The names and values reflect the recommendations */
/* for our Redbook environment. You may change them to suit your */
/* environment as required.                                   */
/*                                                          */
/* This file is designed to be run as an Administrative Command */
/* Line macro. You should use the -itemcommit parameter when you */
/* start the admin session, otherwise the macro could fail!!  */
/*                                                          */
/*================================================================*/
/*-----------------------*/
/* System Administrators */
/*-----------------------*/
register admin sysadmin sysadmin contact='System Administrator'
grant authority sysadmin classes=system
/*-----------------------*/
/* System Support Administrators */
/*-----------------------*/
register admin support support contact='System Support'
grant authority support classes=system
/*-----------------------*/
/* System Reporting Administrators */
/*-----------------------*/
register admin reporter reporter contact='System Reporting'
grant authority reporter classes=system
/*-----------------------*/
/* Client Administrators */
/*-----------------------*/
register admin helpdesk helpdesk contact='Client Administrator'
```
B.1.2 Define client option sets

Example 22-14 shows a Tivoli Storage Manager macro that contains the administrative commands to define our client option sets.

Example 22-14  mac.optionsets

/*================================================================*/
/* Redbook Support Materials File - (mac.optionsets)               */
/* Getting Started with Tivoli Storage Manager - Implementation   */
/* (SG24-5416)                                                   */
/*                                                            */
/* These scripts are supplied to help you implement a            */
/* Tivoli Storage Manager                                       */
/* environment. The names and values reflect the recommendations*/
/* for our Redbook environment. You may change them to suit your */
/* environment as required.                                     */
/*                                                            */
/* This file is designed to be run as an Administrative Command */
/* Line macro. You should use the -itemcommit parameter when you */
/* start the admin session, otherwise the macro could fail!!     */
/*                                                            */
/*================================================================*/
/*--Special Note--------------------------------------------------*/
/* Remove the comments from the following delete cloptset        */
/* commands if you want to rerun this macro.                    */
/*================================================================*/
/* delete cloptset redbook */
/* delete cloptset aix  */
/* delete cloptset netware */
/* delete cloptset windows */
/* Base Option Set */
define cloptset  redbook description="Redbook Base Set"
define clientopt redbook changingretries 4
define clientopt redbook compressalways yes
define clientopt redbook compression off
define clientopt redbook dirmc directory
define clientopt redbook domain all-local
define clientopt redbook maxcmdretries 2
define clientopt redbook memoryefficientbackup no
define clientopt redbook quiet
define clientopt redbook retryperiod 20
define clientopt redbook runasservice yes
define clientopt redbook schedmode prompted
define clientopt redbook scrolllines 20
define clientopt redbook scrollprompt no
define clientopt redbook subdir no
define clientopt redbook tapeprompt no
define clientopt redbook txnbytelimit 25600
/*-----------------*/
/* AIX Options Set */
/*-----------------*/
copy cloptset redbook aix
update cloptset aix description="AIX Clients"
define clientopt aix inclexcl "exclude /unix/" seq=1
define clientopt aix inclexcl "exclude.dir /unix/" seq=2
define clientopt aix inclexcl "exclude /.../core" seq=3
define clientopt aix inclexcl "exclude /tmp/.../*" seq=4
define clientopt aix inclexcl "include /.../dsmwebcl.log special" seq=5
define clientopt aix inclexcl "include /.../dsmsched.log special" seq=6
define clientopt aix inclexcl "include /.../dsmerror.log special" seq=7
define clientopt aix inclexcl "include.image /.../* image" seq=8
/*---------------------*/
/* Netware Options Set */
/*---------------------*/
copy cloptset redbook netware
update cloptset netware description="Netware Clients"
define clientopt netware inclexcl "exclude sys:vol$log.err" seq=1
define clientopt netware inclexcl "exclude sys:tts$log.err" seq=2
define clientopt netware inclexcl "exclude sys:system/sys$log.err" seq=3
define clientopt netware inclexcl "exclude sys:system/events.log" seq=4
define clientopt netware inclexcl "exclude sys:system/secaudit.log" seq=5
define clientopt netware inclexcl "exclude sys:system/system.log" seq=6
define clientopt netware inclexcl "exclude sys:system/cmastert.dba" seq=7
define clientopt netware inclexcl "exclude sys:system/btrieve.trn" seq=8
define clientopt netware inclexcl "exclude sys:system/tsa/tsa$temp.*" seq=9
define clientopt netware inclexcl "include *:/.../dsmwebcl.log special" seq=10
define clientopt netware inclexcl "include *:/.../dsmsched.log special" seq=11
define clientopt netware inclexcl "include *:/.../dsmerror.log special" seq=12
/*---------------------*/
/* Windows Options Set */
/*---------------------*/
copy cloptset redbook windows
update cloptset windows description="Windows Clients"
define clientopt windows inclexcl "exclude *:\...\pagefile.sys" seq=1
define clientopt windows inclexcl "exclude *:\...\netlogon.chg" seq=2
define clientopt windows inclexcl "exclude *:\...\system32\config\...\*" seq=3
define clientopt windows inclexcl "exclude *:\...\ntuser.dat" seq=4
define clientopt windows inclexcl "exclude *:\...\ntuser.dat.log" seq=5
define clientopt windows inclexcl "exclude *:\...\temp\...\*" seq=6
B.1.3 Define policy structure

Example 22-15 shows a Tivoli Storage Manager macro that contains the administrative commands to delete the default storage pools.

Example 22-15  mac.policy

```plaintext
define clientopt windows inclexcl "exclude *:\...\cache\*" seq=7
define clientopt windows inclexcl "exclude *:\...\recycler\*" seq=8
define clientopt windows inclexcl "exclude *:\...\Temporary Internet Files\*" seq=9
define clientopt windows inclexcl "exclude *:\microsoft uam volume\...\*" seq=10
define clientopt windows inclexcl "exclude *:\ibmio.com" seq=11
define clientopt windows inclexcl "exclude *:\ibmdos.com" seq=12
define clientopt windows inclexcl "exclude *:\msdos.sys" seq=13
define clientopt windows inclexcl "exclude *:\io.sys" seq=14
define clientopt windows inclexcl "include *:/.../dsmwebcl.log special" seq=15
define clientopt windows inclexcl "include *:/.../dsmsched.log special" seq=16
define clientopt windows inclexcl "include *:/../dsmerror.log special" seq=17
/*-----------------------------*/
/* Query all client option sets */
/*-----------------------------*/
select * from cloptsets
```
define policyset server server description="Server nodes"
define policyset workstn workstn description="Workstation nodes"

define mgmtclass server server data migdestination=NONE\
description="Default management class for server domain"
assign defmgmtclass server server data
define mgmtclass server server directory migdestination=NONE\
description="Directory management class for server domain"
define mgmtclass server server special migdestination=NONE\
description="Special management class for server domain"
define mgmtclass server server image migdestination=NONE\
description="Image management class for server domain"
define mgmtclass workstn workstn data migdestination=NONE\
description="Default management class for workstn domain"
assign defmgmtclass workstn workstn data
define mgmtclass workstn workstn directory migdestination=NONE\
description="Directory management class for workstn domain"
define mgmtclass workstn workstn special migdestination=NONE\
description="Special management class for workstn domain"
define mgmtclass workstn workstn image migdestination=NONE\
description="Image management class for workstn domain"

define copygroup server server data type=Backup destination=DISKDATA\
frequency=1 verexists=3 verdeleted=1 retextra=100 retonly=100\
mode=modified serialization=shrstatic
define copygroup server server directory type=Backup destination=DISKDIRS\
frequency=1 verexists=nolimit verdeleted=1 retextra=100 retonly=100\
mode=modified serialization=shrstatic
define copygroup server server special type=Backup destination=DISKDATA\
frequency=1 verexists=3 verdeleted=1 retextra=100 retonly=100\
mode=modified serialization=shrdynamic
define copygroup server server image type=backup destination=diskdata\
frequency=1 verexists=3 verdeleted=1 retextra=120 retonly=120\
mode=modified serialization=static
define copygroup workstn workstn data type=Backup destination=DISKDATA\
frequency=1 verexists=1 verdeleted=1 retextra=30 retonly=30\
mode=modified serialization=shrstatic
define copygroup workstn workstn directory type=Backup destination=DISKDIRS\
frequency=1 verexists=nolimit verdeleted=nolimit retextra=30 retonly=30\
mode=modified serialization=shrstatic
define copygroup workstn workstn special type=Backup destination=DISKDATA\
frequency=1 verexists=2 verdeleted=1 retextra=30 retonly=30\"
mode=modified serialization=shrdynamic
define copygroup workstn workstn image type=backup destination=diskdata \
frequency=1 verexists=2 verdeleted=2 retextra=30 retonly=30 \ 
mode=modified serialization=static
define copygroup server server data type=Archive destination=DISKDATA \ 
retver=365 serialization=shrstatic
define copygroup workstn workstn data type=Archive destination=DISKDATA \ 
retver=100 serialization=shrstatic
/*----------------------*/
/* Validate policy sets */
/*----------------------*/
validate policyset server server
validate policyset workstn workstn
/*----------------------*/
/* Activate policy sets */
/*----------------------*/
activate policyset server server
activate policyset workstn workstn

---

### B.1.4 Define schedules

Example 22-16 shows a Tivoli Storage Manager macro that contains the administrative commands to define our schedules.

**Example 22-16**  *mac.schedules*

```bash
/*-------------------------*/
/* Offsite Backup Schedule */
/*-------------------------*/
define schedule redbook_offsite type=admin cmd="run redbook_offsite" \
description="Backup all data for offsite storage" starttime=04:00 active=yes 
```
/* Volume History File Management */
/*-----------------------------*/
define schedule delete_volhist type=admin 
  cmd="delete volhistory type=dbbackup todate=today-6" 
  description="Delete volume history information for database backups" 
  starttime=07:00 active=yes
define schedule backup_volhist type=admin cmd="backup volhistory" 
  description="Backup volume history file" starttime=07:05 active=yes
/*----------------*/
/* Disk Migration */
/*----------------*/
define schedule MIGRATION type=admin cmd="migrate stgpool diskdata lo=0 
  duration=180" desc="Perform migration on DISKDATA storage pool" starttime=07:00 
  active=yes
/*----------------------*/
/* Inventory Expiration */
/*----------------------*/
define schedule EXPIRE_INVENTORY type=admin description="Inventory expiration" 
  cmd="expire inventory" starttime=10:00 active=yes
/*------------------------*/
/* Tape Space Reclamation */
/*------------------------*/
define schedule RECLAIM_OFFDIRS type=admin description="Perform reclamation on 
the OFFDIRS storage pool" cmd="reclaim stgpool offdirs threshold=85 
duration=60" starttime=11:00 active=yes
define schedule RECLAIM_OFFDATA type=admin description="Perform reclamation on 
the OFFDATA storage pool" cmd="reclaim stgpool offdata threshold=85 
duration=180" starttime=12:00 active=yes
define schedule RECLAIM_TAPEDATA type=admin description="Perform reclamation on 
the TAPEDATA storage pool" cmd="reclaim stgpool tapedata threshold=85 
duration=180" starttime=15:00 active=yes
/*----------------*/
/* Audit Licences */
/*----------------*/
define schedule AUDIT_LICENSE type=admin description="Audit licenses" 
  cmd="audit licenses" starttime=00:00 active=yes
/*----------------*/
/* Client Schedules */
/*----------------*/
define schedule server server_nightly starttime=22:00 action=incremental 
  duration=3 durunits=hours 
  description="Nightly backup schedule for SERVER domain"
define schedule workstn workstn_nightly action=incremental starttime=22:00 
  duration=3 durunits=hours 
  description="Nightly backup schedule for WORKSTN domain"
define sched workstn monthly_image starttime=01:00 action=imagebackup object="C:" schedstyle=enhanced month=any weekofmonth=last dayofweek=friday 
  description="Monthly image backup for workstations"
B.1.5 Define server scripts

Example 22-17 shows a Tivoli Storage Manager macro that contains the administrative commands to define our server scripts.

```
Example 22-17  mac.scripts

删除 script redbook_offsite
define script redbook_offsite description="Backup all data for offsite storage"
update script redbook_offsite
="/*
update script redbook_offsite "/* Script Name: redbook_offsite
*/
update script redbook_offsite="/*/ Description: Backup data for offsite storage
*/
update script redbook_offsite="/*/ If there are active node sessions, then
*/
update script redbook_offsite="/*/ reschedule this script to run again in
*/
update script redbook_offsite="/*/ 20 minutes. If there are no active node
*/"
```
update script redbook_offsite "/* sessions, then backup all the onsite storage */"
update script redbook_offsite "/* pools and the ADSM database. */"
update script redbook_offsite "/*----------------------------------------------*/"
update script redbook_offsite "select * from sessions where -"
update script redbook_offsite "        upper(session_type)='NODE'"
update script redbook_offsite "if (rc_ok) goto reschedule"
update script redbook_offsite "backup stgpool diskdirs offdirs wait=yes"
update script redbook_offsite "backup stgpool diskdata offdata wait=yes"
update script redbook_offsite "backup stgpool tapedata offdata wait=yes"
update script redbook_offsite "backup db devclass=coffsite type=full scratch=yes"
update script redbook_offsite "exit"
update script redbook_offsite "reschedule:"
update script redbook_offsite "delete schedule redbook_offsite_retry type=admin"
update script redbook_offsite "define schedule redbook_offsite_retry type=admin -"
update script redbook_offsite "       cmd='run redbook_offsite' active=yes -"
update script redbook_offsite "       starttime=NOW+0:20 perunits=onetime"
/*---------------------------*/
/* Query all redbook scripts */
/*---------------------------*/
query script redbook*

B.1.6 Create storage pools

Example 22-18 shows a Tivoli Storage Manager macro that contains the administrative commands to create storage pools.

Example 22-18  mac.stgcreate

/*================================================================*/
/* Redbook Support Materials File - (mac.stgcreate)               */
/* Getting Started with Tivoli Storage Manager - Implementation */
/* (SG24-5416)                                                 */
/*                                                           */
/* These scripts are supplied to help you implement a          */
/* Tivoli Storage Manager                                     */
/* environment. Names for device classes used should be entered*/
/* between the << >> symbols and these << >> symbols removed.   */
/* The MAXScratch is set purposefully at a high value to avoid  */
/* any misleading out of space messages. You may set it to a more*/
/* meaningful value to better reflect the %util value of your    */
/* pool when q stgpool is run.                                 */
/*================================================================*/
B.1.7 Delete default storage pools

Example 22-19 shows a Tivoli Storage Manager macro that contains the administrative commands to delete the default storage pools.

Example 22-19  mac.stgdelete

delete stgpool backuppool
delete stgpool archivepool
delete stgpool spacemgpool
delete stgpool diskpool
B.2 Server options files

We have created server option files for the AIX, MVS, and Windows NT server environments. Our environment assumes that TCP/IP is the network protocol, Web access is enabled for administrators, and basic performance tuning values are specified.

All possible server options for each platform have been specified in the respective files. Server options have been grouped into the same categories as they appear in the administrator reference manuals for ease of reference. Those categories are:

- Communications
- Automated Cartridge System Library
- Client-server communication processing
- Site dependent
- Database and recovery log
- Group and transfer data
- Messages
- Event logging
- Miscellaneous

Within each category, the options are ordered alphabetically. Options that are not active are preceded by an asterisk (*). All other options are active. Inactive options are those that are either not applicable for our TCP/IP communication protocol, or require further setup, such as those for Tivoli event monitoring.

B.2.1 AIX

Figure 22-20 shows our server options file for AIX. This file can also be used as the basis for a server options file for the HP/UX, Linux and Solaris platforms.

Tivoli Storage Manager HP/UX and Solaris servers only support TCP/IP as a network protocol.

Example 22-20  AIX server options

```
*=====================================================================*
* Tivoli Server Options File - AIX Version - (dsmserv.aix)             *
* Getting Started with Tivoli Storage Manager - Implementation       *
* SG24-5416                                                        *
*=====================================================================*
*---------------*
*Communications *
*---------------*

COMMMETHOD SHAREDMEM
COMMMETHOD TCPIP
```
SHMPort                      1
TCPNodeLyay                      YES
TCPPort                         1500
TCPADMINPort                    1502
TCPWindowsize                   2048
DNSLOOKUP                       Yes
MOVEBatchsize                   1000
MOVESizethresh                  2048
TXNGroupmax                     1024

*--------------------------------------------*
*Automated Cartridge System Library Software *
*--------------------------------------------*

*ACSAccessID
*ACSLockdrive
*ACSquickinit
*ACSTimeoutx
*---------------*
* Client-Server *
*---------------*

COMMTIMEOUT                     300
IDLETEIMEOUT                    30
RESOURCETIMEOUT                  10
*----------------*
* Site Dependent *
*----------------*

DATEFORMAT                        2
LANGUAGE                      AMENG
NUMBERFORMAT                      1
TIMEFORMAT                        1
MAXSESSIONS                      60

*-------------------------*
* Database & Recovery Log *
*-------------------------*

BUFPOOLSIZE                  262144
LOGPOOLSIZE                   10240
SELF TUNEBUFPOOLSIZE             YES
MIRRORREAD DB NORMAL
MIRRORREAD LOG NORMAL
MIRRORWRITE DB SEQUENTIAL
MIRRORWRITE LOG SEQUENTIAL
DBPAGEShadow                    Yes
DBPAGE SHADOW File                "/tsm/files/shadow/dbpgshdw.bdt"
*-------*
* Group *
*-------*

MOVEBATCHSIZE                    500
MOVESIZETHRESH                   256
TXNGROUPMAX                      256
B.2.2 zOS

Example 22-21 shows our server options file for zOS.

Example 22-21  MVS server options

*---------------------------------------------------------------*
* Tivoli Server Options File - zIS Version - (dsmser.mvs)       *
* Getting Started with Tivoli Storage Manager - Implementation  *
* SG24-5416                                                    *
*---------------------------------------------------------------*
*-------------------*
* Communications    *
*-------------------*
COMMMethod          TCPIP
TCPNode1ay          YES
TCPPort             1500
TCPADMINPort        1502
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TCPWindowSize                   2048
DNSLOOKUP                       Yes
MOVEBatchsize                   1000
MOVESizethresh                  2048
TXNGroupmax                     1024
TCPNAME                         TCPIP
*---------------*
* Client-Server *
*---------------*

COMMTIMEOUT                     300
IDLETIMEOUT                      30
RESOURCETIMEOUT                  10
*----------------*
* Site Dependent *
*----------------*

DATEFORMAT                       2
LANGUAGE                     AMENG
NUMBERFORMAT                     1
TIMEFORMAT                       1
*-------------------------*
* Database & Recovery Log *
*-------------------------*

BUFPoolsize                 262144
LOGPoolsize                  10240
SELFTUNEBUFPOOLSIZE            YES
MIRRORRead DB Normal
MIRRORRead LOG Normal
MIRRORWrite DB Sequential
MIRRORWrite LOG Sequential
DBPAGEShadow                    Yes
DBPAGESHADOWFile                "dbpgshdw.bdt"
*-------*
* Group *
*-------*

MOVEBatchsize                  500
MOVESizethresh                 256
TXNGroupmax                    256
*-----------------*
* Message Options *
*-----------------*

EXPQiet                       YES
MESSageformat                    1
MSGINTERval                      1
STAtusmsgcnt                    10
MSGHlight                      0
MSGSUppress                     0
ROUTECode                        11
*-----------------*
* Event Logging *

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B.2.3 Windows

Example 22-22 shows the Windows server options.

---

Example 22-22  Windows server options
---

EVENTSERVER                   YES
FILEEXIT                      NO
FILETEXTEXIT                  NO
USEREXIT                      NO
*TECBegineventlogging
*TECHostname
*TECPort
*---------------*

* Miscellaneous *
*---------------*

DELetionexit             ARCTVEXT
DEVCONFIG        'TSM.SERVER.DEVCONFG'
DEVCONFIG        'TSM.SERVER.DEVCONFG.ALT'
EXPINterval                      0
RESTORE INTERVAL              1440
VOLumeHistory    'TSM.SERVER.VOLHIST'
VOLumeHistory    'TSM.SERVER.VOLHIST.ALT'

B.2.3  Windows

Example 22-22 shows the Windows server options.

---

Example 22-22  Windows server options
---

*---------------*

*Communications  *
*---------------*

COMMMethod                      NAMEDPIPE
COMMMethod                      TCPIP

NAMEDpipename                    \\.\PIPE\TSMPIPE
NPBUFFersize                    8
TCPNodelay                      YES
TCPPort                       1500
TCPADMINPort                    1502
TCPWindowSize                   63
DNSLOOKUP                      Yes
MOVEBatchsize                   1000
MOVESizethresh                  2048
TXNGroupmax                     1024

*---------------*

* Client-Server *
*---------------*
Appendix B. Redbook support material — macros and scripts

COMMTTimeout 300
IDLETimeout 30
RESOURCETTimeout10
*----------------*  
* Site Dependent *  
*----------------*  
DATEformat 2
LANGuage AMENG
NUMBERformat 1
TIMEformat 1
MAXSessions 60

*------------------------*  
* Database & Recovery Log *  
*------------------------*  
BUFPoolsize 262144
SELFTUNEBUFPoolsize Yes
LOGPoolsize 10240
MIRRORRead DB Normal
MIRRORRead LOG Normal
MIRRORWrite DB Sequential
MIRRORWrite LOG Sequential
DBPAGEShadow Yes
DBPAGESHADOWFile "dbpgshdw.bdt"

*------------------*  
* Message Options *  
*------------------*  
DISPLAYLFINFO Yes
EXPQUiet Yes
MESSageformat 1
MSGINterval 1
STATUSmsgcnt 10

*---------------*  
* Event Logging *  
*---------------*  
EVENTSERVer Yes
FILEEXIT No
FILETEXTEXIT No
USEREXIT No

*---------------------*  
* Miscellaneous *  
*---------------------*  
DISABLESCHEDS No
EXPInterval 0
RESTOREINTERVAL 1440
QUERYAuth None

*--------------------------*  
* External backup files *  
*--------------------------*
B.3 Client options files

We have created client option files for the NetWare and Windows 95/98/NT environments. Our environment assumes that TCP/IP is the network protocol, Web access is enabled for administrators, and basic performance tuning values are specified. You must replace fields surrounded by angle brackets (<< and >>) with the specific values for your site.

B.3.1 AIX

B.3.1.1 Client system options file

Example 22-23 shows our client system options file for AIX. This file can also be used as the basis for a client system options file for the HP/UX and Solaris platforms.

Example 22-23  AIX system options file

```
*----------------*
* Stanza name - must match at least one Servername stanzas in dsm.opt
Servername    <<DSM.OPT Stanza name here (not hostname!!!)>>

* Communications.  
NODEname       <<Client node name here>>
COMMMethod     TCPIP
TCPBuffsize    32
TCPNodeDelay   Yes
TCPPort        1500
TCPServeraddress <<TSM Server Hostname here>>
TCPWindowsize  64
DISKBuffsize   1023

*----------------*
* Operations *
*----------------*
COMPRESSION    No
ERRORLOGName   "dsmerror.log"
ERRORLOGRetention 31
SCHEDLOGName   "dsm sched.log"
SCHEDLOGRetention 14
PASSWORDAccess Generate
SCHEDMODE Prompted
```
B.3.2 NetWare

Example 22-25 shows our client options file for NetWare.

Example 22-25 Netware client options file

*=====================================================================*
* Redbook Client Options File - Netware Version (dsm.opt) *
* Getting Started with Tivoli Storage Manager - Implementation *
* SG24-5416 *
*=====================================================================*
NODENAME <<Netware-Server-Name>>

COMMMETHOD              TCPIP
TCPBUFFSIZE                63
TCPNODELAY                Yes
TCPPORT                  1500
TCPSERVERADDRESS <<TSM-Server Hostname here>>
TCPWINDOWSIZE              63
DISKBuffsize             1023

CLUSTERnode               No
COMPRESSion               No
COMPRESSAlways            No
ERRORLOGName              "dsmerror.log"
ERRORLOGRetention         31
SCHEDLOGName              "dsmsched.log"
SCHEDLOGRetention         14
PASSWORDAccess            Generate
SCHEDMODE                 Prompted
MANAGEDServices           Schedule Webclient
NWPWFile                  On
NWUSer                    "<<Servername\user:password must be FQ>>"

DATEFORMAT                1
LANGUAGE              AMENG
NUMBERFORMAT              1
TIMEFORMAT                1

SUBdir                    Yes

B.3.3 Windows

Example 22-26 shows our client options file for Windows
Example 22-26  Windows client options file

*=====================================================================*
* Redbook Client Options File - Windows Version (dsm.opt)             *
* Getting Started with Tivoli Storage Manager - Implementation        *
* SG24-5416                                                           *
*=====================================================================*

*----------------*  
* Communications *  
*----------------*  

NODename                  <<Client node name here>>
COMMMETHOD                TCPIP
TCPBUFFSIZE                63
TCPNODELAY                 Yes
TCPPORT                    1500
TCPSESSIONADDRESS  <<TSM-Server hostname here>>
TCPWINDOWSIZE               63
DISKBUFFSIZE               1023

*------------*  
* Operations *  
*------------*

COMPRESSIon               No
COMPRESSAlways            No
ERRORLOGName              "dsmerror.log"
ERRORLOGRetention         31
SCHEDLOGName              "dsmsched.log"
SCHEDLOGRetention         14
PASSWORDAccess            Generate
SCHEDMODe                 Prompted
MANAGEDServices           Schedule Webclient

*----------------*  
* Site Dependent *  
*----------------*  

DATEFORMAT               1
LANGUAGE               AMENG
NUMBERFORMAT             1
TIMEFORMAT               1

SUBDIR                   Yes

*----------------*  
* Include/Exclude *  
*----------------*  

*None - specified via the Client Option Set (WINDOWS) instead
Glossary

A

Agent A software entity that runs on endpoints and provides management capability for other hardware or software. An example is an SNMP agent. An agent has the ability to spawn other processes.

AL See arbitrated loop.

Allocated storage The space that is allocated to volumes, but not assigned.

Allocation The entire process of obtaining a volume and unit of external storage, and setting aside space on that storage for a data set.

Arbitrated loop A Fibre Channel interconnection technology that allows up to 126 participating node ports and one participating fabric port to communicate. See also Fibre Channel Arbitrated Loop and loop topology.

Array An arrangement of related disk drive modules that have been assigned to a group.

B

Bandwidth A measure of the data transfer rate of a transmission channel.

Bridge Facilitates communication with LANs, SANs, and networks with dissimilar protocols.

C

Client A function that requests services from a server, and makes them available to the user. A term used in an environment to identify a machine that uses the resources of the network.

Client authentication The verification of a client in secure communications where the identity of a server or browser (client) with whom you wish to communicate is discovered. A sender’s authenticity is demonstrated by the digital certificate issued to the sender.

Client-server relationship Any process that provides resources to other processes on a network is a server. Any process that employs these resources is a client. A machine can run client and server processes at the same time.

Console A user interface to a server.

D

DATABASE 2 (DB2) A relational database management system. DB2 Universal Database™ is the relational database management system that is Web-enabled with Java support.

Device driver A program that enables a computer to communicate with a specific device, for example, a disk drive.

Disk group A set of disk drives that have been configured into one or more logical unit numbers. This term is used with RAID devices.
Enterprise network  A geographically dispersed network under the backing of one organization.

Enterprise Storage Server®  Provides an intelligent disk storage subsystem for systems across the enterprise.

Event  In the Tivoli environment, any significant change in the state of a system resource, network resource, or network application. An event can be generated for a problem, for the resolution of a problem, or for the successful completion of a task. Examples of events are: the normal starting and stopping of a process, the abnormal termination of a process, and the malfunctioning of a server.

Fabric  The Fibre Channel employs a fabric to connect devices. A fabric can be as simple as a single cable connecting two devices. The term is often used to describe a more complex network utilizing hubs, switches, and gateways.

FC  See Fibre Channel.

FCS  See Fibre Channel standard.

Fiber optic  The medium and the technology associated with the transmission of information along a glass or plastic wire or fiber.

Fibre Channel  A technology for transmitting data between computer devices at a data rate of up to 1 Gb. It is especially suited for connecting computer servers to shared storage devices and for interconnecting storage controllers and drives.

Fibre Channel Arbitrated Loop  A reference to the FC-AL standard, a shared gigabit media for up to 127 nodes, one of which can be attached to a switch fabric. See also arbitrated loop and loop topology. Refer to American National Standards Institute (ANSI) X3T11/93-275.

Fibre Channel standard  An ANSI standard for a computer peripheral interface. The I/O interface defines a protocol for communication over a serial interface that configures attached units to a communication fabric. Refer to ANSI X3.230-199x.

File system  An individual file system on a host. This is the smallest unit that can monitor and extend. Policy values defined at this level override those that might be defined at higher levels.

Gateway  In the SAN environment, a gateway connects two or more different remote SANs with each other. A gateway can also be a server on which a gateway component runs.

Hardware zoning  Hardware zoning is based on physical ports. The members of a zone are physical ports on the fabric switch. It can be implemented in the following configurations: one to one, one to many, and many to many.

HBA  See host bus adapter.
**Host** Any system that has at least one Internet address associated with it. A host with multiple network interfaces can have multiple Internet addresses associated with it. This is also referred to as a server.

**Host bus adapter (HBA)** A Fibre Channel HBA connection that allows a workstation to attach to the SAN network.

**Hub** A Fibre Channel device that connects up to 126 nodes into a logical loop. All connected nodes share the bandwidth of this one logical loop. Hubs automatically recognize an active node and insert the node into the loop. A node that fails or is powered off is automatically removed from the loop.

**IP** Internet protocol.

**J**

**Java** A programming language that enables application developers to create object-oriented programs that are very secure, portable across different machine and operating system platforms, and dynamic enough to allow expandability.

**Java runtime environment (JRE)** The underlying, invisible system on your computer that runs applets the browser passes to it.

**Java Virtual Machine (JVM™)** The execution environment within which Java programs run. The Java virtual machine is described by the Java Machine Specification which is published by Sun Microsystems. Because the Tivoli Kernel Services is based on Java, nearly all ORB and component functions execute in a Java virtual machine.

**JBOD** Just a Bunch Of Disks.

**JRE** See Java runtime environment.

**JVM** See Java Virtual Machine.

**L**

**Logical unit number (LUN)** The LUNs are provided by the storage devices attached to the SAN. This number provides you with a volume identifier that is unique among all storage servers. The LUN is synonymous with a physical disk drive or a SCSI device. For disk subsystems such as the IBM Enterprise Storage Server, a LUN is a logical disk drive. This is a unit of storage on the SAN which is available for assignment or unassignment to a host server.

**Loop topology** In a loop topology, the available bandwidth is shared with all the nodes connected to the loop. If a node fails or is not powered on, the loop is out of operation. This can be corrected using a hub. A hub opens the loop when a new node is connected and closes it when a node disconnects. See also Fibre Channel Arbitrated Loop and arbitrated loop.

**LUN** See logical unit number.

**LUN assignment criteria** The combination of a set of LUN types, a minimum size, and a maximum size used for selecting a LUN for automatic assignment.

**LUN masking** This allows or blocks access to the storage devices on the SAN. Intelligent disk subsystems like the IBM Enterprise Storage Server provide this kind of masking.

**M**

**Managed object** A managed resource.
Managed resource  A physical element to be managed.

Management Information Base (MIB)  A logical database residing in the managed system which defines a set of MIB objects. A MIB is considered a logical database because actual data is not stored in it, but rather provides a view of the data that can be accessed on a managed system.

MIB  See Management Information Base.

MIB object  A MIB object is a unit of managed information that specifically describes an aspect of a system. Examples are CPU utilization, software name, hardware type, and so on. A collection of related MIB objects is defined as a MIB.

Network topology  A physical arrangement of nodes and interconnecting communications links in networks based on application requirements and geographical distribution of users.

N_Port node port  A Fibre Channel-defined hardware entity at the end of a link which provides the mechanisms necessary to transport information units to or from another node.

NL_Port node loop port  A node port that supports arbitrated loop devices.

Open system  A system whose characteristics comply with standards made available throughout the industry, and therefore can be connected to other systems that comply with the same standards.

Point-to-point topology  It consists of a single connection between two nodes. All the bandwidth is dedicated for these two nodes.

Port  An end point for communication between applications, generally referring to a logical connection. A port provides queues for sending and receiving data. Each port has a port number for identification. When the port number is combined with an Internet address, it is called a socket address.

Port zoning  In Fibre Channel environments, port zoning is the grouping together of multiple ports to form a virtual private storage network. Ports that are members of a group or zone can communicate with each other but are isolated from ports in other zones. See also LUN masking and subsystem masking.

Protocol  The set of rules governing the operation of functional units of a communication system if communication is to take place. Protocols can determine low-level details of machine-to-machine interfaces, such as the order in which bits from a byte are sent. They can also determine high-level exchanges between application programs, such as file transfer.
**RAID**  Redundant array of inexpensive or independent disks. A method of configuring multiple disk drives in a storage subsystem for high availability and high performance.

**SAN**  See Storage Area Network.

**SAN agent**  A software program that communicates with the manager and controls the subagents. This component is largely platform independent. See also subagent.

**SCSI**  Small Computer System Interface. An ANSI standard for a logical interface to computer peripherals and for a computer peripheral interface. The interface utilizes a SCSI logical protocol over an I/O interface that configures attached targets and initiators in a multi-drop bus topology.

**Server**  A program running on a mainframe, workstation, or file server that provides shared services. This is also referred to as a host.

**Shared storage**  Storage within a storage facility that is configured such that multiple homogeneous or divergent hosts can concurrently access the storage. The storage has a uniform appearance to all hosts. The host programs that access the storage must have a common model for the information on a storage device. You need to design the programs to handle the effects of concurrent access.

**Simple Network Management Protocol (SNMP)**  A protocol designed to give a user the capability to remotely manage a computer network by polling and setting terminal values and monitoring network events.

**SNMP**  See Simple Network Management Protocol.

**SNMP agent**  An implementation of a network management application which is resident on a managed system. Each node that is to be monitored or managed by an SNMP manager in a TCP/IP network, must have an SNMP agent resident. The agent receives requests to either retrieve or modify management information by referencing MIB objects. MIB objects are referenced by the agent whenever a valid request from an SNMP manager is received.

**SNMP manager**  A managing system that executes a managing application or suite of applications. These applications depend on MIB objects for information that resides on the managed system.

**SNMP trap**  A message that is originated by an agent application to alert a managing application of the occurrence of an event.

**Software zoning**  Is implemented within the Simple Name Server (SNS) running inside the fabric switch. When using software zoning, the members of the zone can be defined with: node WWN, port WWN, or physical port number. Usually the zoning software also allows you to create symbolic names for the zone members and for the zones themselves.

**SQL**  Structured Query Language.

**Storage administrator**  A person in the data processing center who is responsible for defining, implementing, and maintaining storage management policies.

**Storage area network (SAN)**  A managed, high-speed network that enables any-to-any interconnection of heterogeneous servers and storage systems.
Subagent  A software component of SAN products which provides the actual remote query and control function, such as gathering host information and communicating with other components. This component is platform dependent. See also SAN agent.

Subsystem masking  The support provided by intelligent disk storage subsystems like the Enterprise Storage Server. See also LUN masking and port zoning.

Switch  A component with multiple entry and exit points or ports that provide dynamic connection between any two of these points.

Switch topology  A switch allows multiple concurrent connections between nodes. There can be two types of switches, circuit switches and frame switches. Circuit switches establish a dedicated connection between two nodes. Frame switches route frames between nodes and establish the connection only when needed. A switch can handle all protocols.

W

WAN  Wide Area Network.

Z

Zoning  In Fibre Channel environments, zoning allows for finer segmentation of the switched fabric. Zoning can be used to instigate a barrier between different environments. Ports that are members of a zone can communicate with each other but are isolated from ports in other zones. Zoning can be implemented in two ways: hardware zoning and software zoning.

T

TCP  See Transmission Control Protocol.


Topology  An interconnection scheme that allows multiple Fibre Channel ports to communicate. For example, point-to-point, arbitrated loop, and switched fabric are all Fibre Channel topologies.

Transmission Control Protocol (TCP)  A reliable, full duplex, connection-oriented, end-to-end transport protocol running on top of IP.

Other glossaries:

For more information on IBM terminology, see the IBM Storage Glossary of Terms at:
http://www.storage.ibm.com/glossary.htm

For more information on Tivoli terminology, see the Tivoli Glossary at:
http://publib.boulder.ibm.com/tividd/glossary/termsmst04.htm
## Abbreviations and acronyms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>ABI</td>
<td>Application Binary Interface</td>
</tr>
<tr>
<td>ACE</td>
<td>Access Control Entries</td>
</tr>
<tr>
<td>ACL</td>
<td>Access Control List</td>
</tr>
<tr>
<td>AD</td>
<td>Microsoft Active Directory</td>
</tr>
<tr>
<td>ADSM</td>
<td>ADSTAR Distributed Storage Manager</td>
</tr>
<tr>
<td>AFS</td>
<td>Andrew File System</td>
</tr>
<tr>
<td>AIX</td>
<td>Advanced Interactive eXecutive</td>
</tr>
<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
</tr>
<tr>
<td>APA</td>
<td>All Points Addressable</td>
</tr>
<tr>
<td>API</td>
<td>Application Programming Interface</td>
</tr>
<tr>
<td>APPC</td>
<td>Advanced Program-to-Program Communication</td>
</tr>
<tr>
<td>APPN</td>
<td>Advanced Peer-to-Peer Networking®</td>
</tr>
<tr>
<td>ARC</td>
<td>Advanced RISC Computer</td>
</tr>
<tr>
<td>ARPA</td>
<td>Advanced Research Projects Agency</td>
</tr>
<tr>
<td>ASCII</td>
<td>American National Standard Code for Information Interchange</td>
</tr>
<tr>
<td>ATE</td>
<td>Asynchronous Terminal Emulation</td>
</tr>
<tr>
<td>ATM</td>
<td>Asynchronous Transfer Mode</td>
</tr>
<tr>
<td>AVI</td>
<td>Audio Video Interleaved</td>
</tr>
<tr>
<td>BDC</td>
<td>Backup Domain Controller</td>
</tr>
<tr>
<td>BIND</td>
<td>Berkeley Internet Name Domain</td>
</tr>
<tr>
<td>BNU</td>
<td>Basic Network Utilities</td>
</tr>
<tr>
<td>BOS</td>
<td>Base Operating System</td>
</tr>
<tr>
<td>BRI</td>
<td>Basic Rate Interface</td>
</tr>
<tr>
<td>BSD</td>
<td>Berkeley Software Distribution</td>
</tr>
<tr>
<td>BSOD</td>
<td>Blue Screen of Death</td>
</tr>
<tr>
<td>BUMP</td>
<td>Bring-Up Microprocessor</td>
</tr>
<tr>
<td>CA</td>
<td>Certification Authorities</td>
</tr>
<tr>
<td>CAL</td>
<td>Client Access License</td>
</tr>
<tr>
<td>C-SPOC</td>
<td>Cluster single point of control</td>
</tr>
<tr>
<td>CDE</td>
<td>Common Desktop Environment</td>
</tr>
<tr>
<td>CDMF</td>
<td>Commercial Data Masking Facility</td>
</tr>
<tr>
<td>CDS</td>
<td>Cell Directory Service</td>
</tr>
<tr>
<td>CERT</td>
<td>Computer Emergency Response Team</td>
</tr>
<tr>
<td>CGI</td>
<td>Common Gateway Interface</td>
</tr>
<tr>
<td>CHAP</td>
<td>Challenge Handshake Authentication</td>
</tr>
<tr>
<td>CIDR</td>
<td>Classless InterDomain Routing</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
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<tr>
<td>--------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>CIFS</td>
<td>Common Internet File System</td>
</tr>
<tr>
<td>CMA</td>
<td>Concert Multi-threaded Architecture</td>
</tr>
<tr>
<td>CO</td>
<td>Central Office</td>
</tr>
<tr>
<td>COPS</td>
<td>Computer Oracle and Password System</td>
</tr>
<tr>
<td>CPI-C</td>
<td>Common Programming Interface for Communications</td>
</tr>
<tr>
<td>CPU</td>
<td>Central Processing Unit</td>
</tr>
<tr>
<td>CSNW</td>
<td>Client Service for NetWare</td>
</tr>
<tr>
<td>CSR</td>
<td>Client/server Runtime</td>
</tr>
<tr>
<td>DAC</td>
<td>Discretionary Access Controls</td>
</tr>
<tr>
<td>DARPA</td>
<td>Defense Advanced Research Projects Agency</td>
</tr>
<tr>
<td>DASD</td>
<td>Direct Access Storage Device</td>
</tr>
<tr>
<td>DBM</td>
<td>Database Management</td>
</tr>
<tr>
<td>DCE</td>
<td>Distributed Computing Environment</td>
</tr>
<tr>
<td>DCOM</td>
<td>Distributed Component Object Model</td>
</tr>
<tr>
<td>DDE</td>
<td>Dynamic Data Exchange</td>
</tr>
<tr>
<td>DDNS</td>
<td>Dynamic Domain Name System</td>
</tr>
<tr>
<td>DEN</td>
<td>Directory Enabled Network</td>
</tr>
<tr>
<td>DES</td>
<td>Data Encryption Standard</td>
</tr>
<tr>
<td>DFS</td>
<td>Distributed File System</td>
</tr>
<tr>
<td>FAT</td>
<td>File Allocation Table</td>
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<td>Abbreviation</td>
<td>Description</td>
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<td>-------------</td>
<td>-------------</td>
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<tr>
<td>FC</td>
<td>Fibre Channel</td>
</tr>
<tr>
<td>FDDI</td>
<td>Fiber Distributed Data Interface</td>
</tr>
<tr>
<td>FDPR</td>
<td>Feedback Directed Program Restructure</td>
</tr>
<tr>
<td>FEC</td>
<td>Fast EtherChannel technology</td>
</tr>
<tr>
<td>FIFO</td>
<td>First In/First Out</td>
</tr>
<tr>
<td>FIRST</td>
<td>Forum of Incident Response and Security</td>
</tr>
<tr>
<td>FQDN</td>
<td>Fully Qualified Domain Name</td>
</tr>
<tr>
<td>FSF</td>
<td>File Storage Facility</td>
</tr>
<tr>
<td>FTP</td>
<td>File Transfer Protocol</td>
</tr>
<tr>
<td>FtDisk</td>
<td>Fault-Tolerant Disk</td>
</tr>
<tr>
<td>GC</td>
<td>Global Catalog</td>
</tr>
<tr>
<td>GDA</td>
<td>Global Directory Agent</td>
</tr>
<tr>
<td>GDI</td>
<td>Graphical Device Interface</td>
</tr>
<tr>
<td>GDS</td>
<td>Global Directory Service</td>
</tr>
<tr>
<td>GID</td>
<td>Group Identifier</td>
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<tr>
<td>GL</td>
<td>Graphics Library</td>
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<tr>
<td>GSNW</td>
<td>Gateway Service for NetWare</td>
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<tr>
<td>GUI</td>
<td>Graphical User Interface</td>
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<tr>
<td>HA</td>
<td>High Availability</td>
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<td>HACMP</td>
<td>High Availability Cluster Multiprocessing</td>
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<tr>
<td>HAL</td>
<td>Hardware Abstraction Layer</td>
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<td>HBA</td>
<td>Host Bus Adapter</td>
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<tr>
<td>HCL</td>
<td>Hardware Compatibility List</td>
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<td>HSM</td>
<td>Hierarchical Storage Management</td>
</tr>
<tr>
<td>HTTP</td>
<td>Hypertext Transfer Protocol</td>
</tr>
<tr>
<td>IBM</td>
<td>International Business Machines Corporation</td>
</tr>
<tr>
<td>ICCM</td>
<td>Inter-Client Conventions Manual</td>
</tr>
<tr>
<td>IDE</td>
<td>Integrated Drive Electronics</td>
</tr>
<tr>
<td>IDL</td>
<td>Interface Definition Language</td>
</tr>
<tr>
<td>IDS</td>
<td>Intelligent Disk Subsystem</td>
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<tr>
<td>IEEE</td>
<td>Institute of Electrical and Electronic Engineers</td>
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<tr>
<td>IETF</td>
<td>Internet Engineering Task Force</td>
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<tr>
<td>IGMP</td>
<td>Internet Group Management Protocol</td>
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<tr>
<td>IIS</td>
<td>Internet Information Server</td>
</tr>
<tr>
<td>IKE</td>
<td>Internet Key Exchange</td>
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<tr>
<td>IMAP</td>
<td>Internet Message Access Protocol</td>
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<tr>
<td>I/O</td>
<td>Input/Output</td>
</tr>
<tr>
<td>IP</td>
<td>Internet Protocol</td>
</tr>
<tr>
<td>IPC</td>
<td>Interprocess Communication</td>
</tr>
<tr>
<td>IPL</td>
<td>Initial Program Load</td>
</tr>
<tr>
<td>IPsec</td>
<td>Internet Protocol Security</td>
</tr>
<tr>
<td>IPX™</td>
<td>Internetwork Packet eXchange™</td>
</tr>
<tr>
<td>ISA</td>
<td>Industry Standard Architecture</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
<td>------------------------------------</td>
</tr>
<tr>
<td>iSCSI</td>
<td>SCSI over IP</td>
</tr>
<tr>
<td>ISDN</td>
<td>Integrated Services Digital Network</td>
</tr>
<tr>
<td>ISNO</td>
<td>Interface-specific Network Options</td>
</tr>
<tr>
<td>ISO</td>
<td>International Standards Organization</td>
</tr>
<tr>
<td>ISS</td>
<td>Interactive Session Support</td>
</tr>
<tr>
<td>ISV</td>
<td>Independent Software Vendor</td>
</tr>
<tr>
<td>ITSEC</td>
<td>Initial Technology Security Evaluation</td>
</tr>
<tr>
<td>ITSO</td>
<td>International Technical Support Organization</td>
</tr>
<tr>
<td>ITU</td>
<td>International Telecommunications Union</td>
</tr>
<tr>
<td>IXC</td>
<td>Inter Exchange Carrier</td>
</tr>
<tr>
<td>JBOD</td>
<td>Just a Bunch of Disks</td>
</tr>
<tr>
<td>JFS</td>
<td>Journaled File System</td>
</tr>
<tr>
<td>JIT</td>
<td>Just-In-Time</td>
</tr>
<tr>
<td>L2F</td>
<td>Layer 2 Forwarding</td>
</tr>
<tr>
<td>L2TP</td>
<td>Layer 2 Tunneling Protocol</td>
</tr>
<tr>
<td>LAN</td>
<td>Local Area Network</td>
</tr>
<tr>
<td>LCN</td>
<td>Logical Cluster Number</td>
</tr>
<tr>
<td>LDAP</td>
<td>Lightweight Directory Access Protocol</td>
</tr>
<tr>
<td>LFS</td>
<td>Log File Service (Windows NT)</td>
</tr>
<tr>
<td>LFS</td>
<td>Logical File System (AIX)</td>
</tr>
<tr>
<td>LFT</td>
<td>Low Function Terminal</td>
</tr>
<tr>
<td>JNDI</td>
<td>Java Naming and Directory Interface™</td>
</tr>
<tr>
<td>MSCS</td>
<td>Microsoft Cluster Server</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
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</tr>
<tr>
<td>MSS</td>
<td>Maximum Segment Size</td>
</tr>
<tr>
<td>MSS</td>
<td>Modular Storage Server</td>
</tr>
<tr>
<td>MWC</td>
<td>Mirror Write Consistency</td>
</tr>
<tr>
<td>NAS</td>
<td>Network Attached Storage</td>
</tr>
<tr>
<td>NBC</td>
<td>Network Buffer Cache</td>
</tr>
<tr>
<td>NBF</td>
<td>NetBEUI Frame</td>
</tr>
<tr>
<td>NBPI</td>
<td>Number of Bytes per I-node</td>
</tr>
<tr>
<td>NCP</td>
<td>NetWare Core Protocol</td>
</tr>
<tr>
<td>NCS</td>
<td>Network Computing System</td>
</tr>
<tr>
<td>NCSC</td>
<td>National Computer Security Center</td>
</tr>
<tr>
<td>NDIS</td>
<td>Network Device Interface Specification</td>
</tr>
<tr>
<td>NDMP</td>
<td>Network Data Management Protocol</td>
</tr>
<tr>
<td>NDS</td>
<td>NetWare Directory Service</td>
</tr>
<tr>
<td>NETID</td>
<td>Network Identifier</td>
</tr>
<tr>
<td>NFS</td>
<td>Network File System</td>
</tr>
<tr>
<td>NIM</td>
<td>Network Installation Management</td>
</tr>
<tr>
<td>NIS</td>
<td>Network Information System</td>
</tr>
<tr>
<td>NIST</td>
<td>National Institute of Standards and Technology</td>
</tr>
<tr>
<td>NLS</td>
<td>National Language Support</td>
</tr>
<tr>
<td>NNS</td>
<td>Novell Network Services</td>
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<td></td>
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<td></td>
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<tr>
<td>Abbreviation</td>
<td>Description</td>
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</tr>
<tr>
<td>PCI</td>
<td>Peripheral Component Interconnect</td>
</tr>
<tr>
<td>PCMCIA</td>
<td>Personal Computer Memory Card International Association</td>
</tr>
<tr>
<td>PDC</td>
<td>Primary Domain Controller</td>
</tr>
<tr>
<td>PDF</td>
<td>Portable Document Format</td>
</tr>
<tr>
<td>PDT</td>
<td>Performance Diagnostic Tool</td>
</tr>
<tr>
<td>PEX</td>
<td>PHIGS Extension to X</td>
</tr>
<tr>
<td>PFS</td>
<td>Physical File System</td>
</tr>
<tr>
<td>PHB</td>
<td>Per Hop Behavior</td>
</tr>
<tr>
<td>PHIGS</td>
<td>Programmer's Hierarchical Interactive Graphics System</td>
</tr>
<tr>
<td>PID</td>
<td>Process Identification Number</td>
</tr>
<tr>
<td>PIN</td>
<td>Personal Identification Number</td>
</tr>
<tr>
<td>PMTU</td>
<td>Path Maximum Transfer Unit</td>
</tr>
<tr>
<td>POP</td>
<td>Post Office Protocol</td>
</tr>
<tr>
<td>POSIX</td>
<td>Portable Operating System Interface for Computer Environment</td>
</tr>
<tr>
<td>POST</td>
<td>Power-On Self Test</td>
</tr>
<tr>
<td>PP</td>
<td>Physical Partition</td>
</tr>
<tr>
<td>PPP</td>
<td>Point-to-Point Protocol</td>
</tr>
<tr>
<td>PPTP</td>
<td>Point-to-Point Tunneling Protocol</td>
</tr>
<tr>
<td>PReP</td>
<td>PowerPC® Reference Platform®</td>
</tr>
<tr>
<td>PSM</td>
<td>Persistent Storage Manager</td>
</tr>
<tr>
<td>PSN</td>
<td>Program Sector Number</td>
</tr>
<tr>
<td>PSSP</td>
<td>Parallel System Support Program</td>
</tr>
<tr>
<td>PV</td>
<td>Physical Volume</td>
</tr>
<tr>
<td>PVID</td>
<td>Physical Volume Identifier</td>
</tr>
<tr>
<td>QoS</td>
<td>Quality of Service</td>
</tr>
<tr>
<td>RACF®</td>
<td>Resource Access Control Facility</td>
</tr>
<tr>
<td>RAID</td>
<td>Redundant Array of Independent Disks</td>
</tr>
<tr>
<td>RAS</td>
<td>Remote Access Service</td>
</tr>
<tr>
<td>RDBMS</td>
<td>Relational Database Management System</td>
</tr>
<tr>
<td>RFC</td>
<td>Request for Comments</td>
</tr>
<tr>
<td>RGID</td>
<td>Real Group Identifier</td>
</tr>
<tr>
<td>RISC</td>
<td>Reduced Instruction Set Computer</td>
</tr>
<tr>
<td>RMC</td>
<td>Resource Monitoring and Control</td>
</tr>
<tr>
<td>RMSS</td>
<td>Reduced-Memory System Simulator</td>
</tr>
<tr>
<td>ROLTP</td>
<td>Relative OnLine Transaction Processing</td>
</tr>
<tr>
<td>ROS</td>
<td>Read-Only Storage</td>
</tr>
<tr>
<td>RPC</td>
<td>Remote Procedure Call</td>
</tr>
<tr>
<td>RRIP</td>
<td>Rock Ridge Internet Protocol</td>
</tr>
<tr>
<td>RSCT</td>
<td>Reliable Scalable Cluster Technology</td>
</tr>
<tr>
<td>RSM</td>
<td>Removable Storage Management</td>
</tr>
<tr>
<td>RSVP</td>
<td>Resource Reservation Protocol</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Definition</td>
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<tr>
<td>SACK</td>
<td>Selective Acknowledgments</td>
</tr>
<tr>
<td>SAK</td>
<td>Secure Attention Key</td>
</tr>
<tr>
<td>SAM</td>
<td>Security Account Manager</td>
</tr>
<tr>
<td>SAN</td>
<td>Storage Area Network</td>
</tr>
<tr>
<td>SASL</td>
<td>Simple Authentication and Security Layer</td>
</tr>
<tr>
<td>SCSI</td>
<td>Small Computer System Interface</td>
</tr>
<tr>
<td>SDK</td>
<td>Software Developer's Kit</td>
</tr>
<tr>
<td>SFG</td>
<td>Shared Folders Gateway</td>
</tr>
<tr>
<td>SFU</td>
<td>Services for UNIX</td>
</tr>
<tr>
<td>SID</td>
<td>Security Identifier</td>
</tr>
<tr>
<td>SLIP</td>
<td>Serial Line Internet Protocol</td>
</tr>
<tr>
<td>SMB</td>
<td>Server Message Block</td>
</tr>
<tr>
<td>SMIT</td>
<td>System Management Interface Tool</td>
</tr>
<tr>
<td>SMP</td>
<td>Symmetric Multiprocessor</td>
</tr>
<tr>
<td>SMS</td>
<td>Systems Management Server</td>
</tr>
<tr>
<td>SNA</td>
<td>Systems Network Architecture</td>
</tr>
<tr>
<td>SNAPI</td>
<td>SNA Interactive Transaction Program</td>
</tr>
<tr>
<td>SNMP</td>
<td>Simple Network Management Protocol</td>
</tr>
<tr>
<td>SP</td>
<td>System Parallel</td>
</tr>
<tr>
<td>SPX</td>
<td>Sequenced Packet eXchange</td>
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<tr>
<td>SQL</td>
<td>Structured Query Language</td>
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<tr>
<td><strong>ABBREVIATION</strong></td>
<td><strong>EXPLANATION</strong></td>
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</tr>
<tr>
<td><strong>UPS</strong></td>
<td>Uninterruptable Power Supply</td>
</tr>
<tr>
<td><strong>URL</strong></td>
<td>Universal Resource Locator</td>
</tr>
<tr>
<td><strong>USB</strong></td>
<td>Universal Serial Bus</td>
</tr>
<tr>
<td><strong>UTC</strong></td>
<td>Universal Time Coordinated</td>
</tr>
<tr>
<td><strong>UUCP</strong></td>
<td>UNIX to UNIX Communication Protocol</td>
</tr>
<tr>
<td><strong>UUID</strong></td>
<td>Universally Unique Identifier</td>
</tr>
<tr>
<td><strong>VAX</strong></td>
<td>Virtual Address eXtension</td>
</tr>
<tr>
<td><strong>VCN</strong></td>
<td>Virtual Cluster Name</td>
</tr>
<tr>
<td><strong>VFS</strong></td>
<td>Virtual File System</td>
</tr>
<tr>
<td><strong>VG</strong></td>
<td>Volume Group</td>
</tr>
<tr>
<td><strong>VGDA</strong></td>
<td>Volume Group Descriptor Area</td>
</tr>
<tr>
<td><strong>VGSA</strong></td>
<td>Volume Group Status Area</td>
</tr>
<tr>
<td><strong>VGID</strong></td>
<td>Volume Group Identifier</td>
</tr>
<tr>
<td><strong>VIPA</strong></td>
<td>Virtual IP Address</td>
</tr>
<tr>
<td><strong>VMM</strong></td>
<td>Virtual Memory Manager</td>
</tr>
<tr>
<td><strong>VP</strong></td>
<td>Virtual Processor</td>
</tr>
<tr>
<td><strong>VPD</strong></td>
<td>Vital Product Data</td>
</tr>
<tr>
<td><strong>VPN</strong></td>
<td>Virtual Private Network</td>
</tr>
<tr>
<td><strong>VRMF</strong></td>
<td>Version, Release, Modification, Fix</td>
</tr>
<tr>
<td><strong>VSM™</strong></td>
<td>Virtual System Management</td>
</tr>
<tr>
<td><strong>W3C</strong></td>
<td>World Wide Web Consortium</td>
</tr>
<tr>
<td><strong>WAN</strong></td>
<td>Wide Area Network</td>
</tr>
</tbody>
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Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this redbook.

IBM Redbooks

For information on ordering these publications, see “How to get IBM Redbooks” on page 774. Note that some of the documents referenced here may be available in softcopy only.

- *Deploying the Tivoli Storage Manager Client in a Windows 2000 Environment*, SG24-6141
- *IBM Tivoli Storage Manager Implementation Guide*, SG24-5416
- *Tivoli Storage Manager Version 4.2 Technical Guide*, SG24-6277
- *Tivoli Storage Manager Version 5.1 Technical Guide*, SG24-6554
- *IBM Tivoli Storage Manager Version 5.3 Technical Guide*, SG24-6638
- *Introduction to SAN Distance Solutions*, SG24-6408
- *Back Up Oracle Using Tivoli Storage Management*, SG24-6249
- *Back Up DB2 Using Tivoli Storage Manager*, SG24-6247
- *Back Up Lotus Domino R5 Using Tivoli Storage Management*, SG24-5247
- *Using Tivoli Data Protection for Microsoft Exchange Server*, SG24-6147
- *R/3 Data Management Techniques Using Tivoli Storage Manager*, SG24-5743
- *Using Tivoli Data Protection for Microsoft SQL Server*, SG24-6148
- *Using Tivoli Storage Manager to Back Up Lotus Notes*, SG24-4534
- *Disaster Recovery Strategies with Tivoli Storage Management*, SG24-6844
- *Get More Out of Your SAN with IBM Tivoli Storage Manager*, SG24-6687
- *Backing up WebSphere Application Server with Tivoli Storage Management*, REDP-0149
- *A Practical Guide to Tivoli SANergy*, SG24-6146
- *Implementing IBM Tape in UNIX Systems*, SG24-6502
- *Implementing IBM Tape in Linux and Windows*, SG24-6268
- The IBM TotalStorage Solutions Handbook, SG24-5250
- IBM TotalStorage NAS Backup and Recovery Solutions, SG24-6831
- IBM TotalStorage Tape Selection and Differentiation Guide, SG24-6946
- Managing device addressing of SAN attached tape for use with Tivoli Storage Manager, REDP-0150
- Managing Storage Management Tivoli Enterprise integration with Tivoli Storage Manager, SG24-6117
- IBM Tivoli Storage Manager in a Clustered Environment, SG24-6679
- Tivoli Storage Management Reporting, SG24-6109

Other publications

These publications are also relevant as further information sources:
- IBM Tivoli Storage Manager for AIX Quick Start V5.3, GC32-0770
- IBM Tivoli Storage Manager for AIX Administrator's Guide V5.3, GC32-0768
- IBM Tivoli Storage Manager for AIX Administrator's Reference V5.3, GC32-0769
- IBM Tivoli Storage Manager for HP-UX Quick Start V5.3, GC32-0774
- IBM Tivoli Storage Manager for HP-UX Administrator's Guide V5.3, GC32-0772
- IBM Tivoli Storage Manager for HP-UX Administrator's Reference V5.3, GC32-0773
- IBM Tivoli Storage Manager for Linux Quick Start V5.3, GC32-4692
- IBM Tivoli Storage Manager for Linux Administrator's Guide V5.3, GC32-4690
- IBM Tivoli Storage Manager for Linux Administrator's Reference V5.3, GC32-4691
- IBM Tivoli Storage Manager for Sun Solaris Quick Start V5.3, GC32-0780
- IBM Tivoli Storage Manager for Sun Solaris Administrator's Guide V5.3, GC32-0778
- IBM Tivoli Storage Manager for Sun Solaris Administrator's Reference V5.3, GC32-0779
- IBM Tivoli Storage Manager for Windows Quick Start V5.3, GC32-0784
- IBM Tivoli Storage Manager for Windows Administrator's Guide V5.3, GC32-0782
- IBM Tivoli Storage Manager for Windows Administrator's Reference V5.3, GC32-0783
- IBM Tivoli Storage Manager for AIX Storage Agent User's Guide, GC32-0771
- IBM Tivoli Storage Manager for HP-UX Storage Agent User's Guide, GC32-0772
- IBM Tivoli Storage Manager for Linux Storage Agent User's Guide, GC32-4693
- IBM Tivoli Storage Manager for Sun Solaris Storage Agent User's Guide, GC32-0781
- IBM Tivoli Storage Manager for UNIX Backup-Archive Clients Installation and User's Guide V5.3, GC32-0789
- IBM Tivoli Storage Manager Using the Application Program Interface V5.3, GC32-0793
- IBM Tivoli Storage Manager for System Backup and Recovery - 5.6 - Installation and User's Guide, GC32-9076
- Tivoli SANergy - 2.2.4 - Administrator's Guide, GC32-0740
- IBM Tivoli Storage Manager for Application Servers: Data Protection for WebSphere Application Server Installation and User's Guide, SC32-9075
► *IBM Tivoli Storage Manager for Hardware: Data Protection for EMC Symmetrix for R/3 Installation and User's Guide*, SC33-6386
► *IBM Tivoli Storage Manager for Hardware: Data Protection for IBM ESS for R/3 Installation and User's Guide for DB2 UDB*, SC33-8204
► *IBM Tivoli Storage Manager for Hardware: Data Protection for IBM ESS for R/3 Installation and User's Guide for Oracle*, SC33-8205
► *IBM Tivoli Storage Manager for Mail: Data Protection for Lotus Domino for UNIX and OS/400 Installation and User's Guide*, SC32-9056
► *IBM Tivoli Storage Manager for Mail: Data Protection for Lotus Domino for Windows Installation*, SC32-9057

**Online resources**

These Web sites and URLs are also relevant as further information sources:

► IBM Software: Storage Management:
► IBM Tivoli Software support site
► IBM Tivoli Storage Manager:
► IBM Tivoli Storage Manager Extended Edition:
► IBM Tivoli Storage Manager for Application Servers:
► IBM Tivoli Storage Manager for Databases:
- IBM Tivoli Storage Manager for Enterprise Resource Planning:
- IBM Tivoli Storage Manager for Hardware:
  http://www.ibm.com/software/tivoli/products/storage-mgr-hardware
- IBM Tivoli Storage Manager for Mail:
  http://www.ibm.com/software/tivoli/products/storage-mgr-mail
- IBM Tivoli Continuous Data Protection for Files
- IBM Tivoli Storage Manager for Space Management
- IBM Tivoli Storage Manager HSM for Windows
- IBM Tivoli Storage Manager for Storage Area Networks:
- IBM Tivoli Storage Manager for System Backup and Recovery:
- IBM TotalStorage Productivity Center for Fabric
- IBM TotalStorage Productivity Center for Data
- Tivoli SANergy:
- IBM Tivoli Software support site:
- IBM.com FTP Software Server:
- Tivoli Software Information Center:
  http://publib.boulder.ibm.com/tividd/td/tdprodlist.html
- The Source for Java Technology:
  http://java.sun.com/
- IBM DB2 CommonStore Web site:
  http://www.ibm.com/software/data/commonstore/
- Performance Management Guide:
http://publib.boulder.ibm.com/infocenter/pseries/v5r3/index.jsp

- IBM Storage Media Product Selector:
  http://www.storage.ibm.com/media/products.html

- Tape and Optical Storage:
  http://www.ibm.com/servers/storage/tape

- IBM HP-UX Tape and Medium Changer Device Driver (ATDD) - Readme file:

- IBM Developer Kit for AIX, Java Technology Edition:

- QLogic Technical Support:
  http://www.qlogic.com/support/home_support.asp

- International Organization for Standardization:
  http://www.iso.ch

- American National Standards Organization:
  http://www.ansi.org

- RedHat Linux:
  http://www.redhat.com/

- SuSE Linux:
  http://www.suse.com/index_us.html

- The Linux Documentation Project:
  http://www.tldp.org/

- Linux RPM search engine:
  http://www.rpmfind.net/

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