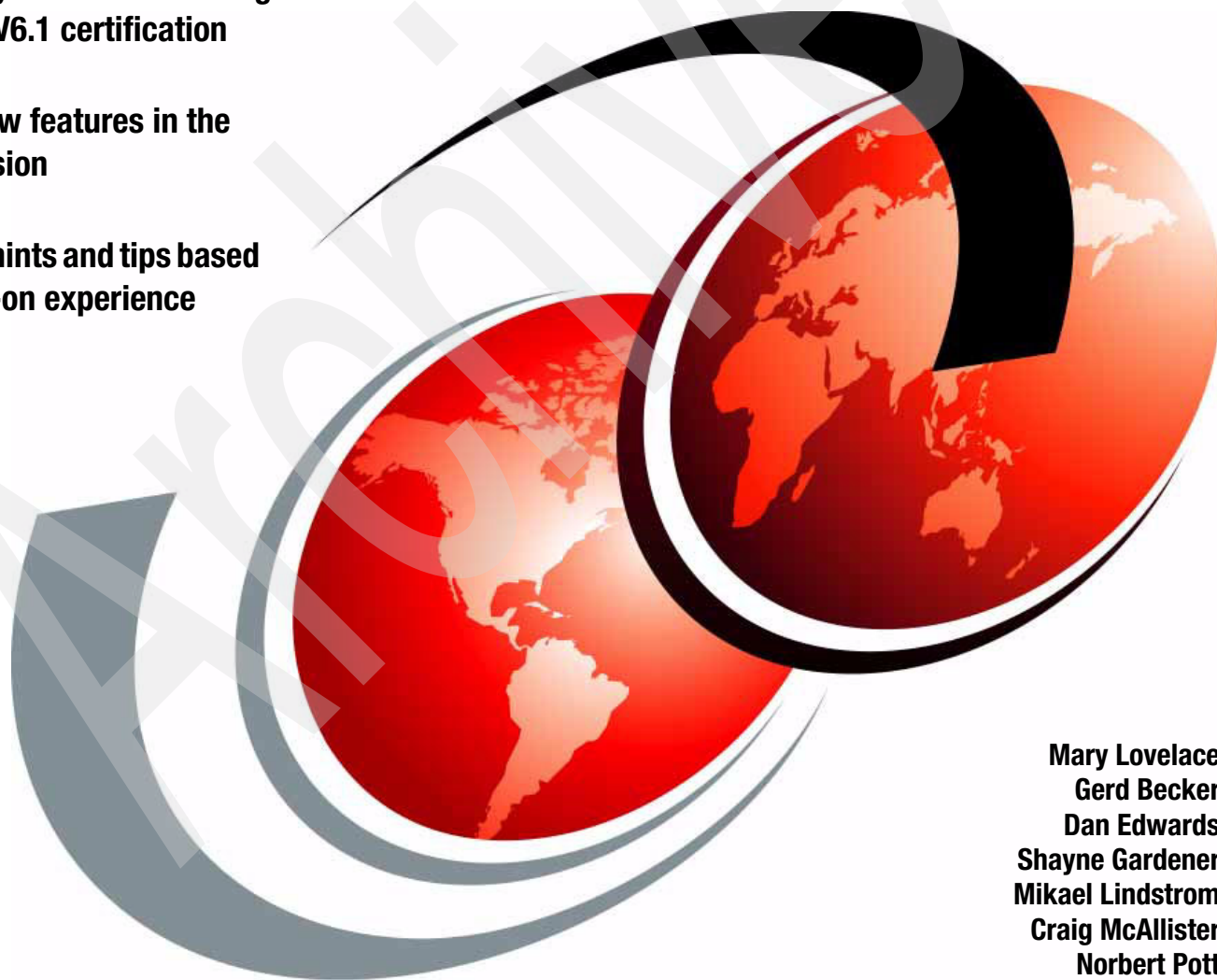


Certification Study Guide Series: **Tivoli Storage Manager V6.1**

Prepares you for Tivoli Storage Manager V6.1 certification

Covers new features in the latest version

Contains hints and tips based on hands-on experience



**Mary Lovelace
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Dan Edwards
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Craig McAllister
Norbert Pott**

Redbooks



International Technical Support Organization

**Certification Study Guide Series: Tivoli Storage
Manager V6.1**

November 2009

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

First Edition (November 2009)

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Preface

This IBM® Redbooks® publication is a study guide for IBM Tivoli® Storage Manager Version 6.1 and is aimed at individuals who want to get IBM Certifications in this specific product.

The IBM Tivoli Storage Manager Certification, offered through the Professional Certification Program from IBM, is designed to validate the skills required of technical professionals who work in the implementation of the IBM Tivoli Storage Manager Version 6.1 product.

This book provides a combination of theory and practical experience needed for a general understanding of the subject matter. The book also provides a link to sample questions that can help in the evaluation of personal progress and provide familiarity with the types of questions encountered in the certification exam.

This publication does not replace practical experience, and it is not designed to be a stand-alone guide for any subject. Instead, it can be an effective tool that, when combined with educational activities and experience, can be a very useful preparation guide for the exam.

The team who wrote this book

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Figure 1 The team: Dan, Craig, Mary, Mikael, Gerd, Shayne, Norbert

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Certification overview

This chapter provides an overview of the skills required to obtain an IBM Advanced Technical Expert certification. The following sections provide a comprehensive review of specific topics that are essential for obtaining the certification:

- ▶ IBM Professional Certification Program
- ▶ IBM Tivoli Storage Manager V6.1 Certification
- ▶ Test 000-025 objectives
- ▶ Recommended resources for study

1.1 IBM Professional Certification Program

Having the right skills for the job is critical in the growing global marketplace. IBM Professional Certification, designed to validate skill and proficiency in the latest IBM solution and product technology, can help provide that competitive edge. The IBM Professional Certification Program Web site is available at:

<http://www.ibm.com/certify/index.shtml>

The Professional Certification Program from IBM offers a business solution for skilled technical professionals who are seeking to demonstrate their expertise to the world.

The program is designed to validate your skills and demonstrate your proficiency in the latest IBM technology and solutions. In addition, professional certification can help you excel at your job by giving you and your employer confidence that your skills have been tested. You might be able to deliver higher levels of service and technical expertise than non-certified employees and move on a faster career track. Professional certification puts your career in your control.

Certification is the way for skilled IT professionals to demonstrate their expertise to the world. It validates your skills and demonstrates your proficiency in the latest IBM technology and solutions.

The certification requirements are tough, but not impossible. Certification is a rigorous process that differentiates you from everyone else.

The mission of IBM Professional Certification is to:

- ▶ Provide a reliable, valid, and fair method of assessing skills and knowledge.
- ▶ Provide IBM with a method of building and validating the skills of individuals and organizations.
- ▶ Develop a loyal community of highly skilled certified professionals who recommend, sell, service, support, or use IBM products and solutions.

The Professional Certification Program from IBM has developed certification role names to guide you in your professional development. The certification role names include IBM Certified Specialist, IBM Certified Solutions/Systems Expert, and IBM Certified Advanced Technical Expert for technical professionals who sell, service, and support IBM solutions.

For technical professionals in application development, the certification roles include IBM Certified Developer Associate and IBM Certified Developer. IBM Certified Instructor certifies the professional instructor.

The Professional Certification Program from IBM provides you with a structured program leading to an internationally recognized qualification. The program is designed for flexibility by allowing you to select your role; prepare for and take tests at your own pace; and, in some cases, select from a choice of elective tests that are best suited to your abilities and needs. Some roles also offer a shortcut by giving credit for a certification obtained in other industry certification programs.

You might be a network administrator, systems integrator, network integrator, solution architect, solution developer, value-added reseller, technical coordinator, sales representative, or educational trainer. Regardless of your role, you can start charting your course through the Professional Certification Program from IBM today.

1.1.1 Benefits of certification

Certification is a tool to help to objectively measure the performance of a professional on a given job at a defined skill level. Therefore, it is beneficial for individuals who want to validate their own skills and performance levels, their employees, or both. For optimum benefit, the certification tests must reflect the critical tasks required for a job, the skill levels of each task, and the frequency by which a task needs to be performed. IBM prides itself on designing comprehensive, documented processes that ensure that IBM certification tests remain relevant to the work environment of potential certification candidates.

In addition to assessing job skills and performance levels, professional certification can also provide the following benefits:

- ▶ For employees:
 - Promotes recognition as an IBM certified professional
 - Helps to create advantages in interviews
 - Assists in salary increases, corporate advancement, or both
 - Increases self esteem
 - Provides continuing professional benefits
- ▶ For employers:
 - Measures the effectiveness of training
 - Reduces course redundancy and unnecessary expenses
 - Provides objective benchmarks for validating skills
 - Makes long-range planning easier
 - Helps to manage professional development
 - Aids as a hiring tool
 - Contributes to competitive advantage
 - Increases productivity, morale, and loyalty
- ▶ For Business Partners and consultants:
 - Provides independent validation of technical skills
 - Creates competitive advantage and business opportunities
 - Enhances prestige of the team
 - Contributes to IBM requirements for various IBM Business Partner programs

Specific benefits can vary by country (or region) and role. In general, after you become certified, you should receive the following benefits:

- ▶ Industry recognition

Certification can accelerate your career potential by validating your professional competency and increasing your ability to provide solid, capable technical support.
- ▶ Program credentials

As a certified professional, you receive (through e-mail) your certificate of completion and the certification mark that is associated with your role for use in advertisements and business literature. You may also request a hardcopy certificate, which includes a wallet-size certificate.

The Professional Certification Program from IBM acknowledges the individual as a technical professional. The certification mark is for the exclusive use of the certified individual.
- ▶ Ongoing technical vitality

IBM Certified professionals are included in mailings from the IBM Professional Certification Program.

1.1.2 Tivoli Software Professional Certification

Tivoli's professional certification program offers certification testing that sets the standard for qualified product consultants, administrators, architects, and partners.

The program also offers an internationally recognized qualification for technical professionals who are seeking to apply their expertise in today's complex business environment. The program is designed for those who implement, buy, sell, service, and support Tivoli solutions and want to deliver higher levels of service and technical expertise.

Whether you are a Tivoli customer, partner, or technical professional wanting to put your career on the fast track, you can start your journey to becoming a Tivoli Certified Professional today.

Benefits of being Tivoli certified

Tivoli Certification has the following benefits:

- ▶ For the individual:
 - IBM Certified certificate and use of logos on business cards
 - Recognition of your technical skills by your peers and management
 - Enhanced career opportunities
 - Focus for your professional development
- ▶ For the IBM Business Partner:
 - Confidence in the skills of your employees
 - Enhanced partnership benefits from Business Partner Program
 - Higher rates for billing out your employees
 - Stronger customer proposals
 - Demonstration of the depth of technical skills available to prospective customers
- ▶ For the customer:
 - Confidence in the services professionals handling your implementation
 - Ease of hiring competent employees to manage your Tivoli environment
 - Enhanced return on investment (ROI) through more thorough integration with Tivoli and third-party products
 - Ease of selecting a Tivoli Business Partner that meets your specific needs

Certification checklist

To pursue certification, follow the steps in this checklist:

1. Select the certification you want to pursue.
2. Determine which tests are required by reading the certification role description.
3. Prepare for the test by using the following resources:
 - Test objectives
 - Recommended educational resources
 - Sample assessment test
 - Other reference materials
 - Opportunities for experience

A sample test is located at:

<http://www.ibm.com/certify/tests/ovr025.shtml>

Note: These resources are available from each certification description page, as well as from the test information page.

4. Register to take a test by contacting one of our worldwide testing vendors:
 - Prometric
 - Pearson VUE (Virtual University Enterprises)

Note: When providing your name and address to the testing vendor, be sure to specify your name exactly as you want it to appear on your certificate.

5. Take the test. Be sure to keep the Examination Score Report provided upon test completion, as your record of taking the test.

Note: After you take the test, the results and demographic data (such as name, address, e-mail, and phone number) are sent from the testing vendor to IBM for processing (allow two to three days for transmittal and processing). After all the tests required for a certification are passed and received by IBM, your certificate will be issued.

6. Repeat steps 3 - 5 until all required tests are successfully completed for the certification. If additional requirements exist (such as another vendor certification or exam), follow the instructions on the certification description page to submit these requirements to IBM.
7. After you complete the certification requirements, an e-mail message is sent to you, asking you to accept the terms of the IBM Certification Agreement.
8. Upon your acceptance, you receive another e-mail with the following deliverables:
 - A certificate in PDF format, which can be printed in either color or black and white.
 - A set of graphics files containing the IBM Professional Certification mark associated with the certification achieved.
 - Guidelines for the use of the IBM Professional Certification mark.
9. To avoid unnecessary delay in receiving your certificate, ensure that your current e-mail is on file by keeping your profile up to date. If you do not have an e-mail address on file, your certificate will be sent by postal mail.

Certificates are sent by e-mail. However, you may also contact IBM at the following e-mail address to request a paper copy of the certificate, including a laminated wallet-sized card:

<mailto:certify@us.ibm.com>

Note: IBM reserves the right to change or delete any portion of the program, including the terms and conditions of the IBM Certification Agreement, at any time without notice. Some certification roles offered through the IBM Professional Certification Program require recertification.

1.2 IBM Tivoli Storage Manager V6.1 Certification

In this section, we categorize the certification process.

1.2.1 Job role description and target audience

An IBM Certified Deployment Professional - IBM Tivoli Storage Manager V6.1 is an individual who has demonstrated the ability to implement and support IBM Tivoli Storage Manager. This individual is expected to be able to perform the tasks listed in this section independently a majority of the time and, in some situations, take leadership and provide mentoring to peers. The tasks must be performed with limited assistance from peers, product documentation, and vendor support services.

1.2.2 Key areas of competency

This person is expected to perform the following tasks independently:

- ▶ Describe IBM Tivoli Storage Manager's features, functions, and benefits.
- ▶ Understand the customer's requirements, design the proper IBM Tivoli Storage Manager solution (including policy definitions, schedules, devices, and communication requirements), and configure IBM Tivoli Storage Manager (including selecting the appropriate IBM Tivoli Storage Manager products).
- ▶ Install IBM Tivoli Storage Manager, set up remote clients and local storage devices, specify backup schedules, authorize users, and perform performance tuning, problem determination, and resolution.
- ▶ Protect the customer's IBM Tivoli Storage Manager server through database and storage pool backups.

1.2.3 Prerequisites

To attain the IBM Certified Deployment Professional - Tivoli Storage Manager V6.1 certification, candidates must pass one test, which is Test 000-025: IBM Tivoli Storage Manager V6.1 Implementation.

The IBM Tivoli Storage Manager V6.1 exam is platform-independent and applies to heterogeneous environments. Candidates *must* have background experience sufficient to prepare for training and testing on storage solutions. The following qualifications are requirements for success:

- ▶ Advanced backup methodologies (full, incremental, differential, image, progressive, on site, off site, and so on)
- ▶ Basic operating systems methodologies
- ▶ Basic networking methodologies
- ▶ Basic storage device knowledge (for example, optical, disk, tape and NAS)
- ▶ Basic hardware knowledge (for example, server, CPU, and memory)

1.2.4 Core requirement

To be certified, you must select Test 000-025: IBM Certified Deployment Professional - IBM Tivoli Storage Manager V6.1 implementation. This test has the following components and characteristics:

- ▶ Approximate number of questions: 70
- ▶ Duration in minutes: 90
- ▶ Format: Multiple choice
- ▶ Required passing score: 65% or 46 correct answers

Important: IBM offers the following promotion code information, which is good for a 15% discount on the indicated Tivoli certification exams if taken at any Prometric or Pearson VUE testing centers:

- ▶ Promotion code: 15T025
- ▶ Amount of discount: 15%
- ▶ Valid for exams: Test 000-025
- ▶ Discount expires: December 31, 2010

1.3 Recommended resources for study

Courses and publications are offered to help you prepare for the certification tests.

1.3.1 Courses

This section provides information about pricing, scheduling, and course registration. Course names and numbers vary depending on the education delivery arm used in each region. Refer to the Tivoli software education Web site to find the appropriate course and education delivery vendor for each geography.

General training information can also be found at this Web site:

<http://ibm.com/training>

The courses are recommended, but not required, before you take a certification test. If you want to purchase Web-based training courses or are unable to locate a Web-based course or classroom course at the time and location you desire, contact one of our delivery management teams at:

- ▶ Americas:
<mailto:tivamedu@us.ibm.com>
- ▶ EMEA:
<mailto:tived@uk.ibm.com>
- ▶ Asia-Pacific:
<mailto:tivtrainingap@au1.ibm.com>

Note: Course offerings are continuously being added and updated. If you do not see the courses listed for your geographical location, contact one of the delivery management teams.

Worldwide schedules are available at the Tivoli software education Web site:

<http://www.ibm.com/software/tivoli/education/>

To check whether a course is approved for IBM PartnerWorld® *You-Pass, We-Pay*, visit:

<http://www.ibm.com/partnerworld/pwhome.nsf/weblook/index.html?OpenDocument>

Course: IBM Tivoli Storage Manager V6.1 Differences and Upgrade

Course duration is two days.

Tivoli Storage Manager V6.1 introduces a DB2-based, non-proprietary database, and new features, commands, and supported devices and platforms. Explore the new features and commands with lectures and hands-on exercises. In this course, you discover features like data deduplication, a method of eliminating redundant data in storage pools, enhancements to the Administration Center, and active-data pools for disaster recovery. You will also install and use Tivoli Common Reporting. You also learn to plan and upgrade Tivoli Storage Manager V5 to Tivoli Storage Manager V6.1. Implementing Tivoli Storage Manager V6.1 involves upgrading from the Tivoli Storage Manager proprietary database to a provided DB2 database. Basic DB2 functions and queries will be discussed in the class, to ensure you have the necessary skills to manage the Tivoli Storage Manager 6.1 database.

For information, go to:

http://www-304.ibm.com/jct03001c/services/learning/ites.wss/au/en?pageType=course_description&courseCode=8S600AU

Course: IBM Tivoli Storage Manager V6.1 Implementation and Administration

Course duration is five days.

This is the first of two 5-day instructor-led courses for implementing and administering IBM Tivoli Storage Manager. Through extensive hands-on exercises, you should learn to install the Tivoli Storage Manager V6.1 server, backup-archive client, and Integrated Solution Console Administration Center. You also learn to create and configure hierarchies of storage pools, define policies to manage the flow of data from disk to disk or tape media, and back up and restore client data.

The student exercises in this course are written for Windows 2003, but the lecture material covers all supported Intel and UNIX platforms.

For information, go to:

http://www-304.ibm.com/jct03001c/services/learning/ites.wss/au/en?pageType=course_description&courseCode=TS610AU

Self study: IBM Tivoli Storage Manager V6.1 product information

Detailed information and documentation about IBM Tivoli Storage Manager V6.1 can be found at the following Web site:

<http://www.ibm.com/software/tivoli/products/storage-mgr/>

Some of the documents contained on this Web site include guides, data sheets, features, advantages, benefits, and flyers. Reading these documents in addition to hands-on experience and skills with the product can help prepare you for certification testing.

1.3.2 Publications

IBM Tivoli Storage Manager documentation and IBM Redbooks publications are useful tools for preparing to take Test 000-025.

IBM Tivoli Storage Manager product documentation

You may want to refer to the following manuals:

- ▶ *IBM Tivoli Storage Manager for AIX Installation Guide Version 6.1*, GC23-9781
- ▶ *IBM Tivoli Storage Manager for AIX Administrator's Guide Version 6.1*, SC23-9769
- ▶ *IBM Tivoli Storage Manager for Windows Installation Guide Version 6.1*, GC23-9785
- ▶ *IBM Tivoli Storage Manager for Windows Administrator's Guide Version 6.1*, SC23-9773
- ▶ *IBM Tivoli Storage Manager for UNIX and Linux Backup-Archive Clients Installation and User's Guide 6.1*, SC23-9791
- ▶ *IBM Tivoli Storage Manager for Windows Backup-Archive Clients Installation and User's Guide Version 6.1*, SC23-9792

To obtain the online documentation for IBM Tivoli Storage Manager, go to:

<http://publib.boulder.ibm.com/infocenter/tsminfo/v6/index.jsp>

IBM Tivoli Storage Manager IBM Redbooks publications

Note: Although some of the IBM Redbooks publications listed here still refer to IBM Tivoli Storage Manager Versions 5.3, 5.4, or 5.5, the content in these books is still valid for IBM Tivoli Storage Manager V6.1 and is very useful.

The following Tivoli Storage Manager publications are helpful:

- ▶ *IBM Tivoli Storage Management Concepts*, SG24-4877

This publication describes the features and functions of IBM Tivoli Storage Manager. It introduces Tivoli storage management concepts for those new to storage management, in general, and to IBM Tivoli Storage Manager, in particular.

This easy-to-follow guide gives a broad understanding of IBM Tivoli Storage Manager software, the key technologies to know, and the solutions available to protect your business. It offers a broad understanding of how IBM Tivoli Storage Manager will work in heterogeneous environments, including Windows, UNIX/Linux, OS/400®, and z/OS platforms, and with such applications as DB/2, Oracle, Lotus® Domino®, Exchange, SAP, and many more.

The book introduces storage management software by explaining the concepts, architecture, and systems management features of IBM Tivoli Storage Manager and showing available complementary products. It will help you design solutions to protect data holdings from losses ranging from those caused by user error to complete site disasters.

- ▶ *IBM Tivoli Storage Manager Implementation Guide*, SG24-5416

This publication describes how to integrate, install, configure, and operate IBM Tivoli Storage Manager Version 5.3 in heterogeneous environments.

You will learn how to implement and operate IBM Tivoli Storage Manager. You should already have 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 important tasks to protect your business: planning, client and server installation, operations, performance considerations, SAN environments, NDMP, as well as explaining many more features. This practical guide is intended for the following 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, and administrators who want to learn more about the basic and advanced components and their implementation.

► *IBM Tivoli Storage Manager Version 5.3 Technical Guide, SG24-6638*

This publication presents an overview of IBM Tivoli Storage Manager Version 5.3, giving detailed descriptions of the changes provided in this new release. This book also covers the cumulative changes in the releases after Version 5.1.

This book is intended for customers, consultants, IBM Business Partners, and IBM and Tivoli staff who are familiar with earlier releases of IBM Tivoli Storage Manager and who want to understand what is new in Version 5.3. It should be used in conjunction with the manuals and readme files provided with the products and is not intended to replace any information contained therein.

► *Certification Study Guide: IBM Tivoli Storage Manager Version 5.3, SG24-7127*

This publication is a study guide for IBM Tivoli Storage Manager Version 5.3 and is meant for those who want to achieve IBM Certifications for this specific product.

The IBM Tivoli Storage Manager Certification, offered through the Professional Certification Program from IBM, is designed to validate the skills required of technical professionals who work in the implementation of the IBM Tivoli Storage Manager Version 5.3 product.

This book provides a combination of theory and practical experience needed for a general understanding of the subject matter. It also provides sample questions that will help in the evaluation of personal progress and provide familiarity with the types of questions that will be encountered in the exam.

► *Deployment Guide for IBM Tivoli Storage Manager Version 5.3, SG24-6761*

Deploying a storage management solution for a small or medium-size business begins with a thorough analysis of the existing business and IT environment. The next step after fully understanding the organization is planning and sizing. This is the key stage, because deployment success depends on how well you plan and size.

This publication provides steps for deploying a storage management solution based on IBM Tivoli Storage Manager. The first two chapters introduce overall planning and sizing issues. Then we focus on the detailed installation and configuration of Tivoli Storage Manager, and offer some deployment scenarios and troubleshooting of storage management implementation.

Readers should be familiar with the following topics:

- Storage management concepts
- Network topologies
- Distributed systems architectures and configuration

► *Deployment Guide Series: IBM Tivoli Storage Manager Version 5.4, SG24-7379*

The objective of this publication is to provide broad instructions about deploying the IBM Tivoli Storage Manager to various environments.

Readers must have general knowledge about communication network architecture and design, basic sizing of the Tivoli Storage Manager database, and basic pool management of Tivoli Storage Manager servers.

This document is intended to be read and used by pre-sales systems engineers and services personnel to build customized deployment of the Tivoli Storage Manager. A

significant amount of knowledge of Tivoli Storage Manager is expected, and ideally the reader should have attended Tivoli Storage Manager basic and advanced training classes.

- ▶ *Using the IBM System Storage N Series with IBM Tivoli Storage Manager*, SG24-7243.

This publication gives detailed descriptions and setup instructions, practical examples and best practices for backing up the IBM System Storage™ N series using IBM Tivoli Storage Manager.

1.4 Test 000-025 objectives

In this section, we review the Test 000-025 objectives.

Section 1: Planning

The following test objectives are for the planning area of the test.

- ▶ Given a qualified, feasible customer service level agreement, and business and legal data retention requirements, apply these agreements to the policy recommendations so that a qualified, validated data retention plan for IBM Tivoli Storage Manager (Tivoli Storage Manager) is produced. Emphasis is on performing the following tasks:
 - Determine feasibility of customer's service level agreement request with current version of Tivoli Storage Manager.
 - Apply business and legal data retention requirements to policy retention requirements.
 - Review policy retention recommendations.
 - Produce a storage management plan.
- ▶ Given the SLAs and design requirements, evaluate the features of Tivoli Storage Manager to design a solution that meets requirements and minimizes cost. Emphasis is on performing the following tasks:
 - Interpret business service-level agreements (SLAs) and retention requirements into technical requirements.
 - Match technical requirements to Tivoli Storage Manager features.
 - Evaluate the cost of each of the features in Tivoli Storage Manager that can be applied to the technical requirements.
 - Design a Tivoli Storage Manager solution that meets the requirements with the minimum cost.
- ▶ Given the knowledge of a proposed Tivoli Storage Manager server environment, a working Internet connection, and an Internet browser, compare the characteristics of the proposed environment with system requirements so that the compliance is confirmed. Emphasis is on performing the following tasks:
 - Open an Internet browser.
 - Navigate to IBM Web site.
 - Navigate to Tivoli Storage Manager product Web page.
 - Select server requirements.
 - Select entry for appropriate server platform.
 - Review requirements.
 - Compare proposed server environment to requirements.
- ▶ Given client hardware, network protocols, and applications, identify customer hardware and operating system (OS) software, determine network connectivity and locate applications so that a list of hardware, operating systems software, and OS configuration

requirements for Tivoli Storage Manager is produced. Emphasis is on performing the following tasks:

- Discover customer's hardware to be used with Tivoli Storage Manager.
- Identify operating systems used on discovered hardware.
- Determine network connectivity and protocols available.
- Locate running applications on hardware to be used with Tivoli Storage Manager.
- ▶ Given the configuration management information about the customer environment, identify the systems and applications in the environment so that a list of required Tivoli Storage Manager nodes can be determined. Emphasis is on performing the following tasks:
 - Identify the systems and applications in the environment.
 - Map the systems and application to Tivoli Storage Manager client nodes.
- ▶ Given customer requirements and knowledge of the Tivoli Storage Manager product family, identify special application requirements to design an appropriate Tivoli Storage Manager solution. Emphasis is on performing the following tasks:
 - Verify customer requirements.
 - Match Tivoli Storage Manager family products with customer requirements.
 - Recommend appropriate Tivoli Storage Manager family products.
- ▶ Given hardware, operating systems, and network connectivity requirements, evaluate bare machine recovery so that the most appropriate methodology can be determined. Emphasis is on performing the following tasks:
 - Determine customer's hardware to be used with Tivoli Storage Manager.
 - Identify operating systems used on hardware.
 - Determine network connectivity and protocols available.
 - Determine the most appropriate bare machine recovery method for the customer's environment.
- ▶ Given the SLAs, design requirements, existing hardware, and hardware preferences, evaluate the infrastructure and design goals, so that a new Tivoli Storage Manager solution which meets requirements and maps to specific hardware is produced. Emphasis is on performing the following tasks:
 - Interpret network infrastructure to determine if it is sufficient to meet needs.
 - Determine if a LAN-free solution should be deployed for Tivoli Storage Manager and the systems where it should be deployed.
 - Evaluate the disk infrastructure of the customer to determine what is appropriate for the Tivoli Storage Manager server and client.
 - Evaluate Tivoli Storage Manager server hardware to determine what is appropriate for the Tivoli Storage Manager server.
 - Design a Tivoli Storage Manager solution which meets the requirements with a given hardware.
- ▶ Given customer requirements, knowledge of Tivoli Storage Manager, and knowledge of DB2® vocabulary, identify features to best address customer requirements so that an appropriate Tivoli Storage Manager solution is designed. Emphasis is on performing the following tasks:
 - Identify Tivoli Storage Manager server features which meet customer requirements.
 - Explain the benefits of the DB2 back-end system.
 - Recommend appropriate Tivoli Storage Manager server and client features.

- ▶ Given the customer's hardware, total amount of data to be protected, percentage of daily change rate for the data, the network connectivity available, policy recommendations, and client applications, evaluate the infrastructure and requirements so that Tivoli Storage Manager backup methods for client data can be recommended. Emphasis is on performing the following tasks:
 - Determine customer's available hardware.
 - Identify total amount of data to be protected.
 - Identify percentage of data that is changed daily.
 - Determine network connectivity and protocols available.
 - Review policy recommendations for Tivoli Storage Manager client nodes.
- ▶ Given the customer's business and policy criteria, evaluate the infrastructure and service level agreements, so that Tivoli Storage Manager backup requirements for individual client application data can be protected. Emphasis is on performing the following tasks:
 - Determine customer's available hardware.
 - Determine customer's application requirements.
 - Identify total amount of data to be protected.
 - Identify type of data to be protected.
 - Determine network connectivity and protocols available.
 - Review policy recommendations for Tivoli Storage Manager client nodes.
 - Determine whether client node is defined for Tivoli Data Protection (TDP) agent.
 - Determine if special setup and configurations for TDP agent backups are required.
- ▶ Given the SLAs, design and security requirements, network infrastructure, amounts of data, and types of data, determine Tivoli Storage Manager storage, feature and database configuration so that the number and location of Tivoli Storage Manager servers in a particular design is planned. Emphasis is on performing the following tasks:
 - Interpret network infrastructure to determine where it should be appropriate to place Tivoli Storage Manager servers.
 - Determine the number of copy pools and versions required in Tivoli Storage Manager to meet design requirements.
 - Determine the features of Tivoli Storage Manager to be used to meet design requirements.
 - Estimate the size of the Tivoli Storage Manager server database in the environment. Identify security requirements.
- ▶ Given customer requirements, knowledge of hardware components and knowledge of Tivoli Storage Manager design, identify appropriate hardware components needed so that an appropriate Tivoli Storage Manager solution can be determined. Emphasis is on performing the following tasks:
 - Apply knowledge of hardware characteristics.
 - Apply knowledge of Tivoli Storage Manager solution design.
 - Apply solution design and hardware component knowledge to customer requirements.
 - Recommend appropriate hardware to implement the Tivoli Storage Manager solution.

Section 2: Installation

The following test objectives are for the installation area of the test.

- ▶ Given the network and hardware that meet requirements for Tivoli Storage Manager, determine and verify the configuration of existing hardware, so that Tivoli Storage Manager software can be installed and configured. Emphasis is on performing the following tasks:
 - Verify the latest Tivoli Storage Manager system requirements on the IBM Tivoli support Web site.
 - Ensure that the required operating system version is installed.
 - Ensure that the required browser version is installed.
 - Test the system for network connectivity.
 - Verify disk and volume or directory space requirements are set up correctly.
 - Verify characteristics of tape device and verify that it is set up correctly.
- ▶ Given a correctly set up system and network which meet the requirements, and access to the Tivoli Storage Manager code, determine whether the installation is new and follows the documented installation steps for any supported operating system so that the Tivoli Storage Manager server is installed on the system. Emphasis is on performing the following tasks:
 - Determine the OS platform.
 - Determine if this is a new installation or an upgrade. If an upgrade, use manual installation.
 - Read appropriate documentation and Support Flashes on the IBM Tivoli support Web site.
 - Identify location of most current Tivoli Storage Manager code, patches, and fixes.
 - Install the Tivoli Storage Manager server code to any supported operating system from the appropriate media (CD or electronic image).
 - Install the license files from the appropriate media (CD or electronic image).
 - Install the language packs from the appropriate media (CD or electronic image).
 - Install the device drivers from the appropriate media (CD or electronic image).
 - Verify the code installed correctly.
- ▶ Given a correctly set up system and network which meet the requirements, and access to the Tivoli Storage Manager code, determine whether the installation is an upgrade and follows the documented installation steps for any supported operating system so that the Tivoli Storage Manager server is installed on the system. Emphasis is on performing the following tasks:
 - Determine the OS platform.
 - Determine if this is a new installation or an upgrade. If new, use the wizard installation.
 - Read documentation and Support Flashes on the IBM Tivoli support Web site.
 - Identify location of the most current Tivoli Storage Manager code, patches, and fixes.
 - Plan the upgrade of the Tivoli Storage Manager server.
 - Choose the method of upgrade.
 - Ensure that enough storage space exists with the chosen upgrade method.
 - Determine the location of the database and logs.
 - Prepare the old Tivoli Storage Manager server.
 - Back up the old system.
 - Install the prepare utility.
 - Extract the database.

- Uninstall the Tivoli Storage Manager server.
- Install the Tivoli Storage Manager V6.1 server.
- Install DB2.
- Create and format the database and logs.
- Insert the old database into the new.
- Verify new installation.
- ▶ Given that the environment requirements are met and the Tivoli Storage Manager server is correctly installed, perform the installation steps so that the Tivoli Storage Manager Backup-Archive client is properly installed. Emphasis is on performing the following tasks:
 - Install the Tivoli Storage Manager Backup-Archive client from the appropriate media (CD or downloaded).
 - Determine which client options are appropriate.
 - Configure client nodes:
 - Server name
 - TCP/IP port
 - Communication method
 - Adaptive subfile for backups (if appropriate)
 - Verify that the client is working.
- ▶ Given a correctly installed Backup-Archive (BA) client and Tivoli Storage Manager server, implement and configure Journal Based Backup (JBB), Logical Volume Snapshot™ Agent (LVSA), and the Administrative client so that additional client features are available. Emphasis is on performing the following tasks:
 - Perform custom installation of the Tivoli Storage Manager Backup-Archive client from the appropriate media (CD or electronic image).
 - Install the JBB.
 - Customize the JBB if needed.
 - Install LVSA.
 - Customize LVSA if needed.
 - Install the Administrative client.
 - Install the Web client.
 - Customize the Web client if needed.
 - Install the Tivoli Storage Manager scheduler.
 - Customize the Tivoli Storage Manager scheduler.
 - Initialize and start services on the appropriate platform.
- ▶ Given that the environment requirements are met and the Tivoli Storage Manager server is correctly installed and operated, install and configure the Tivoli Storage Manager Backup-Archive client in a clustered node environment. Emphasis is on performing the following tasks:
 - Install the Tivoli Storage Manager Backup-Archive client from the appropriate media (CD or downloaded) onto each local node in the cluster. Ensure the application files are stored in the same location on each cluster node.
 - Register a Tivoli Storage Manager node on the Tivoli Storage Manager server specifically for the cluster node.

- Define a client options file on the cluster-shared disk resources with the following options, where appropriate:
 - ServerName
 - TCPPORT
 - COMMETHOD
 - Clusternode (yes on each cluster node)
 - Nodename
 - Domain
 - Password access generate
 - Errorlogname
 - Schedlogname
- Verify each cluster node Backup-Archive client is working by using the appropriate shared resource options file.
- ▶ Given a working Tivoli Storage Manager environment, install the storage agent and configure Tivoli Storage Manager server and client, so that LAN-free backups can be performed. Emphasis is on performing the following tasks:
 - Configure the Tivoli Storage Manager server for library sharing.
 - Install storage agent software for each LAN-free client.
 - Define the paths to the tape drives from the storage agent.
 - Configure the options file on the client and storage agent for connectivity.
 - Validate connectivity.

Section 3: Configuration

The following test objectives are for the configuration area of the test.

- ▶ Given that the IBM Tivoli Storage Manager (Tivoli Storage Manager) server is installed, modify the dsmserv.opt file and issue server option commands so that server options are set appropriately. Emphasis is on performing the following tasks:
 - Configure options in dsmserv.opt file that are appropriate to a customer's environment.
 - Configure options by using server commands that are appropriate to a customer's environment.
- ▶ Given a working Tivoli Storage Manager environment, Tivoli Storage Manager client options file, knowledge of the customer's environment, and security requirements, configure client and server connections and security-related options so that Tivoli Storage Manager server and client operates in a secure environment. Emphasis is on performing the following tasks:
 - Configure communication method.
 - Configure Administrators who will be performing backup tasks.
 - Configure password encryption if required.
 - Configure SSL if required.
 - Configure the client or the server if behind a proxy server or firewall.
 - Configure Tivoli Storage Manager ports that should be turned on or turned off for proper operation.
 - Evaluate the client environment. Allow only admin backup/restores over certain ports.
 - Configure where passwords files should be stored (passworddir).
 - Configure the retention policy as related to security.

- Configure how to preserve file dates related to security.
- Configure data shredding, if required, based on customer requirements.
- Configure data encryption, if required, based on customer requirements.
- ▶ Given a UNIX Tivoli Storage Manager V6.1 environment where the upgrade installation is not yet completed, configure DB2 so that DB2 is configured in a Tivoli Storage Manager V6.1 environment. Emphasis is on performing the following tasks:
 - Run **dsmicfgx** as root user from `/opt/tivoli/tsm/server/bin/` directory or
 - Set up an instance directory to run multiple Tivoli Storage Manager servers.
 - Create a new server options file.
 - Create an appropriate location for the database and logs.
 - Issue the **DSMSERV FORMAT** command to format the database.
 - Start the Tivoli Storage Manager server instance.
 - Register Tivoli Storage Manager licenses.
 - Create a Tivoli Storage Manager instance by using **db2icrt** command.
 - Create the `tsmdbmgr.env` file.
 - Set the `DSMI_api` environment variable.
 - Create the `tsmdbmgr.opt` file.
 - Stop and start the database manager instance, as follows:
 - Use `db2cmd`.
 - Set DB2 instance name.
 - Stop DB2.
 - Start DB2.
 - Update node instance and password by using `dsmsutil` utility.
- ▶ Given the customers hardware, media type available, network connectivity being used, policy recommendations, the Tivoli Storage Manager commands, and processes necessary, configure tape library, drives, and device class so that the library is ready for use. Emphasis is on performing the following tasks:
 - Configure appropriate device drivers.
 - Identify media types available with customer's hardware.
 - Determine network connectivity and protocols available.
 - Configure library, drives, path, and device classes.
- ▶ Given a functioning Tivoli Storage Manager server and sufficient storage space, define storage pools so that storage pools are configured and ready for use. Emphasis is on performing the following tasks:
 - Determine which Tivoli Storage Manager clients will use which storage pools.
 - Configure the appropriate device class.
 - Determine which type of storage pools to create based on the type of data backup requirements.
 - Determine the appropriate type class.
 - Configure the primary storage pools.
 - Configure the archive storage pools.
 - Configure the copy storage pools.
 - Configure the active-data storage pools.

- ▶ Given the customer's business requirements, the policy rules for data protection, storage pools available for use with data deduplication, and the amount and type of data to be deduplicated, configure data deduplication so that a configured storage pool and data deduplication process are available. Emphasis is on performing the following tasks:
 - Determine customer's available hardware.
 - Determine customer's storage pools available.
 - Define storage pool to be used for data deduplication.
 - Identify total amount of data for data deduplication process.
 - Identify type of data to be deduplicated.
 - Review policy recommendations for Tivoli Storage Manager client data.
 - Configure storage pool for client data deduplication process.
- ▶ Given a functioning Tivoli Storage Manager server and client, an existing policy domain, and policy set, create a management class so that backup and archive copy groups can be added. Emphasis is on performing the following tasks:
 - Define management classes and copy groups according to retention requirements and backup locations.
 - Validate the policy set if necessary.
 - Activate the policy set.
- ▶ Given multiple Tivoli Storage Manager server instances, configure enterprise management and server-to-server communications so that Tivoli Storage Manager policy and objects are standardized and Tivoli Storage Manager administration is centralized. Emphasis is on performing the following tasks:
 - Configure server-to-server communications.
 - Configure the hierarchy of the enterprise management.
 - Configure Tivoli Storage Manager objects to be centrally managed by using enterprise management.
 - Test the server-to-server communications.
- ▶ Given an existing Tivoli Storage Manager server, Storage Area Network (SAN) or LAN infrastructure, and a supported Network Data Management Protocol (NDMP) device, install and configure Tivoli Storage Manager support for the NDMP device so that the device can be backed up and restored. Emphasis is on performing the following tasks:
 - Configure the location of the network-attached storage backups.
 - Configure Tivoli Storage Manager policy and Storage Pools for NDMP operations.
 - Schedule the NDMP backups.
- ▶ Given an existing Tivoli Storage Manager server with a tape drive or tape library, SAN or LAN infrastructure, a Network Appliance™, and that the Network Appliance is snapshot capable, configure Network Appliance SnapMirror® to Tape feature so that a successful backup can be performed. Emphasis is on performing the following tasks:
 - Create the Network Appliance snapshot.
 - Ensure a physical location exists for the snap.
 - Define virtual fsmapping.
 - Configure the backup command.
 - Ensure the functionality of the tape drives.
 - Execute Network Appliance backup.
- ▶ Given a correctly configured Tivoli Storage Manager server environment and network appliance disk storage device, configure Tivoli Storage Manager storage to exploit licensed SnapLock® features of the Network Appliance storage so that archived data is

expired based on deletion application events. Emphasis is on performing the following tasks:

- Set the server option RETENTIONEXTENSION to an appropriate value (if required).
- Define a FILE type device class. Specify the following device class option:
 - DIR option to specify a SnapLock-enabled netapp-presented file system
- Define a Tivoli Storage Manager storage pool by using the SnapLock device class previously created. Specify the following storage pool option:
 - RECLAMATIONTYPE set to SnapLock
- Define a management class and archive copy group. Specify the following archive copy group options:
 - Destination set to the storage pool previously defined
 - RETVER and RETMIN appropriate to the customer requirements
 - RETINIT set to EVENT
- Validate policy set.
- Activate policy set.
- ▶ Given a Tivoli Storage Manager V6.1 Server environment and a Windows 2003 or 2008 Active Directory and Tivoli Storage Manager V6.1 BA Client with backed up Active Directory objects, perform a restore so that Active Directory objects are restored. With emphasis on performing the following tasks:
 - ▶ Determine the object to be restored.
 - ▶ From a Tivoli Storage Manager V6.1 BA Client command line, run the command for an Active Directory system within the IBM network to restore the Administrator object:

```
restore adobj  
"CN=Administrator,CN=Users,DC=yourname,DC=yourlocale,  
DC=ibm,DC=com"
```
 - ▶ Confirm that the Administrator is now available for use.
 - ▶ Given the customer's business requirements, the policy rules for data protection, the amount of data to be protected, and VMware server, configure VMware Consolidated Backup (VCB) so that a successful VCB task of VM Images for disaster recovery is available. Emphasis is on performing the following tasks:
 - Determine customer's storage pools available.
 - Review policy recommendations for Tivoli Storage Manager client data.
 - Create VCB task.
 - Configure schedule to run VCB task.
 - Validate VCB success for disaster recovery.
- ▶ Given a functioning Tivoli Storage Manager environment, configure disaster recovery management, so that the server and the client data can be recovered in the event of a disaster. Emphasis is on performing the following tasks:
 - Determine which storage pools will be protected by disaster recovery manager (DRM).
 - Configure active data pools that will be protected by DRM.
 - Gather requirements for recovery plan.
 - Specify defaults for the disaster recovery plan file.
 - Create recovery instructions files.
 - Use the query **drmstatus** command to verify the status of your plan.
 - Determine location of off-site storage.
 - Configure disaster recovery tape rotation.

Section 4: Administration

The following test objectives are for the administration area of the test.

- ▶ Given an existing Tivoli Storage Manager server with a tape drive, label and check in tapes so that the Tivoli Storage Manager server has scratch volumes. Emphasis is on performing the following tasks:
 - Label the tape media for the Tivoli Storage Manager server.
 - Check in the tape media to the Tivoli Storage Manager server.
- ▶ Given access to a Tivoli Storage Manager server through the administration center or administrative command-line interface (CLI), and client machine, add the client to the Tivoli Storage Manager server so that client nodes can be accessed and managed. Emphasis is on performing the following tasks:
 - Use the CLI or Administration Center to register the client node.
 - Verify the client nodes can access the Tivoli Storage Manager server.
- ▶ Given a working Tivoli Storage Manager environment in which one node restores data backed up from another node, create a node access so that one node now has been granted the authority to restore files for another specified node. Emphasis is on performing the following tasks:
 - Create a node access list to grant a given node the ability to restore all data backed up from another node.
 - Configure the node.
 - Test the node.
- ▶ Given a correctly installed and connected Tivoli Storage Manager environment, perform backup so that a successful backup of client data can be created. Emphasis is on performing the following tasks:
 - Initiate a client backup by using:
 - CLI
 - GUI
 - Web client
 - Integrated Solutions Console (ISC)
 - Determine objects to be backed up.
 - Determine type of backup (selective, incremental, and others).
 - Perform backup.
 - Monitor progress and confirm completion.
 - Review Tivoli Storage Manager error log for failures.
- ▶ Given a correctly installed and connected Tivoli Storage Manager environment, perform a restore operation so that successful restore of client data can be obtained. Emphasis is on performing the following tasks:
 - Initiate a client node restore by using:
 - CLI
 - GUI
 - Web client
 - ISC
 - Determine objects and location to be restored.
 - Determine type of restore (point in time, single file, classic, no query, current, inactive and others).
 - Perform restore.
 - Monitor progress and confirm completion.
 - Review Tivoli Storage Manager error log for failures.

- ▶ Given a correctly installed and connected Tivoli Storage Manager environment, perform an archive so that a successful archive of client data can be created. Emphasis is on performing the following tasks:
 - Initiate an archive by using:
 - CLI
 - GUI
 - Web client
 - ISC
 - Determine objects to be archived.
 - Provide a description of the archive.
 - Perform an archive.
 - Monitor progress and confirm completion.
 - Review Tivoli Storage Manager error log for failures.
- ▶ Given a correctly installed and connected Tivoli Storage Manager environment, perform a retrieve of archived files so that a successful retrieve of client data can be verified. Emphasis is on performing the following tasks:
 - Initiate a client archive retrieval by using:
 - CLI
 - GUI
 - Web client
 - ISC
 - Determine the objects and location to be retrieved.
 - Perform the retrieve operation.
 - Monitor progress and confirm completion.
 - Review Tivoli Storage Manager error log for failures.
- ▶ Given client backup and archive data volume, available storage pool size being used, and the amount of Tivoli Storage Manager server time available for maintenance, create administrative schedules so that server maintenance is automated. Emphasis is on performing the following tasks:
 - Identify media types available with customer's hardware.
 - Identify client backup, archive volume, and storage pool sizes.
 - Determine the client backup window to create Tivoli Storage Manager server maintenance window.
 - Create maintenance schedules.
- ▶ Given a correctly configured Tivoli Storage Manager server environment, configure activity log retention option so that the activity log is automatically pruned. Emphasis is on performing the following tasks:
 - Query the current value for activity log retention.
 - Determine the change value.
 - Update the value for activity log retention.
- ▶ Given the customer's hardware and media types available, database size and estimated threshold, configure Tivoli Storage Manager database backup schedule so that database is automatically backed up. Emphasis is on performing the following tasks:
 - Identify media types available with customer's hardware.
 - Manually back up database.
 - Schedule database backup.

- ▶ Given a functioning Tivoli Storage Manager server, set migration thresholds, so that the flow of data through the storage pool is optimized. Emphasis is on performing the following tasks:
 - Determine appropriate migration thresholds for storage pools.
 - Set appropriate migration thresholds for storage pools.
 - Optionally use MIGDELAY parameter to delay migration of a specified number of days.
- ▶ Given a correctly installed BA Client, implement and configure a schedule so that files are backed up automatically to insure that data is available as needed. Emphasis is on performing the following tasks:
 - Determine what needs a scheduled backup, archive, restore, and retrieve.
 - Determine the schedule mode required (polling or prompted).
 - Define a schedule on the server according to the policy requirements.
 - Associate the client node to the schedule.
 - Start the schedule services on the client node.
 - Verify that schedule log file has all schedule occurrences listed.
- ▶ Given a working Tivoli Storage Manager environment, a configured storage agent, a working Tivoli Storage Manager client and API, working tape library, and a working General Parallel File System (GPFS™) system, create a LAN-free backup with GPFS so that a successful GPFS backup is created. Emphasis is on performing the following tasks:
 - Zone the client to ensure access to tape library.
 - Configure storage agent to accept LAN-free movement.
 - Configure Tivoli Storage Manager client to backup GPFS.
 - Test GPFS backup.
- ▶ Given a Tivoli Storage Manager server environment, review messages from the Tivoli Storage Manager server activity log so that errors and issues in the Tivoli Storage Manager environment can be detected. Emphasis is on performing the following tasks:
 - Use the Administration Center or CLI to query the server activity log by using appropriate filter statements.
 - Review the server activity log output for errors.
- ▶ Given a Tivoli Storage Manager environment with backup, archive, restore, and retrieve client events scheduled, monitor these events so that the administrator is aware of the status of all events. Emphasis is on performing the following tasks:
 - Query the activity log.
 - Query events.
 - Interrogate client log files.
 - Examine the reports out of Common Reporter.
- ▶ Given an existing Tivoli Storage Manager server and reporting requirements, and installed and configured the Tivoli Storage Manager management console, configure Common Reporting so that reports can be forwarded to appropriate personnel. Emphasis is on performing the following tasks:
 - Interpret reporting requirements and map them to Tivoli Storage Manager Common Reporting.
 - Configure Common Reporting to run against the Tivoli Storage Manager servers.
 - Configure Common Reporting e-mails and events to be sent to administrators covering failures and other pertinent data.
- ▶ Given a Tivoli Storage Manager environment where disaster recovery management is completely configured and in use, and files are being regularly sent off-site, perform a test

of the disaster recovery plan so that the ability to recover server and client files can be verified. Emphasis is on performing the following tasks:

- Deliver disaster recovery materials to a designated recovery site.
- Break out the disaster recovery plan and the disaster recovery media and follow the instructions, testing any scripts for automation of recovery where possible.
- If instructions are insufficient or data is not recoverable, take steps to correct these issues and try the test again.
- Continue testing and correcting until the Tivoli Storage Manager server, storage pools, and client data are successfully recovered.
- Conduct a plan review and update disaster recovery plan if needed.
- ▶ Given an existing Tivoli Storage Manager server, administrative client, and Common Reporter, extract capacity planning information so that information about current capacity usage for the Tivoli Storage Manager server can be determined. Emphasis is on performing the following tasks:
 - Determine information from the Tivoli Storage Manager environment which can help an organization with capacity planning.
 - Extract capacity planning information from Tivoli Storage Manager Common Reporter.
 - Produce Capacity Management Reports which can help size Tivoli Storage Manager server growth.
- ▶ Given a configured Tivoli Storage Manager server, policy definitions for administrators, nodes and policies, execute Tivoli Storage Manager commands so that server information can be exported and imported. Emphasis is on performing the following tasks:
 - Identify Tivoli Storage Manager policy definitions.
 - Identify system administrators.
 - Identify client nodes.
 - Identify policy domains.
 - Issue import and export commands.

Section 5: Performance Tuning and Problem Determination

The following test objectives are for the performance tuning and problem determination area of the test.

- ▶ Given the customers hardware, IBM Tivoli Storage Manager (Tivoli Storage Manager) maintenance level, and configured Operating system, validate the installation process by using appropriate log files so that installation issues are detected. Emphasis is on performing the following tasks:
 - Verify Tivoli Storage Manager server level, operating system level, and compatibility of hardware (supported or not).
 - Identify Tivoli Storage Manager server availability.
 - Review Tivoli Storage Manager activity log, client event log, installation log, and operating system error logs.
 - Review the various logs for this Tivoli Storage Manager server instance.
 - Identify the installation issue.

- ▶ Given a correctly configured Tivoli Storage Manager server environment, review error messages from the Tivoli Storage Manager server activity log so that corrective action can be taken. Emphasis is on performing the following tasks:
 - Query the activity log for the period of interest.
 - Identify errors, warnings, and informational items.
 - Determine corrective actions to take.
- ▶ Given an operating Tivoli Storage Manager server, determine the performance capabilities of a single Tivoli Storage Manager server so that the performance capabilities of the Tivoli Storage Manager server have been identified. Emphasis is on performing the following tasks:
 - Obtain the following details:
 - Hardware of the Tivoli Storage Manager server (for example, RAM, and CPU)
 - Tivoli Storage Manager server operating system version and patch level details
 - Tivoli Storage Manager server operating system configurations (page space)
 - Tivoli Storage Manager server defined options by interrogating the Tivoli Storage Manager server application through the administrative command line or Integrated Solutions Console or by viewing the server options file
 - Tivoli Storage Manager server TCP/IP network connection details, local device hardware, network infrastructure hardware details, drivers, network topology, medium, bandwidth, and throughput
 - Tivoli Storage Manager server associated storage hardware details including driver versions and connection details
 - If a Storage Area Network is implemented: connection details, network infrastructure hardware details, HBA details, HBA drivers, network topology, medium, bandwidth, and throughput
 - Any other applications running on the Tivoli Storage Manager server
 - Determine that the hardware resources meet all Tivoli Storage Manager server hardware requirements.
 - Compare the current Tivoli Storage Manager server options configuration with optimal tuning to identify any shortcomings.
 - Obtain expected throughput details for network type.
 - Obtain expected throughput for storage hardware devices.
 - Analyze all information to determine the performance capabilities of the Tivoli Storage Manager server.
- ▶ Given an issue which needs to be resolved, locate the appropriate Tivoli Storage Manager self-help resources so that self-help resources for Tivoli Storage Manager issues have been identified. Emphasis is on performing the following tasks:
 - Understand self-help resources available to help diagnose issues.
 - When an issue occurs in the environment, locate self-help resources.
 - Determine the appropriate reporting mechanism for resolving the issue, if necessary.

- ▶ Given the customer's hardware, network environment, and operating system, determine the cause of failure or lack of connectivity so that corrective action can be taken. Emphasis is on performing the following tasks:
 - Verify operational status of customer's hardware and operating system.
 - Verify Tivoli Storage Manager server availability.
 - Review Tivoli Storage Manager activity log, Client event log, and OS error logs.
 - Verify Tivoli Storage Manager communication related information in the options file.
 - Verify communication devices and connectivity methods.
- ▶ Given the customer's hardware and operating system, determine the cause of failure of a specific storage-related device so that the failure can be corrected. Emphasis is on performing the following tasks:
 - Verify operational status of customer's hardware and operating system.
 - Verify Tivoli Storage Manager server availability.
 - Review Tivoli Storage Manager device class, tape drive, library configuration, and attached devices.
 - Review Tivoli Storage Manager activity log, Client event log, OS error logs, and operational reports from Tivoli Common Reporting.
 - Take corrective action.
- ▶ Given the customer's available hardware and connectivity, and Tivoli Storage Manager server availability, check the Tivoli Storage Manager activity log, Client error, and schedule logs to locate messages and errors so that the cause of backup failures can be corrected. Emphasis is on performing the following tasks:
 - Verify operational status of customer's hardware and operating system.
 - Verify Tivoli Storage Manager server availability.
 - Review the Tivoli Storage Manager activity log, Tivoli Storage Manager client error and schedule logs, operating system error logs, and reports from Tivoli Common Reporting.
 - Correct issues with client backups.
- ▶ Given less than optimal performance in a Tivoli Storage Manager environment, adjust Tivoli Storage Manager server and client parameters so that better performance is achieved and client SLAs are met. Emphasis is on performing the following tasks:
 - Investigate current performance of the Tivoli Storage Manager client and server.
 - Determine where performance falls outside of agreed upon SLAs.
 - Make changes to the Tivoli Storage Manager client and server solution to improve performance to meet SLAs, including changes to `dsmserv.opt`, `dsm.opt`, and `dsm.sys`.
- ▶ Given a Tivoli Storage Manager server with damaged or lost media, determine issues with damaged or lost media and attempt to repair or restore them so that the faults with the media are corrected. Emphasis is on performing the following tasks:
 - Determine which media associated with the Tivoli Storage Manager server is damaged or lost.
 - Attempt to recover or repair the media.
 - If media is destroyed, attempt to restore the data.

- ▶ Given a Tivoli Storage Manager environment where the amount of tape media being used is increasing faster than the increase in the amount of data being stored, determine the issues that are causing the inefficient use of media and correct them so that media usage is optimized. Emphasis is on performing the following tasks:
 - Verify that all collocated client data really needs to be collocated.
 - Check volume content and database for inconsistencies.
 - Ensure that tape reclamation and expiration are running regularly.
 - Check to see if data retention is on where it should be off.
 - Check the reclamation threshold to see if it is appropriate.
 - Check the reuse delay to see if it is set too high.
 - Check the off-site reclaim limit for the storage pool to see if it is too low.
 - Check the parameters in the archive copy group.
 - Verify that all processes in the reclamation are completing.

Introduction to IBM Tivoli Storage Manager

In this chapter, we provide an overview of IBM Tivoli Storage Manager concepts. This includes a high-level technical introduction to IBM Tivoli Storage Manager, its architecture, base concepts, and key changes in Version 6.1. The information in this chapter discusses part of the first section of the IBM Tivoli Storage Manager V6.1 Implementation Certification test objectives.

This chapter contains the following topics:

- ▶ IBM Tivoli Storage Manager overview
- ▶ IBM Tivoli Storage Manager architecture
- ▶ Features of IBM Tivoli Storage Manager, standard version
- ▶ Features of IBM Tivoli Storage Manager Extended Edition
- ▶ IBM Tivoli Storage Manager complementary products

2.1 Tivoli Storage Manager introduction

This section introduces you to IBM Tivoli Storage Manager.

2.1.1 Tivoli Storage Manager overview

IBM Tivoli Storage Manager is the number one product of choice for an efficient and effective enterprise wide storage solution. It provides a data protection solution for backup, archiving, disaster recovery planning, space management, database and application protection, bare machine recovery, and record retention. More than 44 operating platforms are supported, using a consistent graphical user interface.

Tivoli Storage Manager provides:

- ▶ Centralized administration for data and storage management
- ▶ Fully automated data protection
- ▶ Efficient management of information growth
- ▶ High-speed automated server recovery
- ▶ Full compatibility with hundreds of storage devices, and local area network (LAN), wide area network (WAN), and storage area network (SAN) infrastructures
- ▶ Optional specifically designed backup solutions for major groupware, enterprise resource planning (ERP) applications, and database products

Tivoli Storage Manager is the premier storage management solution for mixed platform environments.

Businesses face a tidal wave of information and data that seems to increase daily. The ability to successfully manage information and data has become imperative. The IBM Tivoli Storage Manager V6.1 family of products help businesses successfully gain better control and efficiently manage the information tidal wave with significant enhancements in multiple facets of data protection.

From its inception, Tivoli Storage Manager has been a highly scalable and available data protection solution. Tivoli Storage Manager V6.1 takes data protection scalability to the next level with a new relational database, based on IBM DB2 technology, designed to store many more objects and manage more data. Greater availability is delivered through enhancements such as online, automated database reorganization. In addition, the increased scalability and the ability to leverage the latest in server technology helps deliver increased performance of backup and recovery processes.

Tivoli Storage Manager V6.1 delivers new near real-time monitoring and operational reporting capabilities.

Tivoli Storage Manager V6.1 helps decrease the rate of storage capacity required to contain data growth with a new built-in data deduplication feature that helps eliminate redundant data. This can enable significantly more backup data to be stored on disk.

For enterprise IT departments, the ability to work around the clock anywhere in the world, can translate to increasingly stringent recovery point objectives and recovery time objectives, and drives the need for more effective business continuity, planning, and execution.

Tivoli Storage Manager V6.1 helps address these challenges with several new features and enhancements, including:

- ▶ Individual mailbox and item level recovery for Microsoft® Exchange users
- ▶ Up to two times throughput improvement for a single Tivoli Storage Manager server for operations, such as backing up small files from multiple clients
- ▶ Enhancements designed to improve performance for IBM System Storage N series and NetApp Network Attached Storage (NAS)
- ▶ Disaster recovery preparedness enhanced for VMware, IBM System Storage N series, NetApp NAS environments, and Microsoft Windows Active Directory environments

2.1.2 Tivoli Storage Manager architecture

IBM Tivoli Storage Manager clients are the workstations, file servers, mobile computers, and other machines that must have their data protected. IBM Tivoli Storage Manager client software is installed on these systems.

IBM Tivoli Storage Manager architecture is seen in Figure 2-1.

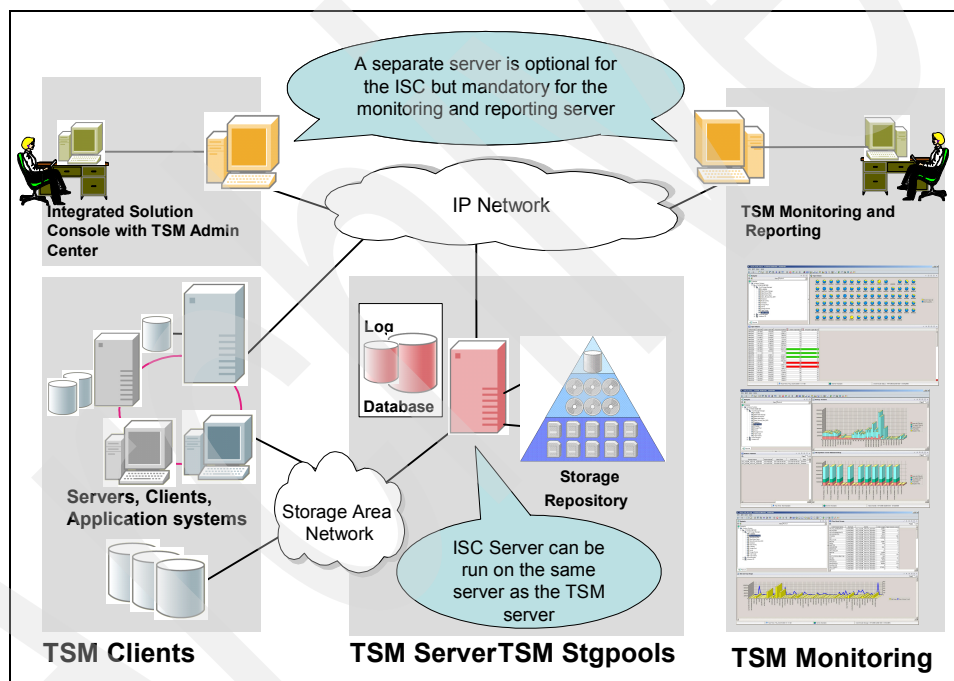


Figure 2-1 IBM Tivoli Storage Manager architecture

Tivoli Storage Manager is based on a DB2 database. The database tracks what is backed up, where it is stored, how long it will be stored for and how many versions of the data are kept and the number and length of time a copy of the file is kept after it is deleted from the original file system.

The relational database allows Tivoli Storage Manager to perform tasks that are not possible when you use a flat file master catalog to track metadata and enables a two-phase commit, which protects the integrity of the database and allows interrupted backups and restores to be restarted.

For example, the relational database can:

- ▶ Move data from one type of storage pool to another
- ▶ Retroactively update backed-up data when a policy changes
- ▶ Track individual files
- ▶ Schedule any type of client or administrative process
- ▶ Reclaim expired dead space on tapes

The Tivoli Storage Manager client sends its data to the Tivoli Storage Manager server either by the LAN or by the SAN. Most backups occur through schedules, but clients can perform on-demand backups when they want. Clients can also restore on their own. Tivoli Storage Manager has an improved Administration Center that was introduced in version 5.3 and can now be installed either on the same machine as the Tivoli Storage Manager Server or on a separate machine.

The actual data that the client sends is stored in storage pools. Tivoli Storage Manager is unique in the fact that the storage pools can form a storage hierarchy of more than 500 supported devices. This approach allows for flexibility, longevity, and, most important, fast backups and restores.

Most businesses back up their data initially to disk storage, allowing for hundreds of clients to back up at the same time. Then, based on policies, the data migrates in a fashion that expedites restoring to tape or optical disk. When the data migrates, all data belonging to one client is moved together to the next pool. By keeping all of that data together, restoring is faster because not as much tape positioning is required. This migration process can also accommodate data movement to collocated tapes, which further expedites the process of restoring by having data for just one user on them. Collocation can be used to group important functions of your business to ensure rapid recovery in the event of disaster.

The environment can be protected by a firewall; Tivoli Storage Manager allows individual configuration of nearly every TCP/IP port that it uses for communication, as follows:

▶ TCP/IP port

To enable the Backup-Archive client, command-line Administrative client, and the scheduler to run outside a firewall, the port specified by the `tcpport` server option must be opened by the firewall administrator. This port is set on the client and the server using the `tcpport` option. The setting must be the same on the client and server. The default TCP/IP port is 1500.

▶ TCP/IP ports for the remote workstation

The two TCP/IP ports for the remote workstation client must be opened. Use the `WEBPORTS` option in the remote workstations option file to specify these ports. If you do not specify the values for the Web ports option, the default zero (0) causes TCP/IP to randomly assign two free port numbers.

2.1.3 Tivoli Storage Manager server

The principal architectural component of the IBM Tivoli Storage Manager server is its DB2 database. The IBM Tivoli Storage Manager database was especially designed for the task of managing data and implements zero-touch administration.

All policy information, logging, authentication and security, media management, and object inventory are managed through this database.

Most of the fields are externalized through IBM Tivoli Storage Manager high-level administration commands, SQL SELECT statements, or, for reporting purposes, by using an ODBC driver. Obviously, this database is fully protected with software mirroring, roll-forward capability, and its own management, online backup and restore functions.

For storing the managed data, the IBM Tivoli Storage Manager server manages a storage repository. The storage repository can be implemented in a hierarchy using any combination of supported media or magnetic or optical disk, tape, and robotic storage devices, which are locally connected to the server system or are accessible through a SAN. To take advantage of SAN technology, the IBM Tivoli Storage Manager server has features implemented that dynamically share SAN-connected, automated tape library systems among multiple IBM Tivoli Storage Manager servers, and also provide (as an option) LAN, or LAN-free and server-free backup.

2.1.4 Tivoli Storage Manager Backup-Archive client

Data is sent to the IBM Tivoli Storage Manager server using the IBM Tivoli Storage Manager Backup-Archive client and complementary products. These products work together with the IBM Tivoli Storage Manager Server base product to ensure that any data stored is managed as defined.

The IBM Tivoli Storage Manager Backup-Archive client, included with the server, provides the operational backup and archive functions. The client implements the patented progressive backup methodology, adaptive subfile backup technology, and unique record retention methods for backup and archive functions.

The Backup-Archive clients are implemented as multi-session clients, which means that they are able to take advantage of the multi-threading capabilities of modern operating systems.

2.1.5 Tivoli Storage Manager for Storage Area Networks

IBM Tivoli Storage Manager for Storage Area Networks (SAN) supports LAN-free backup solutions using a SAN infrastructure. It dynamically shares SAN connected tape libraries and disks with the IBM Tivoli Storage Manager server, and it has the ability to write and read a large amount of client data directly to and from server-owned storage media. This function provides a great opportunity for lowering the backup window, reducing the traffic on the LAN, and reducing the utilization of the IBM Tivoli Storage Manager server.

2.1.6 Tivoli Storage Manager standard version

With the advent of Version 6.1, there is no longer an Express Edition. The standard version of IBM Tivoli Storage Manager contains a rich set of features and provides the core functions of backup, recovery, and archive management, as follows:

- ▶ Progressive backup methodology

Time and storage space are saved by backing up only new files and modified files. The progressive backup feature uses Tivoli Storage Manager's relational database to track data wherever it is stored, restoring the file in one step. Progressive backup eliminates the requirement for traditional full-plus-incremental or full-plus-differential backup and restore procedures, commonly used by other storage management products.

- ▶ Tape resource sharing

This feature enables multiple Tivoli Storage Manager servers to use the same tape library and drives, optimizing tape hardware asset utilization.

- ▶ Network-free rapid recovery

High-speed client data recovery directly from tape or optical devices is supported. Recovery time is minimized by eliminating the use of network and central server resources.

- ▶ Dynamic multithreaded transfer

This feature permits multiple clients to simultaneously transfer data to and from the same Tivoli Storage Manager server. Performance is boosted to more than three times the rate of a single-threaded session. The higher speed is achieved by transparently optimizing the number of data transfer sessions, based on available system resources.

- ▶ Adaptive differencing technology

This feature changes the way data is backed up from the client. Using adaptive differencing, data is transferred to the server either by byte, block, or file level, based on the size of the file being backed up, and the portion of the file that has changed since the last backup. Adaptive differencing technology supports all connectivity strategies, including LANs, WANs, SANs, Internet, and dial-up connections. Adaptive differencing was initially designed with mobile computer users in mind. However, other users who have a requirement to minimize data transmitted over the network can also benefit from the technology.

- ▶ Enterprise administration

This feature simplifies centralized control across multiple Tivoli Storage Manager implementations without sacrificing network performance. Tivoli Storage Manager V6.1 employs the Integrated Solutions Console (ISC), which provides a task-based GUI interface to Tivoli Storage Manager administrative tasks.

- ▶ Clustering

Tivoli Storage Manager includes enhanced support for IBM High Availability Cluster Multi-Processing (HACMP), Microsoft Cluster Server (MSCS), Novell Cluster Services (NCS), and VERITAS Cluster Services (VCS) on Windows.

Tivoli Storage Manager V6.1 has improved the support for Small Computer System Interface (SCSI) and fibre-attached tape device failover on Windows and UNIX, and support for Storage Agents, Library Managers, and Library Clients as cluster members.

- ▶ LAN-free data transfer

An optional module for Tivoli Storage Manager effectively exploits SAN environments by moving data transfers from the communication network to a SAN. Communication

bandwidth availability is therefore improved, increasing service levels for users and customers.

- ▶ **Hierarchical Storage Management**

An optional module for Tivoli Storage Manager automatically and transparently moves unused data files from online disk storage to offline tape storage. If a file is accessed after it has been moved to offline storage, Tivoli Storage Manager transparently recalls the file.

- ▶ **Library and device support**

Tivoli Storage Manager standard version supports libraries with up to three tape drives and up to 40 cartridge capacity. Larger libraries can be accommodated, but with only three devices and 40 slots enabled.

You can find more information about IBM Tivoli Storage Manager standard version at:

<http://www.ibm.com/software/tivoli/products/storage-mgr/>

2.1.7 Tivoli Storage Manager Extended Edition

The Extended Edition of IBM Tivoli Storage Manager expands on the features and possibilities of the standard version described in the previous section.

Tivoli Storage Manager Extended Edition adds disaster recovery planning capability for the server, Network Data Management Protocol (NDMP) control for network-attached storage (NAS) filers, and support for larger capacity tape libraries and more tape drives.

You can find more information in 6.4.13, “NAS and NDMP backup” on page 201 and also at:

<http://www.ibm.com/software/tivoli/products/storage-mgr-extended/>

Disaster Recovery Manager

The Disaster Recovery Manager (DRM) component of Tivoli Storage Manager Extended Edition provides disaster recovery for the Tivoli Storage Manager server and assists with disaster recovery for clients.

DRM offers various options to configure, control, and automatically generate a disaster recovery plan (DRP) file. The plan contains the information, scripts, and procedures required to automate restoration and help ensure quick recovery of data after a disaster. The scripts contain the commands necessary to rebuild the Tivoli Storage Manager server.

A key feature of Tivoli Storage Manager and DRM is the ability to track media in all possible states, such as on-site, in transit, or in a vault. The media movement features of DRM assist greatly with the daily tasks of sending disaster recovery media off-site, and receiving expired media on-site for reuse. With these features, the system administrator can quickly locate all available copies of data.

DRM functions help maintain business continuity by:

- ▶ Establishing and helping to automate a thorough server DRP; clients can then subsequently restore their data from the server if required, and can continue their daily backup procedures.
- ▶ Ensuring that vital site-specific information is available in the same plan.
- ▶ Automating vital recovery steps to return the Tivoli Storage Manager server and backup environment to normal operation.
- ▶ Managing and identifying off-site media required for recovery.

- ▶ Tracking and reporting destroyed systems in the event of a disaster.
- ▶ Storing client configuration information and assigning client recovery priorities.

With DRM, you can recover at an alternate site, on a replacement system with a different hardware configuration, and with people who are not familiar with the applications. The DRP can be periodically tested to certify the recoverability of the server. The DRP can, and must, be re-created easily every day so that it stays current.

During a disaster, these are several commonly encountered errors:

- ▶ A DRP does not exist.
- ▶ The DRP was not tested, or if it was, it is now out of date.
- ▶ The testing team's skills were not sufficient to perform and evaluate testing.
- ▶ The disk volume definitions for the recovery site are not known.
- ▶ The location of recovery tapes is not known.
- ▶ It is not known which tapes are to be applied first.

DRM keeps track of all the vital information required to rebuild the Tivoli Storage Manager environment, such as the:

- ▶ Current server configuration information and its location
- ▶ Current Tivoli Storage Manager server database volumes (size, location, and number)
- ▶ Recovery sequence
- ▶ Currency of the DRP
- ▶ Server and client machines configurations
- ▶ People to be contacted in the event of a disaster
- ▶ Location of the recovery media and the organization or persons responsible
- ▶ Point-in-time (PIT) to which the environment can be restored

During recovery from a disaster, DRM automates the following procedures to restore the Tivoli Storage Manager servers:

- ▶ Restore Tivoli Storage Manager server's key option files.
- ▶ Copy files from alternate locations to production locations.
- ▶ Initialize the Tivoli Storage Manager database and log volumes.
- ▶ Match sizes and locations of the Tivoli Storage Manager database and log volumes.
- ▶ Automatically launch restoration of the Tivoli Storage Manager database.
- ▶ Track media required and availability.
- ▶ Register installed Tivoli Storage Manager server features and return the server state to a valid license configuration.
- ▶ Update Tivoli Storage Manager volume catalog information, including whether volumes have been destroyed during the disaster.
- ▶ Rebuild Tivoli Storage Manager hierarchical storage configuration.
- ▶ Restore destroyed volumes from those available where possible.
- ▶ Recreate the customer backup environment.

Refer to *Disaster Recovery Strategies with Tivoli Storage Management*, SG24-6844. It has a detailed description, recovery scenario, and recovery plan built with DRM. It also has recommendations and examples of using DRM to store client machine information in the DRM plan file for use during a client disaster recovery.

In summary, DRM systematically rebuilds the Tivoli Storage Manager server environment and ensures that current application data for the entire enterprise is available for recovery. This process can all be done automatically from a single scripted command.

NDMP support for Network Attached Storage

For NAS devices, Tivoli Storage Manager Extended Edition uses NDMP to perform high-performance, scalable backups and restores. NDMP-based backups and restores minimize network traffic and transfer data outboard of the Tivoli Storage Manager client and server. NDMP enables a full and differential file system image backup and restore of Network Appliance file servers with OS Data ONTAP® V7.1 or higher, and EMC Celerra systems. Multiple backup and restore operations can be performed simultaneously. General NDMP support also allows other NAS vendors to certify integration with Tivoli Storage Manager.

The NDMP backup and restore features are fully integrated with Tivoli Storage Manager Extended Edition server and client. No extra software is required on the server, client, or NAS appliance. When doing backups and restores, the NAS device and the Tivoli Storage Manager server and client all have specific roles, as shown in Figure 2-2.

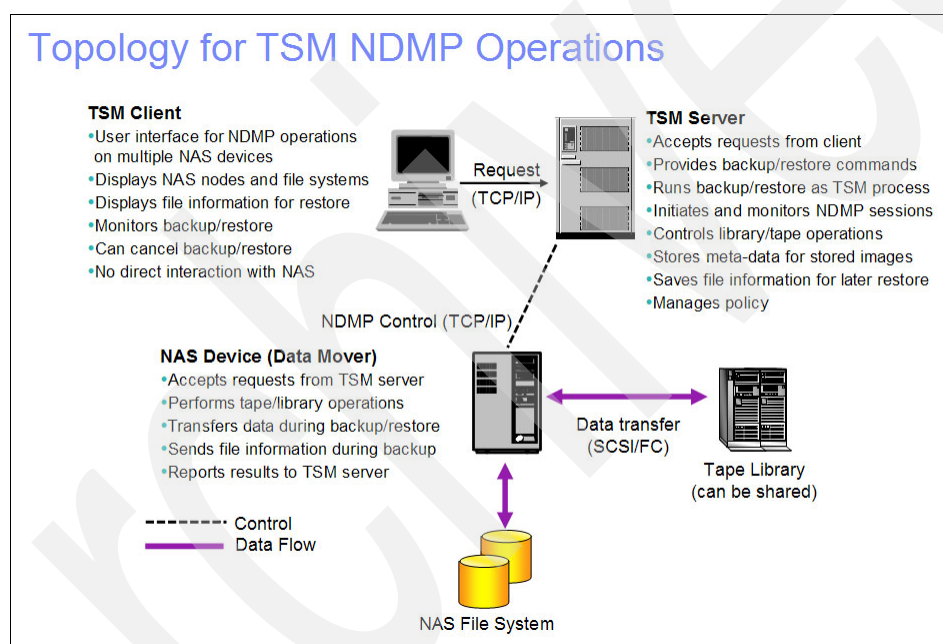


Figure 2-2 Topology for NDMP using IBM Tivoli Storage Manager

Tivoli Storage Manager Extended Edition offers the ability to do file-level and full/differential file system image backup and restore operations of servers that support the NDMP protocol. Now, you can back up directly to the Tivoli Storage Manager hierarchy and also implement DRM, because it now supports NAS storage. Multiple backup and restore operations can be performed in parallel.

During backup and restore operations, data flows directly between the tape drive and the NAS appliance. NDMP for NAS backup uses either an SCSI-attached tape device local to the NAS appliance, or a SAN-attached SCSI or Automated Cartridge System Library Software (ACSL) device that can be shared with the Tivoli Storage Manager server. Library robotics can be controlled directly by the Tivoli Storage Manager server or by passing SCSI commands through an NAS file server.

Drives must be supported by both the NAS appliance and the NAS OS. Drives can be dedicated to NDMP operations from a single NAS file server or can be shared. Multiple NAS

appliances can share SAN-attached shared tape resources if backups are performed through the same Tivoli Storage Manager server. Drives can be also shared with LAN-free backup/restore operations, provided that the library is controlled directly by the Tivoli Storage Manager server.

Extended library and drive support

Tivoli Storage Manager Extended Edition supports larger tape libraries, thus removing the 48-cartridge limit for library capacity, and allowing more than four tape drives within a single library.

Database and application online protection

This feature protects a wide range of application data through the protection of the underlying databases and application management systems holding that data. This module automates data protection tasks and allows database and application servers to continue running their primary applications while they back up and restore data to and from offline storage.

Data Retention

IBM System Storage Archive Manager, previously known as Tivoli Storage Manager for Data Retention, helps manage and simplify the retrieval of the ever-increasing amount of data that organizations must retain for strict records retention regulations. Many regulations demand archiving of records, e-mails, design documents, and other data for many years, in addition to requiring that the data is not changed or deleted.

Bare Machine Recovery

This feature backs up and automatically restores the operating system structures required to rebuild the operating system and also data files. It schedules regular operating system backups so that a recovery brings back the latest information.

2.2 Tivoli Storage Manager complementary products

Tivoli Storage Manager can be integrated with several optional applications that together form a powerful integrated storage management solution. These include:

- ▶ IBM Tivoli Storage Manager for Space Management
- ▶ IBM Tivoli Storage Manager for HSM for Windows
- ▶ IBM Tivoli Storage Manager for Storage Area Networks
- ▶ IBM Tivoli Storage Manager for System Backup and Recovery
- ▶ IBM Tivoli Storage Manager for Data Protection product family
- ▶ IBM Tivoli Continuous Data Protection for Files
- ▶ IBM System Storage Archive Manager
- ▶ IBM Tivoli Storage Manager FastBack

For a full product listing, visit:

<http://www.ibm.com/software/tivoli/products/>

2.2.1 Tivoli Storage Manager for Space Management

IBM Tivoli Storage Manager for Space Management provides hierarchical storage management (HSM) to automatically migrate rarely-accessed files to alternative storage, without disrupting the most frequently used files in local storage. Migrated files are automatically and transparently recalled to primary storage when required by applications or users. Administrators and users are freed from manual file system maintenance tasks, and

more online disk space is available for more important active data. Tivoli Storage Manager for Space Management can also help defer the requirement to purchase additional disk storage for clients, by making optimal use of available client storage.

Tivoli Storage Manager for Space Management offers increased scalability and performance through parallel migrations, improved candidate search, and optimized synchronization between the IBM Tivoli Storage Manager server and the HSM client.

IBM Tivoli Storage Manager for Space Management complements both IBM Tivoli Storage Manager and IBM Tivoli Storage Manager Extended Edition, and is supported on AIX, HP-UX, Solaris, and Linux.

2.2.2 Tivoli Storage Manager for HSM for Windows

IBM Tivoli Storage Manager for HSM for Windows provides hierarchical storage management (HSM) functionality to the Windows platform. As with IBM Tivoli Storage Manager for Space Management, HSM for Windows automatically migrates rarely accessed files to alternative storage, without disrupting the most frequently used files in local Windows file systems. Similarly, migrated files are automatically and transparently recalled to their original location when required by applications or users.

HSM for Windows allows various levels of granularity for migration of files. Files can be migrated individually, and file systems can be partially or fully migrated, based on a comprehensive set of policy options.

IBM Tivoli Storage Manager for Space Management complements both IBM Tivoli Storage Manager and IBM Tivoli Storage Manager Extended Edition.

2.2.3 Tivoli Storage Manager for Storage Area Networks

IBM Tivoli Storage Manager for Storage Area Networks enables your SAN-connected Tivoli Storage Manager servers and client computers to make maximum use of their direct network connection to storage. This software extension enables both servers and client computers to make the bulk of their backup/restore and archive/retrieve data transfers over the SAN instead of the LAN, either directly to tape or to the Tivoli Storage Manager disk storage pool. This ability greatly reduces the impact of data protection on the LAN while also reducing CPU utilization on both client and server.

Some SAN configurations allow specific SAN devices to perform data movements directly to and from some tape devices, further reducing client and server CPU utilization.

Tivoli Storage Manager for Storage Area Networks complements and coexists with the standard library-sharing functionality of both Basic and Extended editions of the Tivoli Storage Manager server.

The core functions of IBM Tivoli Storage Manager for Storage Area Network are:

- ▶ LAN-free backup/restore
- ▶ SAN-connected tape library

This Tivoli Storage Manager component is also commonly referred to as a Storage Agent.

2.2.4 Tivoli Storage Manager for Backup and Recovery

IBM Tivoli Storage Manager for System Backup and Recovery (SysBack®) provides a flexible backup method for AIX systems to help protect data and provide bare machine recovery

capabilities. It offers a comprehensive system backup, restore, and reinstallation tool. SysBack is a simple-to-use and highly effective tool. Any feature may be executed from either the AIX command line or by using the SMIT menu interface.

For Windows platforms, bare machine recovery can be achieved with the Tivoli Storage Manager Backup-Archive client's Automated System Recovery capability.

In addition, Windows, Sun, and Linux bare machine recovery can be done with Cristie Bare Machine Recovery. This integrates directly with Tivoli Storage Manager to provide operating system recovery for these platforms.

Tivoli Storage Manager for FastBack products also provide similar recovery capabilities for the Windows environment only.

2.2.5 Tivoli Storage Manager for data protection

IBM Tivoli Storage Manager provides data protection for a wide variety of applications, databases, mail, and hardware, ensuring that data is safe and secure no matter where it is located or how it is stored.

The data protection products interface directly with the applications using the applications' backup-certified utilities and interfaces, simplifying online backup and restore procedures. These products are described in the following sections.

Tivoli Storage Manager for Databases

IBM Tivoli Storage Manager for Databases software module works with IBM Tivoli Storage Manager to protect a wide range of application data through the protection of the underlying database management systems holding that data. IBM Tivoli Storage Manager for Databases exploits the various backup-certified utilities and interfaces provided for Oracle using RMAN functionality and Microsoft SQL Server, with or without Volume Shadow Copy Service (VSS).

This same functionality is included in the IBM DB2 Universal Database™ package and Informix® Dynamic Server, using ONBAR enabling them to work directly with IBM Tivoli Storage Manager without the need to buy additional modules.

Tivoli Storage Manager for Mail

IBM Tivoli Storage Manager for Mail software module automates the data protection of e-mail servers running either Lotus Domino or Microsoft Exchange. This module uses the application programming interfaces (API) provided by e-mail application vendors to perform online backups without shutting down the e-mail server and improve data-restore performance. As a result, it can help protect the growing amount of new and changing data that should be securely backed up to help maintain mail server application availability 24x7, 365 days a year. The two products available are:

- ▶ IBM Tivoli Storage Manager for Mail: Data Protection for Microsoft Exchange Server 6.1
- ▶ IBM Tivoli Storage Manager for Mail: Data Protection for Lotus Domino 5.5

Tivoli Storage Manager for Enterprise Resource Planning

IBM Tivoli Storage Manager for Enterprise Resource Planning (previously known as Data Protection for SAP) is a software module that works with Tivoli Storage Manager to better protect infrastructure and application data and improve the availability of SAP R/3 servers.

Tivoli Storage Manager for Advanced Copy Services

IBM Tivoli Storage Manager for Advanced Copy Services (formerly known as IBM Tivoli Storage Manager for Hardware) is an optional software module for AIX. It works with and requires either Tivoli Storage Manager or Tivoli Storage Manager Extended Edition and the corresponding data protection module: IBM Tivoli Storage Manager for Databases or IBM Tivoli Storage Manager for ERP that integrates with Tivoli Storage Manager Extended Edition. Tivoli Storage Manager for Advanced Copy Services protects mission-critical data that must be available continuously, and integrates hardware- and software-based snapshot capabilities with Tivoli Storage Manager and its Data Protection components for DB2 UDB, Oracle, and mySAP.

Tivoli Storage Manager for Advanced Copy Services supports a wide range of hardware:

- ▶ IBM Enterprise Storage Server® (ESS)
- ▶ IBM DS6000™
- ▶ IBM DS8000®
- ▶ SAN Volume Controller (SVC) and all devices (IBM and others) supported by the SVC

For a complete list, see:

<http://www.ibm.com/systems/storage/software/virtualization/svc/interop.html>

Tivoli Storage Manager for Advanced Copy Services also provides the following functions:

- ▶ IBM FlashCopy® support for ESS for Oracle
- ▶ FlashCopy support for ESS for DB2
- ▶ FlashCopy support for ESS for mySAP on DB2 UDB
- ▶ FlashCopy support for ESS for mySAP on Oracle
- ▶ Snapshot support for DS8000, DS6000, and SVC for DB2 UDB
- ▶ Snapshot support for DS8000, DS6000, and SVC for Oracle
- ▶ Snapshot support for DS8000, DS6000, and SVC for mySAP on DB2 UDB
- ▶ Snapshot support for DS8000, DS6000, and SVC for mySAP on Oracle
- ▶ Multiple snapshot versions managed by Tivoli Storage Manager policy
- ▶ Coordinated FlashCopy backup of multi-partition DB2 UDB databases distributed across multiple host systems

Support of FlashCopy and snapshot functionality allows for *zero impact* backups and instant recovery. Data transfer to the Tivoli Storage Manager server is handled from a separate storage server, allowing the primary production data to remain online and undisturbed.

Tivoli Storage Manager for Copy Services

IBM Tivoli Storage Manager for Copy Services is an optional module for Windows that integrates with Tivoli Storage Manager or Tivoli Storage Manager Extended Edition. It leverages Microsoft's Volume Shadow Copy Services (VSS). Tivoli Storage Manager for Copy Services provides similar functionality to Tivoli Storage Manager for Advanced Copy Services, but supports Windows VSS and Microsoft Exchange Server 2003 only.

The features of Tivoli Storage Manager for Copy Services are:

- ▶ Single command-line interface (CLI) for performing legacy and VSS snapshot backup, restore, and query operations
- ▶ Single GUI for performing legacy and VSS snapshot backup, restore, and query operations

- ▶ Support for both hardware and software VSS providers that strictly adhere to Microsoft VSS provider requirements
- ▶ Support for a clustered Microsoft Exchange environment
- ▶ Enhanced backup and recovery features that are integrated with existing Microsoft SQL Server backup and restore capabilities
- ▶ Fast backup with minimal impact on your production SQL server with a variety of snapshot providers
- ▶ Near instant restoration of Microsoft SQL Server databases from a shadow copy image to the production volumes
- ▶ Policy-based management of multiple local backup versions so that recovery for multiple versions is easy
- ▶ Improved availability and performance of production database servers with offloaded movement
- ▶ Integrated snapshot capabilities with IBM Tivoli Storage Manager and its data-protection component for Microsoft SQL Server
- ▶ Support for Microsoft Windows

Full and copy backup types are supported, with granularity at the Microsoft Exchange Storage Group level. Backups are managed by Tivoli Storage Manager policies and can be stored on the Tivoli Storage Manager server, local disks or both. Different policies can be assigned for the different storage locations and backup types (full or copy). As with Tivoli Storage Manager for Advanced Copy Services, zero impact backups and instant recovery allow the primary production data to remain online and undisturbed. Data movement to Tivoli Storage Manager storage can be off-loaded to a secondary machine through a VSS hardware provider that supports transportable shadow copy volumes.

2.2.6 Tivoli Continuous Data Protection for Files

According to industry surveys, approximately 70% of corporate data exists on notebooks or desktop machines, and less than 8% of it is backed up regularly. For notebook, desktop, and file server machines that contain important, critical, or sensitive data that is constantly being updated, a typical 24-hour backup cycle might not be sufficient to provide adequate data protection. The addition of IBM Tivoli Continuous Data Protection for Files provides a client machine with the capability of being able, transparently in real time, to back up a file to a Tivoli Storage Manager server as soon as the file is saved. Files that are backed up by this method are managed in the same way as other corporate data by the Tivoli Storage Manager server.

Tivoli Continuous Data Protection for Files was developed with notebook and desktop users in mind, but can be applied to any client with a high rate of change of data on its file systems.

Tivoli Continuous Data Protection for Files provides clients with true point-in-time recoverability. It is supported on AIX, Solaris, Linux, and Windows platforms. For more information, see:

<http://www.ibm.com/software/tivoli/products/continuous-data-protection/>

2.2.7 Tivoli Storage Manager FastBack

IBM Tivoli Storage Manager Fastback is recovery software. It is a specific kind of storage management, which ensures that applications and users are back up and running within minutes following any data loss while performing full data recovery in the background. The software:

- ▶ Protects and recovers data for critical Windows applications.
- ▶ Reduces the need for traditional backup windows with storage management software that captures data changes at the block level; provides extremely low systems overhead.
- ▶ Schedules automated data transfers based on flexible, policy-based settings, helping administrators meet data protection and retention requirements on a per-application basis.
- ▶ Enables data asset recovery from any Windows application, including Microsoft Exchange, Microsoft SQL Server, Oracle, IBM DB2 and SAP.
- ▶ Makes the most effective use of available bandwidth with strategies such as multi-threading, bundling of small files and industry-standard compression.
- ▶ Supports Windows operating systems.

2.2.8 Tivoli Storage Manager FastBack for Bare Machine Recovery

IBM Tivoli Storage Manager FastBack for Bare Machine Recovery provides recovery following a disaster or catastrophic server failure, restoring systems within an hour, as follows:

- ▶ Enables systems recovery following a disaster or catastrophic server failure.
- ▶ Provides the flexibility of recovering to comparable hardware, to dissimilar hardware or to a virtual machine using VMware or Microsoft Virtual Server.
- ▶ Helps protect remote or branch offices with a cost-effective disaster recovery and business resiliency strategy that requires a minimum of standby hardware.
- ▶ Leverages IBM Tivoli Storage Manager FastBack to provide near-instant access to applications and data while full recovery takes place in the background.
- ▶ Facilitates the migration of workloads to new hardware platforms, making it fast and easy to move workloads from old hardware or stand-alone servers to new hardware or blade servers.
- ▶ Enables organizations to perform bare machine recovery in a local office, in a data center or in a central recovery site.
- ▶ Supports Windows operating systems.

2.2.9 System Storage Archive Manager

IBM System Storage Archive Manager facilitates compliance with regulatory requirements. It helps manage and simplify the retrieval of the ever increasing amount of data that organizations must retain for strict records retention regulations. Many regulations demand the archiving of records, e-mails, design documents, and other data for many years, in addition to requiring that the data not be changed or deleted. IBM Tivoli Storage Manager's existing policy-based data management capabilities help organizations meet many of the regulatory requirements of various government and industry agencies. However, certain new regulations require additional safeguards on data retention. IBM System Storage Archive Manager provides data retention policies that help meet these new regulations.

Data retention protection

IBM System Storage Archive Manager makes the deletion of data before its scheduled expiration extremely difficult. Short of physical destruction of the storage media or server, deliberate corruption of data, or deletion of the Archive Manager database, the Archive Manager does not allow data on the storage that is managed by the IBM System Storage Archive Manager server to be deleted before its scheduled expiration date. Content management and archive applications can apply business policy management for ultimate expiration of archived data at the appropriate time.

Features and functions

IBM System Storage Archive Manager hierarchical storage capabilities provides policies that enable data to be stored on the type of media that best meets that data's longevity, access speed, and cost needs.

Movement of the data from one media type to another (as media requires change, or as new types of media become available) is achieved by migration. Migration automates moving the data to help ensure data longevity, and also allows for data to be stored on the type of media that best meets its access speed and cost requirements.

Features and functions include:

- ▶ Expiration policies
Expire the data when it is no longer required, thus freeing up the storage media, and providing cost effectiveness.
- ▶ Off-site data protection is standard
Off-site copies can be created onto any of the hundreds of types of media supported, and similar to the primary copy, is policy-managed to allow for expiration.
- ▶ Archive client program
Permits users to archive files from their workstations or file servers to archive retention-protected storage, and also retrieve archived copies of files to their local workstations.
- ▶ Expiration and deletion suspension
Permits placing an unconditional hold on data, which means that data cannot be deleted or modified until the deletion hold is released.
- ▶ Event-based retention management
Retaining data is subject to a time interval that is calculated after a retention-initiating event occurs. The data then cannot be deleted until the time limit has expired. For example, you can specify that an employee's records be kept for one year after the employee leaves the organization.
- ▶ Data retention protection
Data is not deleted until the retention criteria for the object is satisfied. For more information, visit:

<http://www.ibm.com/software/tivoli/products/storage-mgr-data-reten/>

What is new in IBM Tivoli Storage Manager

This chapter contains an overview of the enhancements and changes that come with the IBM Tivoli Storage Manager Version 6.1, and also the cumulative changes in the releases since Version 5.5.0, when the previous Certification Guide was published.

In this chapter we provide overview information about the following major areas of change:

- ▶ Server enhancements, additions, and changes
- ▶ Client enhancements, additions, and changes
- ▶ Additional Tivoli Storage Manager features

In this chapter, we discuss the new functions of the IBM Tivoli Storage Manager servers, the IBM Tivoli Storage Manager clients and additional functionality for IBM Tivoli Storage Manager products, which will be covered in all sections of the Tivoli Storage Manager V6.1 Implementation Certification Test objectives. At the end of this chapter, you should be able to accomplish these tasks:

- ▶ Describe the new server functions.
- ▶ Describe the new client functions.
- ▶ Describe the new functions of the additional products.

3.1 New features overview

This section summarizes the various new features and changes to the Tivoli Storage Manager components. Subsequent chapters of this book provide greater detail about some of these components. We start with highlights for Version 6.1, then present all version releases, including Version 5.5.0 and Version 5.5.2 for both server and client.

3.1.1 Server enhancements, additions, and changes in version 6.1

This section lists enhancements, additions, and changes in the IBM Tivoli Storage Manager Server introduced in Version 6.1.

IBM Tivoli Storage Manager Version 6.1 servers

New features and enhancements are available in the Tivoli Storage Manager Version 6.1 server and related products. These features and enhancements are summarized in short, high-level descriptions, so that you can start thinking about the potential benefits to your storage-management operations. The changes introduced in Version 6.1 are:

► Administration Center

Many features in the Tivoli Storage Manager Administration Center Version 6.1 are new for previous users. Features include:

- Updated Integrated Solutions Console
- WebSphere® Windows service
- Identify managing servers
- Hover help for table links
- Links to information about server messages and Administration
- Center messages
- Maintenance script enhancements
- Client nodes and backup sets enhancements
- Session and process information available in the health monitor
- Centralized server-connection management
- Changes to management-class activation

► Data deduplication

Data deduplication is a method of eliminating redundant data in sequential-access disk primary, copy, and active-data storage pools. One unique instance of the data is retained on storage media, and redundant data is replaced with a pointer to the unique data copy. The goal of deduplication is to reduce the overall amount of time that is required to retrieve data by letting you store more data on disk, rather than on tape. Figure 3-1 on page 45 is an overview of data deduplication.

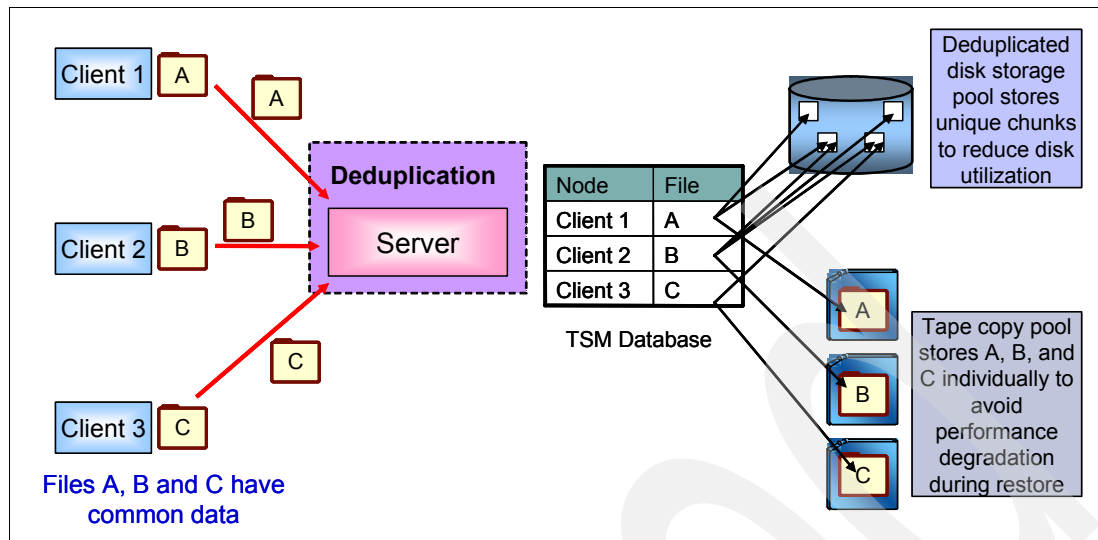


Figure 3-1 Deduplication overview

Data deduplication in Tivoli Storage Manager is a two-phase process. In the first phase, duplicate data is identified. During the second phase, duplicate data is removed by certain server processes, such as reclamation processing of storage-pool volumes. By default, a duplicate-identification process begins automatically after you define a storage pool for deduplication. (If you specify a duplicate-identification process when you update a storage pool, it also starts automatically). Because duplication identification requires extra disk I/O and processor resources, Tivoli Storage Manager lets you control when identification begins as well as the number and duration of processes. You can deduplicate any type of data except encrypted data. You can deduplicate client backup and archive data, Tivoli Data Protection data, and so on. Tivoli Storage Manager can deduplicate whole files as well as files that are members of an aggregate. You can deduplicate data that has already been stored. No additional backup, archive, or migration is required.

For optimal efficiency when deduplicating, upgrade to version 6.1 Backup-Archive client.

Restriction: You can use the data deduplication feature with Tivoli Storage Manager Extended Edition only.

► Storage Devices

New device support and other changes to storage devices are available in Tivoli Storage Manager Version 6.1.

► Disaster recovery manager support for active-data pools

To restore your client systems more quickly and efficiently, you can now use active-data pools in your recovery plans and procedures.

► EXPIRE INVENTORY command enhancements

The EXPIRE INVENTORY command is now enhanced with new functionality.

Additional parameters include NODE, DOMAIN, TYPE, DURATION, and RESOURCE. You can use these parameters to target specific client nodes and domains, and also to determine the type of data to be processed. You can use the RESOURCE parameter to specify the number of parallel processes that you want to run within the single EXPIRE INVENTORY process. You can run up to ten threads at one time, but if you are processing one node, only one thread is used.

- No-query restore changes

The no-query restore (NQR) function and the internal algorithms responsible for NQR have been changed to take advantage of DB2 capabilities and to improve performance. The NQR function has been rewritten to resolve a performance problem encountered when restoring a small number of objects for a client file system with a large number of backup objects spread across a large number of Tivoli Storage Manager server storage pool volumes. NQR performance is now comparable to that of the classic restore function under these conditions. NQR now performs a volume determination phase that must be completed before any objects are restored from DISK, FILE, or tape storage volumes.

- Server database

Tivoli Storage Manager V6.1 provides a new server database. Advantages include automatic statistics collection and database reorganization, full-function SQL queries, and elimination of the need for offline audits of the database. Upgrading to V6.1 requires that data in a current Tivoli Storage Manager server database be extracted and then inserted into the new database structure. Tivoli Storage Manager provides utilities to perform the process.

- ODBC driver support

Tivoli Storage Manager Version 6.1 uses the DB2 open database connectivity (ODBC) driver to query the database and display the results.

- Reporting and monitoring feature

The reporting and monitoring feature uses a combination of the Tivoli Common Reporting tool, IBM Tivoli Monitoring, and the IBM Tivoli Data Warehouse to offer you reports and real time monitoring information about Tivoli Storage Manager servers and client activity.

The IBM Tivoli Storage Manager reporting and monitoring feature uses a combination of reporting and monitoring components to offer you historical reports and real-time monitoring information for the Tivoli Storage Manager servers and clients. For the new design see Figure 3-2 on page 46.



Figure 3-2 Redesigned Reporting and Monitoring

3.1.2 Server enhancements, additions, and changes since Version 5.5.0

This section lists enhancements, additions, and changes for Tivoli Storage Manager Server introduced since Version 5.5.0.

IP address associated with the server interface for NDMP backup data

If your server has multiple network interfaces installed or if you are using a dedicated network for your NDMP backups, transferring data over the network, you might have to define the dedicated network address to the server. Therefore, you may use the server option `NDMPPREFDATAINTERFACE`.

This option specifies the IP address that is associated with the interface in which you want the server to receive all Network Data Management Protocol (NDMP) backup data.

This option affects all subsequent NDMP filer-to-server operations, but does not affect NDMP control connections, which use the system's default network interface. The value for this option is a host name or Internet Protocol version 4 (IPv4) address that is associated with one of the active network interfaces of the system on which the Tivoli Storage Manager server is running. This interface must be IPv4-enabled.

To update this server option without stopping and restarting the server, use the `SETOPT` command. The syntax in the Tivoli Storage Manager server options file is:

```
NDMPPREFDATAINTERFACE ip_address
```

The *ip_address* parameter specifies an address in either dotted decimal or host name format. If you specify a dotted decimal address, it is not verified with a domain name server. If the address is not correct, it can cause failures when the server attempts to open a socket at the start of an NDMP filer-to-server backup. Host name format addresses are verified with a domain name server. There is no default value. If a value is not set, all NDMP operations will use the Tivoli Storage Manager server's network interface for receiving backup data during NDMP filer-to-server backup operations. To clear the option value, specify the `SETOPT` command with a null value (`""`).

Support for NetApp SnapMirror to Tape feature

With Tivoli Storage Manager you can create SnapMirror to Tape images of file systems on NetApp file servers. SnapMirror to Tape feature provides an alternative method for backing up very large NetApp file systems. Because this backup method has limitations, use this method when copying very large NetApp file systems to secondary storage for disaster recovery purposes. You can back up very large NetApp file systems using the NetApp SnapMirror to Tape feature. Using a block-level copy of data for backup, the SnapMirror to Tape method is faster than a traditional Network Data Management Protocol (NDMP) full backup and can be used when NDMP full backups are impractical (see Figure 3-3 on page 48).

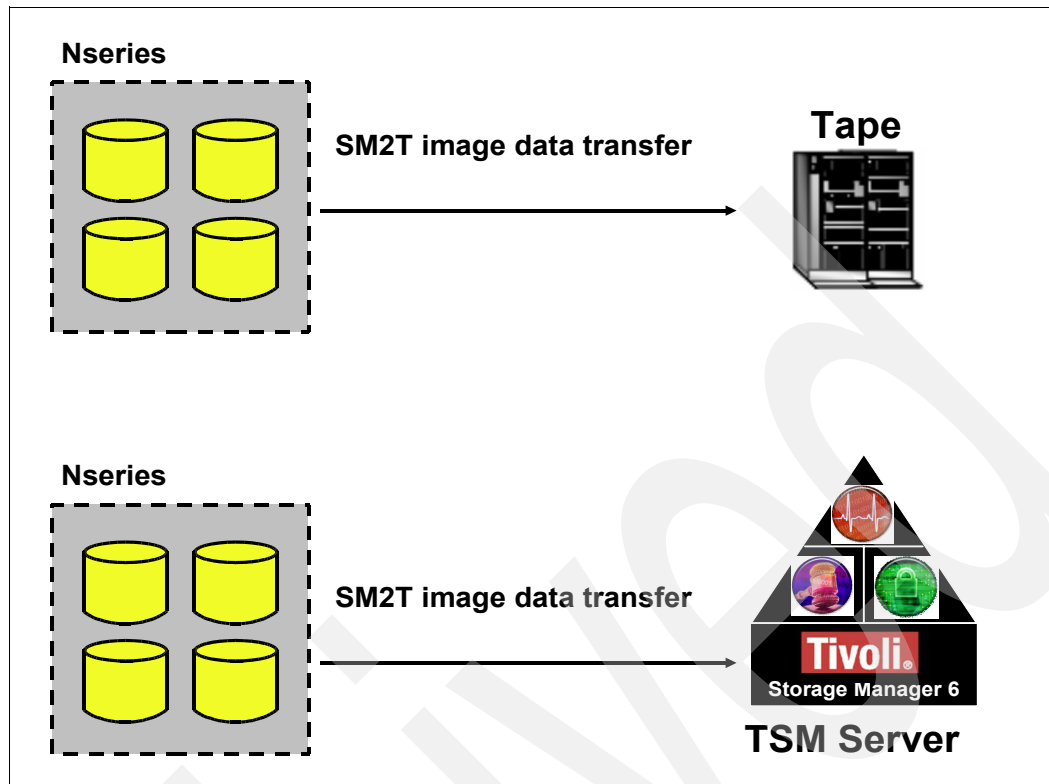


Figure 3-3 NetApp SnapMirror to tape feature

SAN Device mapping for Virtual Tape Library

In a SAN environment, device IDs can change dynamically (for example, device or cabling changes). Tivoli Storage Manager uses a method that dynamically discovers and maps devices in the environment, even when the paths change. Tivoli Storage Manager V5.5 is enhanced to allow for the mapping and discovery of Virtual Tape Library (VTL) devices in the SAN. Note the following information:

- ▶ SAN Device Mapping is done by checking serial number not by worldwide name (WWN).
- ▶ Certain VTLs present the same WWN for all virtual drives.
- ▶ In prior versions, if VTL presented the same WWN for all drives, then when a change in serial number is detected, Tivoli Storage Manager first checked for persistent WWN support in the library, assumed this was a drive swap with persistent WWNs, and thus changed the drive serial number and not the device address.
- ▶ In Version 5.5, if VTL presents the same WWN for all drives, then when a change in serial number is detected, Tivoli Storage Manager first continues to search for the matching serial number before checking for persistent WWNs. If a match is found, the device address for the drive with that serial number is updated.

RELABELSCRATCH parameter

The RELABELSCRATCH parameter allows you to automatically relabel volumes when they are returned to scratch. Support for this parameter is available in Fix Pack 5.5.1 and later levels.

Virtual Tape Libraries (VTLs) maintain volume space allocation after Tivoli Storage Manager has deleted a volume and returned it to a scratch state. The VTL has no knowledge that the volume was deleted and it keeps the full size of the volume allocate, which can be extremely

large depending on the devices being emulated. As a result of multiple volumes that return to scratch, the VTL can maintain their allocation size and run out of storage space.

The only way for the VTL to realize that a volume has been deleted and its space can be reallocated is to write to the beginning of the newly returned scratch volume. The VTL then sees the volume as available. Tivoli Storage Manager can relabel volumes that have just been returned to scratch if the RELABELSCRATCH parameter is specified.

This optional parameter has been added to the DEFINE and UPDATE LIBRARY commands and is intended for use with VTLs. The format for the parameter is:

RELABELSCRATCH Yes | No

The parameter specifies whether the server relabels volumes that have been deleted and returned to scratch. When this parameter is set to Yes, a LABEL LIBVOLUME operation is started and the existing volume label is overwritten. This parameter is optional and intended for use with VTLs.

Note: If you have both virtual and real volumes in your VTL, both types are relabeled when this parameter is enabled. If the VTL includes real volumes, specifying this option could affect performance.

This function is only available for SCSI Libraries.

RECLAIMDELAY and RECLAIMPERIOD with SnapLock volumes

Two server options, RECLAIMDELAY and RECLAIMPERIOD, are available. They enable you to set the reclaim delay time and reclaim period time for SnapLock volumes.

RECLAIMDELAY

This option delays the reclamation of a SnapLock volume, allowing remaining data to expire so that reclaiming the volume is not necessary.

The option specifies the number of days to delay the reclamation of a SnapLock volume. Before reclamation of a SnapLock volume begins, the Tivoli Storage Manager server allows the specified number of days to pass, so that any files remaining on the volume have a chance to expire. The default reclaim delay period is four days and can be set in the range of 1 - 120 days.

RECLAIMPERIOD

This option allows you to set the number of days for the reclamation period of a SnapLock volume.

It specifies the number of days allowed for the reclamation period of a SnapLock volume. After the retention of a SnapLock volume has expired, the Tivoli Storage Manager server reclaims the volume within the specified number of days if there is still data remaining on the volume. The default reclaim period is 30 days and can be set in the range of 7 - 365 days.

HP-UX Passthru driver support on HP-UX

The Tivoli Storage Manager passthru device driver is supported on 64-bit HP-UX 11i v1, v2, and v3. This passthru driver replaces Tivoli Storage Manager's kernel device drivers (tmscsi) and is packaged as part of Tivoli Storage Manager server versions 5.4.3.0, 5.5.1.0 and later.

The following changes have been implemented to the Tivoli Storage Manager server version 5.4.3.0, 5.5.1.0, and later for HP-UX passthru device driver support:

- ▶ The Tivoli Storage Manager device driver package no longer includes the **ddtrace** utility, Tivoli Storage Manager kernel modules `mod.o` for HP 11i v1 or `tsmtape`, `tsmchgr`, `tsmoptc` for HP 11i v2. Two new device configuration tools, `autoconf` and `tsmdlst`, are included in the device driver package and are installed to the `/opt/tivoli/tsm/devices/bin` directory unless you specify another location.
- ▶ The Tivoli Storage Manager passthru device driver is packaged with the Tivoli Storage Manager server and storage agent packages.
- ▶ The `sctl` driver must be loaded into the kernel before devices are configured for the Tivoli Storage Manager passthru device driver. Issue the following command to verify that the `sctl` driver is installed.

```
>lsdev | grep sctl
```

If the driver has been loaded, the output similar to the following output:

```
lsdev | grep sctl
203 -1 sctl ctl
```

- ▶ The HP-UX `stape`, `sdisk`, and `schgr` native drivers are required for device configuration for the Tivoli Storage Manager passthru device driver. To verify that these drivers are loaded in the kernel, issue the following commands from any directory. You should see output similar to what is listed with each command.

```
stape
>lsdev | grep stape
lsdev | grep stape
205 -1 stape tape

sdisk
>lsdev | grep sdisk
lsdev | grep sdisk
188 31 sdisk disk

schgr
>lsdev | grep schgr
lsdev | grep schgr
231 29 schgr autoch
```

Configuring devices for the Tivoli Storage Manager passthru device driver

To configure the devices, follow these steps:

1. Make sure the Tivoli Storage Manager server is not running.
2. Delete the Tivoli Storage Manager device names that have previously been created by issuing the following command:

```
>rm /dev/rmt/tsm*
```

3. Run the **ioscan** command to make sure that all attached tape drives, auto-changers, and optical disk devices have hardware paths associated with corresponding HBAs on the system.
4. Run the **autoconf** utility to configure devices for the Tivoli Storage Manager passthru device driver:

```
/opt/tivoli/tsm/devices/bin/autoconf
```

The **autoconf** utility uses the `tsmddcfg` script to configure devices and calls the `tsmdlst` utility to display all devices that have been configured by the passthru device driver. The device information is saved in `lbinfo`, `mtinfo`, and `optinfo` in the `devices bin` directory.

Note: You can also run **autoconf** with the **-f** option. The **autoconf** utility issues an **ioscan** command to scan the system before configuring devices. This process can take several minutes.

To prevent potential data integrity problems, verify that Tivoli Storage Manager devices can be accessed only through Tivoli Storage Manager passthru special files. If a device is controlled by the passthru driver and also one of the stape, schger, or sdisk drivers, you must delete corresponding device special files that are created by those drivers.

If there are no changes to the device hardware path on the system during the migration from the Tivoli Storage Manager kernel device driver to the passthru device driver, Tivoli Storage Manager device names should remain the same.

3.1.3 Client enhancements, additions, and changes in Version 6.1

This section lists enhancements, additions, and changes for the IBM Tivoli Storage Manager Backup-Archive client introduced in Version 6.1. Changes introduced with V6.1 IBM Tivoli Storage Manager Backup-Archive Client include:

- ▶ Mac OS X-specific information is now included in the UNIX and Linux publication

The *Tivoli Storage Manager for UNIX and Linux Backup-Archive Clients Installation and User's Guide*, SC23-9791 includes the Mac OS X-specific information.

- ▶ Mac OS X NLS support

The Tivoli Storage Manager for Mac OS X Backup-Archive Client now supports the multicultural languages¹ that are supported by the Tivoli Storage Manager.

- ▶ Mac OS X API support

The Tivoli Storage Manager API is now supported on Mac OS X.

- ▶ Improved memory usage for backup of file systems that are managed by hierarchical storage management (HSM)

The Tivoli Storage Manager Backup-Archive client can do a full incremental backup of very large HSM-managed file systems containing 100 000 000 files or more.

- ▶ UTF-8 encoding support is added for Tivoli Storage Manager UNIX and Linux clients

UTF-8 is added for the language locales that are already supported by the Tivoli Storage Manager Backup-Archive Client.

The Tivoli Storage Manager Version 6.1 client message catalogs and help files are encoded in UTF-8. If you are installing Tivoli Storage Manager client message catalogs for languages other than English, you must also have the appropriate `iconv` UTF-8 converters installed on your system. If the appropriate `iconv` UTF-8 converters are not installed, all Tivoli Storage Manager client messages will be displayed in English.

- ▶ Availability of 64-bit binaries

The client packages for Linux on POWER®, Linux zSeries, and one of the AIX clients contain 64-bit binaries.

- ▶ NetApp Snapshot Difference API (SnapDiff API) support

When used with the incremental command, the SnapDiff option streamlines the incremental process by performing an incremental backup of the files reported as changed by the NetApp Snapshot Difference API, instead of scanning the volume looking for files that have changed. Figure 3-4 on page 52 shows how this works.

¹ NLS languages

N-Series and NetApp SnapDiff

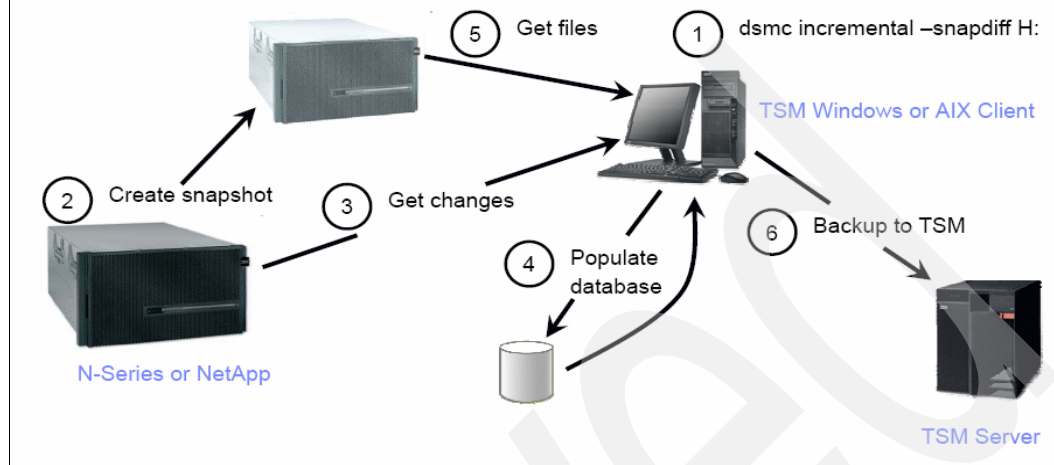


Figure 3-4 N-Series and NetApp SnapDiff

► Full virtual machine (VM) backup and restore support

The Tivoli Storage Manager **backup vm** command has been enhanced to provide full VM backup capabilities in addition to the file-level backup capabilities previously provided. You can copy full VM virtual disk exports to the backup proxy from snapshots. The entire virtual machine is backed up as a single item, similar to a Tivoli Storage Manager image backup. The exports are divided into file chunks of 2 GB and that the Tivoli Storage Manager Backup-Archive client backs up at a file level. This function is described in Figure 3-5.

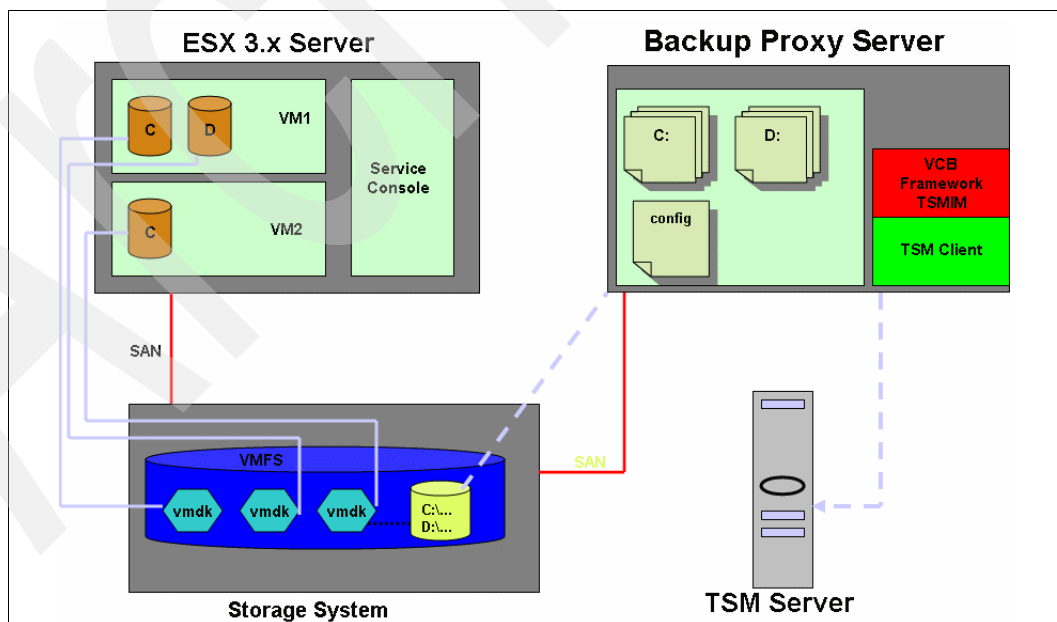


Figure 3-5 VMware Consolidated Backup with full VM backup capabilities

- Support for restoring Active Directory individual objects

You can use Active Directory individual object recovery and item-level restore functions during normal daily operations to recover from accidental corruption or deletion of Active Directory objects by restoring one or more individual Active Directory objects. This feature does not require you to shut down or restart the Active Directory server (see Figure 3-6).

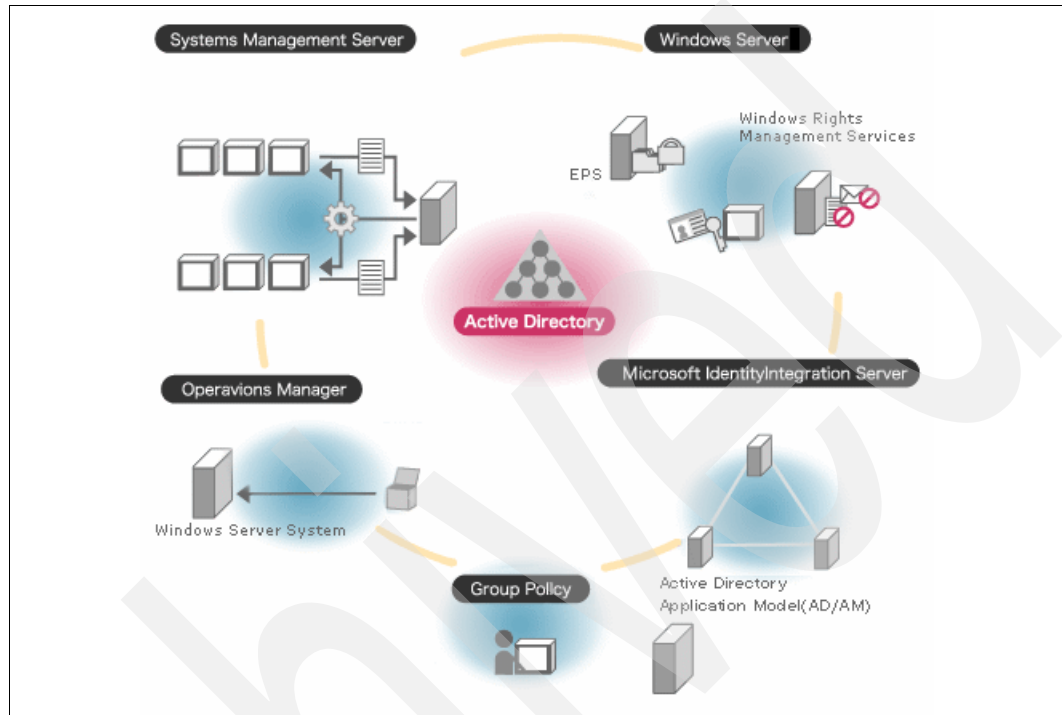


Figure 3-6 Active Directory item-level restore operation

- The Windows Native GUI has been replaced with the Java™ GUI

The Windows GUI is a Java application. The non-Java Windows native GUI is installed as `dsmmfc.exe` in the installation directory. However, it has not been updated with the new Tivoli Storage Manager Version 6.1 features. See Figure 3-7 on page 54.



Figure 3-7 Backup-Archive client Java GUI

- ▶ **Support for querysummary option**
You can use the `querysummary` processing option to extend the query archive and query backup commands. This support provides a restore preview so that you can determine whether to use the classic or no-query restore method.
- ▶ **Support for `srvoptsetencryptiondisabled` option**
You can use the `srvoptsetencryptiondisabled` processing option to ignore encryption options in a client options set from a Tivoli Storage Manager server.
- ▶ **Enhanced help facilities**
The command-line client `help` command is enhanced so that you can specify the command, option, or message on which you want help information.
In the GUI, message boxes are enhanced with a button that you can click to see detailed message information.
- ▶ **New API function `dsmUpdateObjEx`**
The `dsmUpdateObjEx` function call updates the meta information that is associated with backup or archive objects on the server. This provides the ability to select from several archive objects with the same name.

3.2 Additional functionality overview

This section summarizes the status and new features and changes for the Tivoli Storage Manager components:

- ▶ Tivoli Storage Manager for SAN
- ▶ Tivoli Storage Manager HSM for Windows Version 5.5
- ▶ Tivoli Storage Manager Space Management

3.2.1 Tivoli Storage Manager for SAN, enhancements

IBM Tivoli Storage Manager for Storage Area Networks (SAN) is a feature of Tivoli Storage Manager that enables LAN-free client data movement.

This feature allows the client system to directly write data to, or read data from, storage devices attached to a storage area network (SAN), instead of passing or receiving the information over the network. Data movement is thereby off-loaded from the LAN and from the Tivoli Storage Manager server, making network bandwidth available for other uses. For instance, using the SAN for client data movement decreases the load on the Tivoli Storage Manager server and allows it to support a greater number of concurrent client connections. The storage agent, a component of the feature, makes LAN-free data movement possible.

Refer to “Related publications” on page 293.

Enhancement in Version 6.1

Enhancement in Version 6.1 is GPFS file system support for file device class

With Tivoli Storage Manager for Storage Area Networks Version 6.1, you can use the file-device-sharing software IBM General Parallel File System. You may also continue to use either Tivoli SANergy® or IBM TotalStorage SAN File System. IBM General Parallel File System is the preferred option for the operating systems on which it is supported.

3.2.2 Tivoli Storage Manager HSM for Windows Version 6.1, enhancements

IBM Tivoli Storage Manager HSM for Windows provides space management for Microsoft Windows NTFS file systems. File migration policies can be defined by an administrator using the HSM for Windows GUI. File migration eligibility is determined by include and exclude policy criteria such as file type (extension) and various criteria related to the age of a file (creation, modification, last access). HSM for Windows helps free administrators and users from file system pruning tasks. HSM for Windows assists administrators with more effectively managing Windows NTFS disk storage by automatically migrating files (selected based on administrator-established policy) to less expensive storage devices, while preserving Windows NTFS file accessibility.

Refer to *IBM Tivoli Storage Manager HSM for Windows Administration Guide, Version 6.1*, SC23-9795, and *Using the Tivoli Storage Manager HSM Client for Windows*, REDP-4126.

Enhancements in Version 6.1

Enhancements in Version 6.1 are:

- ▶ Automatic threshold migration, which helps to automatically maintain a certain amount of free space on protected file systems
- ▶ Support for Microsoft Windows Server 2008 (64 bit)
- ▶ Support for Internet Protocol V6 (IPv6)

3.2.3 Tivoli Storage Manager for Space Management, enhancements

The IBM Tivoli Storage Manager for Space Management client for UNIX and Linux (the HSM client) migrates files from your local file system to distributed storage and can then recall the files either automatically or selectively. Migrating files to storage frees space for new data on your local file system and takes advantage of lower-cost storage resources that are available in your network environment.

Tivoli Storage Manager for Space Management is available for AIX JFS2 and GPFS, Linux GPFS, Solaris VxFS, and HP-UX JFS file systems. Refer to the *IBM Tivoli Storage Manager for Space Management for UNIX and Linux User's Guide, Version 6.1*, SC23-9794.

Enhancements in Version 6.1

Enhancements in Version 6.1 are:

- ▶ GPFS 3.2 storage pool support

Tivoli Storage Manager V6.1 allows multiple General Parallel File System (GPFS) storage pools in one file system. Monitoring a file system includes monitoring each storage pool in the file system.

The automigration command, **dmsautomig**, permits automatic migration of storage pools and file systems.

- ▶ Hierarchical storage management (HSM) for AIX and Linux for GPFS does not require RSCT file set for cluster support. A new responsiveness service function is being added. It provides:

- Node response monitoring
- Node failure detection and initiate failover actions
- Event notification processing

This function replaces the requirement of installing the RSCT Group Services. Do not use RSCT file set for cluster support.

- ▶ Partial file recall enhancements for optimal tape access

The **dsmrecall** command will recall partial files with the **-OFFSET** and **-SIZE** options. With this command, you can specify the portion of a file that is to be recalled.



Planning for Tivoli Storage Manager

This chapter provides the required information for developing a Tivoli Storage Manager solution based on the data gathered from your needs and the environment that you have.

This chapter contains the following topics:

- ▶ Tivoli Storage Manager planning considerations
- ▶ Recovery objectives

4.1 Tivoli Storage Manager planning considerations

Tivoli Storage Manager is capable of running on many different platforms and environments. This chapter documents the logical options available for any business purpose.

4.1.1 Platform and server

In this section, we examine the platform and server considerations. A Tivoli Storage Manager server runs on several platforms. With only minor differences, a Tivoli Storage Manager server provides the same functionality on every platform. The differences relate to capacity, cost, installation, operation, supported devices, and installed user base.

Installed user base

The number of Tivoli Storage Manager servers installed for a particular platform is a consideration. IBM ships new functions for the most popular Tivoli Storage Manager server platforms (AIX and Windows) first. The more popular a platform, the more customers use the software, creating a lower probability that you will find a unique problem.

Note: z/OS is currently not available as a Tivoli Storage Manager V6.1 Server platform.

Cost

Cost is further divided into platform costs and Tivoli Storage Manager software license costs. Platform costs include the cost of acquiring the hardware and software to run the platform exclusive of the Tivoli Storage Manager software license.

Tivoli Storage Manager license costs vary considerably. For more information, go to:

<http://www-01.ibm.com/software/tivoli/products/storage-mgr/smart-stores.html>

Capacity

A Tivoli Storage Manager server can manage numerous clients and an unlimited amount of data. However, the platform on which the Tivoli Storage Manager server software runs can limit what Tivoli Storage Manager can administer. Various platforms have different capacities in regard to the processing power they can deliver to Tivoli Storage Manager, the number of devices it can attach, and the throughput it can deliver.

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 IBM AIX server to a larger one, is relatively simple. Starting at the top end of a server type and moving to another server type, such as from Microsoft Windows to IBM AIX, involves exporting and importing each client separately. Although the procedure is straightforward, it can be time-consuming and labor-intensive.

Platform installation

The Tivoli Storage Manager server code installation varies by platform in the specifics, but generally follows a similar procedure. Installation on supported Windows platforms can be easier because of 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.

Note: z/OS is currently not available as a Tivoli Storage Manager V6.1 Server platform.

Operation

Operation of a platform varies from almost completely automatic on Windows, with the UNIX and iSeries platforms somewhat more complex.

Operation of Tivoli Storage Manager 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 that are available within the company for a particular operating system platform. If more people are familiar with a particular platform, then maintaining Tivoli Storage Manager in this environment will be easier.

Supported devices

A wide variety of supported devices are available on the Windows and UNIX platforms, including disk drives, tape drives, optical drives, and automated and virtual tape libraries. Although the iSeries uses the standard choice of devices, these devices generally have tremendous capacity.

A concern with the smaller platforms is the ability to attach the required amount of devices as the environment grows. On larger platforms, this concern is usually not as significant.

The number of devices currently used (in an upgrade scenario) or available during installation is also a factor when planning administrative tasks such as the length of a backup window. This factor also has a bearing on how many clients can be supported on a given Tivoli Storage Manager Server.

Server considerations

A number of factors must be considered when you select a server for the Tivoli Storage Manager architecture.

Pre-requisites

One important consideration when planning to upgrade from a previous version of Tivoli Storage Manager to V6.1 is to ensure that there is no installation of DB2 on the existing Tivoli Storage Manager server. Tivoli Storage Manager V6.1 Server cannot be installed on a machine that already has DB2 installed on it.

Choice of platform

If you have experience with Windows, and the Tivoli Storage Manager implementation is small and will remain small, choose Windows. If you are considering a change from 32-bit to 64-bit computing, an upgrade from the current Windows 32-bit environment to 64-bit can be incorporated into an upgrade to Tivoli Storage Manager V6.1.

For more increased capacity, with the penalty of higher complexity, consider the UNIX-based platforms.

Upgrade considerations

Other factors must be considered when you plan to upgrade to Tivoli Storage Manager V6.1.

Upgrade path for clients and servers

As part of a migration plan from Tivoli Storage Manager Version 5.5 to Tivoli Storage Manager Version 6.1, Tivoli Storage Manager clients and servers can be upgraded at different times. This configuration is supported as long as the older version is supported.

Considerations for migrating between processor architectures

When migrating between the Tivoli Storage Manager processor architectures (x32, x64, and IA64), certain items must be considered for a successful migration from one architecture to another. For full details of the permutations and considerations required, visit:

http://publib.boulder.ibm.com/infocenter/tsminfo/v6/topic/com.ibm.itsm.client.doc/c_inst_mig_winarch.html

Upgrading Open File Support or online image

The Open File Support (OFS) and online image installation features have been replaced with a single Logical Volume Snapshot Agent (LVSA) feature. This feature is selected, by default, unless you are upgrading from an installation where OFS or online image operation was being used. You can install LVSA for use during both online image and OFS operations, but those features are not automatically enabled. To enable OFS, the `snapshotproviderfs` option must be set in the `dsm.opt` file; to enable online image, the `snapshotproviderimage` option must be set in the `dsm.opt` file.

Volume Shadow Copy Service (VSS) is also supported for OFS and online image operations. You can enable VSS by setting the `snapshotproviderfs` and `snapshotproviderimage` options in the `dsm.opt` file. If you use VSS, you do not need to install LVSA.

If you are migrating from a previous version of the Tivoli Storage Manager client where you were using the LVSA for OFS or online image, and you decide during the installation to continue to use the LVSA, then you do not need to explicitly set the `snapshotproviderfs` or `snapshotproviderimage` options. Because you do not need to set these options, installing the new client on a large number of systems is easier, because the `dsm.opt` file will not need to be updated to continue to use the OFS or online image functions.

Server system size

In addition to processing, I/O, and memory, multiple servers should also be a consideration depending on how large the environment is. 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. Tivoli Storage Manager system sizing is documented at the Capacity planning Web site:

http://publib.boulder.ibm.com/infocenter/tsminfo/v6/topic/com.ibm.itsm.srv.install.doc/t_srv_plan_capacity.html

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 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 clients usually makes sense.

Multiple servers increase costs. Two small servers may be more expensive than one larger server of the same power. Where one automated tape library might be enough, multiple servers might require multiple automated libraries. Every Tivoli Storage Manager server requires a Tivoli Storage Manager server license. For example, a customer with a large central site and many remote locations with one small network and a slow link to the central site must consider one storage server for the central site and all remote sites. Tivoli Storage Manager V6.1 addresses some of the capacity issues where it is practical to use one Server in a given environment.

The new requirements to ensure that current hardware is capable of running or upgrading to V6.1 are shown table Table 4-1 and at the following Web site:

http://publib.boulder.ibm.com/infocenter/tsminfo/v6/topic/com.ibm.itsm.srv.upgrd.doc/c_srv_upgrd_hwsreqs.html

Table 4-1 Server upgrade matrix

Platform for V5 Server	Required platform for upgrade
HP-UX running on a PA-RISC system	HP-UX running on an Itanium® system
Linux running on an Itanium system (IA64)	Linux running on an x86_64 system
Linux running on a 32-bit x86 system	Linux running on an x86_64 system
Windows running on an Itanium system (IA64)	Windows running on an x86_64 system

IBM System Software Archive Manager

Regulations, laws, or company policy can determine how much information must be kept in a given environment. IBM System Software Archive Manager is a complementary storage product that allows for long term secure archival of data that must not be lost or destroyed for any reason. This product should be considered in the planning phase for your Tivoli Storage Manager implementation if such requirements exist within your business.

System Storage Archive Manager is a software solution that provides long-term, retention protection when you archive business records, files, or data.

In the following circumstances, System Storage Archive Manager should be part of your storage management solution:

- ▶ You must meet regulatory compliance requirements to protect certain data from destruction for a specified length of time.
- ▶ You have internal controls that require that certain data must be archived for extended periods of time
- ▶ You must obtain approval before certain data can be destroyed.
- ▶ Your existing backup infrastructure is being overtaxed by long-term archival mandates and must be expanded or supplemented.

Archiving data to meet regulatory compliance requirements must have additional safeguards or protections, referred to as *data retention protection*. These safeguards help guarantee that data is not deleted prematurely, either inadvertently or maliciously. To meet compliance requirements, System Storage Archive Manager provides additional protections for data archived by Tivoli Storage Manager.

System Storage Archive Manager provides storage management services that permits users to archive files from their workstations or file servers to archive retention protected storage. Archived copies of files can be retrieved to local workstations. System Storage Archive Manager also includes an application program interface (API) client program that you can use to enhance a content-management application with storage management services. When an application is registered with a server as a client node, the application can archive and retrieve objects from archive retention-protected storage.

System Storage Archive Manager uses chronological and event-based retention policies. Chronological retention is a calendar-based policy in which the final expiration countdown begins when an object is sent to System Storage Archive Manager storage. Event-based retention requires a predefined activation event to occur before the final expiration countdown

starts. System Storage Archive Manager provides the ability to override prescribed retention policies using the deletion hold and release events.

4.1.2 Network connectivity

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

Client-server communications options

By default, the server uses these methods of communication:

- **TCP/IP option**

TCP/IP is the most common communication method and possibly the easiest to set up. Certain functions, such as server-to-server communications, server-prompted mode, and the Web clients, require TCP/IP. Internet Protocol version 6 (IPv6) is now supported and a sample setting is included here:

```
commmethod V6Tcpip
tcpserveraddress 2002:92b:111:221:128:33:10:249
tcpport 1500
tcpwindowsize 8
tcpnodelay no
```

- **Named Pipes option**

The Named Pipes communication method is ideal when running the server and client on the same Windows machine because Named Pipes support is internal to the Windows base system. Named Pipes require no special configuration. The follow example is for Named Pipes setting:

```
commmethod namedpipe
namedpipename \\.\pipe\adsmapipe
```

- **HTTP option**

Use the HTTP communication method for the client Web interface. HTTP and communications require a TCP/IP connection. This is a sample HTTP setting:

```
commmethod http
httpport 1581
```

The Integrated Solutions Console and the Tivoli Storage Manager Administration Center software must be installed to use the server administrative Web interface.

- **Shared Memory option**

Tivoli Storage Manager supports shared memory communication between the Storage Manager server and client are on the same machine. To use shared memory, TCP/IP must be installed on the machine. Here is a sample shared memory setting:

```
commmethod sharedmem
shmport 1510
```

Connecting with Tivoli Storage Manager across a firewall

The Tivoli Storage Manager server and clients can work across a firewall. However, the server can also securely manage client backup and restore operations and administrative functions across a firewall.

To enable clients to work across a firewall, configure the firewall to open the ports that the server and clients need. Ports must be opened only if functions beyond those of server-prompted scheduling are required.

Server-prompted scheduling can be handled with the following options of the REGISTER NODE or UPDATE NODE commands:

- ▶ SESSIONINIT= SERVERONLY
- ▶ HLADDRESS
- ▶ LLADDRESS

4.1.3 Client considerations

Tivoli Storage Manager is a client-server program. The client product, which must be installed on the machine you want to back up, is responsible for sending and receiving data to and from the Tivoli Storage Manager server. The Backup-Archive client has two distinct features: backup and archiving.

All Backup-Archive clients are implemented as multi-session clients, which means that they are able to exploit the multithreading capabilities of modern operating systems. This enables the running of backup and archive operations in parallel to maximize the throughput to the server system.

Restore and retrieve

Each of these features has a complementary function as well: restore and retrieve. The restore feature allows users to recover any data that has been backed up previously. Regarding the individual implementation of Tivoli Storage Manager, the user is able to recover from different versions of the lost data. The retrieve feature enables users to request formerly archived data so that this data is accessible again.

Command-line interface

The command-line interface (CLI) is useful for experienced users, and it allows generation of backup or restore scripts for scheduled execution. The graphical interface (GUI) is designed for *ad hoc* backups and restores and does not require any Storage Manager skills.

Windows GUI

The Windows GUI has been migrated to a Java application, and it is the default application. The non-Java Windows native GUI is installed as the `dsmmfc.exe` file in the installation directory, but it has not been updated with the new Tivoli Storage Manager Version 6.1 features.

Online help

To view the non-English online help from the Web Client applet, you must install the language versions of the help files on the agent, the system where the Tivoli Storage Manager Backup-Archive client was installed. If the language versions are not installed or are not available, the online help will be displayed in English.

The Web client is especially useful for those clients, such as NetWare, where no native GUI is available, or for performing remote backup/restore operations, such as in a help desk environment.

Configuration and options files

Configuration files and options files are used to specify one or more servers and communication options for backup and restore services. The file can include authorization

options, backup and archive processing options, scheduling options, and, where applicable, Tivoli Storage Manager for Space Management options.

On a UNIX platform, the Tivoli Storage Manager options reside in two options files:

- ▶ Client system options file (dsm.sys)
- ▶ Client options file (dsm.opt)

On other platforms, the options file (dsm.opt) contains all options. The user sets up these files when the Tivoli Storage Manager Backup-Archive client is first installed on the user's workstation. For the Windows platforms, you should define client options using the DEFINE CLIENTOPT command.

Configuration parameters

The minimum configuration parameters for successful communication are:

- ▶ Communication protocol
The client and server use the same protocol.
- ▶ Tivoli Storage Manager server address
This address identifies the correct Tivoli Storage Manager server to use.
- ▶ Node name
This is the name by which the Tivoli Storage Manager server knows the client. This information is required to allow access for this client. The node name and password are set up on the server, and if different from the machine or host name, they also must be added in the client options file.

4.1.4 ISC/Administration Center

The Administration Center is installed as an IBM Integrated Solutions Console (ISC) component. The ISC enables you to install components provided by multiple IBM applications and access them from a single interface. The Tivoli Storage Manager server can require a large amount of memory, network bandwidth, and processor resources. In most cases, the server performs best when other applications are not installed on the same system. If the system meets the combined requirements for the server and the Administration Center (for example, it has at least 2 GB of physical memory), it can support both applications. You might plan to use the Administration Center to manage an environment with a large number of servers or administrators; if so, then you must consider installing the Administration Center on a separate system.

Software and system requirements

In this section, we list the requirements for the Administration Center and the ISC.

Hardware

The machine that is hosting the Administration Center and Integrated Solutions Console requires the following items:

- ▶ Minimum 500 MB of disk space
- ▶ An additional 679 MB in the /tmp directory (which is also checked during the installation)
- ▶ Minimum 500 MB for the completed installation
- ▶ Virtual memory/swap space must be equal to double the user's physical memory. At a minimum, this should be at least equal to your physical memory
- ▶ Network adaptor

Operating System

The machine that is hosting the Administration Center can be the same machine as the server if it meets the hardware and software requirements and is running a supported operating system, as detailed in the following Web page:

<http://www.ibm.com/support/docview.wss?uid=swg21328445>

Communication Protocol

To use the console across a network, the following items are required for the machine for Network connectivity:

- ▶ Network adapter and connection to a physical network that can carry IP packets
- ▶ Static IP address
- ▶ Configured fully qualified host name

The Integrated Solutions Console must be able to resolve an IP address from its fully qualified host name. To verify that the host name is configured correctly, the user can issue the **ping** command from a command line. An example command is:

```
ping hostname.yourco.com
```

In the example, `hostname.yourco.com` is the fully-qualified host name.

Additional software

The Tivoli Storage Manager Administration Center Web interface for the server and a Web client interface for client machines require a Java Swing-capable Web browser:

- ▶ MS Internet Explorer 6.0, or later with Java 1.5.0
- ▶ Firefox 2 or later with Java 1.5.0

For platform and browser-specific JRE notes, see the *readme* file that is available with the product.

Note:

- ▶ The memory required for the Administration Center is additional memory beyond what is needed for the operating system and your existing applications.
- ▶ For the latest guidelines on the Administration Center, go to:

<http://www.ibm.com>

Use search keyword TSMADMINCENTER.

4.1.5 Reporting and Monitoring

Tivoli Storage Manager Reporting and Monitoring provides reporting and monitoring functionality previously unavailable directly from Tivoli Storage Manager. The reporting and monitoring feature uses a combination of the Tivoli Common Reporting tool, IBM Tivoli Monitoring, and the IBM Tivoli Data Warehouse to offer you reports and real time monitoring information about Tivoli Storage Manager servers and client activity.

Note: Installing the Tivoli Storage Manager Reporting and Monitoring feature directly on a Tivoli Storage Manager HP-UX or Sun Solaris server is not supported. You can monitor and report on HP-UX and Sun Solaris Tivoli Storage Manager servers by creating a monitoring agent instance for these servers on an AIX, Linux, or Windows IBM Tivoli Monitoring server.

Monitoring agent configuration requirement

The only time you configure the Tivoli Storage Manager monitoring agent on the server where you installed the IBM Tivoli Monitoring component is when you have the following conditions:

- ▶ If you have an IT environment that has less than 10 Tivoli Storage Manager servers.
- ▶ If you want to establish a prototype of the Tivoli Storage Manager Reporting and Monitoring server to test the installation first.

Collecting data from multiple Tivoli Storage Manager servers using this configuration requires creation of multiple agent monitoring instances and results in using large amounts of memory. For optimum performance, the Tivoli Storage Manager Reporting and Monitoring server must have at least 4 GB of memory.

For an IT environment that has more than 10 Tivoli Storage Manager servers, install the Tivoli Storage Manager monitoring agent on each Tivoli Storage Manager server you want to monitor. This configuration allows for the most efficient use of memory on both the Tivoli Storage Manager server and the IBM Tivoli Monitoring server.

Before installing the Tivoli Storage Manager Reporting and Monitoring feature, there are some decisions you must make.

You have IBM Tivoli Monitoring currently installed on a server

If you are currently using IBM Tivoli Monitoring, the Tivoli Storage Manager reporting and monitoring feature can be installed on your existing IBM Tivoli Monitoring server but the following requirements must be met:

- ▶ IBM Tivoli Monitoring server must be a fully licensed version of IBM Tivoli Monitoring.
- ▶ IBM Tivoli Monitoring server must be at the 6.2 FP1 level.

For this type of Tivoli Storage Manager reporting and monitoring installation, the IBM Tivoli Monitoring option would not be checked on the installation wizard and the IBM Tivoli Monitoring server is identified when prompted by the installation script.

The version of IBM Tivoli Monitoring that you install with the Tivoli Storage Manager reporting and monitoring feature can only be used for Tivoli Storage Manager reporting functions.

You cannot upgrade or downgrade your existing IBM Tivoli Monitoring installation using the Tivoli Storage Manager reporting and monitoring installation wizard.

You do not have IBM Tivoli Monitoring installed on a server

In this situation, you must install all components of the Tivoli Storage Manager reporting and monitoring feature on one server.

The Tivoli Storage Manager server must be installed on a separate system.

Besides the IBM Tivoli Monitoring component, the Tivoli Storage Manager monitoring agent is also required as part of data collection and monitoring and will be installed on the Tivoli Storage Manager reporting and monitoring server.

Installation scenarios for the Reporting and Monitoring feature

Depending on the type of reporting installation you are performing, you will install different components. The following situations describe three installation scenarios and list the components you install for each scenario:

- ▶ You have Tivoli Storage Manager Version 5.5 and you want to install the Tivoli Storage Manager reporting and monitoring feature only. You perform the following tasks:
 - Install the Tivoli Storage Manager monitoring agent on your Tivoli Storage Manager server.
 - Install the following components on a different system, which will be your Tivoli Storage Manager reporting and monitoring server:
 - IBM Tivoli Monitoring
 - Tivoli Storage Manager monitoring agent
 - Tivoli Storage Manager reporting and monitoring
 - Tivoli Storage Manager reporting and monitoring languages
 - Tivoli Storage Manager Administration Center
- ▶ You are installing Tivoli Storage Manager V6.1 for the first time and you want to install both Tivoli Storage Manager server and the Tivoli Storage Manager reporting and monitoring feature. You perform the following tasks:
 - Install Tivoli Storage Manager V6.1 and the Tivoli Storage Manager monitoring agent on one system.
 - Install the following components on a different system, which will be your Tivoli Storage Manager reporting and monitoring server:
 - IBM Tivoli Monitoring
 - Tivoli Storage Manager monitoring agent
 - Tivoli Storage Manager reporting and monitoring
 - Tivoli Storage Manager reporting and monitoring languages
 - Tivoli Storage Manager Administration Center
- ▶ You have Tivoli Storage Manager Version 5.5 installed and you want to upgrade to Tivoli Storage Manager V6.1. You perform the following tasks:
 - Upgrade your Tivoli Storage Manager Version 5.5 server to Tivoli Storage Manager V6.1 and install the Tivoli Storage Manager monitoring agent on this system.
 - Install the following components on a different system, which will be your Tivoli Storage Manager reporting and monitoring server:
 - IBM Tivoli Monitoring
 - Tivoli Storage Manager monitoring agent
 - Tivoli Storage Manager reporting and monitoring
 - Tivoli Storage Manager reporting and monitoring languages
 - Tivoli Storage Manager Administration Center

System requirements for Reporting and Monitoring

Your system must meet hardware and software requirements before the Tivoli Storage Manager reporting and monitoring feature is installed. These are documented in the Tivoli Storage Manager Server installation guides that are specific to your platform (refer to “Related publications” on page 293). The latest documented hardware requirements are listed in Table 4-2 on page 68.

Table 4-2 Hardware requirements

Type of hardware	Hardware requirements
Hardware	<ul style="list-style-type: none"> ▶ Dual core Intel Pentium® compatible processor or multiprocessor-based computer with a 2 GHz or faster processor ▶ A 64-bit system, minimum for AIX ▶ Network interface card ▶ Graphic display adapter
Disk space	<ul style="list-style-type: none"> ▶ Minimum 30 GB free disk space. Requirements increase as historical data is gathered and stored in Tivoli Data Warehouse. ▶ At least 10 GB free space should be made available in the home directory where the warehouse data is stored
Memory	<ul style="list-style-type: none"> ▶ Minimum 4 GB ▶ If Tivoli Storage Manager monitoring agents are installed on the Tivoli Monitoring server, memory requirements increase quickly as the number of Tivoli Storage Manager servers are monitored from that one IBM Tivoli Monitoring server. ▶ If a Tivoli Storage Manager monitoring agent is installed on a Tivoli Storage Manager server, there is only a single instance of the agent running on the Tivoli Storage Manager server and no increases in memory requirements are needed by the IBM Tivoli Monitoring server.

Table 4-3 describes the minimum software requirements for the Tivoli Storage Manager reporting and monitoring feature.

Note: Be aware that the software listed might not be supported in the future, so consider using newer full-release versions if your system is expected to be employed for a long period of time before the next planned upgrade.

Table 4-3 Software requirements

Type of software	Minimum software requirements
Operating system	<p>One of the following operating systems:</p> <ul style="list-style-type: none"> ▶ Microsoft Windows 2003 Advanced Server with Fix Pack 2 ▶ Red Hat Enterprise Linux, V5 ▶ SUSE Linux Enterprise 10 ▶ AIX, Version 5.3 (64-bit only) <p>All 32- and 64-bit operating systems are supported, except AIX, listed here.</p>
Web browser	<p>A Web browser to log on and use the console. The Web browser can be installed on the same or a separate system. The following browsers can be used:</p> <ul style="list-style-type: none"> ▶ Microsoft Internet Explorer 6.x (Windows systems only) ▶ Mozilla 1.0.2 ▶ Mozilla 1.3 ▶ Mozilla 1.4 <p>Mozilla has published fixes you might need to run on AIX systems.</p> <ul style="list-style-type: none"> ▶ Netscape 6.2 ▶ Netscape 7 <p>Your browser must support the server code page. If your browser does not support the server code page, the windows might be unreadable. If your browser meets these requirements but does not correctly display a Tivoli Storage Manager Web-based interface, consider using a different browser.</p>

Type of software	Minimum software requirements
Communication protocol	At least one of the following communication protocols: <ul style="list-style-type: none"> ▶ Named Pipes ▶ Sharedmemory ▶ TCP/IP Version 4 or Version 6
Optional software	To create your own custom report, the following software is required: <ul style="list-style-type: none"> ▶ Business Intelligence and Reporting Tools (BIRT), version 2.2.1, All-In-One software ▶ IBM Java 1.5 Java Developer's Kit/Java Runtime Environment (JDK/JRE) installed on the server where you are creating custom reports

4.2 Recovery objectives

There are other considerations outside of Tivoli Storage Manager that we also take into account.

4.2.1 Recovery time objective

If a Business Process or service is interrupted, the recovery time objective (RTO) is the amount of time that the interruption can last. This time should be closely related to the service level agreement (SLA) between the provider of the systems supporting the Business Process and the person or department responsible for the Business Process. Disaster recovery management should consider this as part of the overall Disaster Recovery Plan (DRP).

4.2.2 Recovery point objective

The recovery point objective (RPO) is closely related to the RTO as it is usually the agreed amount of "acceptable loss" in the event of a disaster or interruption of service. This "acceptable loss" would be agreed during the establishment of SLAs between the provider of the systems supporting the Business Process and the person or department responsible for the Business Process.

In the example shown in Figure 4-1 on page 70, the RPO is the time between the last full point-in-time backups (15:00) and the actual failure (15:45) because any data changes during that time will not have been captured by the backup environment.

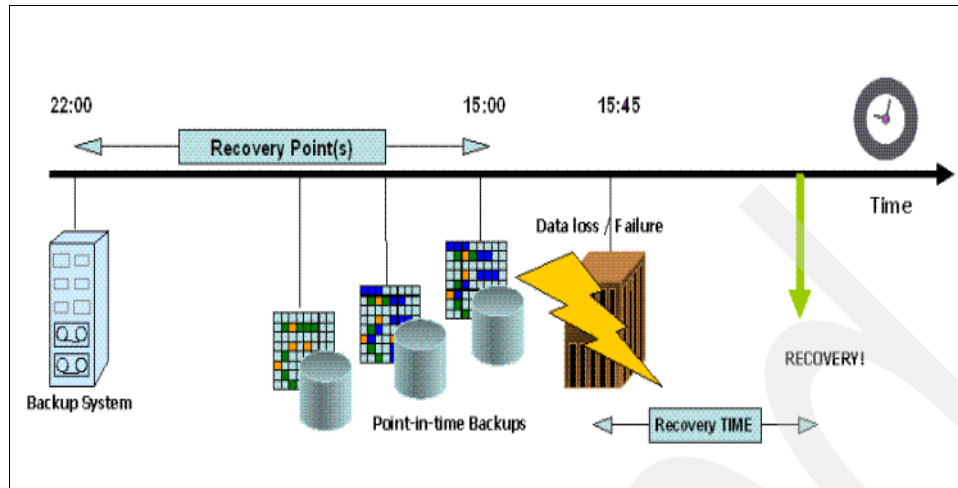


Figure 4-1 RTO and RPO description



Planning the implementation

This chapter provides the information needed to develop a Tivoli Storage Manager solution based on the data gathered from the customer's requirements and their environment.

In this chapter, we discuss the following topics:

- ▶ Required knowledge for the Planning and Installation sections of the test objectives
- ▶ Design Server and Client configuration
- ▶ Determining storage hierarchy and interaction with policy components
- ▶ Evaluating the network infrastructure
- ▶ Planning disaster recovery management
- ▶ Upgrading the Tivoli Storage Manager Server Database from Version 5.5 to Version 6.1 with DB2 Database
- ▶ Consolidation of server instances

5.1 Correlation to certification test objectives

In this chapter, we discuss planning and implementation of the Tivoli Storage Manager V6.1 Implementation Certification Test objectives. This includes customer storage management and hardware requirements, network capabilities, and designing a solution that meets the customer's needs. At the end of this section, you should be able to accomplish these tasks:

- ▶ Document assumptions inherent in the customer requirements and environment.
- ▶ Determine the platform, location, and number of servers.
- ▶ Determine the size and mirroring of the Tivoli Storage Manager server database and logs.
- ▶ Determine the storage pool hierarchy and size of the storage pools and distribution of the storage pool levels in the enterprise.
- ▶ Determine the disaster backup and recovery plan, including the use of electronic vaulting.
- ▶ Determine the protocols to be used for each environment.
- ▶ Determine the service level agreement (SLA) the solution will be required to meet.
- ▶ Determine the appropriate number of servers given the environment.
- ▶ Determine the hardware requirements to meet the solution design and evaluate whether existing hardware will meet the requirements of the solution.
- ▶ Determine which Tivoli Storage Manager features and licenses are required.
- ▶ Determine data types (for example, databases, network attached storage, and mail servers).
- ▶ Evaluate the customer's network infrastructure (for example, LAN, WAN, SAN, and mobile).
- ▶ Determine the upgrade process for the Tivoli Storage Manager Database.
- ▶ Define the process to consolidate multiple server instances.

5.2 Planning the implementation

Depending on the customer environment, planning should be for a clean new implementation.

The checklist steps in this section can help ensure that the customer's functional requirements match the IBM Tivoli Storage Manager capabilities. To determine these requirements, perform the steps in the following sections.

5.2.1 Step 1: Determine backup requirements and service level agreements

To set up an optimal backup and restore system to save all vital and historical data, we have to discuss service level agreements (SLAs) and how the results influence the setup of our system. We should consider the following aspects when we perform the final configuration planning:

- ▶ What kind of data we have to backup and archive?
- ▶ How many nodes do we need?
- ▶ What are the RTO and RPO objectives?
- ▶ When are the backup time and daily maintenance procedures?
- ▶ What are the hardware layout, backup storage, and devices available?
- ▶ What are the disaster recovery aspects?

What kind of data do you have to backup and archive

If you have many mostly small files, the best backup is the traditional incremental backup, when possible in conjunction with journal-based backup. For fast disaster recovery, performing a snapshot image backup once a week might be helpful.

If you have very large objects, such as databases or mail systems, you can perform the data transfer direct to tape with LAN-free backup. Therefore having enough mount points available, which will eventually be physical or virtual tape drives, is necessary.

If you have NAS-Filers, we can do the backup in combination with snapshots, SnapDiff incremental, NDMP file-level, or NDMP SnapMirror-to-tape.

If you have lots of data to archive for a long time period, you have to guarantee that the data can be used for a long time. You should consider that the data format must be readable with the systems available when the data is needed. Do not archive the redo log files for databases when you cannot guarantee that the appropriate database systems will be available. Export the data to a neutral format instead and archive this data.

How many nodes do we need

If your systems are separated, for example, file servers, you can perform daily incremental backup for each node. You can manage the data for the file spaces of each node.

If you have ERP systems such as SAP or databases such as Oracle or a combination of both, you have to design the backup systems for every requirement. We highly recommend defining separate nodes for every "Tivoli Storage Manager for" module or TDP. For instance, if you have an SAP system, composed of a database server, application server, and presentation server, you must have a node for the TDP database and one or more nodes for the file system of the database server, the application servers, and presentation servers. You have the same situation with databases such as Oracle or mail systems such as Microsoft

Exchange or Lotus Domino. How to setup the system and how to register the nodes is documented in the Tivoli Storage Manager documentation for the corresponding application.

For other reasons, such as performance or RTO and RPO, spreading the data over several file spaces and managing them by collocation might be helpful.

To register the nodes, use the administrative command **register node** or the new Administration Center function. To obtain information about nodes and their data, use the commands **query node**, **query occupancy**, **query auditoccupancy** and with special SQL queries. For graphical and historical views, use the Administration Center and the new Tivoli Common Reporting.

RTO and RPO objectives

What are the requirements for backup time, restore time, and restore point? How often do you need to perform backups? Is once a day enough? Do you need fast restores, for single files or for complete servers? To resolve these requirements, you have several choices with Tivoli Storage Manager:

- ▶ You may be able to use snapshot technology for fast backups and recovery.
- ▶ If your tape systems are fast enough, determine how many tape drives you need.

If fast restores are required, you have the following options:

- ▶ Collocate data, by node, group or file space.
- ▶ Copy the active versions of backup into Active Data pools.
- ▶ Keep data on sequential disk for long time.
- ▶ Establish a virtual tape system.
- ▶ Use LAN-free data movement for backup and restore. Be careful with CRC checking, as this will kill your performance.
- ▶ Create backup sets for disaster recovery without operating Tivoli Storage Manager server.
- ▶ Use the client option `resourceutilization` for multi-session client backup and restore.
- ▶ Use No-query Restore for faster restores.
- ▶ Check new copy services, such as Tivoli Storage Manager for Copy Services (Tivoli Storage Manager for CS) or Tivoli Storage Manager for Advanced Copy Services (Tivoli Storage Manager for ACS).

Backup time and daily maintenance

Do we have enough time to perform the daily housekeeping or maintenance process after the daily backup of the data? How many processes can run in parallel? Is the maintenance plan designed for our requirements? Sometimes it is possible to copy the data to the copy pools or active data pools during the backup simultaneously, so that long running copy jobs are not necessary. Sometimes database logs must be written twice to separate copy pools, which we can do simultaneous copy.

Backup of the database is very important and must be performed daily. For disaster protection it should be twice, one backup for onsite recovery and the second backup or database snapshot for disaster recovery.

Hardware layout, backup storage and devices

If you perform backup and archive of very large objects, it may be more cost effective to send the data directly to tape. Physical tape is still the cheapest way to store a huge amount of data. For performance reasons, as with fast restore and multiple session backup, staging the

data to sequential disk might be helpful. The file device class has a number new functions to meet this requirement, such as concurrent access of volumes in sequential file storage pools, a change to the migration threshold mechanism that considers overall pool utilization instead of individual volume and file utilization and new data deduplication. If LAN-free or NDMP backups are required, setting up a virtual tape system might be helpful. This approach provides enough mount points and tape drives without any hardware changes. Native drive throughput is key for backup and restore of large file workloads. Time spent mounting a tape is time not spent backing up or restoring data. Reduce this time with fewer mounts by using larger capacity media or by providing faster mounts.

The locate time is also time not spent backing up or restoring data. The backup must find the current end-of-data quickly and append. It is also helpful for restore to quickly locate data blocks that contain data to restore. This is more important for Tivoli Storage Manager than for other backup-restore products. A full file system restore operation with other products would locate to the beginning of the data and read-restore all blocks belonging to the backup set being restored. A full file system restore operation with Tivoli Storage Manager would locate to each block containing data to be restored, which is not necessarily faster.

Native drive throughput has no measurable effect on backup and restore of small file workloads. It also has no throughput bottlenecks such as slow processor, limited memory, slow disk, using client compression, slow network.

Backhitch time has an important impact on the backup of small file workloads direct to tape because Tivoli Storage Manager forces a buffer flush after every 256 files (maximum). For this reason, customers should back up these workloads to disk and migrate the data to tape. Locate time during Tivoli Storage Manager restore of small file workloads can easily overshadow the time spent actually moving data. This approach can have a significant effect for backup and restore of slow clients such as those with other applications running.

Table 5-1 shows, what we have to check. In the table, XX indicates important, X indicates meaningful, and NS indicates not significant.

Table 5-1 Considerations about tape libraries and performance

Process	Native throughput	Cartridge capacity	Mount time	Locate time	Backhitch time
back up large file, fast client	XX	X	X	X	NS
restore large file, fast client	XX	X	X	X	NS
back up small file, slow client	NS	NS	X	X	XX
restore small file, slow client	NS	NS	X	XX	NS
storage pool migration without collocation	XX	X	X	X	NS
storage pool migration, collocation	XX	NS	XX	XX	NS

For tape drives consider the following information:

- ▶ Configure enough tape drives for:
 - The peak number of Tivoli Storage Manager client sessions backing up direct to tape during the peak backup window
 - Add additional tape drives for other functions that run during the backup window:
 - Storage pool migration
 - Storage pool backup
 - Reclamation
- ▶ Key tape device attributes are:
 - Native write-read throughput
 - Compaction-compression throughput
 - Cartridge capacity
 - Mount time
 - Locate time
 - Backhitch time

Disaster recovery aspects

For disaster recovery reasons, prepare your Disaster Recovery systems so that you can use the data to recreate the original application systems as fast as possible after a disaster situation. Disaster situations vary, from losing a single file or object of a key application to total destruction of the whole data center. You have to carefully plan the kind of disaster to address in what time frame, based on the time and resources you have to do this. If your service level agreements are addressing a high-availability solution, plan this carefully. For all solutions, you should test your disaster recovery periodically and report the results. Use the built-in disaster recovery manager of Tivoli Storage Manager when possible and prepare the DRM planfile daily. You can store the planfile on file systems away from your current data center or send it through e-mail to your Tivoli Storage Manager administrator.

5.2.2 Step 2: Obtain the data retention parameters

To determine the data retention parameters, consider the following information:

- ▶ Number of backup versions

Determine the number of changed copies of a file that you want to keep. How many 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 seven as the number of backups to keep.

Use this number 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). The two options are:

 - Keep the backup version for a specified number of days.
 - Specify NOLIMIT option, which implies that you want IBM Tivoli Storage Manager to retain all backup versions (other than the most recent version), indefinitely.

Note: The current version is kept 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 previously, and you have set this parameter to one. When the next backup cycle runs after the file has been deleted from the client, IBM Tivoli Storage Manager flags 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. The two options are:

- Keep the last backup version for a set number of days.
- Specify NOLIMIT option to indicate 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 having been deleted from the client file system, the one remaining backup version will be deleted from IBM 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 7 days, 31 days, 180 days, 365 days, or 7 years.

Nonstandard requests for archive retention periods are slotted into the retention period group closest to the request without being smaller. 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. However, you can use the backup set feature to retain all nonstandard backup requirements, or even use backup sets instead of archive.

► Off-site copies

Determine whether you want to send a copy of the data off site. Copying data to a removable device such as tape allows the data to be taken off site. An off-site copy, with other procedures, provides recoverability in the event that Tivoli Storage Manager server becomes unusable or data on the Tivoli Storage Manager server becomes corrupted.

► On-site collocation

Determine whether you want to use on-site collocation. Tivoli Storage Manager uses collocation to dedicate the minimum number of tapes required to hold all of one client's files. Collocation reduces elapsed time for multiple file restores and full client restores. 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.

► 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 file space restore, compared with single or a small number of files. Image backups can be very useful for quick restores 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. We recommend keeping 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 affects on the number of tapes that you might need, especially if you want to retain those backup sets for long periods of time or even if you want to have one copy on site and one for off-site 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.

5.2.3 Step 3: Analyze and choose the server platform

Make sure that customer's platforms are fully supported by Tivoli Storage Manager Version 6.1 and calculate the size of the Tivoli Storage Manager server.

There is a little information to guide you in selecting the appropriate Tivoli Storage Manager platform. At the same time, the risk of choosing an inappropriate platform size rises as the size of the Tivoli Storage Manager implementation increases. Small Tivoli Storage Manager implementations are at less risk, and the incremental cost to scale up or down is small. Many sites start small and grow into larger systems.

The Tivoli Storage Manager server is an intensive process. Processing is a function of the number of files to manage and how your platform processes I/O. A large number of small files uses more processing resources 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 processing resources to maintain the database entries therefore Tivoli Storage Manager takes advantage of multiple processors.

I/O is the major part of Tivoli Storage Manager processing. 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 IBM Tivoli Storage Manager requires increases.

5.2.4 Step 4: Determine network load

Network topologies, such as Ethernet and asynchronous transfer mode (ATM) work well with Tivoli Storage Manager. The preferred communication protocol is TCP/IP. Choose the fastest network topology you can afford; otherwise, you should consider several performance functions, such as compression for better utilization in slow networks. Alternatively, the new SAN technologies can be implemented to take full advantage of tape library resources, freeing part of the ordinary network consumption to business applications. Network is the most important consideration when determining the IBM Tivoli Storage Manager solution. Table 5-2 on page 79 gives the estimated network throughput for each network topology.

To estimate the speed of the network required, use the following calculation. Calculate the total amount of data to be transferred during a backup window. For each client, follow these steps:

1. Multiply the GB changed per backup by data compression rate.
2. Sum this number for all clients to obtain the total data to be transferred.
3. Divide the total data transferred by the number of hours in your backup window to obtain the transfer rate in GB/hr.

Table 5-2 Network throughputs

Network topology	MBps	GB/hr
10 Mbps Ethernet	1	3.6
100 Mbps Ethernet	10	36
Gigabit Ethernet	100	360
10 Gigabit Ethernet	1000	3600
ATM 155 Mbps	15.5	55.8

For example, the customer has:

- ▶ Two DB2 database servers, each with 5 GB, that must be fully backed up
- ▶ Two Windows 2008 File servers, each with 60 GB and 5% daily change rate
- ▶ One hour backup window for all servers
- ▶ Limited budget

In the example, use the data in Table 5-2 to calculate the network speed required, as follows:

1. We use the formula: $(5+5) + (2*60*.05) = 16$ GB
2. Given that the backup window is 1 hour, then $16/1 = 16$ GB/hr.

For this environment, Ethernet (100 MBps) is the proper choice because the customer has a limited budget.

5.2.5 Step 5: Review database and log sizing considerations

Consider the items listed in Figure 5-1 on page 79 when you configure the DB2 database and log directories. The figure shows the Tivoli Storage Manager V6 components involved: database, active log directory, mirror log directory, archive log directory, and the archive failover log directory.

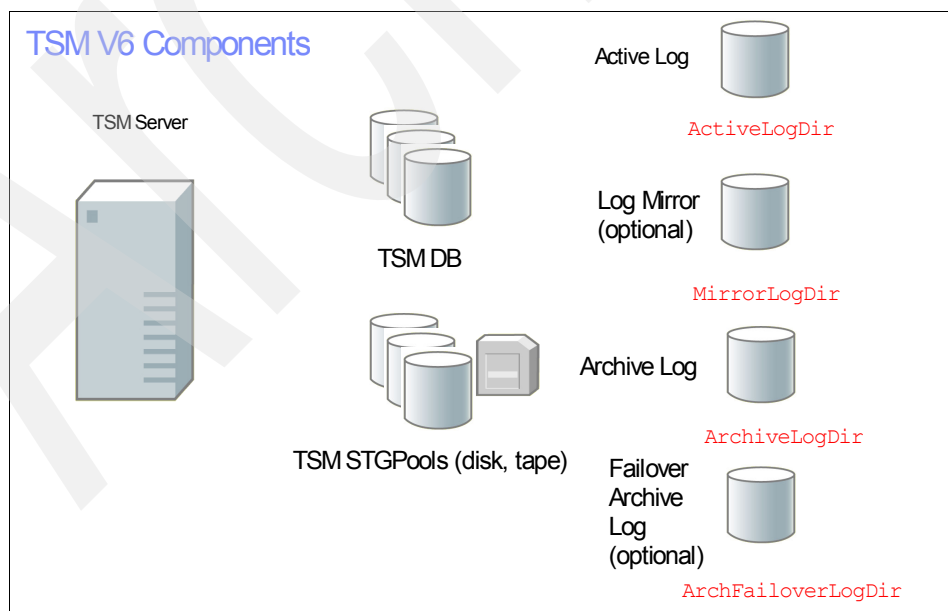


Figure 5-1 Tivoli Storage Manager V6 components

Estimating database space requirements

The process of estimating how much space to configure differs depending on whether you are installing a new server or upgrading an existing server. If you plan to take advantage of the integrated deduplication functionality, you must consider additional database and log space requirements.

Estimate database space requirements for a new server

The size of the database depends on the number of client files to be stored and the method by which the server manages them. If you can estimate the maximum number of files that might be in server storage at any time, you can estimate the database size from the following information:

- ▶ Each stored version of a file requires approximately 600 - 1000 bytes of database space.
- ▶ Each cached file, copy storage pool file, and active-data pool file requires approximately 100 - 200 bytes of database space.
- ▶ Overhead can require up to 25% in additional space.

Space calculations

In these examples, the computations are probable maximums. In addition, the numbers are not based on using file aggregation. In general, aggregation of small files reduces the required database space. Assume the following numbers for a Tivoli Storage Manager system:

- ▶ The size of the database depends on the number of client files to be stored and the method by which the server manages them.
- ▶ If you can estimate the maximum number of files that might be in server storage at any time, you can estimate the database size from the following information:
- ▶ Each stored version of a file requires approximately 600 - 1000 bytes of database space.
- ▶ Each cached file, copy storage pool file, and active-data pool file requires approximately 100 - 200 bytes of database space.
- ▶ Overhead can require up to 50% in additional space.

Versions of files

The following space requirement considerations are for multiple file versions:

- ▶ Backed up files

Up to 500,000 client files might be backed up. Storage policies call for keeping up to three copies of backed up files. The calculation is as follows:

$$500,000 \text{ files} \times 3 \text{ copies} = 1,500,000 \text{ files}$$

- ▶ Archived and space-managed files

- Archived files

Up to 100,000 files might be archived copies of client files.

- Space-managed files

Up to 200,000 files migrated from client workstations might be in server storage.

File aggregation does not affect space-managed files.

At 600 bytes per file, the space required for these files is:

$$(1,500,000 + 100,000 + 200,000) \times 600 = 1.0\text{GB}$$

Cached, copy storage pool, and active-data pool files

The following space requirement considerations are for cached, copy storage pool, and active-data pool files:

- ▶ **Cached copies**

Caching is enabled in a 5 GB disk storage pool. The pool's high and low migration thresholds are 90% and 70% respectively. Thus, 20% of the disk pool, or 1 GB, is occupied by cached files.

If the average file size is about 10 KB, about 100,000 files are in cache at any one time:

$$100,000 \text{ files} \times 200 \text{ bytes} = 19\text{MB}$$

- ▶ **Copy storage pool files**

All primary storage pools are backed up to the copy storage pool:

$$(1,500,000 + 100,000 + 200,000) \times 200 \text{ bytes} = 343\text{MB}$$

- ▶ **Active-data pool files**

All the active client-backup data in primary storage pools is copied to the active-data pool. Assume that 500,000 versions of the 1,500,000 backup files in the primary storage pool are active:

$$500,000 \times 200 \text{ bytes} = 95 \text{ MB}$$

Therefore, cached files, copy storage pool files, and active-data pool files require about 0.5 GB of database space.

Overhead

About 1.5 GB is required for file versions, cached copies, copy storage pool files, and active-data pool files. Allow up to 50% additional space (or 0.7 GB) for overhead. The database should then be approximately 2.2 GB at a minimum.

If you cannot estimate the numbers of files, you can roughly estimate the database size as a range of 1 - 5% of the required server storage space. For example, if you need 100 GB of server storage, your database should be 1 - 5 GB.

During SQL queries of the server, intermediate results are stored in temporary tables that require space in the free portion of the database. Therefore, using SQL queries requires additional database space. The more complicated the queries, the greater the space that is required.

Note: In the preceding examples, the results are estimates. The actual size of the database might differ from the estimate because of factors such as the number of directories and the length of the path and file names. A best practice is to periodically monitor your database and adjust its size as necessary.

Adding a new database directory after initial load causes a reorganization of the database. Avoid this approach because it is expensive and disruptive.

Estimate database space requirements for a server upgrade

The amount of database space that is required depends on the size of the original Tivoli Storage Manager V5 database, and on how much data the server will be managing.

The amount of storage space for the database is managed automatically. The database space can be spread across multiple directories. After you specify the directories for the database, the server uses the disk space available to those directories as required.

Locate the database and recovery log directories on separate physical volumes or file systems. Ideally, use multiple directories for database space and locate them across as many physical devices or logical unit numbers (LUNs) as there are directories.

Plan for 33 - 50% more than the space that is used by the V5 database. Do not include allocated but unused space for the V5 database in the estimate. Some databases can grow temporarily during the upgrade process; consider providing up to 80% more than the space that is used by the V5 database.

Estimate the amount of space that the database will require as follows:

1. Use the **QUERY DB FORMAT=DETAILED** command to determine the number of used database pages in your V5 database.
2. Multiply the number of used database pages by 4096 to get the number of used bytes.
3. Add 33 - 50% to the used bytes to estimate the database space requirements.

Consider testing the upgrade of the database to get a more accurate estimate. Not all databases will grow as much as the suggested 33 - 50% increase in space.

When the server is operating normally, after the upgrade process, some operations might cause occasional large, temporary increases in the amount of space used by the database. Continue to monitor the usage of database space to determine whether the server needs more database space.

For the best efficiency in database operations, anticipate future growth when you set up space for the database. If you underestimate the amount of space that is needed for the database and then must add directories later, the database manager might need to perform more database reorganization, which can consume resources on the system. Estimate requirements for additional database space based on 600 - 1000 bytes per additional object stored in the server.

Note: You cannot use raw logical volumes for the database. If you want to reuse space on the disk where raw logical volumes were located for an earlier version of the server, you must first create file systems on the disk.

Estimating log space requirements

Estimate the active, active log mirror, archive log, and archive failover log space.

Active log space

Ensure that the recovery log has enough space.

The minimum size of the active log is 2048 MB (2 GB); this is the default. The maximum is 131,072 MB (128 GB). You might want to begin with an active log size of 4 - 8 GB. Monitor the space usage and adjust the size of the active log as needed.

Active log mirror space

The active log mirror is a duplicate copy of the active log and should be the same size as the active log.

Creating a log mirror is optional. The additional space that the log mirror requires is another factor to consider when deciding whether to create a log mirror.

Archive log space

The size of the archive log depends on the number of objects stored by client nodes over the period of time between full backups of the database.

A full backup of the database causes obsolete archive log files to be pruned, to recover space. The archive log files that are included in a backup are automatically pruned after two more full database backups have been completed. Therefore, the archive log should be large enough to contain the logs generated since the previous two full backups.

If you perform a full backup of the database every day, the archive log must be large enough to hold the log files for client activity that occurs over two days. Typically 600 - 4000 bytes of log space are used when an object is stored in the server. Therefore you can estimate a starting size for the archive log using the following calculation:

objects stored per day x 3000 bytes per object x 2 days

For example, the result is 30 GB:

5,000,000 objects/day x 3000 bytes/object x 2 days = 30,000,000,000 bytes

Maintaining adequate space for the archive log directory is important. If the drive or file system where the archive log directory is located becomes full and no archive failover log directory is available, the data remains in the active log directory.

Important: This condition can cause the active log to fill up, which causes the server to stop.

Archive failover log space

The archive failover log is used by the server if the archive log directory runs out of space.

Specifying an archive failover log directory can prevent problems that occur if the archive log runs out of space. If the drive or file system where the archive failover log directory is located becomes full, the data remains in the active log directory.

Important: This condition can cause the active log to fill up, which causes the server to stop.

5.2.6 Step 6: Planning the number of Tivoli Storage Manager Server instances

With Tivoli Storage Manager V6.1 and the DB2 database, splitting the environment into multiple instances is no longer necessary. However some logical splitting, such as by organization, service level agreement, or network constraint might be appropriate. Also consider:

- ▶ Security reasons, such as firewall and secure networks
 - ▶ Network throughput when the Tivoli Storage Manager Server and the clients are connected over WAN network
- Move the server to the location of the client so you can use LAN connection for the data transfer. You can still manage this server with Tivoli Storage Manager enterprise management and Administration Center from your headquarters over WAN.
- ▶ Disaster Recovery considerations, where a faster Tivoli Storage Manager server recovery is necessary

From a technical perspective, other factors must be considered when you split your system into multiple instances.

You most certainly can have more than one Tivoli Storage Manager server on any system platform. For Windows, each server is started with a `-k <instancename>` parameter, and each

has its own set of registry keys and directories. This is basically the same as Tivoli Storage Manager 5.5. For optimal performance, 8 GB RAM is recommended. You can probably use only 3 - 4 GB per Tivoli Storage Manager server, but you should monitor it closely.

Also, with more than one server, you might need the DBMEMPERCENT option in the dsmserv.opt file to limit DB2 to some percentage of total RAM. If you have two servers, use 35% to possibly 40% (on each server), if you have three servers, use 22% to possibly 27%. If one server is much smaller than others (library/configuration manager), give it less and the others more. Tivoli Storage Manager needs memory for things other than the DB alone; a range of about 20% and maybe even more than 30% of the memory is needed for things such as managing disk volumes and actually running the Tivoli Storage Manager software.

5.2.7 Step 7: Plan the storage pool

Using Tivoli Storage Manager, you can configure storage pools to provide the best combination of performance throughput and data permanence. The import and export feature enables you to move storage pool data among the different platforms.

IBM Tivoli Storage Manager has three types of storage pools:

- **Primary storage pools**

When a client node backs up, archives, or migrates data, the data is stored in a primary storage pool. When a user tries to restore, retrieve, or export file data, the requested file is obtained from a primary storage pool if possible. Primary storage pool volumes are always located on-site.

A primary storage pool can use random access storage (DISK device class) or sequential access storage (for example, tape, optical, or FILE device classes).

- **Active-data storage pools**

An active-data pool contains only active versions of client backup data. Active-data pools are useful for fast client restores, reducing the number of on-site or off-site storage volumes, or reducing bandwidth when copying or restoring files that are vaulted electronically in a remote location. Active-data storage pools are similar to copy storage pools that can use either sequential disk or tape drives to store the data.

Data migrated by hierarchical storage management (HSM) clients and archive data are not permitted in active-data pools. As updated versions of backup data continue to be stored in active-data pools, older versions are deactivated and removed during reclamation processing.

Important: Restoring a primary storage pool from an active-data pool might cause some or all inactive files to be deleted from the database if the server determines that an inactive file must be replaced but cannot find it in the active-data pool. As a best practice and to protect your inactive data, therefore, you should create a minimum of two storage pools: one active-data pool, which contains only active data, and one copy storage pool, which contains both active and inactive data. You can use the active-data pool volumes to restore critical client node data, and afterward you can restore the primary storage pools from the copy storage pool volumes.

Active-data pools should not be considered for recovery of a primary pool or volume unless the loss of inactive data is acceptable. Active-data pools can use any type of sequential-access storage (for example, a tape device class or FILE device class). However, the precise benefits of an active-data pool depend on the specific device type associated with the pool. For example, active-data pools associated with a FILE device class are ideal for fast client restores because file volumes do not have to be physically

mounted and because the server does not have to position past inactive files that do not have to be restored. In addition, client sessions restoring from file volumes in an active-data pool can access the volumes concurrently, which also improves restore function performance.

Active-data pools that use removable media, such as tape or optical, offer similar benefits. Although tapes must be mounted, the server does not have to position past inactive files. However, the primary benefit of using removable media in active-data pools is the reduction of the number of volumes used for on-site and off-site storage. If you vault data electronically to a remote location, an active-data pool associated with a SERVER device class lets you save bandwidth by copying and restoring only active data.

Points to remember

Consider the following information:

► Active-data pools

- The server does not attempt to retrieve client files from an active-data pool during a point-in-time restore. Point-in-time restore operations require both active and inactive file versions. Active-data pools contain only active file versions. For optimal efficiency during point-in-time restores and to avoid switching between active-data pools and primary or copy storage pools, the server retrieves both active and inactive versions from the same storage pool and volumes.
- You cannot copy active data to an active-data pool from a primary storage pool defined with the NETAPPDUMP, the CELERRADUMP, or the NDMPDUMP data format.
- You cannot copy active data from a primary storage pool defined with a CENTERA device class.

To copy active versions of client backup files from primary storage pools to active-data pools, you can issue the COPY ACTIVE DATA command or you can use simultaneous write. The simultaneous-write function automatically writes active backup data to active-data pools at the same time that the backup data is written to a primary storage pool.

You can issue the COPY ACTIVE DATA command either manually or in an administrative schedule or maintenance script. Regardless of whether you use the COPY ACTIVE DATA command or simultaneous write, the Tivoli Storage Manager server writes data to an active-data pool only if the data belongs to a node that is a member of a policy domain that specifies the active-data pool as the destination for active data.

Restriction: The BACKUP STGPOOL command is not supported for active-data pools.

► Copy storage pools

A copy storage pool provides an additional level of protection for client data. It is created by the administrator backing up a primary storage pool. The copy storage pool contains all current versions of all files, active and inactive, exactly as they appear in the primary storage pool.

A copy storage pool can use sequential access storage (for example, tape, optical, or FILE device classes). Copy storage pools can also be created remotely on another IBM Tivoli Storage Manager server, thus providing electronic vaulting.

Copy pools are not part of the storage migration hierarchy. Files are not migrated to or from copy storage pools. The two ways to store files in a copy storage pool are:

- Copy the primary storage pool to a copy storage pool using the BACKUP STGPOOL command.
- Simultaneously write to the copy storage pools during client data transfer activity.

Tivoli Storage Manager can simultaneously store a client's files to each copy storage pool specified for the primary storage pool where the client's files are written. This is illustrated in Figure 5-2. The simultaneous write to the copy pools takes place only during a backup or archive from the client (in other words, when the data enters the storage pool hierarchy). It does not take place during data migration from a Tivoli Space Manager client or on a LAN-free backup from a storage agent. As many as ten copy storage pools can be specified for each primary storage pool (see Figure 5-2).

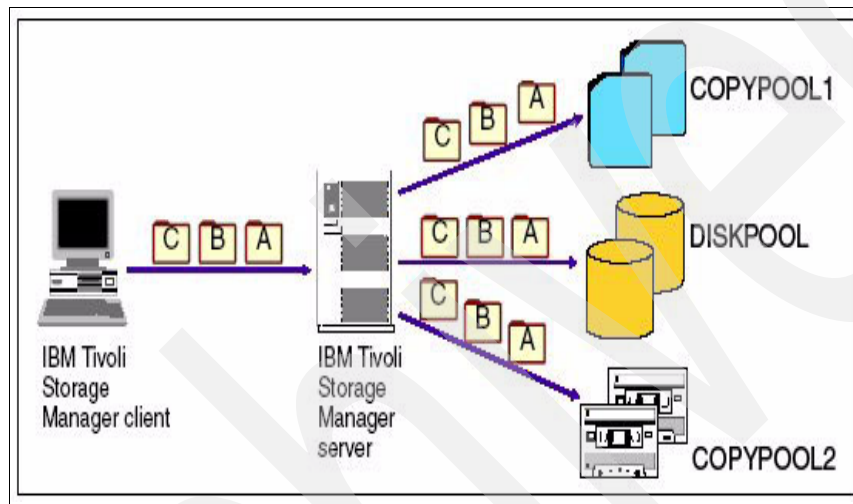


Figure 5-2 Simultaneous write

This function reduces the overall copy storage pool window and places copies of data off-site faster.

5.2.8 Step 8: Estimate size of total IBM Tivoli Storage Manager disk required

IBM Tivoli Storage Manager requires a disk to operate. The disk holds the database, active logs, archive logs, primary storage pools and if necessary the active-data storage pools.

If sequential storage pools are used on disk (which can be primary, active data, or copy), using the data deduplication feature to eliminate redundant data in sequential-access storage pools is possible. Deduplication applies extra load to the server so it requires extra disk I/O and processor resources.

Choose a disk model that meets your present estimated needs and has room for expansion. Multiple I/O paths and hot-swappable components should also be considered, both for performance and availability. You should size the disk subsystem for growth because Tivoli Storage Manager implementations grow substantially.

Consider the following factors:

► Backup disk sizing

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

- a. Multiply the GB changed per backup by (1 minus the Data compression rate); the result is the total bytes transferred for each client.
- b. Sum the total bytes transferred for all clients to obtain the total bytes transferred per backup cycle.
- c. Add 15% to the total bytes transferred per backup cycle to obtain the storage pool size. This calculation allows for variations in the size and number of files per backup.

► Archive disk sizing

In most environments, archive disk sizing is less critical than for backup. Archives can run less frequently than backups, and on weekends when the overall workload is lighter.

To increase the storage pool to hold archive data too, follow these steps:

- a. Group all machines that require simultaneous archive operations during one common time frame (for example, every month). Select the biggest group to obtain the peak archive size.
- b. Take 10% of the peak archive size to obtain the archive storage size.

► Image disk sizing

If you plan to use image backups, consider sizing the disk storage pool to hold the file spaces you want to back up. This is because image backups are single objects and, therefore, the server will require that size for storing data. To ensure that objects stored in your disk storage pools are not too large, you can use the `maxsize` parameter in the storage pool definitions to redirect such objects automatically to the defined next pool.

► Device configuration table and volume history file sizing

The device configuration table and the volume history table also require disk space, but typically this is a small amount. The device configuration table has entries for defined device classes and definitions for drives and libraries. All volumes used by Tivoli Storage Manager are tracked in the volume history database, including the volume identifier for the database backups. The volume history is periodically copied to a volume history file that you specify with the `VOLUMEHISTORY` option in the `dsmserv.opt` file.

Note: With the new DB2 recovery functionality, restoring and recovering the Tivoli Storage Manager server database without an existing volume history file is no longer possible.

► Total disk

Consider the following items when you calculate total disk space:

- IBM Tivoli Storage Manager code (depended on platform)
- IBM Tivoli Storage Manager database
- IBM Tivoli Storage Manager active log
- IBM Tivoli Storage Manager archive log
- Primary storage pools
- Active-data storage pools
- Copy storage pools
- Device configuration table and volume history table
- Other (RAID and operating system)

5.2.9 Step 9: Determine tape considerations and sizing

Most Tivoli Storage Manager systems, use tape as the ultimate destination for data storage. A variety of tape subsystems are available for most Tivoli Storage Manager server platforms. In general, choose the biggest, fastest, and most automated tape drive solution with the greatest number of drives you can afford. Optical disks are an alternative to tape, but we recommend tape because it is generally faster and more convenient to work with.

Determine sizing for tape devices and backup tapes:

- ▶ Tape devices

Tape drives are available in all sizes, including, but not limited to, digital linear tape (DLT), super DLT (SDLT), linear tape open (LTO), IBM TotalStorage 3590, IBM System Storage TS1130 Tape Drive, and other device types. Each type of drive has different data capacity, performance, cost, and reliability characteristics. Although data capacity and cost per megabyte stored are important, reliability is much more important.

In general, tape drives where the tape touches the read/write heads, such as 4 mm and 8 mm, tend to be less reliable (and slower) than tape drives where the tape does not touch the read/write heads, such as IBM TotalStorage 3580 model L33 Tape Drive and IBM System Storage TS1130 Tape Drive. We recommend an automated tape library with a bar code reader for all but the smallest of IBM Tivoli Storage Manager implementations.

- ▶ Backup tapes

To determine the number of on-site tape volumes required for backup operations, perform the following calculations:

- If this is a sequential storage pool (tape device), multiply the primary storage pool size by the number of backup versions to obtain the versions pool size.
- Add the sum of all total storage used fields for each client to the versions pool size to obtain the tape pool size.
- Divide the tape pool size by the device capacity to obtain the number of tape cartridges required. Consider whether the data is compressed by the client or the tape hardware. Normally, hardware compression is more effective than software compression and it does not require processor consumption.
- Add 50% to cater to tapes that are in filling status to obtain the total cartridges required for on-site 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.

5.2.10 Step 10: Identify the IBM Tivoli Storage Manager administrator ID

An Tivoli Storage Manager administrator controls Tivoli Storage Manager resources. There can be numerous administrators with varying levels of authority. Using the Web Backup-Archive client to perform backup, restore, archive, and retrieve operations on the behalf of other users using a Web browser is possible. Help desk personnel can use the Tivoli Storage Manager Web Client to perform these client tasks for their users without having to log on to the client machine.

Because 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. Conversely, numerous administrator IDs might give too many people too much authority.

Note: Never use the default administrative user ID ADMIN and password. This constitutes a security risk because this combination of user ID and password are public knowledge.

5.3 Storage hierarchy

A data storage policy can be very simple or very complex. The simplest policy has one set of rules that applies to all of the data in an organization, while the most complex policy has a unique set of rules for each individual file. Most installations fall somewhere between these two extremes (see Figure 5-3).

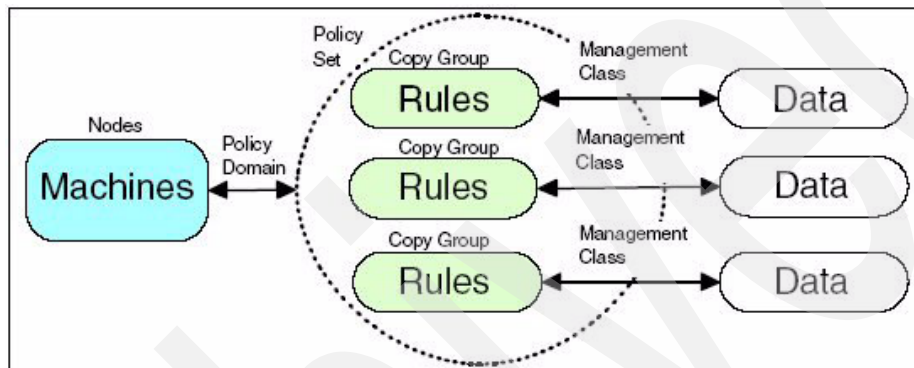


Figure 5-3 Data storage policy relationships and resources

Tivoli Storage Manager has entities that group and organize the resources and define relationships between them. A machine, or node in Tivoli Storage Manager terminology, is grouped together with other nodes into a policy domain. The domain links the nodes to a policy set that 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.

5.3.1 Policy components

Most of the data storage policy components exist to provide flexibility in our configuration or to serve as containers for rules. The hierarchical structure of the Tivoli Storage Manager policy components is shown in Figure 5-4. The policy domain must exist before the policy set, and so on.

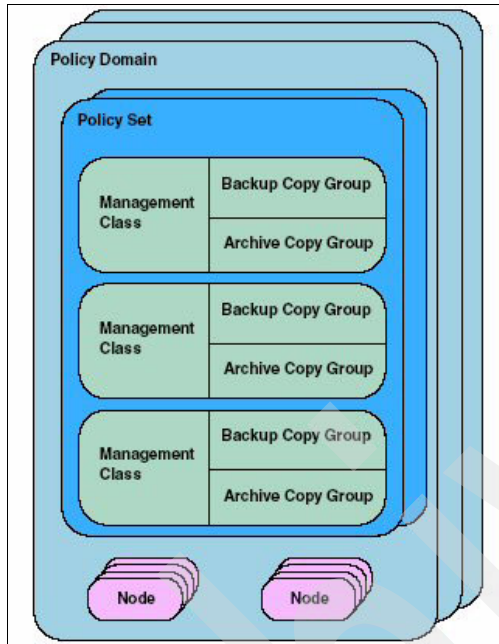


Figure 5-4 Data storage policy components

5.3.2 Copy groups

The copy groups consist of rules used to govern the retention of data. The two types of copy groups are: a backup copy group that holds the rules for backup data, and an archive copy group that holds the rules for archive data.

Although these two copy groups serve different purposes, they also share common characteristics. They both specify where to store the data sent to them from backup-archive operations. The copy group destination parameter specifies a valid primary storage pool to hold the backup or archive data. The copy group bridges the gap between data files and storage pools, as illustrated in Figure 5-5. This diagram shows the types of data flowing through the copy groups and into the storage pools. Note that a one-to-one relationship does not necessarily exist between copy groups and storage pools. It is possible to have just one storage pool that is the destination for all of the copy groups. Figure 5-5 on page 91 shows the data flow.

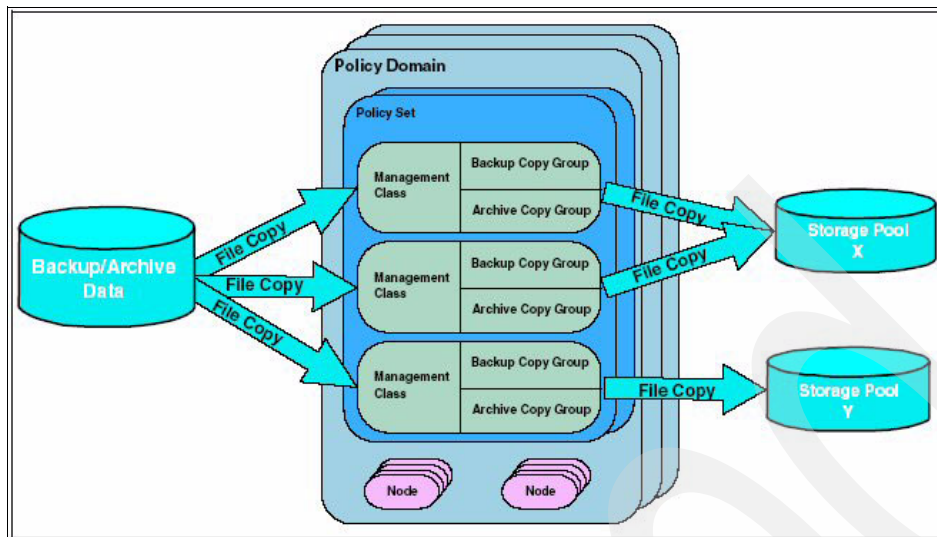


Figure 5-5 Copy group data flow

Both copy groups also need to know what to do with files that are modified during a backup or archive operation.

The copy serialization parameter provides four options:

- ▶ The `shrstatic` setting specifies that a file will not be backed up if it is modified during backup, but multiple attempts will be made to back up the file.
- ▶ The `static` setting specifies that a file will not be backed up if it is modified during backup and no additional attempts will be made.
- ▶ The `shrdynamic` setting specifies that a file will be backed up if it is modified during backup but multiple attempts will be made to back it up without modification first. If that cannot be done, then the file will be backed up anyway.
- ▶ The `dynamic` setting specifies that a file will be backed up even if it is modified during backup. No preliminary attempt is made to back up the file unmodified; it is backed up on the first attempt.

If Open File Support is enabled, using Logical Volume Snapshot Agent or Microsoft Volume Shadow Service, the copy serialization can be defined as static, because the handling of open files will be controlled by the Open File Support. This approach can increase backup performance.

5.3.3 Backup copy group

The backup copy group is concerned with two logical objects: the file and the file copy. A file is the actual data on a client node, while a file copy is a point-in-time copy of the file stored on the server. In other words, the Tivoli Storage Manager server contains file copies and nodes contain files.

A file can be in one of *two* possible states:

- ▶ Existing: An existing file on a node is a file that has been previously backed up and still exists on the node.
- ▶ Deleted: A deleted file is a file that has been previously backed up and subsequently deleted from the node.

This simple concept is important when discussing data storage rules.

A file copy can be in one of *three* states:

- ▶ Active: The most current copy of the file
- ▶ Inactive: The previous copy or version of the file
- ▶ Expired: A copy to be removed from the Tivoli Storage Manager server

A backup file copy is set to the expired state when it no longer conforms to the rules specified in the backup copy group.

The retention periods that we set in our rules specify the length of time to retain inactive file copies.

Important: No retention period exists for active file copies; they exist as long as the file exists on the node.

Whether the file exists on the node will affect which rules are used to expire the file copies. If the file exists, the following two backup copy group parameters are in effect:

- ▶ `verexists`

This parameter specifies the number of file copies, or versions, to keep. This number includes active and inactive file copies.

- ▶ `retextra`

This parameter specifies how long to keep inactive file copies. When a file changes from active to inactive, it will be kept for `retextra` days and then removed. Note that the retention period starts when the file copy becomes inactive, not from its original backup date.

If the file has been deleted, the active file copy will be made inactive. At this point, there are only inactive file copies for this data in the Tivoli Storage Manager server, and the following parameters apply:

- ▶ `verdeleted`

This parameter specifies the number of file copies to keep after the file has been deleted.

- ▶ `retonly`

This parameter specifies how long to maintain the last file copy of the data. This is the number of days to keep the last copy only and does not apply to other inactive file copies.

5.3.4 Archive copy group

The archive copy group works with entire archives as single unique entities, so it has fewer rules. There is only ever one copy of a particular archive, so we do not have to worry about rules to manage versions. We still have to specify the retention period for the archive object and that is done with the `retver` setting. It specifies the number of days to retain the archive copy from the day of the archive operation. Additional settings such as `retinit` and `retmin` have special functionality, if the server runs in retention protection mode, which is always set in a IBM System Storage Archive Manager.

5.3.5 Management class

The management class serves two purposes: It contains copy groups and associates data to them. A management class must contain at least one copy group, which may be a backup or archive copy group, or it may contain both a backup and an archive copy group. Figure 5-6 on

page 93 shows the basic structure of a management class with both copy groups defined. It also illustrates how a management class links the backup-archive data to the rules defined in a copy group. The link is very granular and can be assigned to a single file or groups of files. When a file is linked to a management class, it is said to be bound to the management class.

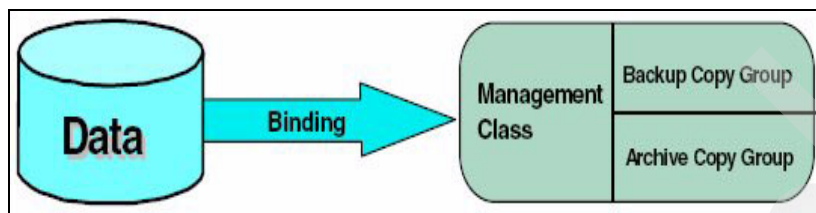


Figure 5-6 Management class

A special instance of a management class exists that is called the default management class. There is only one for each logical grouping of nodes (policy domain), and it contains the rules that you want used for your data unless you explicitly bind it to another management class. Therefore, the two ways of binding data to a management class are: default and explicit. Unless an object is explicitly defined, the default management class is used.

Binding your backup data to different management classes enables you to manage different types of files with different sets of rules. Backup data is bound to a management class by using the include option of the Tivoli Storage Manager client include-exclude list.

Binding is the process of associating a file name with a management class name. Files are bound to a management class name when:

- ▶ A user can bind a file to a specific management class name using the INCLUDE option on an include-exclude list.
- ▶ A user can bind a file to a management class name using the ARCHMC option when archiving a file.
- ▶ A user can bind a directory to a management class name using the DIRMC option when backing up a file.
- ▶ The client node can bind a file to the default management class in the active policy set, when a user does not bind to a specific management class name.

The management class is bound to the file during backups, as follows:

- ▶ All backup versions of a file are bound to the same management class.
- ▶ Backup versions of a file can be rebound to a different management class.
- ▶ Rebinding is the process of associating a file with a new management class name.
- ▶ Archive files are never rebound because each archive operation creates a different archive copy.

5.3.6 Policy set

A policy set is a group of management classes. Multiple policy sets can exist within a policy domain, but only one of them can be active at a time. In other words, the active policy set contains the only group of management classes that can be bound to the data within the domain. Management classes in other policy sets are not available unless you activate the policy set that contains them. Each time a new management class is defined in the policy set, you must validate and activate the current policy set.

A policy set can contain many management classes, but only one of them can be the default. The basic structure of a policy set is shown in Figure 5-7 and illustrates that the policy set is used primarily for flexibility. It allows us to group management classes and assign one of them as a default for the policy domain.

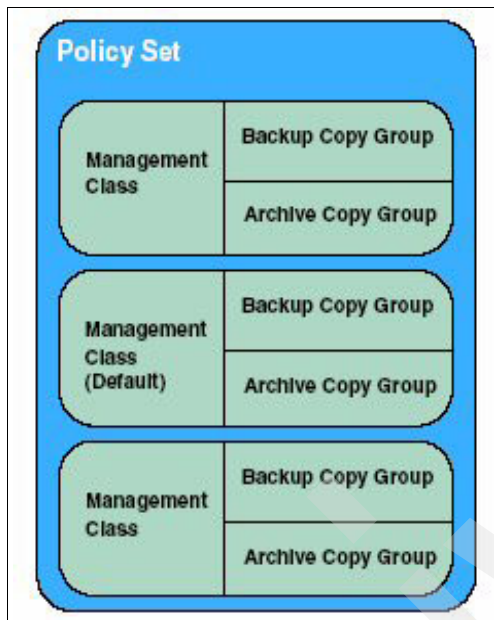


Figure 5-7 Policy set

A policy domain enables you to logically group machines in your organization according to:

- Default policy

This policy is the default set of rules to apply to the clients. The rules define the storage management policy, including how many copies of data to keep and how long to keep them. The default management class of the active policy set contains the default rules applied to the domain.

- Administrative control

Access to the client data and the policy rules can be restricted to certain administrators by allowing or disallowing the administrators access to the policy domain.

5.4 Planning disaster recovery management

One of the most valuable business assets is the critical data that resides on the computer systems throughout the company. The recovery of this data needs to be a primary focus of the disaster recovery plan.

Tivoli Storage Manager, Extended Edition delivers disaster recovery with its Disaster Recovery Manager (DRM) function. This feature can also be licensed to your base product. It offers various options for configuring, controlling, and automatically generating a disaster recovery plan, whenever the storage manager database is updated. This plan contains the information, scripts, and procedures needed to automate restoration and help ensure quick recovery of data after a disaster.

DRM also manages and tracks the media on which data is stored, whether on-site, in transit, or in a vault, so that your data can be easily located if disaster strikes. The scripts can help

you document your basic IT recovery strategy, the steps to rebuild your core systems, and the critical machines that you must recover. Figure 5-8 shows a typical scenario for DRM.

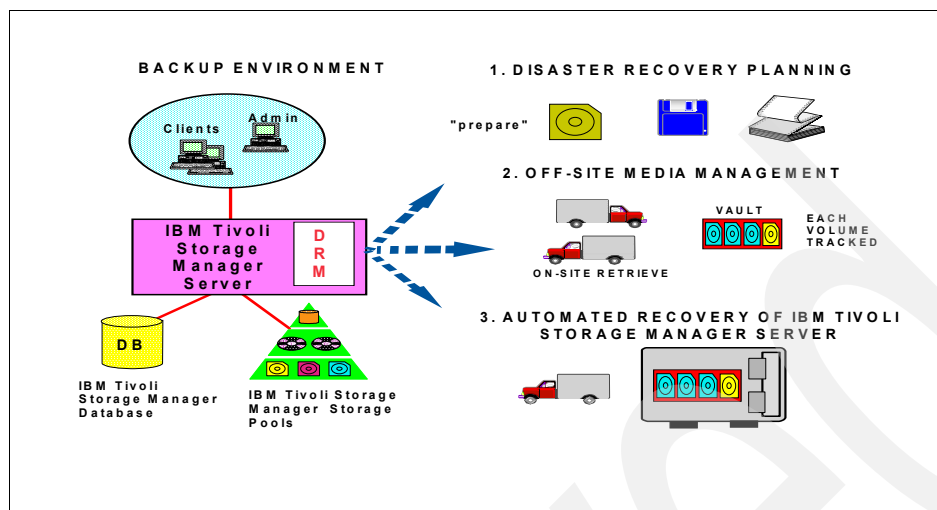


Figure 5-8 Disaster recovery flow

Disaster recovery management is accomplished with Tivoli Storage Manager through the following actions:

- ▶ Backing up client data to the Tivoli Storage Manager server
- ▶ Backing up the server database to removable media and storing the media off site
- ▶ Backing up the primary storage pools and storing the media off site
- ▶ Using the disaster recovery plan file to assist with the Tivoli Storage Manager server recovery
- ▶ Optionally, using LAN-free recovery options, such as backup sets, where available and appropriate to improve recovery
- ▶ Optionally, using virtual volumes to save data, recovery plan files, and database information electronically to an alternate Tivoli Storage Manager server

The three types of data objects that Tivoli Storage Manager and DRM monitor and track are:

- ▶ Tivoli Storage Manager server database backups
The heart of Tivoli Storage Manager, database backup, is vital for server recovery.
- ▶ Copy storage pool data
As Tivoli Storage Manager backs up the clients, new data is stored in the primary pools. For off-site storage requirements, use copy storage pools. The `BACKUP STORAGEPOOL` command copies all new primary storage pool files to the copy storage pool. This ensures that the copy storage pool is an up-to-date reflection of your most recent backup. Each time the primary pool is backed up to the copy storage pool (this should be performed daily), the newly generated tapes should be sent off site.
- ▶ Active data pool data
`MOVE DRMEDIA` and `QUERY DRMEDIA` commands can process active-data pool volumes except those in the `MOUNTABLE` state. You can limit processing to specified active-data pools.
When the recovery plan file is generated, you can limit processing to specified pools.

For example, to specify that only the active-data pools named ACTIVEPOOL1 and ACTIVEPOOL2 are to be processed, enter the following command:

```
set drmactivedatastgpool activepool1,activepool2
```

To remove any specified active-data pool names, specify a null string ("") in the following command:

```
SET DRMACTIVEDATASTGPOOL
```

Active-data pool volumes in a MOUNTABLE state are processed only if you specify the active-data pools using the SET DRMACTIVEDATASTGPOOL command or the ACTIVEDATASTGPOOL parameter on the MOVE DRMEDIA, QUERY DRMEDIA, and PREPARE commands. Processing of active-data pool volumes in MOUNTABLE state is different than the processing of copy storage pool volumes in MOUNTABLE state. All MOUNTABLE copy storage pool volumes are processed regardless whether you specify copy storage pools with either the SET DRMCOPYSTGPOOL command or the COPYSTGPOOL parameter.

The default is that the active-data pools are not managed with DRM. If you do not issue the SET DRMACTIVEDATASTGPOOL command or if you use this command to remove the names of all active-data storage pools, the Tivoli Storage Manager server processes active-data pool volumes specified using the ACTIVEDATASTGPOOL parameter, as follows:

- MOVE DRMEDIA and QUERY DRMEDIA: The server processes all active-data pool volumes except those in MOUNTABLE state.
 - PREPARE: The server processes only the active-data pool volumes that are marked onsite at the time the PREPARE command is run. These volumes are marked UNAVAILABLE.
- Tivoli Storage Manager Server option file
- This is included in the DRM plan file

5.4.1 Server recovery steps

DRM simplifies the disaster recovery planning process for the Tivoli Storage Manager server by generating a recovery plan file that is based on a predefined recovery strategy. The recovery plan file contains the information and procedures necessary to help restore the key components of the Tivoli Storage Manager server.

The content of the plan file includes:

- Installation-specific server recovery instructions
- A list of Tivoli Storage Manager database backup and copy storage pool volumes required to perform the recovery, including the off-site location where the volumes reside
- Devices required to read the database backup and copy storage pool volumes
- Space requirements for the Tivoli Storage Manager database and recovery log
- A copy of Tivoli Storage Manager configuration files: device configuration (devconfig) and volume history (volhist) files, and dsmserv.opt file
- Shell scripts and Tivoli Storage Manager macros for performing server database recovery and primary storage pool recovery

Note: To perform a successful DRM recovery, the volhist is required to ensure that the location of media can be identified. It cannot be recreated so a copy *must* be available.

5.4.2 Creation of a current disaster recovery plan

To make the creation and maintenance of the server disaster recovery plan easier, the **prepare** command automatically queries the required information from the Tivoli Storage Manager server and creates the recovery plan file. The **prepare** command can be scheduled using the Tivoli Storage Manager central scheduling capabilities.

Off-site recovery media management

Knowing the location of off-site recovery media is critical to the successful implementation of a disaster recovery management plan.

The off-site recovery media management function provides:

- ▶ Determination of which database and copy storage pool volumes need to be moved off site and back on site
- ▶ Automatic ejection of volumes from an automated library
- ▶ Tracking of the media location and state in the Tivoli Storage Manager database

The **query drmedia** command determines which tapes should be taken off site. This function enables database backup volumes and copy storage pool volumes to be treated as logical collections that are selected to move off site for safekeeping and on-site for use. The reclamation of off-site volumes includes the capability to specify the number of days to retain a Tivoli Storage Manager database backup series. After the expiration interval is reached, the data on the media is no longer considered to be valid. The media can then be reused.

Client recovery information

DRM enables the machine information needed to help recover the Tivoli Storage Manager clients stored in the Tivoli Storage Manager database. This information includes:

- ▶ Tivoli Storage Manager client machine location, machine characteristics, and recovery instructions
- ▶ Business priorities associated with the Tivoli Storage Manager client machines
- ▶ Description, location, and volume and media labels of Tivoli Storage Manager client boot media
- ▶ Centralized management of the disaster recovery process

5.4.3 Maintenance script enhancements for disaster recovery management

Tivoli Storage Manager uses a maintenance script to perform scheduled maintenance tasks. In V6, you can generate a maintenance script in either of the following ways:

- ▶ A *predefined* maintenance script is one that is generated through a wizard. This script contains standard commands that cannot be altered. A predefined script can only be modified in the wizard.
- ▶ A *custom* maintenance script is created using the Administration Center maintenance script editor. To have more control of your maintenance tasks, you can modify the commands that you specify. You can also use the editor to update your custom maintenance script.

5.4.4 Using virtual volumes to transfer data to another server

You can store the results of database backups and other items on another server as a virtual volume. Tivoli Storage Manager lets a server (a source server) store the results of the following items on another server (a target server):

- ▶ Database backups
- ▶ Export operations
- ▶ Storage pool operations
- ▶ DRM PREPARE command

The data is stored as virtual volumes, which appear to be sequential media volumes on the source server but which are actually stored as archive files on a target server. Virtual volumes can be any of the following items:

- ▶ Database backups
- ▶ Storage pool backups
- ▶ Data that is backed up, archived, or space managed from client nodes
- ▶ Client data migrated from storage pools on the source server
- ▶ Any data that can be moved by EXPORT and IMPORT commands
- ▶ DRM plan files

The source server is a client of the target server, and the data for the source server is managed only by the source server. In other words, the source server controls the expiration and deletion of the files that comprise the virtual volumes on the target server.

Note: The use of virtual volumes is not supported when the source server and the target server reside on the same Tivoli Storage Manager server.

At the target server, the virtual volumes from the source server are seen as archive data. The source server is registered as a client node (of TYPE=SERVER) at the target server and is assigned to a policy domain. The archive copy group of the default management class of that domain specifies the storage pool for the data from the source server.

Note: If the default management class does not include an archive copy group, data cannot be stored on the target server.

Using virtual volumes provides the following benefits:

- ▶ The source server can use the target server as an electronic vault for rapid recovery from a disaster.
- ▶ Smaller Tivoli Storage Manager source servers can use the storage pools and tape devices of larger Tivoli Storage Manager servers.
- ▶ For incremental database backups, it can decrease wasted space on volumes and under use of high-end tape drives.

Be aware of the following aspects when you use virtual volumes:

- ▶ If you use virtual volumes for database backups, you might have the following situation: SERVER_A backs up its database to SERVER_B, and SERVER_B backs up its database to SERVER_A. If this is the only way databases are backed up, if both servers are at the same location, and if a disaster strikes that location, you could have no backups with which to restore your databases.
- ▶ Moving large amounts of data between the servers can slow down your communications significantly, depending in the network bandwidth and availability.
- ▶ You can specify in the device class definition (DEVTYPE=SERVER) how often and for how long a time the source server will try to contact the target server. Keep in mind that frequent attempts to contact the target server over an extended period can affect your communications.
- ▶ The use of Centera storage pool as target for virtual volume is not supported.
- ▶ Under certain circumstances, inconsistencies may arise among virtual volume definitions on the source server and the archive files on the target server. You can use the RECONCILE VOLUMES command to reconcile these inconsistencies.
- ▶ If you want to enable data validation between a source and target server, enable the settings using both the DEFINE SERVER and REGISTER NODE commands.
- ▶ Storage space limitations on the target server affect the amount of data that you can store on that server.
- ▶ To minimize mount-wait times, the total mount limit for all server definitions that specify the target server should not exceed the mount-total limit at the target server. For example, a source server has two device classes, each specifying a mount limit of two. A target server has only two tape drives. In this case, the source server mount requests could exceed the target server's tape drives.

Note: When you issue a DEFINE SERVER command, the source server sends a verification code to the target server. When the source server begins a session with the target server, it also sends the verification code. If the code matches what was previously stored on the target, the session is opened in read/write mode. If the verification code is lost at the source server (for example, after a database restore), the code can be reset by issuing an UPDATE SERVER command with the FORCESYNC=YES parameter.

5.5 Upgrade the Tivoli Storage Manager Server

A successful upgrade of 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 connectivity, should all have been performed before starting the upgrade to Tivoli Storage Manager V6.1.

5.5.1 The basics of planning the upgrade

The upgrade process is a resource-intensive process and there are a number of considerations in planning for the upgrade. In some ways, this upgrade process is similar to previous upgrades, but because of the time and resources required, it can become complicated.

The upgrade we describe in 5.6, "Upgrade scenarios" on page 113 is based on a fairly simple Tivoli Storage Manager configuration, but shows you how the issues we have already covered previously can affect the upgrade strategy.

Database considerations

The database with Tivoli Storage Manager V6 is DB2, so one of the things that can be done is to query the database directly without the need to go through the Tivoli Storage Manager administrator command line. Although this approach provides several additional options, remember that you must treat this database as read-only and not make any changes to the schema, configuration, or content through that interface.

Tivoli Storage Manager V6 contains a major restructuring of the Tivoli Storage Manager database. We are converting from the proprietary B-tree database, which has been the heart of Tivoli Storage Manager for many years, to a DB2 database which is external to Tivoli Storage Manager.

There are several reasons for converting. The current database implementation is reaching its limits in terms of size, performance and function. You might be experiencing the impact of reaching those limits, creating multiple instances of Tivoli Storage Manager to handle your workload. Just as important, this change positions Tivoli Storage Manager for additional growth in capacity, and also new function that is easier to implement with the employment of the richer database.

A goal is to have equivalent performance compared to Version 5, that is, the overall throughput, for a representative set of operations, and should be comparable to that with the proprietary database. This is the first implementation of Tivoli Storage Manager using DB2 and as such there may be some side effects of such a port. Another goal is to make this process as transparent as possible.

Real memory recommendation

There is a significant increase in real memory recommendation. The recommended memory size is approximately four times the current recommended values. For instance, in the past this was 2 GB per instance on AIX; now the recommendation is 8 GB per instance. This is not a minimum, and is not a requirement, it is simply a recommendation for a normal workload.

Another change is growth in the database itself. The overall size of the database can increase; also DB2 might use additional disk space for temporary work based on workload.

Database recovery log space

The database recovery log space requirement also increases for this upgrade. DB2 is managing this log space and you will need space for both an active log and for archive logs. The database is in roll-forward mode, there is no support for circular logging.

5.5.2 Upgrade process

We briefly describe the upgrade process here and will provide more detail later. Basically, we prepare the existing V5 database, extract its contents, then insert that extracted data into a newly created DB2 database.

Compared to previous release-to-release upgrades, this is a time-consuming process. Carefully plan your upgrade strategy.

The fall-back plan is basically the same as it has been in the past, but perhaps a little more complex because of the addition of the DB2 installation. You must reinstall your previous release of Tivoli Storage Manager and restore its database. There are no changes to your existing storage pools, so the normal precautions for protecting previously backed data are sufficient, such as disabling migration and reclamation.

Tivoli Storage Manager V6 upgrade considerations

Consider the following aspects when planning an upgrade.

- ▶ You can run multiple Tivoli Storage Manager and database instances on the same OS image.
- ▶ You can forget about having to do DB audits and off-line reorganizations.
- ▶ You cannot use an existing DB2 code installation on the system (you must use the DB2 that installs with the Tivoli Storage Manager server).
- ▶ You cannot use a DB2 from a remote system.
- ▶ The database and log volumes must be on a file system, you cannot use raw logical volumes for the database and log volumes (raw logical volumes are still used for storage pool volumes).
- ▶ You cannot run multiple software levels of Tivoli Storage Manager on the same OS. If you run multiple instances on the same OS and you upgrade one of them, they all will have the same software level.
- ▶ You can run multiple Tivoli Storage Manager database upgrades at the same time, if you have enough resources.
- ▶ You can use Tivoli Storage Manager export/import operation to go from V5.x to V6 to do the upgrade instead of using Tivoli Storage Manager DB upgrade utilities.
- ▶ You cannot change OS platforms with the upgrade.
- ▶ You cannot merge multiple Tivoli Storage Manager databases with the database upgrade. It is possible to consolidate multiple Tivoli Storage Manager instances by using the Tivoli Storage Manager export/import.
- ▶ You cannot change OS platforms after the upgrade using DB2 export/import operation. Tivoli Storage Manager export/import must still be used for this.

5.5.3 System requirements for the V6 server system

If the system that is running V5 has Windows 32-bit, we strongly recommend upgrading to Windows 64-bit.

Check that the system memory meets the server requirements. If you plan to run multiple instances of the V6 server on the system, each instance requires the memory listed for one server. Multiply the memory for one server by the number of instances planned for the system.

5.5.4 System requirements for Windows

This section contains the hardware and software requirements for Tivoli Storage Manager V6.1 installation on a Windows system.

Hardware

Table 5-3 on page 102 lists the hardware requirements for your Windows system. For further details, refer to the *IBM Tivoli Storage Manager for Windows Installation Guide V6.1*, GC23-9785 to assist you in understanding greater detail for disk planning.

Check that the system memory meets the server requirements. If you plan to run multiple Tivoli Storage Manager instances of the V6.1 server on the system, each Tivoli Storage Manager Instance requires the memory listed for one server. Multiply the memory for one server by the number of Tivoli Storage Manager Instances planned for the system.

Table 5-3 Hardware requirements for Tivoli Storage Manager V6.1 for Windows

Type of hardware	Hardware requirements
Processor	Intel Pentium compatible processor or multiprocessor-based computer
Disk space	At least 3 GB of free disk storage (for a default installation) Plan for more space for the database logs <ul style="list-style-type: none"> ▶ 200 MB partition size in the C:\ drive ▶ 200 MB temporary directory space ▶ 300 MB in the Tivoli Storage Manager Instance directory Additional disk space is required for database and log files. The server is installed in the drive you select, and the database and logs can be installed in another drive.
Memory	At least 2 GB is required. A minimum of 4 GB for production servers is required. Use 8 GB for normally loaded servers.

Software

Table 5-4 lists the minimum software requirements for Tivoli Storage Manager V6.1 running on a Windows system.

Note: We recommend that you migrate from Windows 32-bit to 64-bit Windows.

Table 5-4 Software requirements for Tivoli Storage Manager V6 for Windows

Type of software	Minimum software requirements
Operating system	Use one of the following operating systems: <ul style="list-style-type: none"> ▶ Microsoft Windows Server 2003: Standard, Enterprise, or Datacenter Edition ▶ Microsoft Windows Server 2003: Standard, Enterprise or Datacenter x64 Edition (64-bit). ▶ Microsoft Windows Storage Server 2003 ▶ Microsoft Windows Storage Server 2003 x64 ▶ Microsoft Windows Server 2008: Standard, Enterprise, or Datacenter Edition: ▶ Microsoft Windows Server 2008: Standard, Enterprise, or Datacenter x64 Edition (64-bit)
Communication protocol	At least one of the following communication protocols (installed by default with the current Windows operating systems): <ul style="list-style-type: none"> ▶ Named Pipes ▶ TCP/IP Version 4 or Version 6 ▶ Shared memory
Web browser	A Web browser to log in and use the console. The Web browser can be installed on the same or a separate system. The following browsers are supported: <p>Microsoft Internet Explorer 6.0 SP1 Microsoft Internet Explorer 7.0</p> <ul style="list-style-type: none"> ▶ FireFox 1.5 ▶ FireFox 2.0 ▶ FireFox 3.0 ▶ Mozilla 1.7.8 <p>Your browser must support the server code page. If your browser does not support the server code page, the windows might be unreadable. If your browser meets these requirements but does not correctly display a Tivoli Storage Manager Web-based interface, consider trying a different browser.</p>

5.5.5 System requirements for AIX

This section contains the hardware requirements for Tivoli Storage Manager V6.1 installation on an AIX system.

Hardware

Table 5-5 lists the hardware requirements for your AIX system. For further details, refer to Capacity Planning in *Tivoli Storage Manager for AIX, Installation Guide*, GC23-9781 to help with disk planning.

Table 5-5 Hardware requirements for Tivoli Storage Manager V6.1 for AIX

Type of hardware	Hardware requirements
Hardware	64-bit p4, p5 or p6 System p® computer
Disk space	Minimum disk space requirements: <ul style="list-style-type: none">▶ 5 MB for the /var directory▶ 2 GB for the /opt directory▶ 160 MB for the /tmp directory▶ 300 MB for the /usr directory
Memory	At least 2 GB is required. A minimum of 4 GB for production servers is required, but 8 GB is optimal.

Table 5-6 lists the minimum software requirements for Tivoli Storage Manager v6.1 running on an AIX system.

Table 5-6 Software requirements for Tivoli Storage Manager v6 for AIX

Type of software	Minimum software requirements
Operating system	<p>For AIX 5.3 running in a 64-bit kernel environment, the additional requirements for DB2 are:</p> <ul style="list-style-type: none">▶ AIX 5.3 Technology Level (TL) 6 and Service Pack (SP) 2 plus the fix for APAR IZ03063▶ Minimum C++ runtime level with the xIC.rte 9.0.0.8 and xIC.aix50.rte 9.0.0.8 file sets. These file sets are included in the June 2008 cumulative fix package for IBM C++ Runtime Environment Components for AIX. <p>For AIX 6.1 running in a 64-bit kernel environment requires the following file sets for DB2:</p> <ul style="list-style-type: none">▶ Minimum C++ runtime level with the xIC.rte 9.0.0.8 and xIC.aix61.rte 9.0.0.8 file sets. These file sets are included in the June 2008 cumulative fix package for IBM C++ Runtime Environment Components for AIX.
Communication protocol	A configured communication method
Drivers	<p>If you have an IBM 3570, IBM 3590, or IBM Ultrium tape library or drive, install the most current device driver before you install Tivoli Storage Manager V6.1. You can locate the device drivers at:</p> <p>ftp://ftp.software.ibm.com/storage/devdrv/</p>

5.5.6 Space requirements for the Tivoli Storage Manager V6 server

Determine and configure DB2 database and recovery log space that is required before starting the upgrade process.

Unique, empty directories are required for the following items for the upgraded server:

- ▶ The database
- ▶ The recovery log
 - Active log
 - Archive log
 - Optional: Log mirror for the active log
 - Optional: Secondary archive logs (failover location for archive log)
- ▶ The instance directory for the server, which is a directory that will contain files specifically for this server instance (the server options file and other server-specific files)

Database space requirements

For planning purposes, a newly formatted Tivoli Storage Manager V6 database is approximately 400 MB in size. The minimum active log is 2 GB in size. The size of the archive log space depends upon the activity of the system. As active logs are filled, they are copied to the archive log directory or the failover archive log directories.

Database sizing example

We size a new V6 database, now using 600 - 1000 bytes per object as the sizing estimate. The amount of database space that is required depends on the size of the original V5 database, and on how much data the server will be managing.

How large will the Tivoli Storage Manager V6 DB be after the upgrade has completed? During the IBM beta test of Tivoli Storage Manager V6.1, over 200 customers participated and approximately 80 databases were tested with the upgrade process across multiple platforms. In general, the DB size after the upgrade was completed was approximately the same size. In some cases, a doubling of the size was seen. For planning purposes, customers should use a value of one-third larger than the original utilized space value of their database.

This 130% value is the average size after the DB upgrade was completed. During the actual upgrade process, temporary space was being used and released. This extra space necessary for temporary space might require the DB to be as much as two times the original size for the upgrade to complete.

If Content Manager (CM) is being used, or the DB contains many objects that have longer filenames, this space requirement will be larger. In one case during the beta, the space requirement was two times the original size for a CM system.

The amount of storage space for the database is managed automatically. The database space can be spread across multiple directories. After you specify the directories for the database, the server uses the disk space available to those directories as required.

Locate the database and recovery log directories on separate physical volumes or file systems. Ideally, use multiple directories for database space and locate them across as many physical devices or logical unit numbers (LUNs) as there are directories.

Plan for 33 - 50% more than the space that is used by the V5 database. In the estimate, do not include allocated but unused space for the V5 database. Some databases can grow temporarily during the upgrade process; consider providing up to 80% more than the space that is used by the V5 database.

Estimate the amount of space that the database will require, as follows:

1. Use the `QUERY DB FORMAT=DETAILED` command to determine the number of used database pages in your V5 database.
2. Multiply the number of used database pages by 4096 to get the number of used bytes.
3. Add 33 - 50% to the used bytes to estimate the database space requirements.

Consider testing the upgrade of the database to get a more accurate estimate. Not all databases will grow as much as the suggested 33 - 50% increase in space.

When the server is operating normally, after the upgrade process, some operations might cause occasional large, temporary increases in the amount of space used by the database. Continue to monitor the usage of database space to determine whether the server needs more database space.

Future database growth

For the best efficiency in database operations, anticipate future growth when you set up space for the database. If you underestimate the amount of space that is needed for the database (and then have to add directories later), the database manager might need to perform more database reorganization, which can consume resources on the system. Estimate requirements for additional database space based on 600 - 1000 bytes per additional object stored in the server.

Restriction: You cannot use raw logical volumes for the database. If you want to reuse space on the disk where raw logical volumes were located for an earlier version of the server, you must create file systems on the disk first.

Visit the support site for the latest information and recommendations.

Recovery log space requirements

The amount of recovery log space that is required depends on the amount of client activity with the server. The estimates based on this information should be used as a starting point. After the server is upgraded, monitor the active log and archive log directories to ensure that these directories have enough free space to handle the actual server workload.

Requirements include:

- ▶ **Active log**

The minimum size of 2 GB is large enough to complete the upgrade process. When you begin normal operations with the server, you might have to increase the size of the active log. The required size depends on the amount of concurrent activity that the server handles. A large number of concurrent client sessions might require a larger active log. For example, the server might need an 8 GB or larger active log.

- ▶ **Active log mirror**

The active log mirror is optional. Its size requirement is the same as the size of the active log.

- ▶ **Archive log**

The size required depends on the number of objects stored by client nodes over the period of time between full backups of the database.

Remember: A full backup of the database causes obsolete archive log files to be pruned, to recover space. The archive log files that are included in a backup are automatically pruned after two more full database backups have been completed.

If you perform a full backup of the database every day, the archive log must be large enough to hold the log files for client activity that occurs over two days. Typically 600 - 4000 bytes of log space are used when an object is stored in the server. You can estimate a starting size for the archive log space by using the following calculation. It uses the number of objects stored per day, multiplied by 3000 bytes per objects, multiplied by two days. The result is 30 GB:

5 000 000 objects/day x 3000 bytes/object x 2 days = 30 000 000 000 bytes

Secondary (failover) archive log

If the archive log becomes full, the failover archive log is used. Specifying a failover archive log is useful only if you locate it on a different physical drive or file system from the archive log.

For the latest information and recommendations, go to:

<http://www.ibm.com/software/sysmgmt/products/support/IBMTivoliStorageManager.html>

5.5.7 Space requirements for the upgrade process and upgraded server

In addition to the space required for the upgraded server itself, some additional disk space is needed for the upgrade process. For example, if you are upgrading the server on the same system where it is currently located, you need enough space for two copies of the database during the upgrade process.

The space requirements for the upgraded V6.1 server depends on the size of the V5 database and other factors. See the topics about estimating space requirements and the database and recovery log requirements for more details.

The space requirements for the upgrade process depend on how you move the data from the V5 database to the new database. You can move the data to the new database by using the media method or the network method, with the following requirements:

- ▶ The media method requires sequential media. The sequential media can be tape or sequential disk device class (FILE device type).
- ▶ The network method requires a network connection between systems, if you are upgrading on a new system.

Space requirement examples

Table 5-7 lists tips for estimating space requirements. Select the scenario that best fits your upgrade plan, then read down the column.

Table 5-7 Tips for estimating space requirements

Items that require space	Type of space	Scenario 1: Same system as V5 server; media method	Scenario 2: Same system as V5 server; network method	Scenario 3: New system; media method	Scenario 4: New system; network method
V5 database: space allocated for the original database	Disk	Space that is allocated for the V5 database	Space that is allocated for the V5 database	0	0
V5 database: final backup copy	Sequential media	Space that is used by the V5 database (based on percent use)	Space that is used by the V5 database (based on percent use)	Space that is used by the V5 database (based on percent use)	Space that is used by the V5 database (based on percent use)
V5 database: extracted data	Sequential media	Space that is used by the V5 database (based on percent use)	0	Space that is used by the V5 database (based on percent use)	0
V5 recovery log	Disk	V5 recovery log. The amount of space that is allocated for the V5 recovery log	V5 recovery log. The amount of space that is allocated for the V5 recovery log	0	0
V6.1 database: estimated size	Disk	Disk space used by the V5 database plus 33 - 50% more	Disk space used by the V5 database plus 33 - 50% more	Disk space used by the V5 database plus 33 - 50% more	Disk space used by the V5 database plus 33 - 50% more
V6.1 database: first backup	Sequential media	Same as estimated database size	Same as estimated database size	Same as estimated database size	Same as estimated database size
V6.1 active log directory	Disk	2 GB during the upgrade process. A higher value might be needed for normal use.	2 GB during the upgrade process. A higher value might be needed for normal use.	2 GB during the upgrade process. A higher value might be needed for normal use.	2 GB during the upgrade process. A higher value might be needed for normal use.
V6.1 active log mirror (optional)	Disk	If used, same size as active log	If used, same size as active log	If used, same size as active log	If used, same size as active log
V6.1 archive log directory	Disk	Estimate based on client activity and database backup frequency	Estimate based on client activity and database backup frequency	Estimate based on client activity and database backup frequency	Estimate based on client activity and database backup frequency

Table 5-8 on page 109 lists space requirements for the conversion to Tivoli Storage Manager V6.1 in a sample filled-in work sheet for a 100 GB V5 database that has 80% space utilization, with the assumption that the database increases by 33 - 50% when upgraded.

The columns are for each upgrade strategy you can employ. We tested each of the items listed in the rows shown in Table 5-7 on page 107, as follows:

1. The archive log is the DB2 archive log and is managed by DB2 and cleaned up by a successful backup of the database. The size of these archive logs is dependent on the activity of your Tivoli Storage Manager server and we will explain how to estimate that later in this chapter.
2. The eventual size of the Tivoli Storage Manager V6 database is really a function of the utilization of your current database. There is no exact formula to calculate the size of the Tivoli Storage Manager V6 database. The numbers here are taken from our experience in the lab.
3. The last two items, the database backup and the extract, are also dependent on the utilization of your current database and can be on any sequential media you can define in a device class. These do not have to be on disk, they can be on tape or other sequential media (see Table 5-8 on page 109).

We now discuss an example of the disk space needed on the target system for this sample upgrade. Assume the current database is 100 GB and 80% utilized, and

- ▶ The default active log size is 2 GB, that is comprised of four 512 MB log files.
- ▶ We do not perform log mirroring in this example, so that value will be zero.

Estimating the archive log is a little more involved. Assuming this 100 GB database holds 160 million objects and that we experience a 5% change rate on our clients, we then should back up about 8 million objects each day. Now, assuming an average log size of 3,500 bytes per each object including all the associated DB updates, that works out to be almost 30 GB of log space required.

These archive logs get deleted a day after a successful backup of the database, so we need to plan for at least 2 days of log space. Why two days? After a database backup, the last 24 hours worth of logs are retained. We have all of those logs plus all the ones we accumulate from that point until the next database backup. Add some extra space for those days when it gets really busy for whatever reason. So just say 80GB for the archive logs.

Note: You can schedule the database backup several times a day and also to sequential device devclass on disk

Based on the V5 database of 100 GB, assume we set aside enough space in the V5 environment to accommodate the maximum recovery log size of 13 GB.

For the size of the V6 database, the high estimate is 50% larger than the current space used within the V5 database. That becomes 120 GB. However, we also consider that during the `dsmserve insertdb` process itself, the database can expand another 20% during the update phase, so we will round that up to 145 GB, even though the eventual database returns to 120 GB when the upgrade completes.

The size of the database backup for our V5 instance is about the same as the used space within the database, or about 80 GB. Also consider that you need a backup of your new V6 database too, and that is 120 GB. Keep in mind these are on sequential media and can be on either disk or tape.

The size of the extract from the V5 instance is about the same as the used space within the database, or about 80 GB. The extract can also be on either disk or tape.

Before we get too excited about the totals here, the left column is the worst case, and the right column is what you need when you are finished with the upgrade and have cleaned up the V5 remnants.

Table 5-8 Sample space estimates for a 100 GB V5.5 database

Items that require space	Type of space	Scenario 1: Same system as V5 server; media method	Scenario 2: Same system as V5 server; network method	Scenario 3: New system; media method	Scenario 4: New system; network method
V5 database: space allocated for the original database	Disk	100 GB	100 GB	0	0
V5 database: final backup copy	Sequential media	80 GB	80 GB	80 GB	80 GB
V5 database: extracted data	Sequential media	80 GB	0	80 GB	0
V5 recovery log	Disk	12	12	0	0
V6.1 database: estimated size	Disk	106 - 120 GB	106 - 120 GB	106 - 120 GB	106 - 120 GB
V6.1 database: first backup	Sequential media	106 - 120 GB	106 - 120 GB	106 - 120 GB	106 - 120 GB
V6.1 active log directory	Disk	8 GB	8 GB	8 GB	8 GB
V6.1 active log mirror (optional)	Disk	(8 GB)	(8 GB)	(8 GB)	(8 GB)
V6.1 archive log directory	Disk	80 GB	80 GB	80 GB	80 GB
Total disk space required during the upgrade process	Disk	307 - 320 GB (315 - 328 GB)	307 - 320 GB (315 - 328 GB)	307 - 320 GB (315 - 328 GB)	307 - 320 GB (315 - 328 GB)
Total sequential media required during the upgrade process	Sequential media	267 - 280 GB	187 - 200 GB	267 - 280 GB	187 - 200 GB
Total disk space for the V6.1 server after upgrade and cleanup	Disk	195 - 208 GB (203 - 216 GB)	195 - 208 GB (203 - 216 GB)	195 - 208 GB (203 - 216 GB)	195 - 208 GB (203 - 216 GB)

5.5.8 Work sheet for planning space for the V6.1 server

Use the work sheet in Table 5-9 to help you plan the amount and location of storage needed for the V6.1 server.

Table 5-9 Worksheet for planning space

Item	Space required	Location
The instance directory for the server, which is a directory that contains files specifically for this server instance (the server options file and other server-specific files)		
The database		
Active log		
Archive log		
Optional: Log mirror for the active log		
Optional: Secondary archive log (failover location for archive log)		

The upgrade process creates a new database, determines and configures DB2 space before starting the upgrade.

the current goal for the upgrade process is 5 - 10 GB per hour, but that range assumes a *Normal* Tivoli Storage Manager workload. Content Manager DBs have more objects per GB, so they may be considerably slower when using GB per hour estimate

5.5.9 Upgrade considerations

In this section, we discuss upgrade considerations to Tivoli Storage Manager V6.

Windows Tivoli Storage Manager Servers

If the Tivoli Storage Manager server being upgraded contains multiple NICs, disabling all of them except one might be necessary in order to use the Database Upgrade Wizards. The NICs can be re-enabled after the DB upgrade has completed

Shared library configurations

If you have a shared library configuration upgrade the library manager server first and then the library clients. Library clients must be at least level 5.4 or later for compatibility with V6 Tivoli Storage Manager Server.

Library Manager configurations are:

- If Library Manager moves to new server:
 - a. Move V5.5 Library Manager to the new system.
 - b. Update connectivity, (for example, paths).
 - c. Validate Library Manager configuration works with existing V5.5 code.
 - d. Upgrade Library Manager to New Tivoli Storage Manager in place

- ▶ If Library Manager remains on existing server:
 - Determine what else is on that OS instance.
- ▶ If Multiple Tivoli Storage Manager instances on single OS:
 - Only one version of Tivoli Storage Manager code can be installed at a time, same as prior upgrades.
- ▶ If upgrade in place (either media or network):
 - All instances must be upgraded at same time.
- ▶ If upgrading to a new system (either media or network):
 - Update network address on clients.
 - Update network address on storage agents.

5.5.10 High level overview of the database upgrade process

This section presents a high-level overview of the database upgrade process of the two main components:

- ▶ Tivoli Storage Manager 5.5 requirements for processing source 5.x database include:
 - DSMUPGRD stand-alone utility
 - Must be run on a 5.5 server code level

The main commands are:

- PREPAREDB
- QUERYDB
- EXTRACTDB

The secondary commands are:

- UPDATE
- EXTEND
- LOG/DB

- ▶ Tivoli Storage Manager V6.1 requirements for processing target 6.1 database are:
 - Stand-alone server commands (DSMSERV <commandname>), which are:
 - LOADFORMAT
 - INSERTDB

DSMUPGRD stand-alone utility

The upgrade utilities prepare and extract data from a Tivoli Storage Manager version 5.3, 5.4, or 5.5 server database for insertion into an empty Tivoli Storage Manager V6.1 server database.

The DSMUPGRD utilities are run on the original database. The DSMUPGRD PREPAREDB utility upgrades a server database version to V5.5, and performs some cleanup to prepare for the extraction process.

Important: After a V5.3 or V5.4 server database is upgraded to V5.5, the database can no longer be used by a V5.3 or V5.4 server. If you do not want the database on your production server to be upgraded, you can restore the database backup on another system, then upgrade that copy of the database.

The DSMUPGRD EXTRACTDB utility extracts the data from a server database. You can use the utility to either simultaneously extract and insert the data into a new database over a

network, or extract the data to media for later insertion into a new database. The data extraction operation can be run with multiple processes.

If a problem occurs during the database preparation or extraction, the DSMUPGRD EXTEND DB and DSMUPGRD EXTEND LOG utilities are available to make more space available for the database or log.

PREPAREDB command

The first step in the upgrade process is to back up the database in case you need to roll back the database upgrade to the previous version. The PREPAREDB command prepares a 5.x database for upgrade to 6.1 and is the required second step in the upgrade process. This upgrades the database version to 5.5 if it is not at that level already.

The command also checks for known database problems, such as moving from asterisk-based to ASCII-based UNIX System Services file space conversion status. The tool stops if it detects any UNIX System Services file spaces that are not converted.

Tivoli Storage Manager V6.1 does not support the presence of network-attached storage (NAS) backups with table of contents, and presence of backup sets. This will be fixed in V6.1.2

When the database problem check is finished, it backs up device configuration information to the configured default devconfig files and backs up server instance's registry entries on Windows.

EXTRACTDB

Use the DSMUPGRD EXTRACTDB utility to extract data from a server database. The data can be inserted into a version 6.1 server database either later or at the same time as the extraction process.

EXTRACTDB (media)

The EXTRACTDB command extracts data from the V5.5 database and writes extracted data to sequential media.

EXTRACTDB (network)

The EXTRACTDB command sends extracted data over network session.

EXTEND DB

Emergency database extension is the same as DSMSESV EXTEND DB. However, EXTEND DB is used if PREPAREDB database upgrade runs out of database space; it extends the database even if the version is lower than V5.5.

EXTEND LOG

Emergency log extension is the same as DSMSESV LOG. However, EXTEND LOG is used when PREPAREDB database upgrade runs out of log space; it extends the log even if the version is lower than V5.5

UPDATE

Use this utility to create registry entries for a V5 server instance if a problem in the upgrade process has removed the entries when they are still needed. It is used (used to replace the current required) in the following situations:

- ▶ You are upgrading a V5 server to V6.1 on the same system.
- ▶ The V6 instance directory differs from the V5 instance directory.
- ▶ The V6 LOADFORMAT command is run before PREPAREDB command.

Upgrade utilities

The V6.1 stand-alone upgrade commands of within V6.1 DSMSEV are.

- ▶ DSMSEV LOADFORMAT
- ▶ DSMSEV INSERTDB

LOADFORMAT

This command formats a new V6.1 database for use during upgrade. It has identical syntax and usage as DSMSEV FORMAT. The LOADFORMAT command creates database and logs, and defines tables. It does not insert any default values into the database.

INSERTDB

This command inserts data into the Tivoli Storage Manager V6.1 database. It reads data from media or from the network session and has explicit knowledge of Tivoli Storage Manager V5.5 database schema. The command performs the following actions:

- ▶ Maps data from V5.5 schema to V6.1 schema.
- ▶ Validates data before inserting it into database.
- ▶ In some cases, corrects data before inserting it.
- ▶ Logs invalid rows that cannot be corrected.

INSERTDB (media)

The INSERTDB command reads extracted data from sequential media.

INSERTDB (network)

The INSERTDB command reads extracted data from the network session, initializes the server, and then waits for a connection. The following message is produced:

ANR1336I INSERTDB: Ready for connections from the source server

5.6 Upgrade scenarios

You can upgrade the server on the same system or a new system, and use either a media method or a network method to move data from the original server database to the upgraded server database.

Table 5-10 on page 114 presents an overview of the scenarios. Select a scenario from the Scenario column in the table. It will take you to the section that describes the detailed procedure for that scenario.

Table 5-10 Server upgrade scenarios

Scenario for upgrading the server	Location of upgraded server	Method for moving data
"Scenario 1: same system, media method" on page 114	Same system as original server	Media method
"Scenario 2: same system, network method" on page 116	Same system as original server	Network method
"Scenario 3: new system, media method" on page 118	New system	Media method
"Scenario 4: new system, network method" on page 119	New system	Network method

5.6.1 Scenario 1: same system, media method

In this scenario, all upgrade tasks are performed on the same system. The database is extracted to media and later inserted into the Tivoli Storage Manager V6.1 database.

You can use the wizard, or perform the upgrade by manually using the utilities. The wizard offers a guided approach to the upgrade of a server. By using the wizard, you can avoid certain configuration steps that are complex when done manually.

Summary of the wizard method scenario

This is an high-level overview of a Tivoli Storage Manager V6.1 upgrade on a same system using the media method wizard; see Figure 5-9 on page 115.

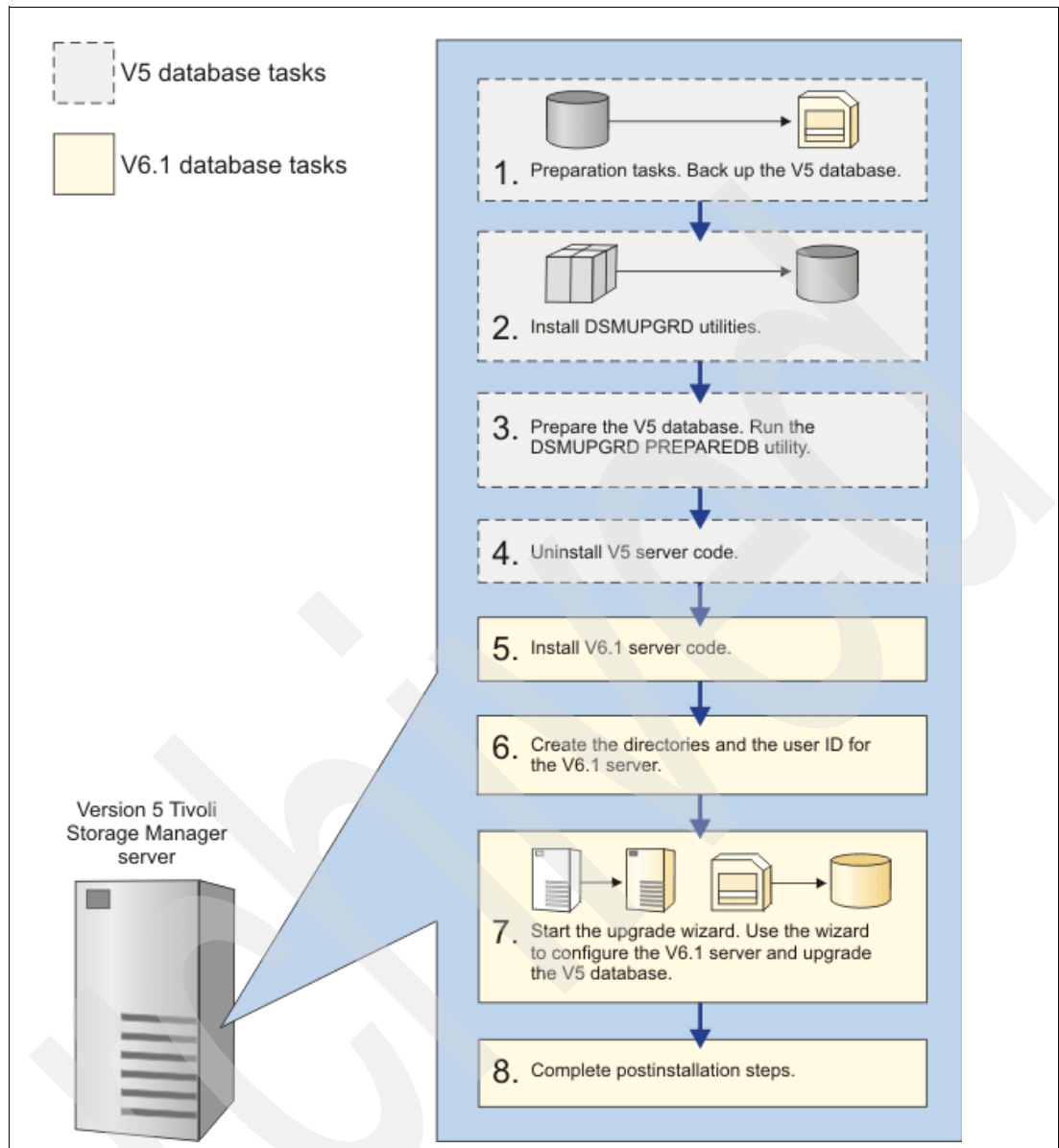


Figure 5-9 Upgrade to 6.1 on a same system using the media method wizard

The following steps summarize the procedure for this scenario:

1. Perform all preparation tasks, which includes performing a database backup.
2. Install the upgrade utilities package (DSMUPGRD) on the system. The utilities package must be installed whether you are using the upgrade wizard or performing the upgrade with utilities.
3. Prepare the V5 database using the utility DSMUPGRD PREPAREDB.
4. Uninstall the V5 server code.
5. Install the V6.1 server code on the system.
6. Create the directories for the V6.1 database and logs, and the user ID that will own the server instance.

7. Start the upgrade wizard to configure the new server and upgrade the V5 database. With the wizard, you complete the following tasks:
 - a. Extract the V5 database to external media.
 - b. Create and format an empty database to receive the data.
 - c. Insert the data from the media to which it was extracted.
 - d. Configure the system for database backup.
8. Complete the post-installation tasks, including backing up the database and verifying the database contents.

5.6.2 Scenario 2: same system, network method

In this scenario, all upgrade tasks are performed on the same system. The data is extracted from the original server database and inserted into the new server database at the same time.

You can use the wizard, or perform the upgrade manually by using the utilities. The wizard offers a guided approach to the upgrade of a server. By using the wizard, you can avoid certain configuration steps that are complex when done manually.

Upgrading the server using the wizard

This is a high-level overview of a Tivoli Storage Manager V6.1 upgrade on the same system using the network method wizard; see Figure 5-10 on page 117.

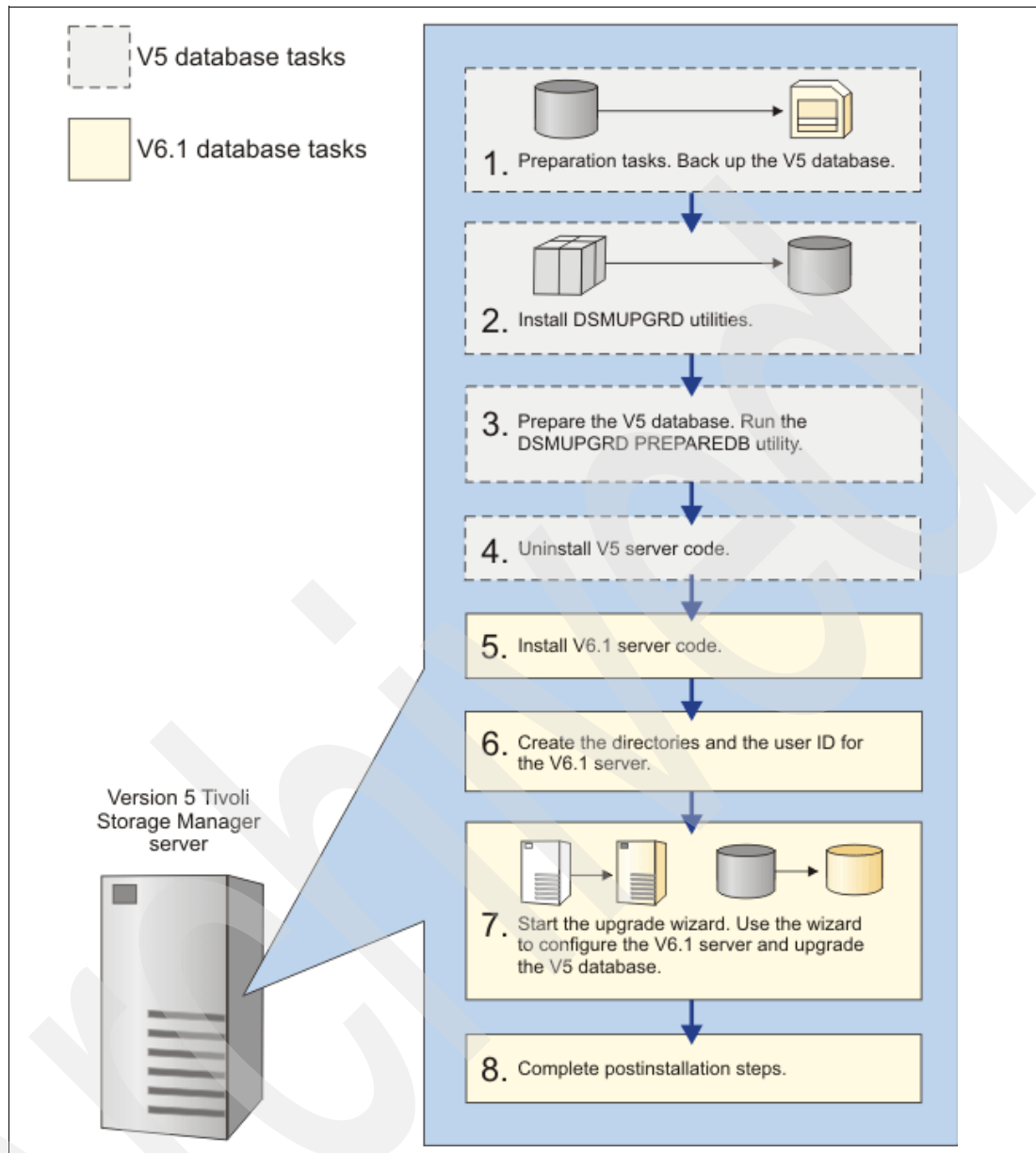


Figure 5-10 Upgrade to V6.1 on a same system using the network method wizard

The following steps summarize the procedure for this scenario:

1. Perform all preparation tasks, which includes performing a database backup.
2. Install the upgrade utilities package (DSMUPGRD) on the system. The utilities package must be installed whether you are using the upgrade wizard or performing the upgrade with utilities.
3. Prepare the V5 database using the utility DSMUPGRD PREPAREDDB.
4. Uninstall the V5 server code.
5. Install the V6.1 server code on the system.
6. Create the directories for the V6.1 database and logs, and the user ID that will own the server instance.

7. Start the upgrade wizard to configure the new server and upgrade the V5 database. With the wizard, you complete the following tasks:
 - a. Create and format an empty database to receive the data.
 - b. Move the data from the V5 database to the V6.1 database.
 - c. Configure the system for database backup.
8. Complete the post-installation tasks, including backing up the database and verifying the database contents.

5.6.3 Scenario 3: new system, media method

In this scenario, some upgrade tasks are performed on the original system and some on the new system. The database is extracted to media and later inserted into the V6.1 database.

You can use the wizard, or perform the upgrade manually by using the utilities. The wizard offers a guided approach to the upgrade of a server. By using the wizard, you can avoid certain configuration steps that are complex when done manually.

Upgrading the server using the wizard

This is a high-level overview on a Tivoli Storage Manager V6.1 upgrade on a new system using the media method wizard; see Figure 5-11.

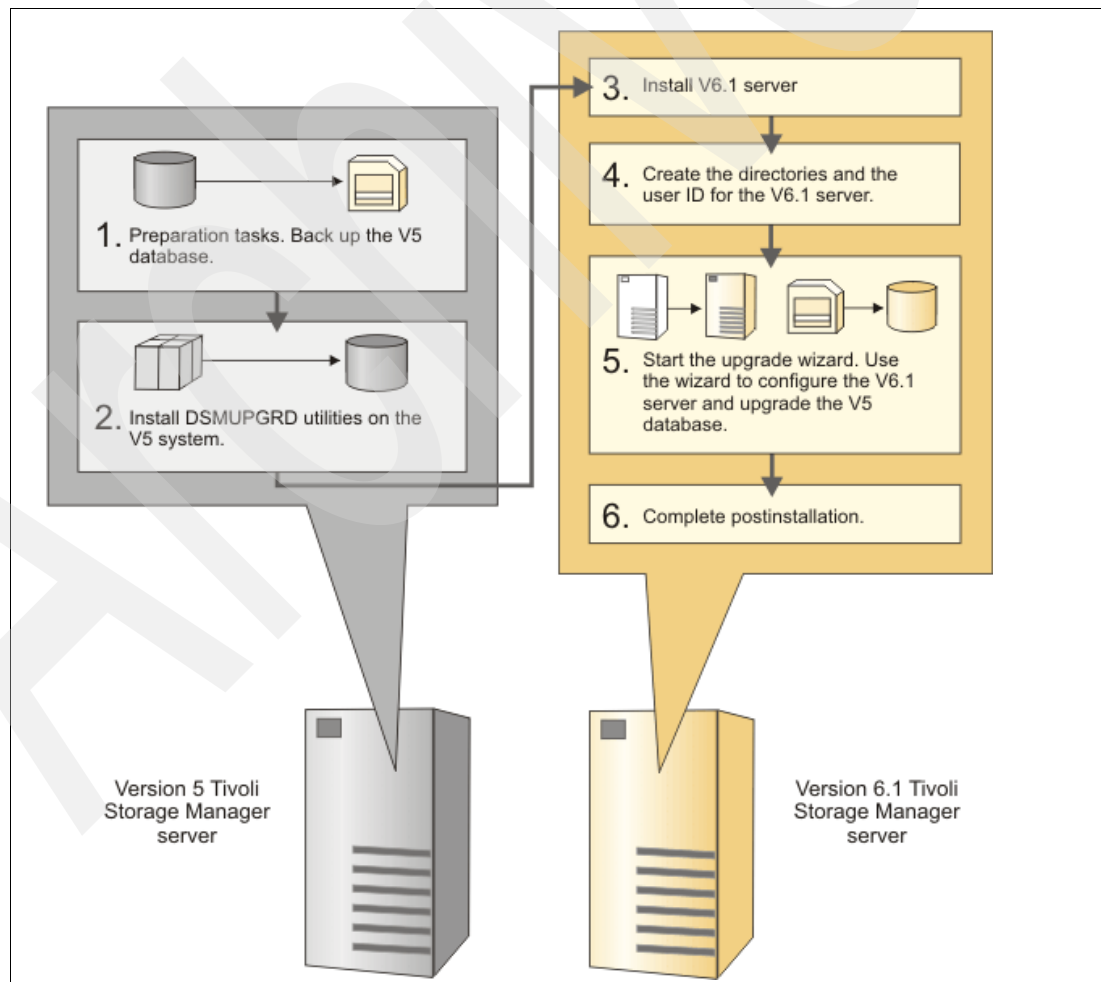


Figure 5-11 Upgrade to V6.1 on a new system using media wizard

The following steps summarize the procedure for this scenario:

1. Perform all preparation tasks on the original system. Preparation includes performing a database backup.
2. Install the DSMUPGRD utilities package on the original system. The utilities package must be installed whether you are using the upgrade wizard or performing the upgrade manually with utilities.
3. Install the Tivoli Storage Manager V6.1 server code on the new system.
4. Create the directories for the Tivoli Storage Manager V6.1 database and logs, and the user ID that will own the server instance.
5. Start the upgrade wizard to configure the new server and upgrade the V5 database. With the wizard, you complete the following tasks:
 - a. On the original system, prepare the V5 database.
 - b. On the original system, extract the V5 database to external media.
 - c. On the new system, create and format an empty database to receive the data.
 - d. On the new system, insert the data from the media to which it was extracted.
 - e. Configure the new system for database backup.
6. Complete the post-installation tasks, including backing up the database and verifying the database contents.

5.6.4 Scenario 4: new system, network method

In this scenario, certain upgrade tasks are performed on the original system and certain tasks are performed on the new system. The data is extracted from the original server database and sent over the network connection to be inserted into the new server database.

You can use the wizard, or perform the upgrade manually by using the utilities. The wizard offers a guided approach to the upgrade of a server. By using the wizard, however, you can avoid certain configuration steps that are complex when performed manually.

Upgrading using the wizard

This is a high-level overview on a V6.1 upgrade on a new system using the network method wizard; see Figure 5-12 on page 120.

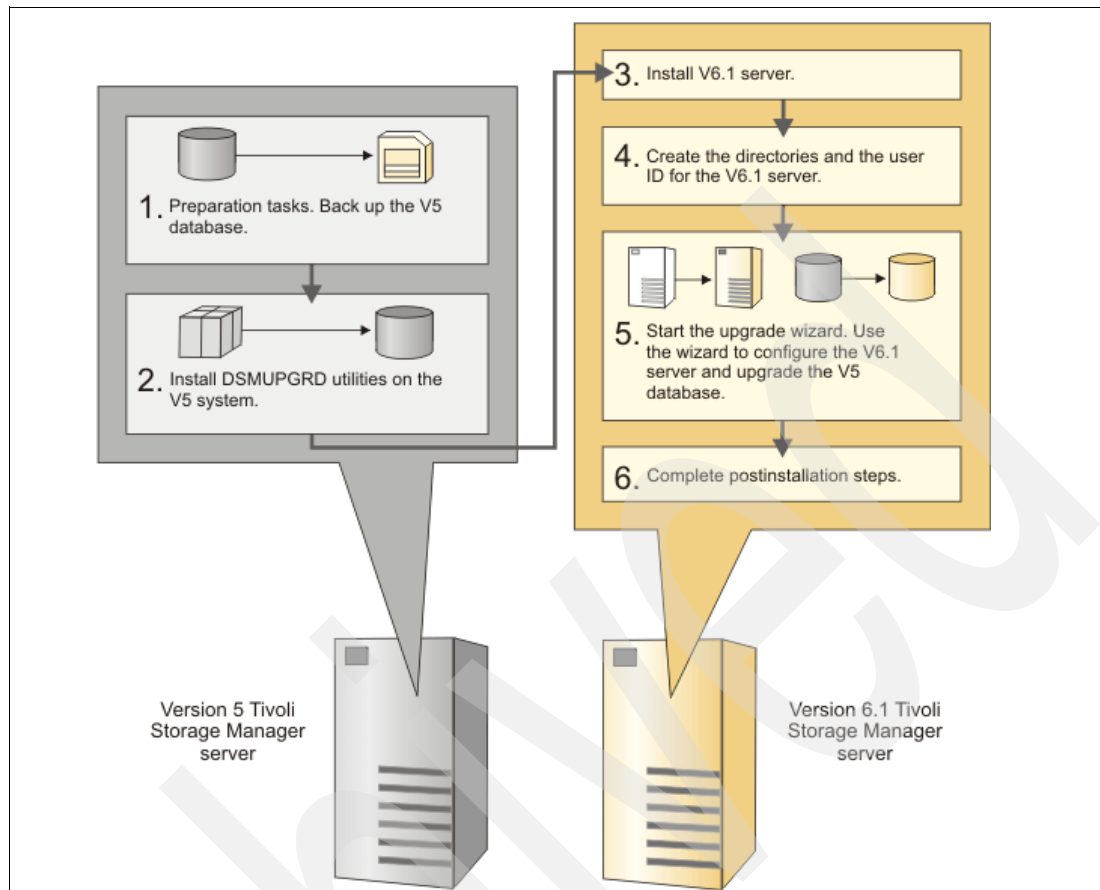


Figure 5-12 Upgrade to V6.1 on a new system using the network method wizard

The following steps summarize the procedure for this scenario:

1. Perform all preparation tasks on the original system. Preparation includes performing a database backup.
2. Install the DSMUPGRD utilities package on the original system. The utilities package must be installed whether you are using the upgrade wizard or performing the upgrade manually with utilities.
3. Install the V6.1 server code on the new system.
4. Create the directories for the V6.1 database and logs, and the user ID that will own the server instance.
5. Start the upgrade wizard to configure the new server and upgrade the V5 database. With the wizard, you complete the following tasks:
 - a. On the original system, prepare the V5 database.
 - b. On the new system, create and format an empty database to receive the data.
 - c. Move the data from the V5 database to the V6.1 database.
 - d. Configure the new system for database backup.
6. Complete the post-installation tasks, including backing up the database and verifying the database contents.

5.6.5 Database upgrade wizards

The wizards are supported on all Tivoli Storage Manager Server platforms. Use the wizards because they are less complex than command-line utilities. The DB upgrade is automatically performed; the ability to perform DB backups is mostly automatically configured. The wizard creates and configures your server/database instance prior to performing the upgrade.

5.6.6 Summary of the upgrade

The messages in the Load New Database window should always be checked, so any informational messages are seen from the insert and extraction process.

Messages from the database insertion process:

Example 5-1 shows the database insertion process. Note the return code 405.

Example 5-1 Messages from the database insertion process

```
ANR1336I INSERTDB: Ready for connections from the source server. Remaining time: 1:00:00
ANR8206I TCP/IP Version 4 administrative driver ready for connection with clients on port 1500.
ANR8200I TCP/IP Version 4 driver ready for connection with clients on port 1525.
ANR1336I INSERTDB: Ready for connections from the source server. Remaining time: 0:59:30
ANR0408I Session 1 started for server $UPGRADESOURCE$ (Windows) (Tcp/Ip) for V6 Database
Upgrade.
ANR1337I A DBSPACE trigger has been removed.
ANR1337I A LOGSPACE trigger has been removed.
ANR1379I INSERTDB: Read 34,249,632 bytes and inserted 251,422 database entries in 0:00:00 (0.00
megabytes per hour).
ANR1379I INSERTDB: Read 606,450,451 bytes and inserted 4,391,709 database entries in 0:05:11
(6690.68 megabytes per hour).
ANR1379I INSERTDB: Read 1,085,441,646 bytes and inserted 7,607,483 database entries in 0:10:18
(6029.13 megabytes per hour).
ANR1379I INSERTDB: Read 1,325,219,033 bytes and inserted 9,413,251 database entries in 0:15:26
(4910.15 megabytes per hour).
ANR1379I INSERTDB: Read 1,575,287,817 bytes and inserted 11,155,415 database entries in 0:20:29
(4399.67 megabytes per hour).
ANR1379I INSERTDB: Read 1,821,897,938 bytes and inserted 13,048,509 database entries in 0:25:34
(4076.40 megabytes per hour).
ANR1379I INSERTDB: Read 2,084,615,297 bytes and inserted 14,751,729 database entries in 0:30:36
(3898.04 megabytes per hour).
ANR0409I Session 1 ended for server $UPGRADESOURCE$ (Windows).
ANR0136I Table updating statistics performed successfully for 5 of 5.
ANR1524I INSERTDB: Beginning database update phase.
ANR1525I INSERTDB: Updated 234 of 4,373,439 database entries in 0:02:15.
ANR1525I INSERTDB: Updated 234 of 4,373,439 database entries in 0:07:15.
ANR1525I INSERTDB: Updated 4,373,439 of 4,373,439 database entries in 0:11:05 ANR1395I INSERTDB:
Process 1, database insert, has completed.
ANR1397I INSERTDB: Found 82 database objects.
ANR1398I INSERTDB: Processed 82 database objects.
ANR1399I INSERTDB: Failed to process 0 database objects.
ANR1517I INSERTDB: Processed 15,859,059 database records.
ANR1518I INSERTDB: Read 2,207,931,666 bytes.
ANR1519I INSERTDB: Elapsed time was 0:55:07.
ANR1445I INSERTDB: Throughput was 2291.50 megabytes per hour.
ANR1446I RUNSTATS: Table updating statistics started.
ANR0136I Table updating statistics performed successfully for 119 of 119.
ANR1528I RUNSTATS: Table updating statistics completed in 0:14:43.
ANR0369I Stopping the database manager because of a server shutdown.
Insertion process completed with return code 405
```

Return code 405 from the Insert process

Example 5-1 shows a return code 405 from the Insert process although message ANR1395I indicates success. The reason is because of a problem in the message parsing code where the string is searching from the beginning of the thread instead of the whole string. The ANR1395I message that indicates success is not found in the string and the Insertion process completed with return code 405.

Note: As an example of the upgrade wizard non-zero return code on successful INSERTDB, the message shows:

```
ANR1525I INSERTDB: Updated 4,373,439 of 4,373,439 database entries in 0:11:05.  
ANR1395I INSERTDB: Process 1, database insert, has completed.
```

The last line displayed is:

```
Insertion process completed with return code 405
```

For INSERTDB, the message ANR1395I indicates success.

Messages from the database extraction process:

Example 5-2 shows the database extraction process.

Example 5-2 Messages from the database extraction process

```
Waiting for the new server to initialize...  
ANR0900I Processing options file C:\Program Files\Tivoli\TSM\server1\dsmserv.opt.  
ANR7800I DSMSERV generated at 12:07:33 on Mar 12 2009.  
Tivoli Storage Manager for Windows  
Version 5, Release 5, Level 2.0  
Licensed Materials - Property of IBM  
(C) Copyright IBM Corporation 1990, 2007.  
All rights reserved.  
U.S. Government Users Restricted Rights - Use, duplication or disclosure  
restricted by GSA ADP Schedule Contract with IBM Corporation.  
ANR4726I The ICC support module has been loaded.  
ANR0990I Server restart-recovery in progress.  
ANR0200I Recovery log assigned capacity is 1000 megabytes.  
ANR0201I Database assigned capacity is 5000 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, 23.47.17.a1.e3.cf.11.dd.b7.b4.00.50.56.90.7c.69, has  
initialized.  
ANR4726I The NAS-NDMP support module has been loaded.  
ANR7808W Sun Microsystems Library Attach module libacs.dll is not available from the  
system.  
ANR1792W HBAAPI vendor library failed to load or is missing.  
ANR8482W The server is unable to obtain the serial number of the SCSI device MSL.  
ANR8482W The server is unable to obtain the serial number of the SCSI device MSL.  
ANR8840E Unable to open device lb0.0.0.4 with file handle 2.  
ANR8440E Initialization failed for SCSI library MSL; will retry in 2 minute(s).  
ANR9969E Unable to open volume D:\TSM\STG\STGVOL01.DSM. The most likely reason is that  
another TSM server is running and has the volume allocated.  
ANR1311E Vary-on failed for disk volume D:\TSM\STG\STGVOL01.DSM - unable to access disk  
device.
```

ANR9969E Unable to open volume E:\TSM\STG\STGVOL07.DSM. The most likely reason is that another TSM server is running and has the volume allocated.
 ANR9969E Unable to open volume D:\TSM\STG\STGVOL13.DSM. The most likely reason is that another TSM server is running and has the volume allocated.
 ANR9969E Unable to open volume D:\TSM\STG\STGVOL14.DSM. The most likely reason is that another TSM server is running and has the volume allocated.
 ANR9969E Unable to open volume E:\TSM\STG\STGVOL15.DSM. The most likely reason is that another TSM server is running and has the volume allocated.
 ANR9969E Unable to open volume E:\TSM\STG\STGVOL16.DSM. The most likely reason is that another TSM server is running and has the volume allocated.
 ANR1311E Vary-on failed for disk volume E:\TSM\STG\STGVOL16.DSM - unable to access disk device.
 ANR1311E Vary-on failed for disk volume E:\TSM\STG\STGVOL15.DSM - unable to access disk device.
 ANR1311E Vary-on failed for disk volume D:\TSM\STG\STGVOL14.DSM - unable to access disk device.
 ANR1311E Vary-on failed for disk volume D:\TSM\STG\STGVOL13.DSM - unable to access disk device.
 ANR1311E Vary-on failed for disk volume E:\TSM\STG\STGVOL07.DSM - unable to access disk device.
 ANR4029I EXTRACTDB: Database checkpoint started.
 ANR4030I EXTRACTDB: Database checkpoint completed.
 ANR0610I EXTRACTDB started by ADMINISTRATOR as process 1.
 ANR0408I Session 1 started for server \$UPGRADE\$ (Windows) (Tcp/Ip) for V6 Database Upgrade.
 ANR8482W The server is unable to obtain the serial number of the SCSI device MSL.
 ANR8482W The server is unable to obtain the serial number of the SCSI device MSL.
 ANR8840E Unable to open device lb0.0.0.4 with file handle 2.
 ANR8441E Initialization failed for SCSI library MSL.
 ANR1392I EXTRACTDB: Extracted 3,736,534 database entries in 197,824 pages and wrote 515,744,948 bytes in 0:05:00 (5892.00 megabytes per hour).
 ANR1392I EXTRACTDB: Extracted 7,143,650 database entries in 410,279 pages and wrote 1,030,018,805 bytes in 0:10:00 (5892.00 megabytes per hour).
 ANR1392I EXTRACTDB: Extracted 9,045,569 database entries in 506,661 pages and wrote 1,274,861,977 bytes in 0:15:07 (4822.49 megabytes per hour).
 ANR1392I EXTRACTDB: Extracted 11,123,470 database entries in 622,107 pages and wrote 1,569,211,751 bytes in 0:20:07 (4461.97 megabytes per hour).
 ANR1392I EXTRACTDB: Extracted 12,796,983 database entries in 703,265 pages and wrote 1,794,542,333 bytes in 0:25:07 (4087.33 megabytes per hour).
 ANR1392I EXTRACTDB: Extracted 14,352,904 database entries in 792,509 pages and wrote 2,005,587,569 bytes in 0:30:07 (3809.19 megabytes per hour).
 ANR0409I Session 1 ended for server \$UPGRADE\$ (Windows).
 ANR1382I EXTRACTDB: Process 1, database extract, has completed.
 ANR1383I EXTRACTDB: Found 124 database objects.
 ANR1384I EXTRACTDB: Processed 82 database objects.
 ANR1385I EXTRACTDB: Skipped 42 empty database objects.
 ANR1386I EXTRACTDB: Failed to process 0 database objects.
 ANR1387I EXTRACTDB: Processed 15,859,059 database records.
 ANR1388I EXTRACTDB: Read 879,821 database pages.
 ANR1389I EXTRACTDB: Wrote 2,207,931,596 bytes.
 ANR1390I EXTRACTDB: Elapsed time was 0:34:47.
 ANR1391I EXTRACTDB: Throughput was 3631.05 megabytes per hour.

Extraction process completed with return code 0

The upgrade is now complete, click **Done** to continue. See Figure 5-13 on page 124.

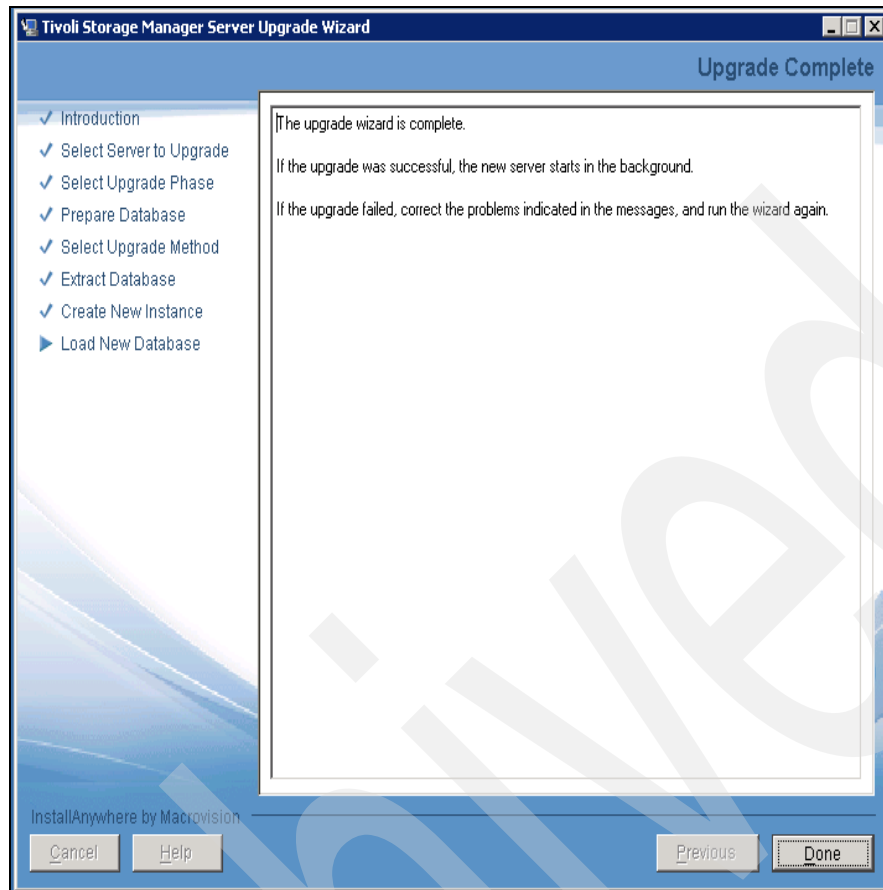


Figure 5-13 Tivoli Storage Manager Server Upgrade

After the upgrade process is complete, we can start the Tivoli Storage Manager V6.1 server on the new system.

5.6.7 Upgrading using utilities

To use the utilities for the upgrade, follow these steps:

1. Perform all preparation tasks on the original system. Preparation includes performing a database backup.
2. Install the DSMUPGRD utilities package on the original system. The utilities package must be installed whether you are using the upgrade wizard or performing the upgrade manually with utilities.
3. Install the Tivoli Storage Manager V6.1 server code on the new system.
4. Create the directories for the V6.1 database and logs, and the user ID that will own the server instance.
5. On the original system, prepare the V5 database using the utility DSMUPGRD PREPAREDB.
6. On the new system, create and format an empty database to receive the data. The database is created with the `db2icrt` command. The database is formatted using the DSMSERV LOADFORMAT utility.
7. On the new system, start the insertion process for the new server. Use the utility DSMSERV INSERTDB.

8. On the original system, start the extraction process for the V5 database using the utility DSMUPGRD EXTRACTDB.
9. Configure the system for database backup.
10. Complete the post-installation tasks, including backing up the database and verifying the database contents.

Summary

In summary, prepare for the upgrade by checking requirements, preparing the space that is required, backing up the server, and modifying certain server settings. Follow the preparation steps carefully to protect your server and its data.

Important: Sometimes, after the upgrade to V6.1 is complete, conditions might cause the need to temporarily revert to the previous version of the server. Successfully reverting to the previous version of the server is possible only if you performed all preparation steps. To understand why it is important to perform all preparation steps, review the procedure for reverting an upgraded server to its previous version. Refer to 5.6.8, “Recovering from upgrade problems” for information.

5.6.8 Recovering from upgrade problems

To revert to the previous version of Tivoli Storage Manager, perform one of the following steps:

- ▶ If your source server is at Tivoli Storage Manager V5.3 when dsmupgrd preparedb is performed

Restore the database from backups prior to restarting your server. You must re-install Tivoli Storage Manager 5.3 from installation media if using the upgrade method that is already in place.

Note: The dsmupgrd utility upgrades a V5.3 database to Tivoli Storage Manager V6.1, but Tivoli Storage Manager V5.3 is no longer supported for other support issues.

- ▶ If your source server is at Tivoli Storage Manager V5.4 when dsmupgrd preparedb is performed

Restore the database from backups prior to restarting your server. You must re-install Tivoli Storage Manager 5.4 from installation media if using the in-place upgrade method.

- ▶ If your source server is at Tivoli Storage Manager V5.5.0 through V5.5.2 when dsmupgrd preparedb is done

Although you do not have to restore the database from backups before restarting your server, you must re-install Tivoli Storage Manager V 5.5 from installation media if using in-place upgrade methods.

Note: Because this approach could change at V5.5.3, review the readme files to check whether this applies.

How to restart the upgrade process

If you must restart the upgrade process, be aware that the upgrade process is not checkpoint restartable. If for any reason the process fails or is cancelled, it must be restarted from the beginning.

If you are using the extract to media method for upgrade and have completed the extract, you can restart the upgrade from the insertdb step after cleaning up directories and reformatting the database.

More information is available at the following Web site:

http://publib.boulder.ibm.com/infocenter/tsminfo/v6/topic/com.ibm.itrm.srv.upgrd.doc/ts_srv_upgrd_restartupgrd.html

5.7 Consolidation of server instances

By switching the underlying proprietary Tivoli Storage Manager database to IBM DB2, improvements in scalability (the system can now handle more than 1 billion objects per Tivoli Storage Manager server) and performance (as much as 300% improvement in backup performance) are achieved. The change enables Tivoli Storage Manager servers to be consolidated over time (an expected 2:1 reduction in the number of backup servers needed) because previous size restrictions have been eliminated.

As mentioned before, merging instances together during the upgrade process is not possible. To perform a successful consolidation of multiple instances, use the export/import method.

Export/import method

You use the Tivoli Storage Manager EXPORT command with the export/import method to move the data from your Tivoli Storage Manager V5.x server to the V6.1 server. You can also export the source server data to available media and import it to your V6.1 server at a later time. For more information about exporting and importing data, use the instructions in the Administrator's Guide for your platform; command syntax is found in the Administrator's Reference. Refer to "Related publications" on page 293.

The export/import method includes moving the data to a V6.1 server, then stopping the source server after the data is extracted. After the production database is moved to the V6.1 server, all the source server storage pools are made accessible to the V6.1 server, and that server can then be put into production. Validate that the data moved successfully before doing maintenance (for example, deleting file spaces and nodes) on the V5.x server.

Alternatively, if you want to use the concurrent method but you want to re-provision some or all of that storage hardware to the Tivoli Storage Manager V6.1 server, you must define new hardware to the V5.x server, create a device class, create a storage pool using that device class, and then issue either the MIGRATION or the MOVE DATA/MOVE NODEDATA commands to move data off the existing hardware and to the new devices.

One way to estimate the time needed for this method is to measure the time necessary to export a sample of node data, and then import that data to the test Tivoli Storage Manager V6.1 server.

To analyze how many nodes and how much file space you have to export, enter the following commands:

```
query node format=detail
query filespace
```

Advantages of the export/import method

Advantages include:

- ▶ Server-to-server export and import can be the quickest way to move data, depending upon the export approach used and the devices or infrastructure available to support that data movement.
- ▶ Data movement can be staged by node or by other criteria.
- ▶ You can eliminate the V5.x server more quickly.
- ▶ Deleting file spaces from the source server while the export and import procedures for each node finish can save you time and eliminate duplicate data.
- ▶ You can choose to export just the active backup data, which reduces the amount of data to be transferred and exports only the most recent data. You can then keep the source server for restore purposes only.

Disadvantages of the export/import method

Disadvantages include:

- ▶ Planning resources are required.
- ▶ Network storage and personnel resources are required.
- ▶ The network or the data transfer load might be reduced over a long period of time if active data is exported to the V6.1 server, instead of leaving it on the source server.

Server-to-server export/import method

To move your Tivoli Storage Manager for V5.x data to your V6.1 server using server-to-server export, complete the following steps:

1. Install the Tivoli Storage Manager server, Version 6.1.
2. Move the administrative definitions to the V6.1 server. You can do this by issuing either the `EXPORT SERVER FILEDATA=NONE` command or the `EXPORT ADMIN` command. In either case, review the information for the `EXPORT` commands to determine which command is best for the type of administrative definitions (administrators, policies, schedules, and so on) that must be moved.
3. Issue the `EXPORT NODE` command to move specific nodes or groups of nodes. Use the server-to-server communications over TCP/IP.
4. Issue the following command to test the accessibility of the exported data:
`AUDIT VOLUME FIX=NO RTRVLOGICAL=YES`
5. Issue a corresponding `IMPORT` command on the Tivoli Storage Manager V6.1 server.
6. Import the data to the Tivoli Storage Manager V6.1 server using the `IMPORT` command:
`import server filedata=all mergefilespace=yes`

Moving V5.x data to media using the export/import method

To move the data to your choice of media, complete the following steps:

1. Install the Tivoli Storage Manager server V6.1.
2. Move the administrative definitions to the V6.1 server.
3. Issue the `EXPORT NODE` command to move specific nodes or groups of nodes to media.
4. Issue the following command to test the accessibility of the exported data:
`AUDIT VOLUME FIX=NO RTRVLOGICAL=YES`
5. Import the data from the media on the V6.1 server at any time.

Hints and tips

Note the following information:

- ▶ Review the EXPORT command parameters to determine the selection criteria that best apply to your environment and goals.
- ▶ Move selected nodes or node groups to the Tivoli Storage Manager V6.1 server using the EXPORT command. You must decide which nodes are better moved together or apart. For example, nodes belonging to the same collocation group can be exported together.

Installing and configuring a solution

This chapter provides the detailed information for installing and configuring a Tivoli Storage Manager solution in a customer environment. We discuss the installation and configuration of the Tivoli Storage Manager server and client and show how to set up a proper backup environment, established by the planning, which we discussed in previous chapters.

We also introduce administrative standards for storage management environment, client backup and restore types, schedule and automation function, and implementation tips for disaster recovery management.

6.1 Tivoli Storage Manager server installation

First, we discuss the installation of the server, and the client code that is used to implement Tivoli Storage Manager. We provide the information to plan, install, customize, and maintain your Tivoli Storage Manager server.

Tivoli Storage Manager server and client code fixes and enhancements are released regularly. Refer to “Related publications” on page 293 for links to the latest fixes, Tivoli Storage Manager Web site, readme files, and other FTP services.

6.1.1 Basic installation

Installation can be done either with an operating system utility (for example, IBM AIX SMIT or the Windows setup wizard) or the command-line interface (CLI). Within the basic installation, you create the Tivoli Storage Manager database, log volumes, standard policy domain and backup policies, and device drivers. Your final task is to register the administrative and the backup and archive client.

The basic installation with the wizard uses a step-by-step process. Like the previous version of the installation wizard, the most recent version allows customization of the installation process as shown in Figure 6-1.

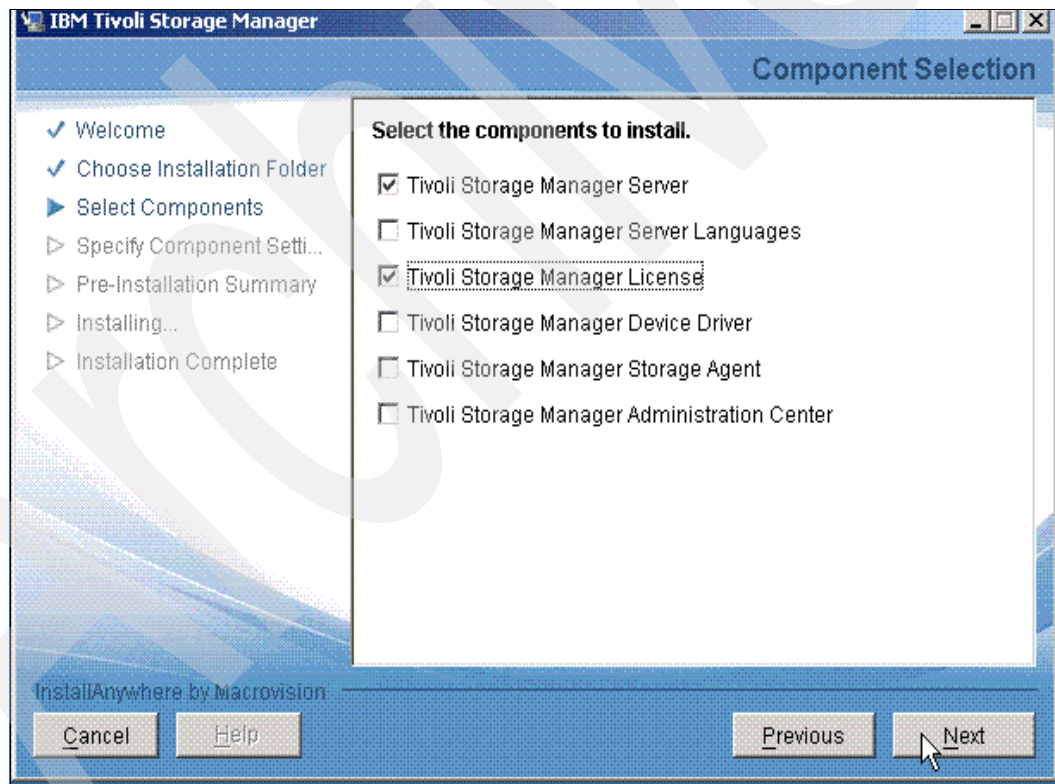


Figure 6-1 Tivoli Storage Manager installation components

DB2 Version 9.5 is installed during the Tivoli Storage Manager server installation and you are prompted to create and confirm a password, which must contain either an at sign (@) or a number sign (#) character if you are installing on Windows Server 2008. Defaults are provided for the DB2 user name and database name. An empty database instance, called

DB2TSM, is created during the installation. This DB2TSM database instance is not used by Tivoli Storage Manager but is part of the installation process as seen in Figure 6-2.

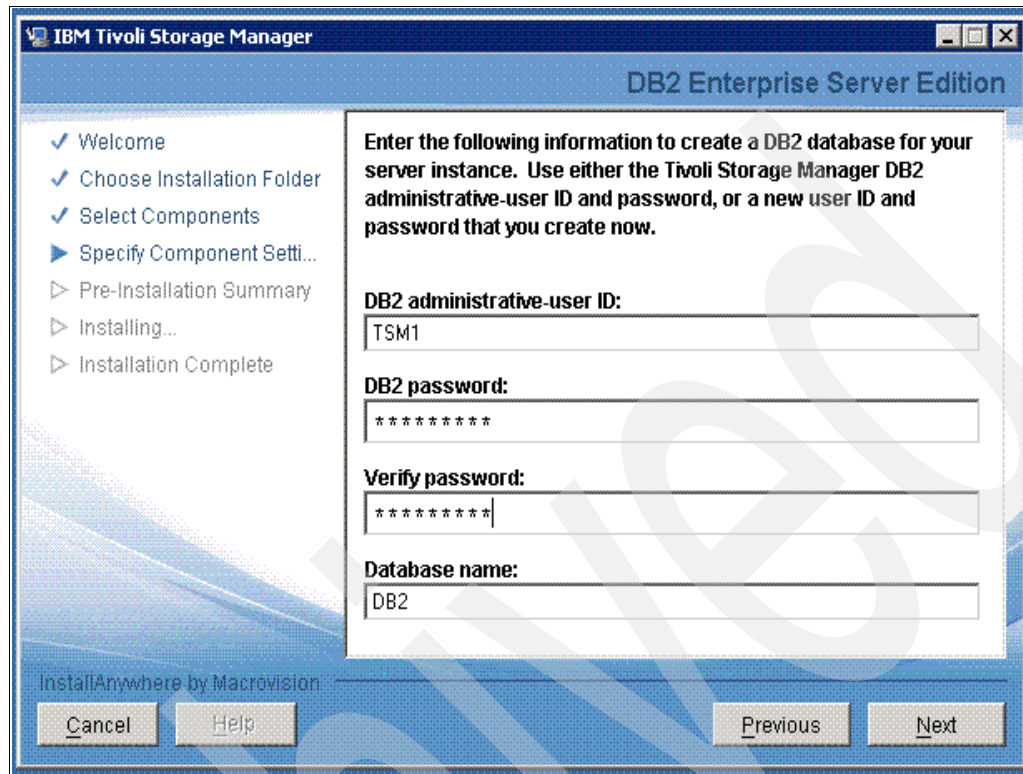


Figure 6-2 DB2 Database and password components

The next component to be installed in the installation process is the Deployment Engine, which is used in all platform installs. See Figure 6-3.

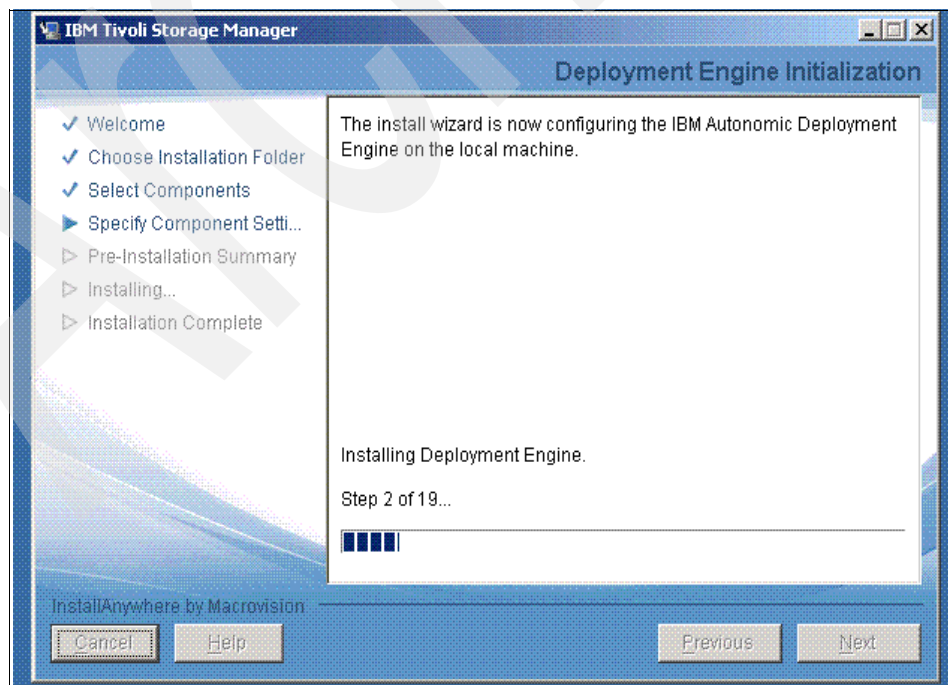


Figure 6-3 Deployment Engine installation

A pre-Installation summary appears next. It lists the components you have chosen to install, where you have defined the DB2TSM instance folder and also the disk space information for the installation as shown in Figure 6-4.

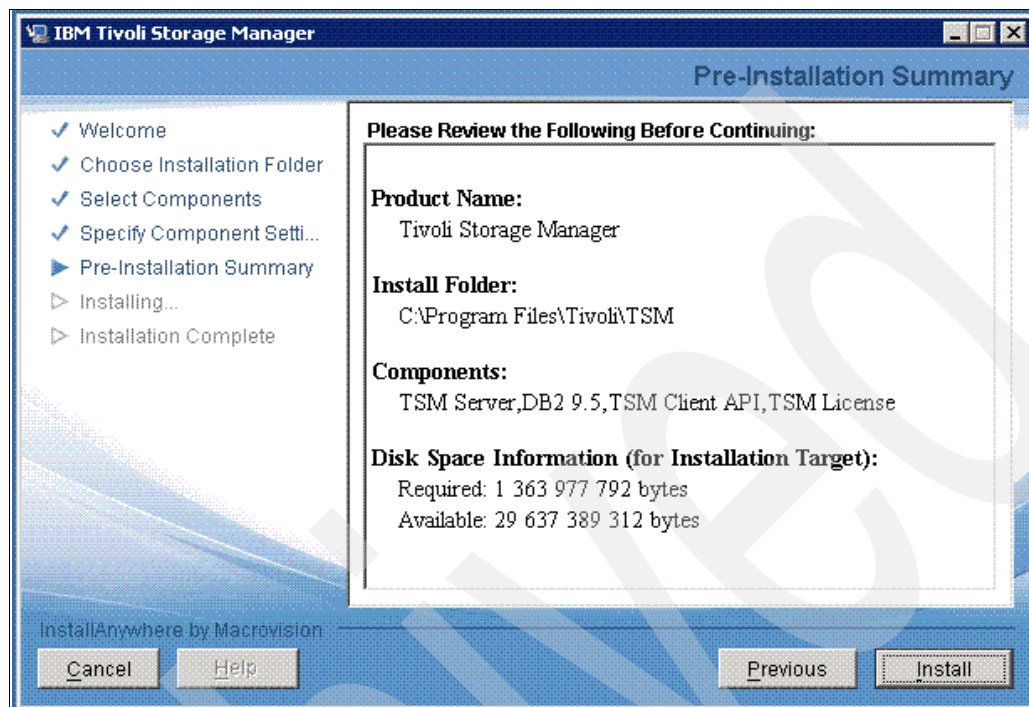


Figure 6-4 Pre-Installation Summary

The Deployment Engine now performs the installation. After the installation is completed a message is displayed on the summary page that Tivoli Storage Manager is successfully installed.

A summary of the installation is displayed as shown in Figure 6-5 on page 133. If any errors occurred during the installation, another summary page lists the errors and directs you to an error log file. These errors should be fixed before continuing. The installation log is stored in the directory that was chosen for installation (look for the log.txt and logs.zip files).

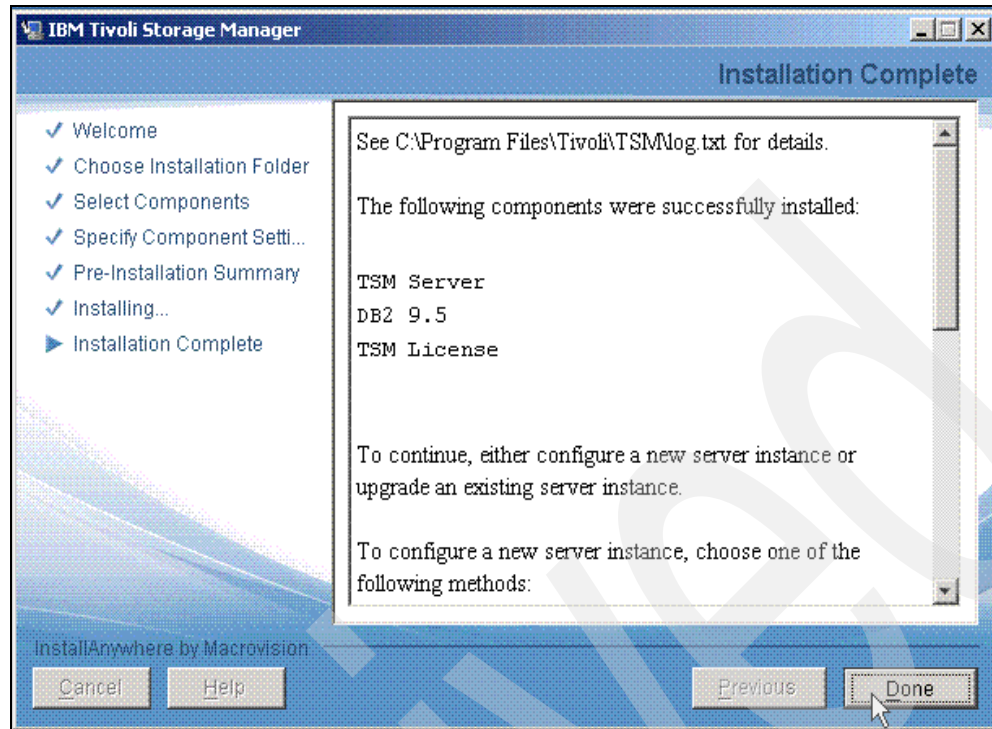


Figure 6-5 Installation completed

Other installation methods

Other installation methods are available depending on your current environment and future capacity or platform plans.

When installing Tivoli Storage Manager V6.1 on Windows most of the underlying functions and procedure calls are hidden from view by the GUI installer.

However, other installations require more control. One important phase of the installation during the Linux or UNIX installations is to begin the DB2 installation.

Using the configuration wizard

After you install Tivoli Storage Manager Version 6.1, one of the options for configuring Tivoli Storage Manager is to use the configuration wizard on your local system. By using the wizard, you can avoid the configuration steps that are complex when done manually.

Start the wizard on the system where you installed the Tivoli Storage Manager Version 6.1 server. Ensure that the operating system requirements are met and then start the wizard:

UNIX operating systems requirements

Requirements include:

- ▶ The system where you installed the Version 6.1 server program must have the X Window client. You must also be running an X Window server on your desktop.
- ▶ The systems must have one of the following protocols enabled: Secure Shell (SSH), remote shell (RSH), or Remote Execution Protocol (REXEC).
- ▶ You must be able to log in to the V6.1 system with the user ID that you created for the server instance, using the SSH, RSH, or REXEC protocol. When using the wizard, you must provide this user ID and password to access the system.

Windows operating systems requirements

Requirements include:

- ▶ The systems must have one of the following protocols enabled: secure shell (SSH), remote shell (RSH), Remote Execution Protocol (REXEC), or Windows server message block (SMB).
- ▶ SMB is the interface used by file and print sharing (also known as CIFS). To use the SMB protocol, you must ensure that file and print sharing is enabled, and that port 445 is not blocked by your firewall. If you are running on Windows Server 2008 or Windows Vista, you might also have to disable User Account Control (at least while running this wizard). If you choose not to disable User Account Control, you must ensure that one of the other protocols is configured to allow the wizard to run.
- ▶ You must be able to log on to the system using a protocol that is enabled on the system, using either the user ID that was created during installation (default name is db2user1), or some other user ID that exists on the system. When using the wizard, you must provide the user ID and password to access the system.

Start the wizard

To start the local version of the wizard, perform the following steps:

- ▶ On UNIX systems, open the `dsmicfgx` program in the `/opt/tivoli/tsm/server/bin/` directory. This wizard can only be run as a root user.
- ▶ On Windows systems, double-click the `dsmicfgx.exe` program in the `C:\Program Files\Tivoli\TSM\server` directory.

Follow the instructions to complete the configuration. The wizard can be stopped and restarted, but the server will not be operational until the entire configuration process is complete.

6.1.2 Customization

The Tivoli Storage Manager server has a number of options and settings that control its operation. Tivoli Storage Manager uses the options specified in the options file at server start-up. You can specify many server settings using an administrative interface.

Options file

Tivoli Storage Manager provides a server options file with a set of default options to start the server. The supplied file contains information about what options and option values can be specified. You can display the current server options using the **query options** command. Some of the server options can be changed without restarting the server with the **setopt** command. It updates the server options file and also the content of the server main memory or address space. For information what options can be updated online use the **help setopt** command.

A default sample server options file, `dsmserve.opt.smp`, is created during Tivoli Storage Manager installation in the `/opt/tivoli/tsm/server/bin` directory for UNIX systems and in the directory where the server executables are stored on Windows systems. You must set up communications between the server and clients by creating a new server options file. To do so, copy the sample file to the directory for the server instance.

Ensure that you have a server instance directory, for example `/home/tsminst1/instance1`, and copy the sample file to this directory. Name the new file `dsmserve.opt` and edit the options. Complete this set-up before you initialize the server database. Each sample or default entry

in the sample options file is a comment, a line beginning with an asterisk (*). Options are not case-sensitive and one or more blank spaces is allowed between keywords and values.

Table 6-1 shows the default server option files and their default locations.

Table 6-1 Server option file locations

Platform	File location
AIX	/opt/tivoli/tsm/server/bin/dsmserv.opt.smp
Linux	/opt/tivoli/tsm/server/bin/dsmserv.opt.smp
HP-UX	/opt/tivoli/tsm/server/bin/dsmserv.opt.smp
Solaris	/opt/tivoli/tsm/server/bin/dsmserv.opt.smp
Windows 2003 and Windows 2008	C:\Program Files\Tivoli\server1\dsmserv.opt.smp

Although the number of server options is very large, only a small number must 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 that the following options are set before starting any configuration on your Tivoli Storage Manager server:

- COMMmethod
- TCPport
- VOLUMEHistory
- DEVCONFig
- MAXSESSIONS

Note: At server initialization, the server reads the server options file. If you update a server option by editing the file, you must remember to stop and restart the server to activate the updated server options file.

Some server options control special situations such as maintenance or daily server tasks. To prevent automatic expiration, you can set the expiration interval to 0 (zero). You can use the `expinterval 0` server option in the server option file (`dsmserv.opt`) or set the interval without restarting the server dynamically with the following setting:

```
setopt expinterval=0
```

The following options must be defined in the `dsmserv.opt` server option file and must be removed after successful maintenance:

- To prevent automatic migration and reclamation: `nomigrrec1`
- To prevent client schedules and administrative schedules: `disablescheds yes`

Settings

Tivoli Storage Manager provides default server runtime settings that are stored in the Tivoli Storage Manager database and persist across server restarts. You specify the server settings in the administrative interface. To use the **set** command, you must have system administrator privileges.

You are able to alter your server name by using the **set servername new_name** command and the server password with the **set serverpassword new_password** command.

You can also display the current server level and settings with the **query status** command.

Important:

- ▶ If this is a source server for virtual volume operations, changing its name can affect its ability to access and manage the data it has stored on the corresponding target server.
- ▶ To prevent problems related to volume ownership, do not change the name of a server if it is a library client. Before changing the name of a server, be aware of the following additional restrictions:
 - Windows clients use the server name to identify which passwords belong to which servers. Changing the server name after the clients are connected forces the clients to reenter the passwords.
 - You must set unique names on servers that communicate with each other. For details, see the Administrator's Guide for your platform; refer to "Related publications" on page 293. On a network where clients connect to multiple servers, all servers should have unique names.
- ▶ If you change the server password and have communication established with other servers and storage agents, reconfiguring the associated systems might be necessary. If you do not know the original password set during installation, reconfiguring might be difficult.

Many of the server settings have influence on security aspects of the Tivoli Storage Manager system. If you set the authentication to off, your TSM system, the server, and the client data are no longer password-protected. If you set the registration to open, which happens during minimal configuration setup of a Windows system, everyone can access the Tivoli Storage Manager server as node and will be assigned automatically to the Standard policy domain. For security reasons, the authentication should always be set to "on" and for administrative reasons, the registration should be set to "closed." The activity log retention default is one day and should be set to an appropriate value, for example 7 days for one week.

You can also display the current server level and all settings with the **query status** command.

6.1.3 Licensing

Tivoli Storage Manager, Extended Edition includes several features, such as disaster recovery manager, large libraries, and NDMP. Other Tivoli Storage Manager licensed products, such as Tivoli Storage Manager for Mail, Tivoli Storage Manager for Databases, Tivoli Storage Manager for ERP, Tivoli Storage Manager for Advanced Copy Services, Tivoli Storage Manager for Copy Services, and Tivoli Storage Manager for Space Management/HSM are not required to be registered to the Tivoli Storage Manager server.

Registering licensed features

If you bought a base Tivoli Storage Manager server license, you can obtain licenses for licensed features, and register those licenses by using the **register license** command to specify the license files.

You can register any or all of the features. For example, if you want to license the server for extended edition, use the following command:

```
register license file=tsmee.lic
```

Saving your licenses

When license registration is complete, the licenses are stored in a file named NODELOCK in the server start directory. You might have to register your licenses again for any of the following reasons:

- ▶ The server is corrupted.
- ▶ The server has moved to a different machine.
- ▶ The NODELOCK file is destroyed or corrupted.

Monitoring licenses

The two commands that monitor the license registration on your Tivoli Storage Manager system are:

- ▶ `query license`

Use this command to display details of your current licenses and determine licensing compliance.

- ▶ `audit license`

Use this command to compare the current configuration with the current licenses.

If you do not use the `audit license` command, it will be executed periodically at server start, defined in the server settings with `SET LICENSEAUDITPERIOD` or by default every 30 days.

6.1.4 User management and security

Administrators, client nodes, and client sets provide user management and security.

Administrators

A Tivoli Storage Manager administrator manages Tivoli Storage Manager resources on the server, such as storage pools, devices, and data management policies. An administrator might also be responsible for backup and restore of client data. The number of administrators and their level of privileges will vary according to environment.

The two ways to create a Tivoli Storage Manager administrator ID are to use the **register node** and **register admin** commands. The **register admin** command is used to explicitly create an administrator ID with certain defined privileges. The **register node** command automatically creates an administrator ID with the same name as the node and owner access privilege to the node.

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 is not possible if you have revoked the system privilege from the `server_console` administrative ID.

Administrator user privileges

Privileges are granted to an administrator through the **grant authority** command. You need system privileges to issue this command. The administrative user privileges are:

- System

An administrator with system privilege can perform any Tivoli Storage Manager administrative task. All other privileges are included when an administrator is assigned system privilege.

Note: Every administrator with system privilege has implicit node owner privilege for any node and is therefore able to restore all data from any node. The administrator also has access to all defined NAS nodes through the Web interface.

- Policy

An administrator can have either unrestricted or restricted policy privilege:

- An administrator with *unrestricted* policy privilege can manage the backup and archive policy definitions (for example, management classes, copy groups, and schedules) for client nodes assigned to any policy domain. When new policy domains are defined to the server, an administrator with unrestricted policy privilege is automatically authorized to manage the new policy domains.
- An administrator with *restricted* policy privilege can perform the same operations as an administrator with unrestricted policy privilege, but only for specified policy domains.

Note: Every administrator with node privilege has implicit node owner privilege for every node in the policy domain he has access to and is also able to restore all data from that node. He also has access to all defined NAS nodes in that policy domain through the Web interface.

- Storage

An administrator can have either unrestricted or restricted storage privilege:

- An administrator with *unrestricted* storage privilege has the authority to manage the Tivoli Storage Manager database, recovery log, and all storage pools. An administrator with unrestricted storage privilege cannot define or delete storage pools.
- An administrator with *restricted* storage privilege can manage only those storage pools to which the administrator is authorized, but cannot manage the Tivoli Storage Manager database or recovery log.

- Operator

An administrator with operator privilege controls the immediate operation of the Tivoli Storage Manager server and the availability of storage media.

- Node

An administrator with node access privilege can remotely access a Web Backup-Archive client and perform backup and restore actions on that client using an administrative user ID and password.

An administrator with node owner privilege has full access to all functions and all data of that node through command line, GUI, and Web client.

Client nodes

Every client node has to be registered and assigned a password to identify itself against its designated server, and to prevent access to data of other users.

To simplify administration and automation, the client password is usually stored locally on the client by using this option:

```
passwordaccess generate
```

This option allows the password to authenticate itself to the server; it prevents situations where users forget their passwords and are unable to operate basic functions of Tivoli Storage Manager.

The password is encrypted before being stored. When the password expires, the Tivoli Storage Manager server and client negotiate a new random password according to the configured password rules. The client then re-encrypts this password and stores it locally.

With Tivoli Storage Manager, the client system can encrypt its data during backup or archive using standard Advanced Encryption Standard (AES) 128-bit encryption. If you use the AES 128-bit encryption feature to encrypt your data during backup or archive, data is encrypted during network transfer and remains encrypted in the storage pool. You must have the encryption key in order to restore or retrieve the data. Data Encryption Standard (DES) 56-bit encryption can be used, however, AES 128-bit is the default.

Since Tivoli Storage Manager Version 5.5, using transparent client encryption is possible.

Transparent client encryption

Tivoli Storage Manager V5.5 provides Backup-Archive client transparent data encryption for archive and retrieve and backup and restore, including no query restore (NQR), with all key management (generation, retrieval) done by Tivoli Storage Manager.

Before V5.5, the Tivoli Storage Manager Backup-Archive client could already encrypt client data with key management done by the client user. Files to be encrypted were selected through the `include.encrypt` and `exclude.encrypt` options. The Backup-Archive client supported two options, `ENCRYPTKEY=PROMPT` (default) and `ENCRYPTKEY=SAVE`.

When `ENCRYPTKEY=PROMPT`, you are prompted to specify the key upon every invocation of the Backup-Archive client. You therefore have to remember each client key used.

When `ENCRYPTKEY=SAVE`, your r specified encryption key is saved to the local password file (`TSM.PWD` in UNIX, Linux, Macintosh, and NetWare, and the registry on Windows) for use on subsequent invocations. All files backed up or archived by that node then have the same encryption key.

The API supported these same two options, and the following third option, for transparent encryption:

```
ENABLECLIENTENCRYPTKEY
```

With this option set, the API internally generates an encryption key and saves the key to the Tivoli Storage Manager server. The option `ENABLECLIENTENCRYPTKEY` is not applicable to the Backup-Archive client; it is an API-only option and is ignored by the client during backup or archive.

In Tivoli Storage Manager V5.5, the `ENCRYPTKEY` option now applies to both the Backup-Archive client and the API. Use the option `ENCRYPTKEY=GENERATE` to enable transparent (server-managed) encryption. The `ENCRYPTKEY` option is the preferred way to specify the type of encryption to be used. Table 6-2 on page 140 provides an overview of the supported option settings.

Note: Although the ENABLECLIENTENCRYPTKEY option is still supported and usable by the API client, it might be removed in the future. Therefore, use ENCRYPTKEY=GENERATE.

Table 6-2 Encryption option settings

Option setting		Action	
ENABLECLIENTENCRYPTKEY	ENCRYPTKEY	API	Backup-Archive client
NO	GENERATE	Transparent encryption	Transparent encryption
NO	PROMPT	Key prompted encryption	Key prompted encryption
NO	SAVE	Encryption key saved locally	Encryption key saved locally
YES	GENERATE	Transparent encryption	Transparent encryption
YES	PROMPT	API error	Key prompted encryption
YES	SAVE	API error	Encryption key saved locally

When ENCRYPTKEY=GENERATE, the Backup-Archive client generates an internal encryption key during session initialization with the server. This key is used to encrypt all files backed up or archived on that session.

The option is only applicable during backup and archive processing. Files that are encrypted on the Tivoli Storage Manager server are properly decrypted and restored or retrieved with or without the specification of these options.

Note: Encryption processing is used to ensure that data moving from the client to the server (and the data on the server) cannot be read by an unauthorized person. Authorization to restore the data is not changed by using this option.

One of the advantages of this support is that the encryption key is saved on the server. If the original machine is rebuilt, or you are trying to recover on another machine, the data will be transparently decrypted and restored on the target machine because the key is part of the server data. There is no need to access an encryption key on the original machine.

The ENCRYPTKEY=GENERATE option is only supported if Backup-Archive client and server are at V5.5 or later.

Client option sets

One way of maintaining client nodes is to centrally define options that the clients will use during backup, restore, archive, and retrieve operations. This is done using client option sets.

A Tivoli Storage Manager client session has a set of options that are used during the backup, archive, restore, or retrieval processes. Options can be specified in two ways:

- ▶ Client options *file*, which is mandatory
- ▶ Client options *set*, which is optional

The client options file is a configuration file (or files, in the case of UNIX clients) that is local to each Tivoli Storage Manager client. It contains entries of valid client options with an associated value. It also contains include-exclude file specifications.

A client option set is a set of Tivoli Storage Manager client options stored in the Tivoli Storage Manager database. It is used in conjunction with a client options file. An option set can be associated with one or more clients, but a client can be associated with only one option set.

You use client option sets for ease of administration. Management of an environment where the number of clients is growing and the number of options is increasing can be complex. The use of client option sets centralizes the management of those options and clients. It is easier to update a client options set once than to perform the same update to the local client options file on each node.

6.1.5 New DB2 database

The Tivoli Storage Manager database contains information about registered client nodes, policies, schedules, and the client data in storage pools. The database is key to the operation of the server. The information about the client data, also called metadata, includes the file name, file size, file owner, management class, copy group, and location of the file in server storage. The server records changes made to the database (database transactions) in its recovery log. The recovery log is used to maintain the database in a transactionally consistent state, and to maintain consistency across server startup operations.

Experienced DB2 administrators can choose to perform advanced SQL queries and use DB2 tools to monitor the database. However, do not use DB2 tools to change DB2 configuration settings from those that are preset by Tivoli Storage Manager, or alter the DB2 environment for Tivoli Storage Manager in other ways. The Tivoli Storage Manager V6.1 server has been built and tested extensively using the data definition language (DDL) and database configuration that Tivoli Storage Manager deploys.

Attention: Making changes to the DDL or database configuration without using Tivoli Storage Manager interfaces can adversely affect performance, damage or destroy the server database, or cause data to become permanently lost. Do not use database tools or interfaces other than those provided or documented by Tivoli Storage Manager to change configuration settings from those that are set by Tivoli Storage Manager at installation. Do not alter the DB2 environment in other ways. If you use database tools or interfaces other than those provided or documented by Tivoli Storage Manager, you must treat the server database as read-only. Using other interfaces to make changes to the Tivoli Storage Manager server database is not supported.

The database does not store client data; it points to the locations of the client files in the storage pools. The database includes information about:

- ▶ Client nodes and administrators
- ▶ Policies and schedules
- ▶ Server settings
- ▶ Locations of client files on server storage
- ▶ Server operations (for example, activity logs and event records)

Attention: If the database is unusable, the entire Tivoli Storage Manager server is unavailable. If a database is lost and cannot be recovered, the backup, archive, and space-managed data for that server is lost.

DB configuration

With the use of Database Managed Space (DMS) table space design, the database manager controls the storage space. Use the DBDIR/DBFILE parameter with the **DSMSERV [LOAD] FORMAT** command to specify up to 128 directories available to DB2 as *containers*, which is (this is DB2 terminology for what Tivoli Storage Manager calls *database directories*). The database volumes are managed by DB2, you are no longer asked to format them. You cannot place the containers on raw logical volumes and you should make sure each container is in a separate file system and LUN.

You can add directories to an existing installation by using the **EXTEND DBSPACE** command, which requires a restart of the server for the change to become active.

Note: Adding a new database directory after initial load causes a reorganization of the database, which is expensive and disruptive and should be avoided.

Additional considerations when configuring the database are:

- ▶ The database manager uses striping to ensure an even distribution of data across all containers. Use DB2 striping when writing data into multiple containers. If you choose to implement disk striping along with DB2 striping, the extent size of the table space and the strip size of the disk should be identical.
- ▶ The containers that make up a DMS table space do not need to be the same size; however, this is not normally recommended, because it results in uneven striping across the containers, and sub-optimal performance. If any container is full, DMS table spaces use available free space from other containers.
- ▶ If the disk subsystem supports it, disable the read cache for the database but enable the write cache for it. In addition configure for random IO access.
- ▶ The database is used to contain committed Tivoli Storage manager transactions.
- ▶ Page sizes used for the database are 8 KB and 32 KB depending on the table space. The largest tables, such as the big inventory tables, use a 32 KB page size. For any other table that we did not designate as large, we use a page size of 8 KB. The maximum supported database size is 1 TB. Although we have not tested performance for this, from current feedback page sizes used work fine with default disk subsystem segment sizes.
- ▶ Use fast disk. Using the slow internal disk included by default in most servers, or using consumer grade PATA/SATA disk will slow everything down.
- ▶ If your disk storage is virtualized (such as when using a SAN Volume Controller), or is controlled by a RAID controller, you may be able to further improve I/O parallelism by setting the DB2 registry variable DB2_PARALLEL_IO by using the DB2SET command

```
db2set DB2_PARALLEL_IO=value
```

The value is a comma-separated list of table space IDs or the asterisk character (*), followed by a colon, followed by a number that indicates the number of physical disks backing your database container (directory). For Tivoli Storage Manager, specify the asterisk character (*) for the table space IDs, and then the number of disks you have in your raid configuration. As an example, for Guns of 4+1 RAID5, you would use:

```
db2set DB2_PARALLEO_IO=*:4
```

This requires restarting DB2.

- ▶ Separate the Tivoli Storage Manager components (DB LUNs, Log LUNs, Storage Pool LUNs)

Automatic storage

The database defined for Tivoli Storage manager takes advantage of the AUTOMATIC STORAGE parameter. Automatic storage is a storage management technique where storage for multiple table spaces is automatically managed at the database level. Note the following information:

- ▶ Multiple table spaces automatically draw increments of storage from a *database storage pool* on demand.
- ▶ Automatic storage removes the need to watch for disk shortages in each individual table space
- ▶ Automatic storage removes the need to manually enlarge containers or add stripe sets
- ▶ Automatic storage uses DMS infrastructure internally: combines performance benefits of DMS infrastructure with manageability benefits of SMS (System Managed Space)

Automatic storage allows the server to:

- ▶ Create the database and associate a set of storage paths with it.
- ▶ Add storage paths to the database after creation.
- ▶ Create AUTOMATIC STORAGE table spaces. Note the following information:
 - No explicit container definitions are provided.
 - Containers are automatically created across the database storage paths.
 - Growth of existing containers and addition of new ones are managed by DB2.
- ▶ Redefine database storage paths during a database restore.

Monitoring the database space

If the server cannot automatically extend the database, it tries to prevent a server crash. We intentionally forced this by filling the database file system while a client ran a backup. Example 6-1 shows that the server ends the transaction and closes the session with the client.

Example 6-1 ANR0131E, Server database space exhausted

```
ANR0131E dbieva1.c(809): Server DB space exhausted.
ANR0162W Supplemental database diagnostic information: -1:57011:-289
([IBM][CLI Driver][DB2/NT] SQL0289N Unable to allocate new pages in table
space "LARGESPACE1".  SQLSTATE=57011
).
ANR0532W smnode.c(3361): Transaction 0:7594 was aborted for session 4 for node
OLDSK00L (WinNT).
ANR0514I Session 4 closed volume D:\GALLIUM_SERVER1\FILECLASS\0000003F.BFS.
ANR0403I Session 4 ended for node OLDSK00L (WinNT).
```

You should monitor the file system for space available to the database; use the QUERY DBSPACE command as shown with Example 6-2.

Example 6-2 Monitoring the database for available space

```
tsm: TIRAMISU>q dbspace

Location: g:\tsm\server1\database
Total Size of File System (MB): 59,388.70
Space Used on File System (MB): 59,387.81
Free Space Available (MB): 0.00
```

LOG configuration

You specify the logs used by the server with the **ACTIVELOGDIR** and the **ARCHLOGDIR** parameters to the **DSMSERV [LOAD] FORMAT** command. Both parameters are required; for the active log, you can additionally specify the optional **ACTIVELOGSIZE** parameter. If you do not specify the active log size, it defaults to 2 GB. The active log directory specifies the directory in which the Tivoli Storage Manager server writes and stores active log files. There is only one active log location. The name must be a fully qualified directory name. The directory must already exist, it must be empty, and it must be accessible by the user ID of the database manager. The maximum number of characters is 175. In this context, active log is a Tivoli Storage Manager term, DB2 uses logs and archive logs.

Optionally you can specify the following parameters with either of the format commands:

- ▶ **ARCHFAILOVERLOGDIR** specifies the directory to be used as an alternate storage location if the **ARCHLOGDIR** directory is full.
- ▶ **MIRRORLOGDIR** specifies the directory in which the server mirrors the active log (those files in the **ACTIVELOGDIR** directory).

For both, the same restrictions apply as with the **ARCHLOGDIR** parameter.

Active log directory considerations

Considerations include:

- ▶ It contains current in-flight transaction data.
- ▶ I/O characteristic is sequential.
- ▶ Usage is required.
- ▶ Is a fixed-size non-circular log type.
- ▶ Roll-forward mode is supported only.
- ▶ Active log files are created in 512 MB sized files.

The number of logs created is determined by **ACTIVELOGSIZE** divided by 512. If you specified an odd number with the **ACTIVELOGSIZE**, the value is rounded up to the next even number.

- ▶ If a transaction is not committed and all active log files are filled, the server halts.
- ▶ Default **ActiveLogSize** is 2 GB; maximum supported value is 128 GB.
- ▶ The **ACTIVELOGDIR** value can be changed in the **dsmserv.opt** file (requires restarting the server); the initial value is taken from the format command.

Active log mirror directory considerations

Considerations include:

- ▶ It contains mirrored copies of active transaction data.
- ▶ I/O characteristic is sequential.
- ▶ Use is optional but is recommended.
- ▶ Mirror log files are created in 512 MB sized files.
- ▶ If mirror log directory becomes full, a message is issued, and the server continues.
- ▶ The **MIRRORLOGDIR** value can be changed in the **dsmserv.opt** file (requires restarting the server); the initial value is taken from the format command if specified.

Archive log directory considerations

Considerations include:

- ▶ It contains committed transaction data.
- ▶ I/O characteristic is sequential.
- ▶ Usage is required.
- ▶ Have up to three full backups worth of space for archive logs.
- ▶ Required to roll forward transactions after a database restore process.
- ▶ Log files older than 2 full backups ago are removed after DB backup.
- ▶ The ARCHIVELOGDIR value can be changed in the dsmserv.opt file (requires restarting the server); the initial value is taken from the format command.

Archive failover log directory considerations

Considerations include:

- ▶ Used in case Archive Log Directory becomes full to hold archive logs.
- ▶ I/O characteristic is sequential.
- ▶ Use is optional.
- ▶ If in use, logs are moved back to ACTIVELOGDIR location for a database restore process.
- ▶ Log files are removed after DB backup.
- ▶ The ARCHFAILOVERLOGDIR value can be changed in the dsmserv.opt file (requires a server restart), the initial value is taken from the format command if specified.

The active log directory and the mirror log directory should be on a high-speed reliable disk, the archive log directory can be configured to use a slower disk. The failover archive log can be even slower; assuming it is used infrequently you can even use NFS.

The log file flow is illustrated with Figure 6-6 on page 146. When a log file is full, it is closed by DB2 and is copied to the archive log directory; transactions might still be active when the file gets archived. The server continues to copy full log files to the archive log directory until the directory becomes full, then copies will go to the failover archive log directory if defined. If even the failover archive log directory fills up, (for example, because of unexpected workload), the active logs remain in the active log directory. This factor can result in an out-of-log-space condition and a server-halt if the active log directory fills up too.

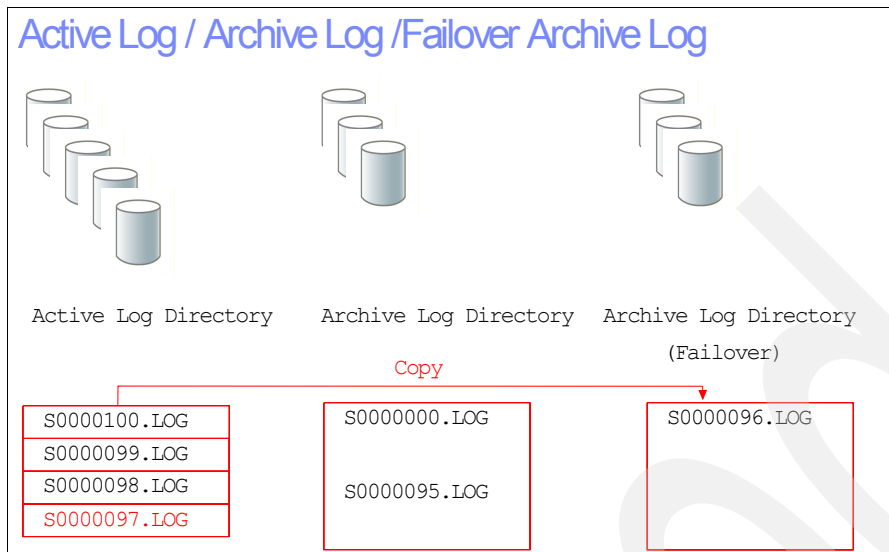


Figure 6-6 Tivoli Storage Manager log file flow

Log file management

The DB2 database manager uses a number scheme to name log files. This naming strategy has implications for log file reuse and log sequences. Also, a DB2 database that has no client application connection uses a new log file when the next client application connects to that database server. These two aspects of DB2 Data Server database logging behavior affect the log file management choices you make.

Consider the following aspects when managing database logs:

- ▶ The numbering scheme for archived logs starts with S0000000.LOG, and continues through S9999999.LOG, accommodating a potential maximum of 10 million log files. The database manager resets to S0000000.LOG if:
 - A database configuration file is changed to enable rollforward recovery.
 - A database configuration file is changed to disable rollforward recovery.
 - The S9999999.LOG file has been used.

The DB2 database manager reuses log file names after restoring a database (with or without rollforward recovery). The database manager ensures that an incorrect log is not applied during rollforward recovery. If the DB2 database manager reuses a log file name after a restore operation, the new log files are archived to separate directories so that multiple log files with the same name can be archived. The location of the log files is recorded in the recovery history file so that they can be applied during rollforward recovery. You must ensure that the correct logs are available for rollforward recovery.

When a rollforward operation completes successfully, the last log that was used is truncated, and logging begins with the next sequential log. Any log in the log path directory with a sequence number greater than the last log used for rollforward recovery is re-used. Any entries in the truncated log following the truncation point are overwritten with zeros. Ensure that you make a copy of the logs before invoking the rollforward utility. (You can invoke a user exit program to copy the logs to another location.)

- ▶ If a database has not been activated (by way of the ACTIVATE DATABASE command), the DB2 database manager truncates the current log file when all applications have disconnected from the database. The next time an application connects to the database, the DB2 database manager starts logging to a new log file. If many small log files are being produced on your system, you might want to consider using the ACTIVATE DATABASE command. This saves the overhead of having to initialize the database when

applications connect, and also saves the overhead of having to allocate a large log file, truncate it, and then allocate a new large log file.

- An archived log can be associated with two or more different log sequences for a database, because log file names are reused (see Figure 6-7 on page 147). For example, if you want to recover Backup 2, two possible log sequences could be used. If, during full database recovery, you roll forward to a point in time and stop before reaching the end of the logs, you have created a new log sequence. The two log sequences cannot be combined. If you have an online backup image that spans the first log sequence, you must use this log sequence to complete rollforward recovery.

If you have created a new log sequence after recovery, any table space backup images on the old log sequence are invalid. This is usually recognized at restore time, but the restore utility fails to recognize a table space backup image on an old log sequence if a database restore operation is immediately followed by the table space restore operation. Until the database is actually rolled forward, the log sequence that is to be used is unknown. If the table space is on an old log sequence, it must be reset by the table space rollforward operation. A restore operation using an invalid backup image might complete successfully, but the table space rollforward operation for that table space will fail, and the table space will be left in restore pending state.

For example, suppose that a table space-level backup operation, Backup 3, completes in range S0000013.LOG through S0000014.LOG in the top log sequence (see Figure 6-7). If you want to restore and roll forward using the database-level backup image, Backup 2, you will need to roll forward through S0000012.LOG. After this, you could continue to roll forward through either the top log sequence or the (newer) bottom log sequence. If you roll forward through the bottom log sequence, you will not be able to use the table space-level backup image, Backup 3, to perform table space restore and rollforward recovery.

To complete a table space rollforward operation to the end of the logs using the table space-level backup image, Backup 3, you will have to restore the database-level backup image, Backup 2, and then roll forward using the top log sequence. After the table space-level backup image, Backup 3, has been restored, you can initiate a rollforward operation to the end of the logs.

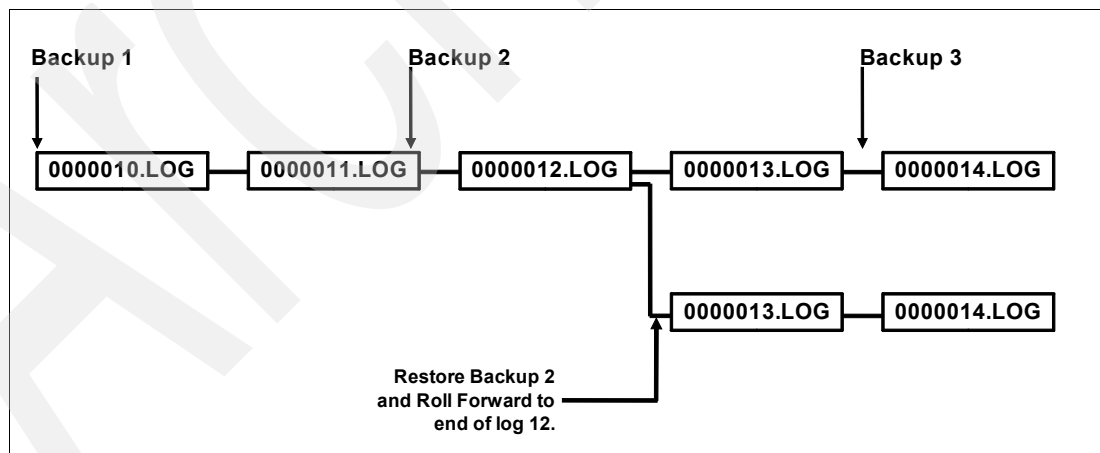


Figure 6-7 DB2, re-use of log file names

Increase database space

In case your database grows, you can use the EXTEND DBSPACE command to add more directories to an existing installation. This approach requires restarting the server for the change to become active. Example 6-3 on page 148 shows how we submitted the EXTEND DBSPACE command.

Example 6-3 Extend dbspace command

```
TSM:TIRAMISU>extend dbspace m:\tsmdb\dbdir3
ANR2017I Administrator SERVER_CONSOLE issued command: EXTEND DBSPACE
m:\tsmdb\dbdir3
ANR2592I Directory(ies) 'm:\tsmdb\dbdir3' has been defined in the database space.
```

After we restart the server, the new database directory gets populated by DB2 and is available for the our server.

Note: Adding a new database directory after an initial load causes a reorganization (REORG) of the database. As this is expensive and disruptive it should be avoided.

Extending the logs

As in Tivoli Storage Manager Version 5.5 and before, taking care of individual log files is no longer necessary, because the handling of the files is completely done by DB2.

The log files consist of active log and archive log, which are mandatory, and log mirror and failover archive log, which are optional. The location where the log files are stored is defined during the creation of the Tivoli Storage Manager Server Database with the **dsmserv** format command during the setup of the Tivoli Storage Manager instance and written into the Tivoli Storage Manager Server option **dsmserv.opt** file.

Backing up the database

Tivoli Storage Manager client API now is used by Tivoli Storage Manager server backup/restore database commands. **BACKUP DB** or **RESTORE DB** tell DB2 to back up or restore the Tivoli Storage Manager database to the server over the Tivoli Storage Manager backup API, as illustrated with Figure 6-8 on page 149. DB2 already knows how to back itself up to the server, with this design you can use disk or tape devices already controlled by the Tivoli Storage Manager server. There is no need to reserve devices dedicated to just database backup. The key benefits achieved are:

- ▶ Uses existing Tivoli Storage Manager server capabilities for volume management.
- ▶ Is transparent to volume history, devconfig, DELETE VOLHIST and others.
- ▶ Uses existing server capabilities for off-site media management such as MOVE DRMEDIA, PREPARE and others.

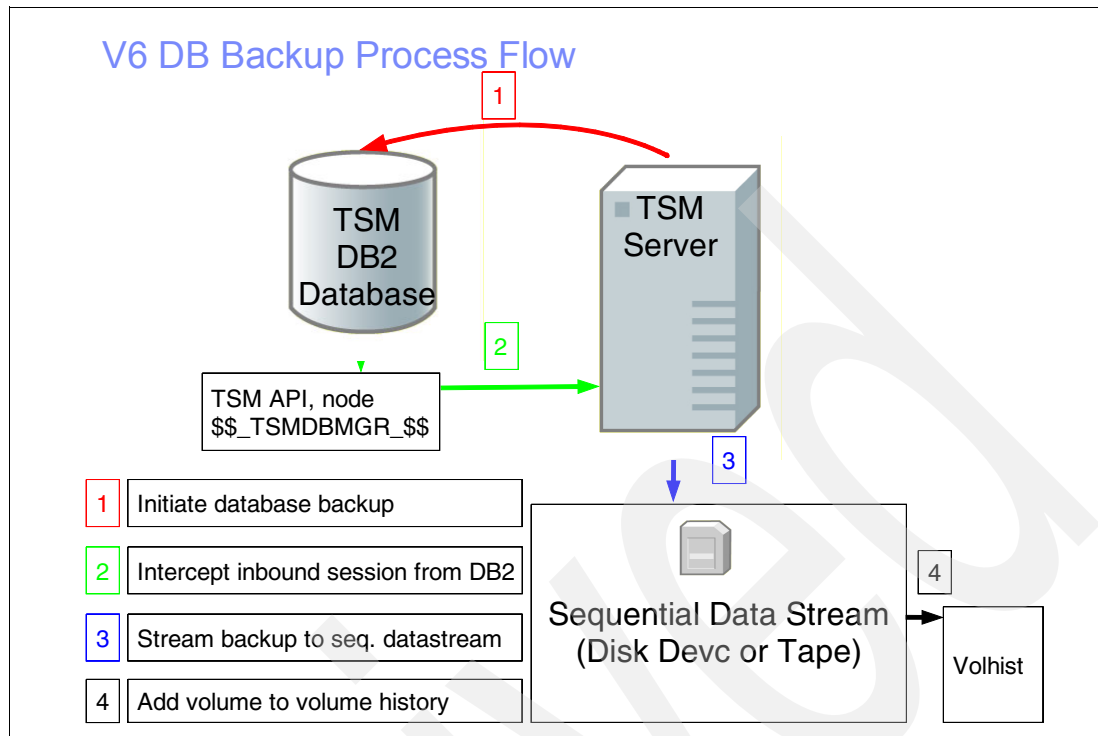


Figure 6-8 V6 database backup process flow

The first time we encounter a server database back up being performed is after installation. Example 6-4 lists the messages reported

Example 6-4 ANR2976I and ANR2974I

```

ANR4726I The ICC support module has been loaded.
ANR0152I Database manager successfully started.
ANR0152I Database manager successfully started.
ANR1380I The buffer pool monitor switch is enabled.
ANR1004I Server formatting complete, database ready for loading.
ANR0369I Stopping the database manager because of a server shutdown.
ANR2976I Offline DB backup for database TSMDB1 started.
ANR2974I Offline DB backup for database TSMDB1 completed successfully.
  
```

Manual database backup

Although the ANR2974I reported with Example 6-4 on page 149 might imply to you that everything is already set up for a successful database backup, at this time, the offline backup is required by DB2 to switch from circular logging to archive logging. The offline backup performed on each **dsmserv loadformat** command uses the archive log directory to hold the backup data.

This initial backup is required by DB2 in order for Tivoli Storage Manager to set the recovery log processing mode to ROLLFORWARD. Now, this database backup only contains the server schema (DDL). This database backup is subsequently deleted because it only contains the server schema definitions which can be recreated by Tivoli Storage Manager anyway.

After completing the installation and configuration of the server, perform a full database backup. This database backup and any subsequent database backups are tracked in the

server volume history, as expected, and used as part of the server disaster recovery manager (DRM) processing.

Configuring for manual database backups

So we still need to complete the configuration for a successful database backup. Example 6-5 shows the error message reported without any configuration being done if you submit the backup command, assumed you have a file device class already configured.

Example 6-5 ANR2590E reported

```
tsm: TIRAMISU>backup db devc=file
ANR2590E BACKUP DB failed - SET DBRECOVERY command has not been issued.
```

So we issue SET DBRECOVERY; Example 6-6 shows the results.

Example 6-6 SET DBRECOVERY command.

```
tsm: TIRAMISU>set dbrecovery file
ANR2782I SET DBRECOVERY completed successfully and device class for automatic
DB backup is set to FILE.
```

You use the SET DBRECOVERY command to specify the device class to be used for full automatic backups. You can verify the current setting with the QUERY DB FORMAT=DETAIL command. See Example 6-7.

Example 6-7 Query the database and verify DBRECOVERY setting

```
TSM:TIRAMISU>q db f=d
ANR2017I Administrator SERVER_CONSOLE issued command: QUERY DB f=d

      Database Name: TSMDB1
Total Size of File System (MB): 59,389
    Space Used by Database(MB): 448
    Free Space Available (MB): 27,231
      Page Size(Bytes):
        Total Pages: 32,772
        Usable Pages: 32,636
        Used Pages: 23,740
        Free Pages: 8,896
    Buffer Pool Hit Ratio: 97.4
    Total Buffer Requests: 53,137
        Sort Overflows: 0
        Lock Escalation: 0
    Package Cache Hit Ratio: 68.5
    Last Database Reorganization:
      Full Device Class Name: FILE
    Incrementals Since Last Full: 1
    Last Complete Backup Date/Time: 06/03/2009 09:19:32
```

As you can see with Example 6-7 on page 150, the output returned by the QUERY DATABASE command has changed. Table 6-3 on page 151 gives you the details.

Table 6-3 QUERY DATABASE description

Field	Description
Database Name	The name of the database
Total Size of File System (MB)	Total space (in megabytes) in the current storage location Windows: Total space on the drive where the directory is located UNIX and Linux: Total space in the file system where the path is located
Space Used by Database (MB)	Space (in megabytes) currently allocated and in use in the current storage location
Free Space Available (MB)	Space (in megabytes) not in use but available in the database Windows: Space remaining on the drive where the directory is located UNIX and Linux: Space remaining in the file system where the path is located
Page Size (Bytes)	The database page size (in bytes)
Total Pages	Total number of pages in table space.
Usable Pages	The number of usable pages in table space.
Used Pages	The number of used pages in table space
Free Pages	Number of pages not in use in table space.
Buffer Pool Hit Ratio	The total hit ratio percentage. The ratio of physical reads to logical reads gives the hit ratio for the buffer pool. The lower the hit ratio, the more the data is being read from disk rather than the cached buffer pool which can be a more costly operation
Total Buffer Requests	The total number of buffer pool data logical reads and index logical reads since the last time the database was started or since the database monitor was reset.
Sort Overflows	The total number of sorts that ran out of the sort heap and might have required disk space for temporary storage
Lock Escalation	The number of times that locks have been escalated from several row locks to a table lock.
Package Cache Hit Ratio	A percentage indicating how well the package cache is helping to avoid reloading packages and sections for static SQL from the system catalogs. It also indicates how well the package cache is helping to avoid recompiling dynamic SQL statements. A high ratio indicates it is successful in avoiding these activities
Last Database Reorganization	The last time that the database manager performed an automatic reorganization activity
Full Device Class Name	The name of the device class this is used for full database backups.

Field	Description
Incrementals Since Last Full	The number of incremental backups that were performed since the last full backup.
Last Complete Backup Date/Time	The date and time of the last full backup.

If the Tivoli Storage Manager DB2 API is not configured, the database backup will fail and you have to manually set up the API:

- ▶ Tivoli Storage Manager API is installed on server machine (done by CLI installation)
- ▶ Tivoli Storage Manager API has the correct client option settings
- ▶ DSMI_DIR, DSMI_CONFIG, DSMI_LOG environment variables are set in DB2 instance process
- ▶ DSMI_DIR, DSMI_CONFIG, DSMI_LOG point to correct places
 - API executables
 - API configuration files
 - API log file directory
- ▶ The correct password is set

Start a manual database backup with the BACKUP DB command as in Example 6-8.

Example 6-8 The first manual backup

```

TSM:TIRAMISU>backup db devc=file type=full
ANR2017I Administrator SERVER_CONSOLE issued command: BACKUP DB devc=file
type=full
ANR4559I Backup DB is in progress.
ANR0984I Process 10 for DATABASE BACKUP started in the BACKGROUND at 09:29:37.
ANR2280I Full database backup started as process 10.
TSM:TIRAMISU>
ANR0406I Session 17 started for node $$_TSMDBMGR_$$ (DB2/NT) (Tcp/Ip
gallium(4668)).
ANR8340I FILE volume G:\TSM\SERVER1\FILECLASS\44132980.DBV mounted.
ANR0511I Session 17 opened output volume G:\TSM\SERVER1\FILECLASS\44132980.DBV.A
NR1360I Output volume G:\TSM\SERVER1\FILECLASS\44132980.DBV opened (sequence
number 1).
ANR1361I Output volume G:\TSM\SERVER1\FILECLASS\44132980.DBV closed.
ANR0514I Session 17 closed volume G:\TSM\SERVER1\FILECLASS\44132980.DBV.
ANR0403I Session 17 ended for node $$_TSMDBMGR_$$ (DB2/NT).
ANR0406I Session 18 started for node $$_TSMDBMGR_$$ (DB2/NT) (Tcp/Ip
gallium(4673)).
ANR8340I FILE volume G:\TSM\SERVER1\FILECLASS\44133021.DBV mounted.
ANR0511I Session 18 opened output volume G:\TSM\SERVER1\FILECLASS\44133021.DBV.A
NR1360I Output volume G:\TSM\SERVER1\FILECLASS\44133021.DBV opened (sequence
number 1).
ANR1361I Output volume G:\TSM\SERVER1\FILECLASS\44133021.DBV closed.
ANR0514I Session 18 closed volume G:\TSM\SERVER1\FILECLASS\44133021.DBV.
ANR0403I Session 18 ended for node $$_TSMDBMGR_$$ (DB2/NT).
ANR4550I Full database backup (process 10) completed.
ANR0985I Process 10 for DATABASE BACKUP running in the BACKGROUND completed
with completion state SUCCESS at 09:30:23.

```

Note that the configuration for a UNIX server database backup through the API differs slightly from the example for the Windows platform.

If you submit the BACKUP DB command with a different device class a warning message ANR4976W will be reported, reminding you about the DBRECOVERY default device class as shown in Example 6-9.

Example 6-9 ANR4976W, database backup to different device class

```
TSM:TIRAMISU>backup db type=full devc=test
ANR2017I Administrator SERVER_CONSOLE issued command: BACKUP DB type=full
devc=test
ANR4976W The device class TEST is not the same as device class FILE defined for
the serverbackup node $_TSMDBMGR_$.
ANR2280I Full database backup started as process 14.ANR4559I Backup DB is in progress.
ANR0984I Process 13 for DATABASE BACKUP started in the BACKGROUND at 10:39:47.
the serverbackup node $_TSMDBMGR_$.
ANR2280I Full database backup started as process 13.
```

If you use the Tivoli Storage Manager Server Instance Configuration wizard to create a server instance, configuration is done automatically. By using the wizard, you can avoid some configuration steps that are complex when done manually. Start the wizard on the system where you installed the Tivoli Storage Manager Version 6.1 server. On a UNIX system, you find the **dsmicfgx** program in the Tivoli Storage Manager server's bin directory. On a Windows system, you can double-click the **dsmicfgx.exe** program in the C:\Program Files\Tivoli\TSM\server directory.

Note: Use the GUI post-installation configuration, **dsmicfgx** or **dsmicfgx.exe**, to configure the server for database backup. You avoid configuration steps that are complex when done manually.

Summary

You do not have to submit DB2 commands to backup a V6 Tivoli Storage Manager database. You can still use the known backup commands for manual database backups, as you did with earlier versions. However, you need to configure the server to be able to backup through the API used by DB2 to complete the task.

Configuring the server for automatic database backups

The same commands are available to backup the server Version 6 database as it was in prior releases.

Backup methodologies

If the Tivoli Storage Manager server database or the recovery log is unusable, the entire server is unavailable. If a database is lost and cannot be recovered, all of the data managed by that server is lost. If a storage pool volume is lost and cannot be recovered, the data on the volume is also lost.

To back up the database and storage pools regularly, define administrative schedules. If you lose your database or storage pool volumes, you can use offline utilities provided by IBM Tivoli Storage Manager to restore your server and data.

With the proprietary database, good practice has been to configure for regular full backups followed by a sequence of incremental backups. The maximum number of incremental backups you can run between full backups is 32. Assuming you scheduled weekly full backups, the scenario looks like the one shown with Figure 6-9 on page 154.

V5 database backup

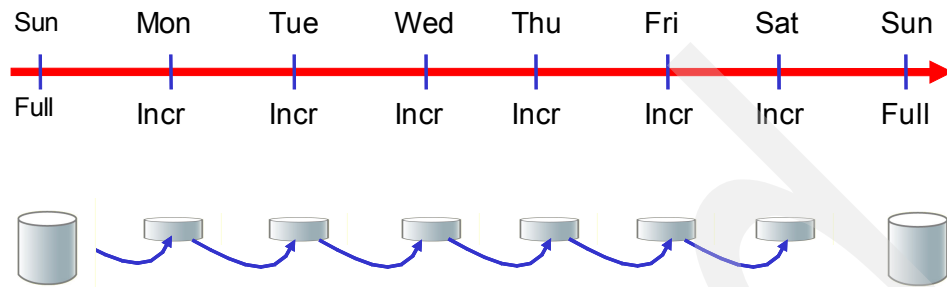


Figure 6-9 V5 style database backup schedule

The V6 backup command does not appear to have changed much since the previous version; the database backup methodologies supported are:

- ▶ Full Backup
 - Specifies that you want to run a full backup of the Tivoli Storage Manager database.
 - For devclass tape, at least one tape volume is used; it contains the database backup and also active/archive logs since the last full backup.
 - For devclass file, at least two volumes are used; the first contains the database backup, the second contains active or archive logs since last full backup.
 - Clears the archive logs.
- ▶ Incremental Backup
 - Runs an incremental backup of the Tivoli Storage Manager database. An incremental (or cumulative) backup image contains a copy of all database data that has changed since the last successful full backup operation was performed.
 - For devclass tape, at least one volume is used; it contains changed pages, plus initial database metadata.
 - For devclass file, at least two volumes are used; they contain changed pages, plus initial database metadata.
- ▶ Tivoli Storage Manager DB Snapshot
 - Specifies that you want to run a full snapshot database backup. The entire contents of a database are copied and a new snapshot database backup is created without interrupting the existing full and incremental backup series for the database.
 - Should be used in addition to full and incremental backups.
 - For devclass tape, at least one tape volume is used; it contains the database backup and also active and archive logs since last full backup.
 - At least two volumes used; the first volume contains the database backup, the second contains active and archive logs since last full backup.

The following file device class volume naming conventions apply:

- DBV: normal backup file device class volume
- DSS: snapshot backup file device class volume

Now, we compare the V5 style database backup schedule with the same approach adopted to a V6 server. Figure 6-10 shows how the space requirements rise with each incremental backup.

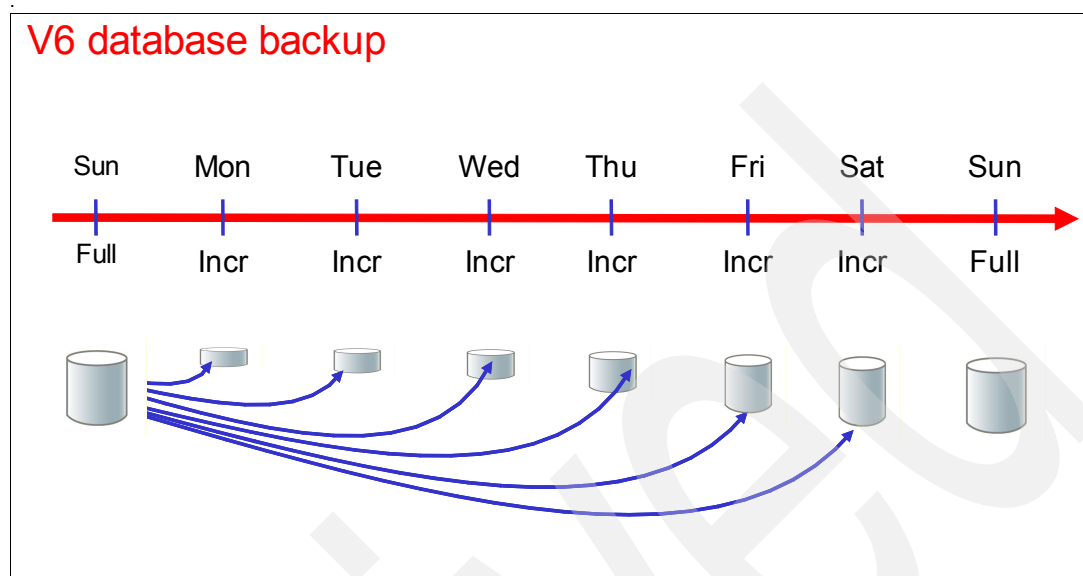


Figure 6-10 V6 style database backup schedule

In DB2 terms, the backup methodology introduced for the Tivoli Storage Manager server is an *incremental cumulative backup*. The incremental database now represents all database data that has changed since the most recent, successful, full backup operation. For example, if you plan to restore to Wednesday's backup, you only need Sunday's full backup, plus the last incremental backup for Wednesday. If you want to complete the same task in V5 you need Sunday's full backup and the incremental backup volumes from Monday, Tuesday, and Wednesday.

If you are used to the methodology of weekly full database backups and in-between incremental backups, you should notice the difference when staying with this approach:

1. Only full backups allow for the deletion of archive log volumes.
2. The incremental backups do not free archive log space, requiring more space in the archive log directories.
3. The incremental database backups result in increased volume utilization to include the additional archive log information.

Scheduled automatic backups

We describe how to configure regular database backups and combine those with triggered backups. As an administrator, you are responsible for monitoring the activity log and adjust the scheduled backups to best meet your requirements.

Define a scheduled database backup as an administrative schedule. Example 6-10 on page 156 shows the command.

Example 6-10 Define a schedule for full database backup

```
TSM:TIRAMISU>define schedule db_daily_backup type=administrative cmd="backup db
deviceclass=file type=full" starttime=10:00
ANR2017I Administrator SERVER_CONSOLE issued command: DEFINE SCHEDULE db_daily_backup
type=administrative cmd='backup db deviceclass=file type=full'
starttime=10:00
ANR2577I Schedule DB_DAILY_BACKUP defined.
TSM:TIRAMISU>q sched db_daily_backup type=admin f=d
ANR2017I Administrator SERVER_CONSOLE issued command: QUERY SCHEDULE
db_daily_backup type=admin f=d
```

```

Schedule Name: DB_DAILY_BACKUP
Description:
  Command: backup db deviceclass=file type=full
  Priority: 5
Start Date/Time: 06/12/2009 10:00:00
Duration: 1 Hour(s)
Schedule Style: Classic
  Period: 1 Day(s)
  Day of Week: Any
  Month:
  Day of Month:
  Week of Month:
Expiration:
  Active?: No
Last Update by (administrator): SERVER_CONSOLE
Last Update Date/Time: 06/12/2009 18:55:45
Managing profile:
```

With this setup, we protect the server by running database backups at least once per day. More frequent backups might be needed if the server handles high numbers of client transactions. Monitor the activity log for triggered database backups that are starting and for messages that indicate a database backup is required; see Table 6-5 on page 159. The observation enables for proper scheduling. A best practice is to schedule regular backups of the server database, and verify that they occur as scheduled. We do this with Example 6-11.

Example 6-11 Verification that scheduled database backups are working

```
ANR2750I Starting scheduled command db_daily_backup ( backup db deviceclass=file type=full
).
ANR2017I Administrator SERVER_CONSOLE issued command: BACKUP DB type=full
devc=file
ANR0984I Process 2 for DATABASE BACKUP started in the BACKGROUND at 14:51:29.
ANR2280I Full database backup started as process 2.
TSM:TIRAMISU>
ANR0406I Session 1 started for node $$_TSMDBMGR_$$ (DB2/NT) (Tcp/Ip gallium(32-
23)).
ANR8340I FILE volume G:\TSM\SERVER1\FILECLASS\44843491.DBV mounted.
ANR0511I Session 1 opened output volume G:\TSM\SERVER1\FILECLASS\44843491.DBV.
ANR1360I Output volume G:\TSM\SERVER1\FILECLASS\44843491.DBV opened (sequence
number 1).
ANR1361I Output volume G:\TSM\SERVER1\FILECLASS\44843491.DBV closed.
ANR0514I Session 1 closed volume G:\TSM\SERVER1\FILECLASS\44843491.DBV.
ANR0403I Session 1 ended for node $$_TSMDBMGR_$$ (DB2/NT).
ANR0406I Session 2 started for node $$_TSMDBMGR_$$ (DB2/NT) (Tcp/Ip gallium(32-
49)).
ANR8340I FILE volume G:\TSM\SERVER1\FILECLASS\44843516.DBV mounted.
ANR0511I Session 2 opened output volume G:\TSM\SERVER1\FILECLASS\44843516.DBV.
ANR1360I Output volume G:\TSM\SERVER1\FILECLASS\44843516.DBV opened (sequence
```


number 1).

```

ANR1361I Output volume G:\TSM\SERVER1\FILECLASS\44843516.DBV closed.
ANR0514I Session 2 closed volume G:\TSM\SERVER1\FILECLASS\44843516.DBV.
ANR0403I Session 2 ended for node $$_TSMDBMGR_$$ (DB2/NT).
ANR4550I Full database backup (process 2) completed.
ANR0985I Process 2 for DATABASE BACKUP running in the BACKGROUND completed with
completion state SUCCESS at 14:51:57.

```

Triggered automatic backups

With the combination of automatic and triggered backups, you can have a good idea of the schedule definitions that must be implemented.

With DB2 automatic backup enabled, DB2 can decide to perform database backups based on a number of criteria or thresholds, including the following questions:

- ▶ Has the minimum required number of full backups been performed?
- ▶ Has the time interval between database backups been exceeded?
- ▶ How much log space has been consumed since the last database backup?

After evaluating the DB2 automatic database backup capabilities in the development lab, the database backup processing was determined not to be consistent with the typical server administration model used by Tivoli Storage Manager.

Administrators used the DBBACKUPTRIGGER command to specify when Tivoli Storage Manager backs up the database. A backup occurred when the specified percentage of the assigned capacity of the recovery log was reached. Configuring the DBBACKUPTRIGGER is no longer required. There is a new approach to trigger database backups; frequency and timing of the database backup are explicitly controlled by the Tivoli Storage Manager server itself.

Tivoli Storage Manager triggers full and incremental database backup as a result of the following criteria:

- ▶ Log space consumed since the last backup

The DB2 API `db2GetSnapshot()` function is used to get the first (`firstActiveLogFileName`) and the last active log file number (`lastActiveLogFileName`)

Calculate `logSpaceUsedSinceLastBackup` by counting the number of log files used since the last backup and multiply by the log file size:

$$\text{lastActiveLogFileName} - (\text{firstActiveLogFileName} + 1) \times 512$$

If this value is greater than the maximum log size, the `ACTIVELOGSIZE` parameter configured with the **[load]format** command, a full database backup is started. This represents the same trigger that would be used by automatic DB2 backup trigger: How much log space has been consumed since the last database backup?

- ▶ Log utilization ratio

The DB2 API `db2GetSnapshot()` function is used to get `totalActiveLogSpaceUsed` and `totalActiveLogSpaceAvailable`.

The log utilization ratio is calculated with the following formula:

$$\text{logUsedRatio} = \text{totalActiveLogSpaceUsed} / (\text{totalActiveLogSpaceUsed} + \text{totalActiveLogSpaceAvailable})$$

If the `logUsedRatio` exceeds the predefined threshold of 80%, an automatic incremental backup will be triggered.

Use the QUERY LOG F=D command to monitor the log usage, the output changed from earlier versions. For details see Example 6-12. If the server is not running, you can use the DSMSEV DISPLAY LOG utility (details are in Table 8-2 on page 276).

Example 6-12 QUERY LOG command

```
TSM:TIRAMISU>q log f=d
ANR2017I Administrator SERVER_CONSOLE issued command: QUERY LOG f=d

      Total Space(MB): 2,048
      Used Space(MB): 0.28
      Free Space(MB): 2,039.72
      Active Log Directory: d:\tsm\server1\activelog
      Mirror Log Directory:
      Archive Failover Log Directory:
      Archive Log Directory: d:\tsm\server1\archivelog
```

Table 6-4 explains the new fields for the QUERY LOG F=D command:

Table 6-4 QUERY LOG command

Field	Description
Total Space(MB)	Specifies the maximum size in megabytes of the active log.
Used Space(MB)	Specifies the total amount of active log space that is used in the database in megabytes
Free Space(MB)	Specifies the amount of active log space in the database that is not being used by uncommitted transactions in megabytes
Active Log Directory	Specifies the location where active log files are stored. When you change the active log directory, the server moves all archived logs to the archive log directory and all active logs to a new active log directory
Mirror Log Directory	Specifies the location where the mirror for the active log is maintained
Archive Failover Log Directory	Specifies the location into which the server saves archive logs if the logs cannot be archived to the archive log directory
Archive Log Directory	Specifies the location into which the server can archive a log file after all the transactions that are represented in that log file are completed

Messages indicating a database backup is required

In addition to the triggered backup-related activity log messages, you should watch the server activity log for occurrences of the messages shown with Table 6-5 on page 159. If any of the messages occurs, you must monitor the available space in the active log and archive log storage paths. You might have to run an additional database and adjust your database backup schedules.

Table 6-5 Database related messages requiring administrator attention

Message	Reason for the message being issued
ANR0293I	The server is performing an online reorganization for the table referenced in the message.
ANR0294I	The online reorganization for the table referenced in the message has ended.
ANR0295I	The active log space used exceeds the log utilization threshold.
ANR0296I ^a	The space used in the log file system exceeds the threshold for log file system utilization.
ANR0297I	The log space used since the last database backup exceeds the maximum log file size.

a. For some configurations, this message can be ignored. See the following technote for details:
<http://www.ibm.com/support/docview.wss?uid=swg21380107>

Online table reorganization consumes log space. As a result of the log use because of database reorganization, a database backup might become necessary to manage the available active log space. Example 6-13 shows the messages being issued for the BF.Aggregated.Bitfiles and the Backup.Objects tables.

Example 6-13 ANR0293I, ANR0294I:Indicators for database backup requirement

```

ANR0293I Reorganization for table BF.Aggregated.Bitfiles started.
..
ANR0294I Reorganization for table BF.Aggregated.Bitfiles ended.
..
ANR0293I Reorganization for table Backup.Objects started.
..
ANR0294I Reorganization for table Backup.Objects ended.

```

If you try to back up a database without a valid VOLUMEHISTORY option configured to the dsmserv.opt file, the backup can fail with message ANR2639E, shown in Example 6-14.

Example 6-14 ANR2639E; VOLUMEHISTORY option not configured

```

TSM:TIRAMISU>backup db type=full devc=file
ANR2017I Administrator SERVER_CONSOLE issued command: BACKUP DB type=full
devc=file
ANR2639E BACKUP DB failed - no files have been defined for storing sequential
volume history information.

```

Summary

In Tivoli Storage Manager V5.x, the log was circular and as such the notion of how much log would be freed up by a database backup had significance because it implied that the log was healthy and the end of the log could be moved up to free some amount of space based on the database backup.

With V6, the log no longer is circular, so the need to free a specific amount of log space during a database backup is no longer significant. Database backup with V6 is more purely oriented on protecting the database than was previously the case.

Although the V5 database backup triggers are no longer supported, Tivoli Storage Manager still triggers automatic backups. Depending on which trigger is met, a full or an incremental backup is executed.

Process flow for restoring the database

If a database is damaged or destroyed and a database backup and other files are available, the database can be restored. In addition to simply preparing for a disaster, you can also use the restore process to distribute your database and or log volumes to different file systems available to your Tivoli Storage Manager server.

Figure 6-11 explains the new flow for a restore process of the Tivoli Storage Manager server database.

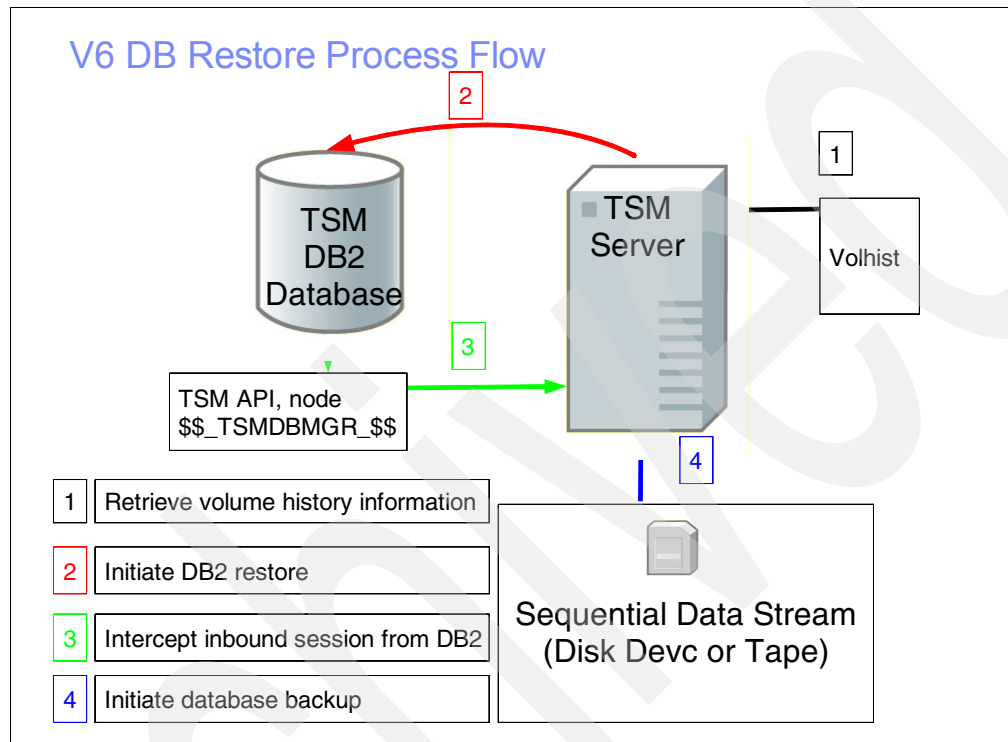


Figure 6-11 V6 database restore process flow

Three types of database restore operations are supported:

- ▶ Restoring the database to its most current state
- ▶ Restoring the database to a point in time
- ▶ Restoring the database from a snapshot

This chapter has an example of a restore scenario and the requirements necessary for successfully restoring.

Prerequisites for restoring

To restore your database, the following information is required:

- ▶ You must have copies of the volume history file and the device configuration file.
- ▶ You must have copies of, or you must be able to create, the server options file and the database and recovery log setup information (the output from detailed queries of your database and recovery log).

The server needs information from the volume history file. Volume history information is stored in the database, but during a database restore operation, it is not available from there.

Important: Make a copy of your volume history file and save it. The file cannot be re-created.

The database volumes we created with the database backup from Example 6-8 on page 152 are listed by the volume history file as shown in Example 6-15.

Example 6-15 Volume history file content

```
*****
*
*                               Sequential Volume Usage History
*                               Updated 06/04/2009 09:30:23
*
*****
Operation Date/Time: 2009/06/12 14:51:29

Volume Type: BACKUPFULL
* Location for volume G:\TSM\SERVER1\FILECLASS\44843491.DBV is: ''
Database Backup LLA: FULL_BACKUP.20090612145129.1
Database Backup HLA: \NODE0000\
Volume Name: "G:\TSM\SERVER1\FILECLASS\44843491.DBV"
Backup Series:      5
Backup Op:          0
Volume Seq:         1
Device Class Name:  FILE
Database Backup ID:      0 ,      3073
Database Backup Home Position:  0
Database Backup Total Data Bytes :      0 , 381800459
Database Backup Total Log Bytes:      0 , 13656075
Database Backup Log Block Number:     -1 ,      -1
*****
Operation Date/Time: 2009/06/12 14:51:29

Volume Type: BACKUPFULL
* Location for volume G:\TSM\SERVER1\FILECLASS\44843516.DBV is: ''
Database Backup LLA: FULL_BACKUP.20090612145129.2
Database Backup HLA: \NODE0000\
Volume Name: "G:\TSM\SERVER1\FILECLASS\44843516.DBV"
Backup Series:      5
Backup Op:          0
Volume Seq:         2
Device Class Name:  FILE
Database Backup ID:      0 ,      3074
Database Backup Home Position:  0
Database Backup Total Data Bytes :      0 , 381800459
Database Backup Total Log Bytes:      0 , 13656075
Database Backup Log Block Number:     -1 ,      -1
*****
```

There is new information in the volume history file and the volume history file is now needed for restoring the database. The new information is:

- ▶ Database Backup LLA

This is provided by DB2 and used by the process of restoring to determine the DB2 backup time stamp.

- ▶ Database Backup Home Position

This is the home position for the tape used by the restore process to know where the database data starts. This is only valid for tape volumes; for file device class, this is 0 (zero).

- ▶ Database Backup Total Data Bytes

This is the total number of DB data bytes in this database backup.

- ▶ Database Backup Total Log Bytes:

This is the total number of bytes for recovery log in this database backup.

- ▶ Database Backup Log Block Number:

This is the starting block number where the backup recovery log starts. This is only valid for tape volumes; for file device class, this is -1 (minus 1). Tivoli Storage Manager needs this information because the database backup/restore operations are done in two sessions: One is for the database data and the other is for the recovery logs.

Note: Saving your volume history file is essential. Without it, you cannot restore your database.

To ensure the availability of volume history information, be sure to take one of the following steps:

- ▶ Store at least one copy of the volume history file off site or on a disk separate from the database.
- ▶ Store a printout of the file off site.
- ▶ Store a copy of the file off site with your database backups and device configuration file.
- ▶ Store a remote copy of the file, for example, on an NFS-mounted file system.

The VOLUMEHISTORY server option enables you to specify backup volume history files. Then, whenever the server updates volume information in the database, it also updates the same information in the backup files.

You can also back up the volume history information at any time, by using the **backup volhistory** command. If you do not specify file names, the server backs up the volume history information to all files specified with the VOLUMEHISTORY server option.

To ensure that updates are complete before the server is halted, follow these steps:

1. Do not halt the server for a few minutes after issuing the BACKUP VOLHISTORY command.
2. Specify multiple VOLUMEHISTORY options in the server options file.
3. Examine the volume history file to see if the file is updated.

Restoring the database

Before we can start the restore process, we create a file for the database directory locations to be used with the restore command. We enter each location on a separate line. In our scenario the dbdir.txt file has the definitions, shown in Example 6-16.

Example 6-16 dbdir.txt file

```
i:\tsm\dbdir1  
j:\tsm\dbdir2
```

Example 6-17 documents the restore process. Note that we had to fully qualify the on parameter to the restore command for this to work successfully. This parameter specifies a file that lists the directories to which the database will be restored. (Our definition are in Example 6-16 on page 163.)

Example 6-17 Database restore to a new database and log structure.

```
G:\Program Files\tivoli\tsm\server1>"c:\Program Files\tivoli\tsm\server\dsmserve.exe"  
restore db todate=today totime=now source=dbsnapshot  
on=g:\progra~1\tivoli\tsm\server1\dbdir.txt active=logd=k:\tsm\active  
recoveryd=m:\recoveryd  
ANR0900I Processing options file G:\Program Files\tivoli\tsm\server1\dsmserve.o-  
pt.  
ANR7800I DSMSESV generated at 09:55:28 on Jun 11 2009.
```

Tivoli Storage Manager for Windows
Version 6, Release 1, Level 2.0

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```
ANR4726I The ICC support module has been loaded.  
ANR1636W The server machine GUID changed: old value (), new value (10.81.67.e1-  
.6a.5a.11.dd.aa.6e.00.02.55.c6.b9.40).  
ANR7808W Sun Microsystems Library Attach module libacs.dll is not available from the  
system.  
ANR8200I TCP/IP Version 4 driver ready for connection with clients on port 1500.  
ANR0152I Database manager successfully started.  
ANR4916I Starting point-in-time database restore snapshot to date 06/12/2009 16:50:55.  
ANR4620I Database backup series 2 operation 0 device class FILE.  
ANR8340I FILE volume G:\TSM\SERVER1\FILECLASS\44844582.DSS mounted.  
ANR1363I Input volume G:\TSM\SERVER1\FILECLASS\44844582.DSS opened (sequence number 1).  
ANR1364I Input volume G:\TSM\SERVER1\FILECLASS\44844582.DSS closed.  
ANR8340I FILE volume G:\TSM\SERVER1\FILECLASS\44844610.DSS mounted.  
ANR1363I Input volume G:\TSM\SERVER1\FILECLASS\44844610.DSS opened (sequence number 1).  
ANR1364I Input volume G:\TSM\SERVER1\FILECLASS\44844610.DSS closed.  
ANR4638I Restore of backup series 2 operation 0 in progress.  
ANR0406I Session 1 started for node $$_TSMDBMGR_$$ (DB2/NT) (Tcp/Ip gallium(2688)).  
ANR8340I FILE volume G:\TSM\SERVER1\FILECLASS\44844582.DSS mounted.  
ANR0510I Session 1 opened input volume G:\TSM\SERVER1\FILECLASS\44844582.DSS.  
ANR1363I Input volume G:\TSM\SERVER1\FILECLASS\44844582.DSS opened (sequence number 1).  
ANR4912I Database full restore in progress and DB Data bytes transferred 67,371,008.  
ANR4912I Database full restore in progress and DB Data bytes transferred 134,742,016.  
ANR4912I Database full restore in progress and DB Data bytes transferred 202,113,024.  
ANR4912I Database full restore in progress and DB Data bytes transferred 269,484,032.  
ANR4912I Database full restore in progress and DB Data bytes transferred 336,855,040.
```

```

ANR1365I Volume G:\TSM\SERVER1\FILECLASS\44844582.DSS closed (end reached).
ANR4912I Database full restore in progress and DB Data bytes transferred 381,800,459.
ANR1364I Input volume G:\TSM\SERVER1\FILECLASS\44844582.DSS closed.
ANR0514I Session 1 closed volume G:\TSM\SERVER1\FILECLASS\44844582.DSS.
ANR0403I Session 1 ended for node $$_TSMDBMGR_$$ (DB2/NT).
ANR0406I Session 2 started for node $$_TSMDBMGR_$$ (DB2/NT) (Tcp/Ip gallium(2710)).
ANR8340I FILE volume G:\TSM\SERVER1\FILECLASS\44844610.DSS mounted.
ANR0510I Session 2 opened input volume G:\TSM\SERVER1\FILECLASS\44844610.DSS.
ANR1363I Input volume G:\TSM\SERVER1\FILECLASS\44844610.DSS opened (sequence number 1).
ANR1365I Volume G:\TSM\SERVER1\FILECLASS\44844610.DSS closed (end reached).
ANR4912I Database full restore in progress and DB transaction log bytes transferred
27,291,659.
ANR1364I Input volume G:\TSM\SERVER1\FILECLASS\44844610.DSS closed.
ANR0514I Session 2 closed volume G:\TSM\SERVER1\FILECLASS\44844610.DSS.
ANR0403I Session 2 ended for node $$_TSMDBMGR_$$ (DB2/NT).
ANR0406I Session 3 started for node $$_TSMDBMGR_$$ (DB2/NT) (Tcp/Ip gallium(2712)).
ANR0403I Session 3 ended for node $$_TSMDBMGR_$$ (DB2/NT).
ANR0153I Database manager already running.
ANR1380I The buffer pool monitor switch is enabled.
ANR0153I Database manager already running.
ANR4917I Point-in-time database restore with snapshot complete, restore date 06/12/2009
15:09:40.
ANR0369I Stopping the database manager because of a server shutdown.

```

Our restore process is complete, but did we reach our goal, the relocation of the database and log volumes. We start the server and use the QUERY DBSPACE and the QUERY LOG command again to verify; the result is shown in Example 6-18. The database is spread over drives J and K; the active log is on drive K and the archive log was relocated to drive L. Mission completed.

Example 6-18 Relocation verification

```

TSM:TIRAMISU>q dbspace
ANR2017I Administrator SERVER_CONSOLE issued command: QUERY DBSPACE

                Location: j:\tsm\dbdir2
Total Size of File System (MB): 5,114.41
Space Used on File System (MB): 709.00
    Free Space Available (MB): 4,405.41

                Location: i:\tsm\dbdir1
Total Size of File System (MB): 5,114.41
Space Used on File System (MB): 708.98
    Free Space Available (MB): 4,405.43

TSM:TIRAMISU>q log f=d
ANR2017I Administrator SERVER_CONSOLE issued command: QUERY LOG f=d

                Total Space(MB): 2,048
                Used Space(MB): 2.80
                Free Space(MB): 2,037.20
                Active Log Directory: k:\tsm\activelog
                Mirror Log Directory:
Archive Failover Log Directory:
                Archive Log Directory: L:\tsm\archivelog

```

Summary

In this section, we discussed an example of a database restore scenario. You should now know how to prepare and complete a database restore process. In addition, you now understand that the V5 approach of adding and deleting databases volumes for Tivoli Storage Manager database relocation no longer works. Relocating server volumes requires restoring the database and results in server downtime. Therefore, planning in the beginning is important.

6.1.6 Data policies

The Tivoli Storage Manager data management is governed through one or more policy domains, policy sets, management classes, and copy groups:

- **Policy domain:** A policy domain is a group of policy users with one or more policy sets that manage the data and storage resources. Each Tivoli Storage Manager client is associated to a policy domain. The following command defines a policy domain named AIX:

```
define domain AIX
```

- **Policy set:** A policy set contains one or more management classes that exist for a policy domain. Although a number of policy sets can be created, only one can be active at any given time. The following command defines a policy set named POLICY1 for the AIX policy domain:

```
define policyset AIX POLICY1
```

- **Management class:** A management class defines how the data will be managed. There can be multiple archive or backup management classes for a policy domain. The following command defines the management class SYSTEM to the AIX domain and POLICY1 policy set:

```
define mgmtclass AIX POLICY1 SYSTEM
```

- **Copy groups:** Copy groups control the data retention of the backup versions and archive copies. Copy groups also control which storage pool will be used for each management class. The following command creates a backup copy group for the AIX policy domain, POLICY1 policy set, SYSTEM management class:

```
define copygroup AIX POLICY1 SYSTEM type=backup destination=backuppools  
verexists=2 verdeleted=1 retextra=30 retonly=60
```

- The policy definitions can be checked to verify that the policy set is complete. The following command verifies the policy set definitions:

```
validate policyset AIX POLICY1
```

- The following command activates the policy set if no significant errors are found:

```
activate policyset AIX POLICY1
```

- The following command sets the SYSTEM management class as the default for the AIX domain policy, POLICY1 domain:

```
assign defmgmtclass AIX POLICY1 SYSTEM
```

6.2 Setting up storage pools

When you are defining a new device for the Tivoli Storage Manager server, the device must first be configured for the operating system.

In Figure 6-12 you can see how physical and logical storage objects are interacting.

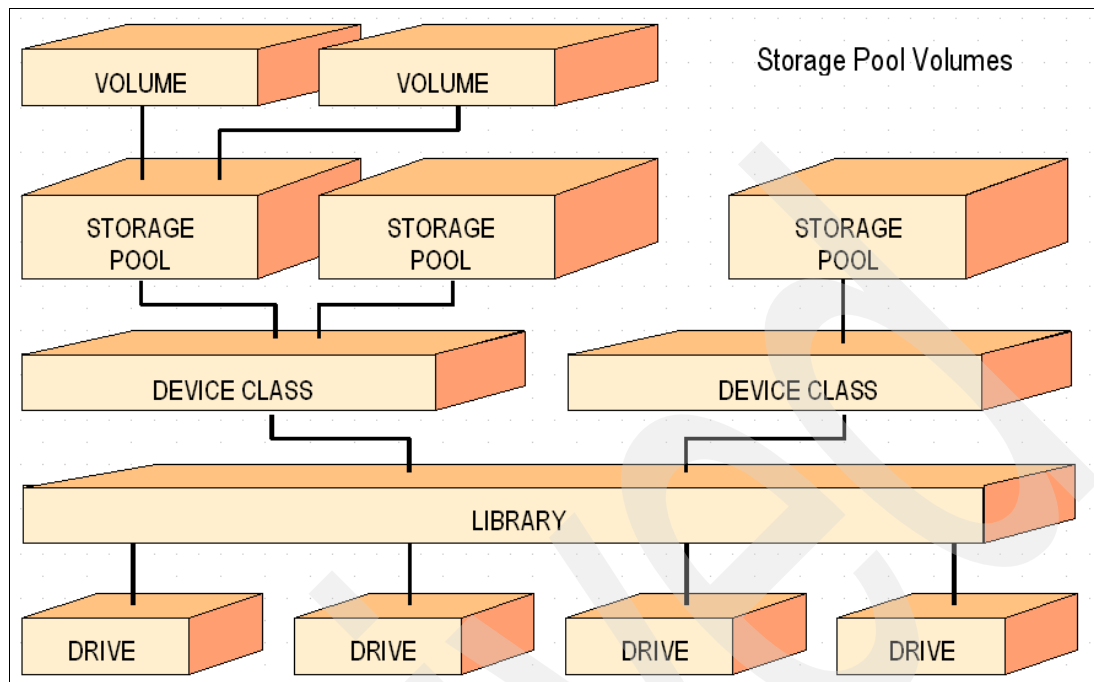


Figure 6-12 Overview of physical and logical storage objects

Tivoli Storage Manager treats physical devices as the following two types, which are connected locally to the server:

- Random access devices

Random access devices refer to magnetic disk devices that are used for two main purposes:

- To store the database and recovery log.
- To store client data that has been backed up or archived from client nodes. The client data is stored in disk storage pools.

- Sequential storage devices

For Tivoli Storage Manager, sequential storage devices are tape libraries, optical devices, WORM devices, and active data storage pools. They are stored using the FILE device class.

To configure a device for Tivoli Storage Manager, six components must be configured in two component classes, physical and logical as follows:

- Physical:

- Library: AUTOMATED or MANUAL.
- Drive (or drives, if there are more than one in your library)
- Library and tape path or disk path.

- Logical:

- Device class: Here you specify the device type and associate the device class name with the device type and the library name. Here the device type is from a Tivoli Storage Manager defined list, and the command is common to all Tivoli Storage Manager server platforms, for example, 4MM, DLT, FILE, or LTO.

- Storage pool: This specifies the device class to use for the storage pool that you are creating and includes specific storage pool rules for handling data.
- Volumes: This is where you label the volumes and either define them as scratch volumes or as private volumes belonging to a particular storage pool.

Important: To successfully define storage pools to Tivoli Storage Manager, a certain order 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, and therefore it should be created first.

6.2.1 Defining a library (physical class)

First, you must define a library, even if you are using a single tape drive. The **define library liblt04 libtype=scsi autolabel=yes** command defines an automated library named liblt04. There is no device name associated with a manual library, because the library part is considered virtual.

6.2.2 Defining a device path to the automated library (physical class)

Define a path from a source to a destination. A path provides access to a destination from a source. You must define the source and destination before you can define a path.

For example, if a path is required between a server and a library, you must first issue the DEFINE LIBRARY command and then issue the DEFINE PATH command. A path must be defined after you issue the DEFINE LIBRARY command in order to make the library usable by Tivoli Storage Manager software. It must also be defined before you can define your drives.

The following command defines a library path:

```
define path ITSM_Server LIBLT04 srct=server autodetect=yes desttype=library
device=/dev/smc0
```

6.2.3 Defining a drive (physical class)

After defining the library, you should define a drive for the library to use, utilizing the device number that the operating system uses to recognize it. The drive therefore must be configured for that operating system.

To define a drive named ltodrive1 in the automated library, named liblt04, use the following command:

```
define drive liblt04 ltodrive1 serial=autodetect online=yes element=autodetect
```

6.2.4 Defining a device path to the drive (physical class)

Use this command to define a path from a source to a destination. A path provides access to a destination from a source. You must define the source and destination before you can define a path.

For example, if a path is required between a server and a drive, you must first issue the DEFINE DRIVE command and then issue the DEFINE PATH command. A path must be defined after you issue the DEFINE DRIVE command in order to make the drive usable by Tivoli Storage Manager software.

The following command defines a drive path:

```
define path ITSM_SERVER LT0DRIVE1 srct=server autodetect=yes desttype=drive  
libr=LIBLT04 device=/dev/rmt0
```

6.2.5 Defining a device class (logical class)

A device class can be considered a software driver. It is defined so that Tivoli Storage Manager can communicate with the physical drive correctly. The following command defines a device class named `lto_class1` that uses a predefined Tivoli Storage Manager device type of LTI in the library named LIBLT04:

```
DEFINE DEVCLASS LTO_CLASS_1 DEVTYPE=LTO FORMAT=DRIVE ESTCAPACITY=52428800K  
MOUNTLIMIT=DRIVES MOUNTWAIT=60 MOUNTRETENTION=60 LIBRARY=LIBLT04
```

After you have set up the device classes to match the physical devices available to your Tivoli Storage Manager server, you use these classes when defining the storage pools.

6.2.6 Defining a storage pool (logical class)

This section discusses various storage pools.

Random access device storage pools

We do not need to define the device class for a disk storage pool, because the disk storage pools use the Tivoli Storage Manager predefined device class called DISK.

Sequential storage pools

A disk can simulate a sequential device, such as tape using the FILE device class. If you are using a single tape drive and want to perform reclamation, then the pool type you specify as the reclaim storage pool must be a primary sequential storage pool. The FILE device class is required when active data storage pools are created.

A copy pool must also use sequential access storage and can be defined on a disk using this device type. To configure a sequential storage pool, you must first define a FILE device class, and indicate to Tivoli Storage Manager which directory to use and what the maximum size of this file can be.

Determine the amount of disk space needed for any of the storage pools:

- ▶ For *backup* storage pools, provide enough disk space to support sufficient daily incremental backups.
- ▶ For *archive* storage pools, provide sufficient space for a user to archive a file system of moderate size without causing migration from the disk storage pool to occur.
- ▶ For *active-data* storage pools, provide sufficient disk or tape space that allows for the daily rate of change for all the servers that will use this storage pool.

The following command defines a device class named CFILE using a Tivoli Storage Manager predefined device type of FILE with a maximum capacity of 12 MB:

```
define devclass cfile devtype=file directory=/tsm/stgpool/ maxcapacity=12m
```

The following command lists the capacity of the storage pools:

```
query stg
```

Active-data storage pool

An active-data storage pool contains only active versions of client backup data.

Active-data pools are useful for fast client restores, reducing the number of on-site or off-site storage volumes, or reducing bandwidth when copying or restoring files that are vaulted electronically in a remote location.

Data migrated by hierarchical storage management (HSM) clients and archive data are not permitted in active-data pools. As updated versions of backup data continue to be stored in active-data pools, older versions are deactivated and removed during reclamation processing.

Restoring a primary storage pool from an active-data pool might cause some or all inactive files to be deleted from the database if the server determines that an inactive file needs to be replaced but cannot find it in the active-data pool. As a best practice and to protect your inactive data, therefore, you should create a minimum of two storage pools: one active-data pool, which contains only active data, and one copy storage pool, which contains both active and inactive data. You can use the active-data pool volumes to restore critical client node data, and afterward you can restore the primary storage pools from the copy storage pool volumes. Active-data pools should not be considered for recovery of a primary pool or volume unless the loss of inactive data is acceptable.

Active-data pools can use any type of sequential-access storage (for example, a tape device class or FILE device class). However, the precise benefits of an active-data pool depend on the specific device type associated with the pool. For example, active-data pools associated with a FILE device class are ideal for fast client restore operations because FILE volumes do not have to be physically mounted and because the server does not have to position past inactive files that do not have to be restored. In addition, client sessions restoring from FILE volumes in an active-data pool can access the volumes concurrently, which also improves restore performance.

Active-data pools that use removable media, such as tape or optical, offer similar benefits. Although tapes need to be mounted, the server does not have to position past inactive files. However, the primary benefit of using removable media in active-data pools is the reduction of the number of volumes used for on-site and off-site storage. If you vault data electronically to a remote location, an active-data pool associated with a SERVER device class lets you save bandwidth by copying and restoring only active data.

Remember the following information:

- ▶ The server does not attempt to retrieve client files from an active-data pool during a point-in-time restore operation. Point-in-time restore operations require both active and inactive file versions. Active-data pools contain only active file versions. For optimal efficiency during point-in-time restore operations and to avoid switching between active-data pools and primary or copy storage pools, the server retrieves both active and inactive versions from the same storage pool and volumes.
- ▶ You cannot copy active data to an active-data pool from a primary storage pool defined with the NETAPPDUMP, the CELERRADUMP, or the NDMPDUMP data format.
- ▶ You cannot copy active data from a primary storage pool defined with a CENTERA device class.

Copying active versions of client backup data to active-data pools

To copy active versions of client backup files from primary storage pools to active-data pools, you can issue the COPY ACTIVE DATA command or you can use simultaneous-write function, which automatically writes active backup data to active-data pools at the same time that the backup data is written to a primary storage pool.

You can issue the COPY ACTIVE DATA command either manually or in an administrative schedule or maintenance script.

Regardless whether you use the COPY ACTIVE DATA command or simultaneous-write function, the Tivoli Storage Manager server writes data to an active-data pool only if the data belongs to a node that is a member of a policy domain that specifies the active-data pool as the destination for active data.

Restriction: The BACKUP STGPPOOL command is not supported for active-data pools.

Active-data pools as sources of active file versions for server operations

The Tivoli Storage Manager uses a search order to locate active file versions.

During client sessions and processes that require active file versions, the Tivoli Storage Manager server searches certain types of storage pools, if they exist:

1. An active-data pool associated with a FILE device class
2. A random-access disk (DISK) storage pool
3. A primary or copy storage pool associated with a FILE device class
4. A primary, copy, or active-data pool associated with on-site or off-site removable media (tape or optical)

Although the list implies a selection order, the server might select a volume with an active file version from a storage pool lower in the order if a volume higher in the order cannot be accessed because of the requirements of the session or process, volume availability, or contention for resources such as mount points, drives, and data.

Copy storage pool

A copy storage pool can use only sequential access storage (for example, tape, optical, or file device classes). The device class you define must represent the type of device you are using for your copy pool.

Shredding

When data is deleted on random disk or tape devices, it is not physically removed from the media. Shredding provides the capability to ensure that the deleted space is overwritten so that the deleted data is not easily reconstructed. Shredding can be set to run automatically or manually, it does not occur immediately after the data is deleted, and the deleted space is not available to be reused until the shredding process has completed. The storage pools used for shredding need to be configured.

The following command overwrites the deleted data area three times:

```
define stgpool shred4 disk shred=3
```

The shredding automatic option must be added to the dsmserve.opt file. To run manually, no changes have to be made to the dsmserve.opt file. The following command shreds the deleted data area for 60 minutes:

```
shred data duration=60
```

Defining primary storage pools

A primary storage pool can use random access storage (DISK device class) or sequential access storage (for example, tape, optical, or file device classes).

Primary storage pool for an automated library

After you have defined the device class, you can define the storage pool you are going to use with the library.

The following command defines a storage pool named TAPEDATA using the device class named LTO_CLASS1:

```
define stgpool tapedata LTO_CLASS_1 highmig=100 maxscratch=10
```

The high migration parameter is set to 100 to stop migration because there is no NEXTSTGPOOL for this storage pool to migrate to. The MAXSCRATCH value of 10 means that when 10 scratch tapes have been used, the storage pool indicates that it is full.

Primary storage pool for a disk

Using the Tivoli Storage Manager predefined DISK device class, you can define a primary disk storage pool.

The following command defines a storage pool named DISKDATA with a high migration threshold of 70% and a low migration threshold of 30%. It uses the predefined Tivoli Storage Manager DISK device class:

```
define stgpool diskdata disk description="Data Storage" high=70 low=30
```

Primary storage pool for sequential disk

This is where a disk can simulate a sequential device, such as tape. The following command defines a storage pool named DISKFILE using a device class named CFILE:

```
define stgpool diskfile cfile maxscratch=100 highmig=100
```

The MAXSCRATCH parameter must be included because it simulates a sequential storage pool and because there is no next storage pool in this case, migration is disabled.

The following command defines an active-data storage pool named DATA.

```
define stgpool DATA CFILE pooltype=activedata
```

For newly defined storage pools, the default storage pool collocation setting is now GROUP.

If you specify COLLOCATE=GROUP but do not define any collocation groups or if you specify COLLOCATE=GROUP but do not add nodes to a collocation group, data is collocated by node.

Note: Be sure to consider tape usage when organizing client nodes into collocation groups. For example, if a tape-based storage pool consists of data from grouped and ungrouped nodes and you specify COLLOCATE=GROUP, the server performs the following actions:

- ▶ Collocates the data by group for grouped nodes only. When possible, the server collocates data belonging to a group of nodes on a single tape or on as few tapes as possible. Data for a single node can also be spread across several tapes associated with a group.
- ▶ Collocates the data by node for ungrouped nodes. When possible, the server stores the data for a single node on a single tape. All available tapes that already have data for the node are used before available space on any other tape is used.

6.2.7 Defining storage pool volumes (logical class)

Tivoli Storage Manager is dynamic; you can add or remove volumes without interrupting server operations. For example, if you install a new type of device such as a disk pool, the Tivoli Storage Manager administrator can move the storage pool data from the old pool to the new pool without stopping the server. Or, if you have to add space to a storage pool, you can easily define new volumes and thereby expand the size of the storage pool without disrupting service.

Library volumes

Library volumes are volumes that are checked in to an automated library, including scratch volumes and private volumes.

The two methods of labeling a volume in a library:

- ▶ A one-step process: Uses the **label libvolume** command.
- ▶ A two-step process: Uses the DSMLABEL utility to create a volume and the Tivoli Storage Manager **define volume** command to define the volume to a storage pool.

You must use a unique label for every tape or optical volume defined in Tivoli Storage Manager. If the tapes you purchase have physical external labels, we highly recommend setting the Tivoli Storage Manager internal labels to match.

Disk storage pool

Disk volumes can be defined to a Tivoli Storage Manager storage pool using either a one-step or two-step process:

- ▶ In a one-step process, the following command defines a volume that is located in /tsm/stgpool/ and that is named diskdata1.dsm to the storage pool DISKDATA. It also prepares the volume and formats it as a background process of size 50 MB:

```
define volume diskdata /tsm/stgpool/diskdata1.dsm formatsize=50
```
- ▶ The two-step process requires preparing the disk volume using the DSMFMT utility and then defining the volume to the storage pool using the **define volume** command.

6.2.8 Audit volume

The **audit volume** command checks for inconsistencies between the database references for what files are stored on a volume, and what is actually found to be stored on the volume. The volume must be mounted in a tape drive so that the contents can be read.

This command differs from the **query content** command, which displays only the database view of the what is stored and does not require the volume to be mounted.

The **audit volume** command is especially useful when integrity errors are detected on a volume, because 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.

Tivoli Storage Manager V6.1 now has the capability to run commands using QUERY MEDIA and the CMD and CMDFile switches. This capability allows an administrator to use complex logical statements to interrogate media in the library. The potential to automate AUDIT VOLUME for particular library volumes exists by using this functionality, which enables a Tivoli Storage Manager administrator to remotely check volumes and audit them as necessary.

The QUERY MEDIA functionality is described in the Tivoli Storage Manager V6.1 reference information located at:

http://publib.boulder.ibm.com/infocenter/tsminfo/v6/topic/com.ibm.itsm.srv.ref.doc/r_cmd_media_query.html

6.2.9 Backup storage pool

The **backup stgpool** command backs up a primary storage pool to a copy pool. If the primary storage pool is a sequential storage pool, then this command requires two physical drives. The input volume from the primary storage pool will be mounted in one, and the output volume from the copy storage pool will be mounted in the other. The two drives can be in the same or different tape libraries. To back up a random access storage pool to a sequential storage pool requires only one drive.

The following command backs up a storage pool named TAPEDATA to a copy pool named OFFDATA:

```
backup stgpool tapedata offdata
```

6.2.10 Checking in library volumes

The **checkin libvolume** command checks in a library volume that has been physically placed in the library, so that it can be seen by Tivoli Storage Manager.

The following command checks in volume DAN001 as a scratch volume:

```
checkin libv liblto4 dan001 status=scratch
```

6.2.11 Checking out library volumes

The three steps for checking out library volumes are follows:

1. Check out the library volume.

The following command checks out the library volume named DAN001 from a library named LIBLTO4:

```
checkout libv liblto4 dan001
```

2. Check for outstanding mount requests.
3. Reply to the mount request.

6.2.12 Migration

Migration processing maintains free space in a primary storage pool. The server can move data stored in a random access disk storage pool to a slower but less expensive sequential access storage pool.

Figure 6-13 on page 174 shows how automatic migration works.

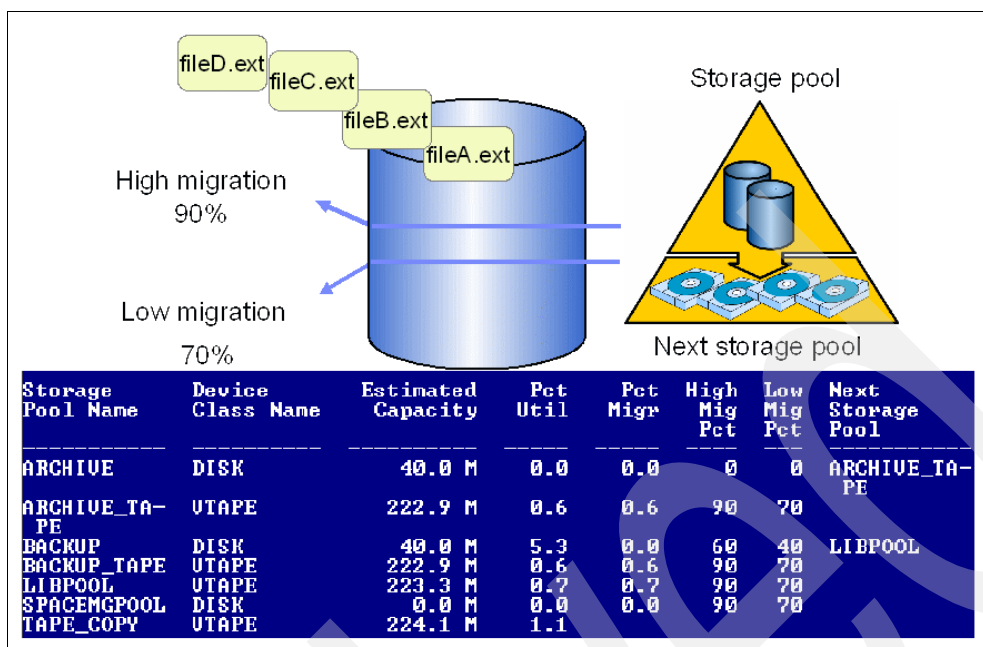


Figure 6-13 Overview, how automatic migration works

When you define or update a storage pool, you can set migration thresholds to specify when the server should start and stop migrating data to the next storage pool in the storage hierarchy. Before Version 5.5, migration thresholds for FILE type disk pools were defined in terms of a percentage of total data capacity for the disk storage pool. The method of calculation has been slightly changed for these storage pools, so now the underlying file system capacity is taken into account as well. The **query stg** command now reflects the available space for FILE pools, including the file system capacity, in the Estimated Capacity field. In addition, the Percent Migrated (Pct Migr) field will show the percent of migratable data versus the percent of volumes with data on them. The server starts a migration process when the storage pool reaches the high-migration threshold. The migration process will run until the low-migration threshold has been reached. The default high-migration threshold value is 90%, and the default low-migration threshold value is 70%.

Migration threshold values

Setting migration thresholds for disk storage pools ensures sufficient free space on faster devices, which can lead to better performance. Choosing thresholds appropriate for your situation takes some experimenting. Ensure that migration occurs frequently enough to maintain some free space but not so frequently that the device is unavailable for other use. When choosing the high-migration threshold, consider the amount of storage capacity provided for the storage pool, and the amount of free storage needed to store additional files without having migration occur. Keeping the high-migration threshold at a single value means that migration processing could start at any time of day, whenever that threshold is exceeded.

Manually starting migration

You can control when migration occurs by using administrative commands or schedules to change the thresholds. You can set the high-migration threshold to a high setting during the night when clients run their backup operations. You can then lower the high-migration threshold during the day when you want migration to occur. Choose a time when your tape drives and mount operations are available for the operation. Use the **UPDATE STGpool** command to change the high-migration and low-migration threshold values. You can specify an integer in the range of 0 - 100 for the high-migration threshold. You can specify an integer

in the range of 0 - 99 for the low-migration threshold. Multiple concurrent processes let you make better use of your available tape drives. Specify the number of processes to be used for migrating files from the storage pool with the MIGPProcess optional parameter in the **DEFINE STGpool** or the **UPDATE STGpool** command.

Ending migration

Migration will continue to run until it reaches the value set on the low-migration threshold. The smaller the low threshold, the longer time that a migration runs. Set the low-migration threshold to 0% if you want all the data to migrate to the next storage pool. After the migration processing completes, reset the thresholds to the previous settings.

Note: The command cancel process will not end migration processing unless the thresholds have been reset to a value that will allow migration processing to end.

Minimum and maximum high-migration thresholds

Setting the high-migration threshold to 100% prevents migration processing. If the storage pool is at 100% capacity, and the high-migration threshold value is 100%, then new files will bypass the storage pool and will be directly written to the next storage pool. Setting the high-migration threshold value to 0% causes all files in the storage pool to be migrated. If new files attempt to write to the storage pool, they will be directly written to the next storage pool.

Attention: Performance might be affected as a result of files being written directly to tape instead of disk.

Standard migration

When data in a storage pool uses a percentage of the pool's capacity that is equal to the high migration threshold, the server migrates files from that pool to the next storage pool. The server checks for the node of the client that has backed up or migrated the largest single file space or has archived files that occupy the most space.

Migration using the migdelay parameter

You can ensure that files remain in a storage pool for a minimum amount of time before the server migrates them to another pool, by setting a migration delay period (migdelay) for a storage pool. The file must remain in the storage pool at least as long as the migration delay period. For disk storage pools, the last time the file was accessed is also considered for migration delay.

Using migdelay with the migcontinue parameter

Another storage pool parameter, the migration continue parameter (migcontinue) works with the migration delay parameter. It tells Tivoli Storage Manager what should be done if, because of migration delay, enough data is not available to meet the low migration parameter. The setting can be:

- ▶ **Yes:** Informs Tivoli Storage Manager that, if it is not able to reach the low migration value, it is to disregard the migration delay value.
- ▶ **No:** Informs Tivoli Storage Manager that not reaching the low migration value is acceptable.

Figure 6-14 shows how `migdelay` and `migcontinue` influence the migration process.

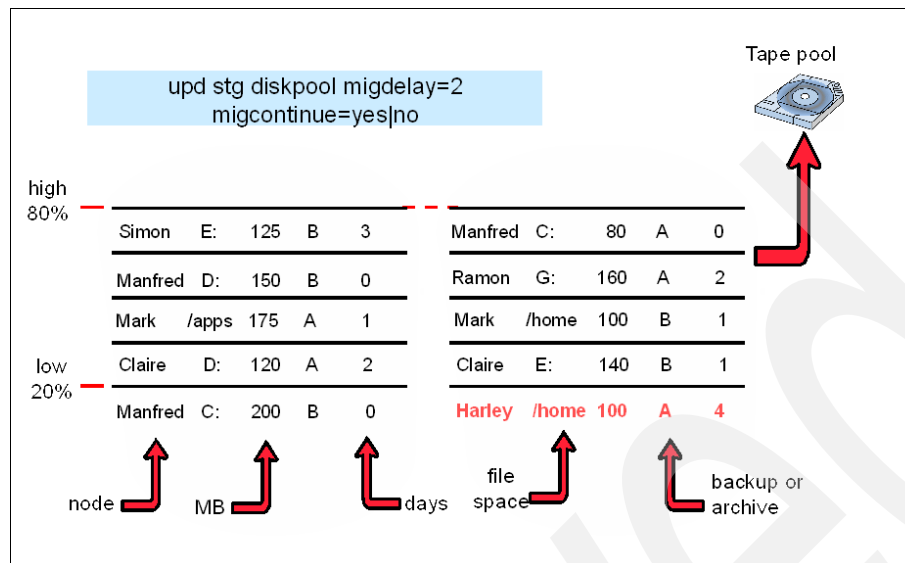


Figure 6-14 `migdelay` with `migcontinue`

Enabling cache for disk storage pools

You can enable cache by specifying `CACHE=YES` when you define or update a storage pool. When cache is enabled, the migration process leaves behind duplicate copies of files on disk after the server migrates these files to the next storage pool in the storage hierarchy. The copies remain in the disk storage pool, but in a cached state, so that subsequent retrieval requests can be satisfied quickly. However, if space is needed to store new data in the disk storage pool, cached files are erased and the space they occupied is used for the new data. When cache is disabled and migration occurs, the server migrates the files to the next storage pool and erases the files from the disk storage pool. By default, the system disables caching for each disk storage pool because of the potential effects of cache on backup performance. You might want to set migration thresholds lower when you use caching.

Migrate STGpool command

Use the **STGpool** command to migrate files from one storage pool to the next storage pool in the storage hierarchy. This command can be used only with primary storage pools. Only one migration or reclamation process for a given storage pool is allowed at any given time. If a migration or reclamation process is already running for the storage pool, you cannot start another migration process for the storage pool. You should use this command only if you are not going to use automatic migration for the storage pool. To prevent automatic migration from running, set the `HIGHMIG` parameter of the storage pool definition to 100. You can override the value of the `LOWMIG` parameter on **define stgpool** and **update stgpool** commands by specifying a value for the `LOWMIG` parameter on the **migrate stgpool** command. The **migrate stgpool** command ignores the value of the `HIGHMIG` parameter of the storage pool definition. Migration will occur regardless of the value of the `HIGHMIG` parameter. This command creates one or more migration processes that can be canceled with the **cancel process** command. The number of processes is limited by the `MIGPROCESS` attribute of the storage pool definition. To display information about background processes, use the **query process** command. To issue this command, you must have system privilege, unrestricted storage privilege, or restricted storage privilege for both the storage pool from which the files are to be migrated and the next storage pool to which files are to be migrated.

Note: You can disable migration for all storage pools by using the undocumented server option `NOMIGRRECL`. Enable the `NOMIGRRECL` option by adding it to the server options file. The advantage of using `NOMIGRRECL` is that it turns off all migration and reclamation at once instead of you having to issue commands to disable migration and reclamation for the various storage pools. The disadvantage is that there is no documentation for additional information.

If during upgrade or maintenance processes, you have specified the server option `NOMIGRRECL`, automatic migration and reclamation will be prohibited, but migration by command will be possible. The high and low migration values will be temporarily set to zero. Do not forget to remove this option after you have finished your upgrade or maintenance process. To change this option, restart the server.

6.2.13 Data movement

The `MOVE DATA` command moves the data from one volume to another within the same storage pool (this requires that two drives be available if it is a sequential storage pool) or to another storage pool.

As stated previously, collocation keeps client files close together, maybe even in one volume, which can increase restore performance. In large environments, collocation usually uses a great deal of tape, so it can be an uneconomical choice for them. Moreover, numerous mounts are required during migration and reclamation. However, collocation can be used in large environments to decrease restore time. Tivoli Storage Manager enables you to move data down to a level of a client's file spaces using the `MOVE NODEDATA` command. This offers a chance to collocate data for specified nodes only on demand so the next restore would finish faster.

Using the same command, Tivoli Storage Manager also enables data movement between different storage pools. Unlike migration, selected client data can be moved rather than the entire storage pool. Moving data to a storage pool offers fast and parallel access, such as a disk storage pool. So multiple clients can restore their data faster using multiple sessions.

6.2.14 Reclamation

Reclamation, which is shown in Figure 6-15 on page 178, is used to free complete tape (or optical) volumes in sequential storage pools. Because Tivoli Storage Manager keeps a defined number of versions of files when it performs incremental backups, the oldest copy of a file (beyond the defined number of versions to keep) gets marked for expiration. This file is deleted when the next expiration occurs.

For volumes that are not marked as off-site volumes, reclamation can occur only after the volume is full and then begins to empty because of file deletion. The reclamation process is very device intensive; it typically requires at least two available drives in the library.

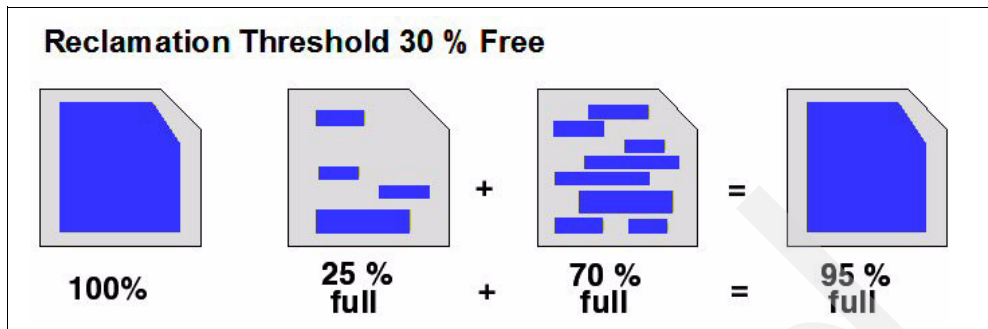


Figure 6-15 Reclamation of tapes

For off-site volumes, reclamation can occur regardless of whether the volume has ever been filled. An off-site volume is eligible for reclamation when the percentage of unused space in the volume is greater than the reclaim parameter value. The unused space includes space that has never been used in the volume and space that has become empty because of file deletion.

Single drive reclamation

To work most efficiently, reclamation requires two or more drives. Nevertheless, reclamation can be performed by a single drive in Tivoli Storage Manager by specifying the RECLAIMSTGPOOL parameter. This parameter allows another storage pool to be used as the holding area for the sequential volume being consolidated.

The storage pool specified as the reclaim storage pool must be a primary sequential storage pool on the system.

Reclamation of off-site volumes

Tivoli Storage Manager cannot physically move the data from one off-site volume to another because the volumes are in a vault and are not available in the library.

Tivoli Storage Manager manages reclamation for an off-site copy pool by obtaining the active files from a primary storage pool or from an on-site volume of a copy pool. These files are then written to a new volume in the copy pool, and the database is updated. A message is then issued that an off-site volume was reclaimed.

6.2.15 Reduce restore times

Storage pool configuration can reduce restore operation times with the following techniques:

- ▶ Collocation (minimizes the number of tape volumes used to store client data)
- ▶ Disk caching (restores data from disk even if it has already been migrated)
- ▶ Moving data to fast access storage pools or consolidating data before restoring them
- ▶ Active data pools

6.2.16 Collocation

Collocation is a process whereby the server attempts to keep all files belonging to a client node on a minimal number of sequential access storage volumes.

Collocation has four options:

- ▶ Collocation by group enables you to define a group of client nodes to use the fewest number of volumes. This could be used when you have high capacity tapes and the client nodes archive / backup data is small in comparison to the volume capacity.
- ▶ Collocation by node enables you to put each client node's backup data on the fewest number of volumes. This is the same as putting COLLOCATE=YES in previous Tivoli Storage Manager versions.
- ▶ Collocation by file space enables you to put each file space for a client node on the fewest number of volumes.
- ▶ Setting the COLLOCATE parameter to NO disables collocation.

To collocate data when files from different client nodes are mixed in the same storage pool, set collocation to group or node when you define or update a sequential storage pool. This reduces the number of volume-mount operations required when users restore or retrieve many files from the storage pool at the same time that you increase mounts during a migration process. Collocation, shown in Figure 6-16, therefore improves access time for these operations.

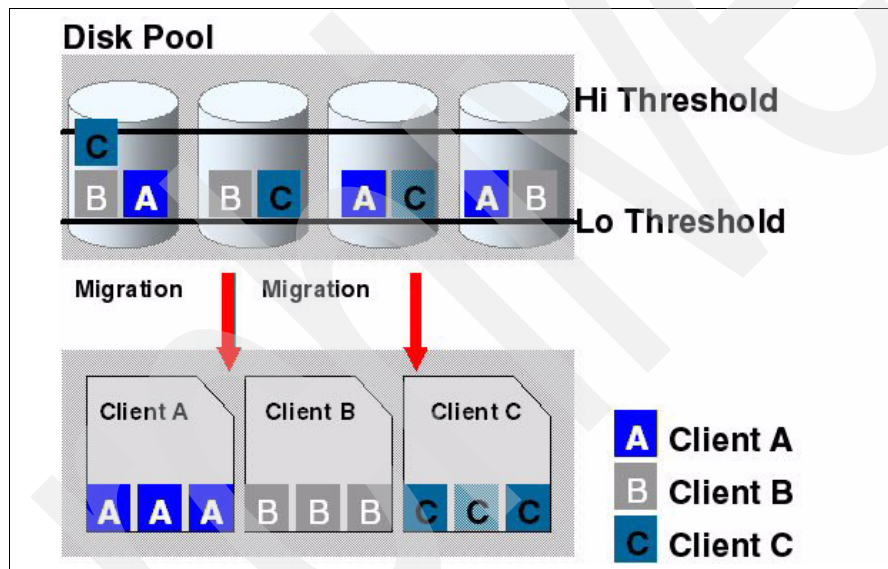


Figure 6-16 Storage pool collocation

6.2.17 Collocation by group

The utilization of tapes is improved when using collocation by providing for collocation of a group of nodes whose data will be collocated together on sequential media. Collocation can reduce the number of volume mounts that are required when a large number of files is restored from a sequential-access storage pool by minimizing the number of tapes on which the data is stored. Although tapes provide larger and larger capacity, they can be more efficiently used when data from multiple nodes is stored on them while still preserving the benefits of collocation. The efficiency of Tivoli Storage Manager internal data-transfer operations is improved by transferring all nodes in the group together. This can result in less database scanning, with fewer tape-passes and reduced tape wear for file processing.

If no groups and members are defined, collocation by group works the same as using collocation by node. 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.

Figure 6-17 shows collocation by groups. For newly defined storage pools, the default storage pool collocation setting is now GROUP.

Note: Because the collocation setting for primary sequential storage pools is group, you may waste space in your tape storage pools. If the nodes are not grouped, every node will use one or more tape volumes.

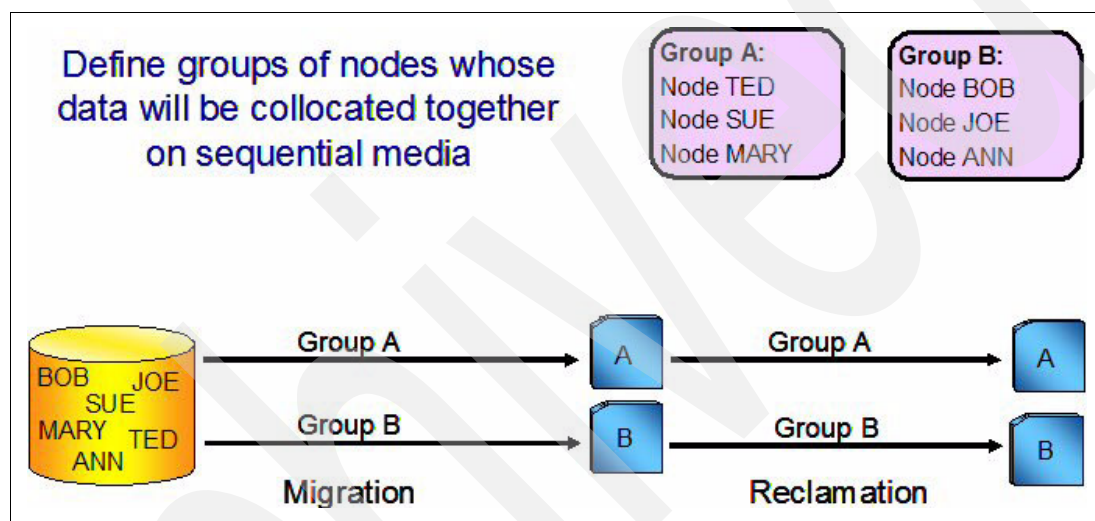


Figure 6-17 Collocation by groups

The following commands are used to define a collocation group and collocation member.

```
DEFINE COLLOGROUP group_name
DEFINE COLLOCMEMBER group_name node_name,node_name, ...
```

6.2.18 How to recover data in a primary storage pool

To improve data availability, you can back up primary storage pools to copy storage pools. This protects against the possibility of media failure.

Back up without interruption of services

Incremental backups can take place while the server is operational and available to clients. The administrator can decide which storage pools should be backed up, and then can also schedule these backups using the central scheduling feature of Tivoli Storage Manager. The storage pool backups can run at a time convenient for the business.

Restore one volume in a storage pool.

Restore individual volumes within a storage pool to recover from a media failure.

Restore a complete storage pool.

Restore all damaged volumes within a storage pool to recover from a complete loss of a storage pool.

Support disaster recovery.

Identify removable media volumes containing storage pool backup data to be sent to an off-site location for disaster recovery purposes. Provide management for the volumes that are stored off site for disaster recovery protection. Address the issues of file expiration, volume reclamation, and volume rotation. Identify which volumes will return to the on-site location if you need to recover from a major disaster or from loss of a few volumes at the on-site location.

Automatically switch to a duplicate copy if the primary file is damaged.

If you cannot obtain the primary file, the duplicate copy is automatically used, if one is available.

Backing up storage pools

Use the **backup stgpool** command to create backup copies of files that reside in a primary storage pool and store the backup copies in a copy storage pool. If a file is already duplicated in the specified copy storage pool, a new copy of the file is not made in that copy pool. One primary pool can use multiple copy storage pools. You can have many copy storage pools for each primary storage pool; you are not limited to two or three backup copies. Each copy pool requires additional database and storage pool space, a potentially important consideration. By supporting multiple copy storage pools, Tivoli Storage Manager supports both media and disaster recovery by physically separating these copies. This separation reduces the risk of losing data as a result of a disaster. You create multiple backup copies of a primary pool by initiating the backup of the primary storage pool for each copy pool. The incremental backup is performed for each copy storage pool. The files are copied only if they are not already in that copy or if the copy in the copy pool has a different insertion date (that is, the file has changed since it was last copied into the copy pool).

The copy pool with all on-site volumes is used for media failure. Because all volumes are stored on-site, they might be destroyed if a disaster occurs. You can use the copy pool with on-site volumes to reduce the potential for data integrity loss because of media failure or other problems. If the primary file is not available or becomes corrupted, Tivoli Storage Manager will access and use a duplicate file from a copy storage pool.

Disaster recovery is the reason for providing copy storage pools with off-site volumes. Off-site volumes in this disaster recovery copy storage pool are never automatically used by Tivoli Storage Manager. The volumes in this copy pool should be marked with the access mode of OFFSITE to make sure that Tivoli Storage Manager does not request a mount of the volume.

The off-site volumes in the disaster recovery copy storage pool should be stored off-site with the database backup to make sure that you can recover the Tivoli Storage Manager environment if a disaster occurs.

An error message occurs when you try to access files from a copy storage pool that contains off-site volumes only. You can temporarily move the volume on-site and recover the files from volumes that belong to the disaster recovery storage pool.

Handling off-site volumes

Change the status of the tapes that were used to perform the copy storage pool for off-site disaster recovery as not available to Tivoli Storage Manager. To change the status, use the update volume command specifying **ACCESS = OFFSITE**. Tivoli Storage Manager does not issue mount requests for off-site volumes. This process can be automated with Disaster Recovery Manager.

Restoring storage pool files

Tivoli Storage Manager supports recovery in various situations

File-level backups

Tivoli Storage Manager performs storage pool backups at the file level to allow for recovery at different levels. Depending on the situation, you sometimes restore only files that have been damaged. In the event of a media failure, you can restore individual volumes, or you might have to restore multiple primary storage pool volumes because of a major failure. Tivoli Storage Manager supports recovery in all these situations.

Damaged files

A damaged file is one for which a data integrity error has been detected, such as when a client attempts to restore, retrieve, or recall the file or during an audit volume operation. If a data integrity error is detected for a file in either a primary or a copy storage pool, that copy of the file is marked as damaged in the database. If the same file is stored in other storage pools, the status of those file copies is not changed.

File copies that have been marked as damaged are:

- ▶ Not restored, retrieved, or recalled to clients
- ▶ Not moved with migration, reclamation, or move data
- ▶ Not restored during a restore stgpool or restore volume operation (if the backup copy in the copy storage pool is damaged)

To facilitate restoring of entire volumes, DESTROYED volume access mode is introduced. If a volume has an access mode of DESTROYED, it is not mounted for either read or write access.

The **restore volume** command recreates files that reside on a volume or volumes in the same primary storage pool. You can use this command to recreate files for one or more primary volumes that have been lost or physically damaged. When you issue the **restore** command against a storage pool volume, the volume will have an access mode of DESTROYED, and all files that have been backed up from this volume will be restored to the other volumes in that pool.

Damaged volumes within a storage pool

The **restore stgpool** command restores files on any volumes that have been designated as DESTROYED using the **update volume** command. This command also restores all files in a storage pool that have previously been identified as having data integrity errors.

The **restore stgpool** command is useful for restoring a large number of volumes (more than can be practically listed using a single restore volume command) after a major disaster, or for recreating damaged primary files.

Restoring damaged primary storage pool files

Tivoli Storage Manager automatically accesses a copy storage pool file if the volume is onsite. Typically, a file is obtained from the primary storage pool when an attempt is made to access that file. However, Tivoli Storage Manager attempts to access the file from a copy storage pool if the primary copy of the file has been marked as damaged and cannot be obtained. Tivoli Storage Manager also uses the duplicate copy if the primary file is stored on a volume that is designated as UNAVAILABLE, DESTROYED, or OFFLINE.

For certain operations such as restore, retrieve, or recall of files to clients and export of file data, Tivoli Storage Manager can also access a file from a copy storage pool if the primary file is located in a storage pool that is marked as UNAVAILABLE.

If the file is stored on a volume with ACCESS=OFFSITE, the file will not be obtained from the copy pool. Instead an error message will be issued to the client.

If a primary file copy is marked as damaged and a usable backup copy exists in a copy storage pool, the primary file can be recreated using the restore stgpool command. To recreate damaged files in the primary pool, you can define a schedule that executes the following command:

```
RESTORE STGPOOL primarypool
```

The RESTORE STGPOOL command will restore all damaged files in the primary pool. If you are using off-site copy volumes only, these volumes must be brought on-site before you can issue the restore stgpool command. Otherwise, Tivoli Storage Manager will write an error message saying that the files on offline volumes cannot be restored. You can issue the restore stgpool command with a PREVIEW option to obtain a list of required copy storage pool volumes.

Recovering from a media loss

In this scenario, an operator inadvertently destroys a tape volume (VOL2) belonging to the primary storage pool. An administrator performs the following action to recover the data stored on the destroyed volume by using the on-site copy storage pool:

```
restore volume VOL2
```

This command sets the access mode of VOL2 to DESTROYED and attempts to restore all the files that were stored on VOL2. The files are not actually restored to VOL2, but to another volume in the primary storage pool. All references to the files on VOL2 are deleted from the database, and the volume itself is deleted from the database.

The restoration of a volume might be incomplete. Use the **query content** command to get more information about the remaining files on volumes for which restoration was incomplete.

The restoration might be incomplete for one or more of the following reasons:

- ▶ Files were either never backed up or the backup copies are marked as damaged.
- ▶ A copy storage pool was specified on the restore command, but files were backed up to a different copy storage pool.
- ▶ Volumes in the copy storage pool that are needed to perform the restore operation are off-site or unavailable.

If the **query content VOL2** command showed files remaining, you would have to take action. Analyze the cause for the situation. You might have to delete the volume with DISCARDDATA=YES setting to get the volume out of the storage pool. To delete the volume after successful restore operation, use the following command:

```
DELETE VOLUME VOL2 DISCARDDATA=YES
```

Backup and recovery tips

The tips listed in this section should you with backup and recovery operations.

- ▶ Create a minimum of two storage pools:
 - Active-data pool
 - Conventional copy storage pool

You can use the active-data pool to restore critical client node data, and after, you can restore the primary storage pools from the copy storage pool volumes that include the active and inactive versions. If an active-data pool becomes lost or damaged, you can restore it from the primary storage pool by using the **copy activedata** command.

Note: Restoring a primary storage pool from an active-data pool might cause some or all inactive files to be deleted from the database if the server determines that an inactive file needs to be replaced but cannot find it in the active-data pool. As a best practice and to protect your inactive data, therefore, you should create a minimum of two storage pools: one active-data pool, which contains only active data, and one copy storage pool, which contains both active and inactive data. You can use the active-data pool volumes to restore critical client node data, and after you can restore the primary storage pools from the copy storage pool volumes. Active-data pools should not be considered for recovery of a primary pool or volume unless the loss of inactive data is acceptable.

- Back up entire primary storage pool hierarchy to the same copy pool.

Tivoli Storage Manager can recognize that when a file migrates down the storage hierarchy, it does not need to be copied again into a copy pool. Or, if you move a file with the move data command, Tivoli Storage Manager can recognize this situation. Migration works if you have set up your configuration so that each primary storage pool hierarchy is copied to the same copy pool.

- Consider using at least one copy pool for on-site recovery and one for disaster recovery.

It is useful to have one backup copy of a primary pool that is kept on-site to be used for media failures or damaged files. Remember that if you access a file that is damaged in the primary storage pool, Tivoli Storage Manager will automatically let you access the copy in the copy pool, if the copy pool volumes are on-site. To be prepared for disaster situations, have one backup copy of a primary pool that is used for off-site storage. The primary pool is copied to on-site volumes in this special disaster recovery copy pool, and then the administrator can change the volume access mode to OFFSITE and physically move the volumes to an off-site location.

- Use administrative command scheduling to automate storage pool backups.

You can use the administrative command scheduling facility to automate storage pool backups. The backup stgpool command can be scheduled to initiate at regular intervals.

- Back up the storage pool first.

By backing up storage pools first, you ensure that all storage pool files are recorded in the database. You might have extra records in the database, but at least there should be a record for each file in the storage pools. The storage pool backups might take longer than the database backup. The storage pools should be backed up first to reduce the inconsistencies between the database and the storage pools.

- Back up the database and storage pool together.

To prepare for server disaster recovery, both the server database and storage pools should be backed up at the same time. In this way, the database and storage pools will match (be in sync) to a greater degree.

- Save the volume history and device configuration file.

To ensure the integrity of the storage pool data, save the volume history and device configuration files and send them off site.

- Use Disaster Recovery Manager.

In the planfile, created with the **prepare** command, you can find the instructions who are necessary to restore a storage pool.

REUSEDELAY parameter

You should delay the reuse of any reclaimed volumes in copy storage pools for as long as you keep your oldest database backup. Delaying reuse may help you to recover data under certain conditions during recovery from a disaster. When you define or update a sequential access storage pool, you can use the REUSEDELAY parameter. This parameter specifies the number of days that must elapse before a volume can be reused or returned to scratch status after all files have expired, deleted, or moved from the volume. If REUSEDELAY is set to 0 (zero), you run the risk of data loss.

6.2.19 Query content

The **query content** command queries the contents of a volume and lists all the files contained on it. This command is useful when a volume is damaged or before you:

- Request the server to fix inconsistencies between a volume and the database
- Move files from one volume to another volume
- Delete a volume from a storage pool

Because this command can take a long time to run and the results can be very large, consider using the COUNT parameter to limit the number of files displayed.

Note: Files that are cached in a disk volume and that are marked as damaged are not included in the results.

6.2.20 SQL commands

Tivoli Storage Manager uses a database that accepts Structured Query Language (SQL) commands. Tivoli Storage Manager provides three system catalog tables to help you find what information is available:

- 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.

To determine the location of the information that you want, issue the SELECT command to query these tables. You can use TABLES, COLUMNS, and ENUMTYPES to display the database structure:

- SELECT * FROM TABLES
- SELECT * FROM COLUMNS
- SELECT * FROM ENUMTYPES

Many commands can be generated in this way to create a customized query to the Tivoli Storage Manager database. Examples include:

- ▶ `select * from volumes where error_state='YES'`

This command lists all volumes from the database table `VOLUMES` that are in an error condition. If you do not have volumes in an error condition, this command fails.

- ▶ `select node_name, client_version, client_release from nodes`

This command lists all the Tivoli Storage Manager clients with their Tivoli Storage Manager version and release.

- ▶ `select node_name, count(*) from backups group by node_name`

This command lists how many files have been backed up from each node. If you replace `BACKUPS` with `ARCHIVES`, you see the number of files archived from each node.

Important: You cannot issue the `select` command from a server console.

The `select` command does not lock and unlock records, so contention for a record can cause the server to erroneously issue message:

ANR2034E: SELECT: No match found using this criteria.

Check your selection criteria, and if you believe it is correct, try the command again.

To stop the processing of a `select` command after it starts, cancel the administrative session from which the command was issued. Cancel the session from either the server console or another administrative session.

Temporary table spaces are used to process SQL queries within DB2. Inadequate temporary space can cause SQL queries to fail.

6.3 Backup-Archive client installation

After Tivoli Storage Manager server is installed, you can install the Backup-Archive client.

6.3.1 Client components

Each client has two major components that help you protect your important data:

- ▶ Software components

These are the software programs and customization files that you must have in place to use Tivoli Storage Manager. The most important are the client interfaces. Each is designed so that you can perform all client operations from the one that best suits your needs. For successful interaction with the server, you must configure some basic parameters in a client options file.

- ▶ Operation components

When you use the Tivoli Storage Manager interface to back up or archive a file, it sends a copy of the file and its associated attributes to the Tivoli Storage Manager server. The Tivoli Storage Manager client can perform backup and archive operations to send data to its designated server.

6.3.2 Client interfaces

The three types of Tivoli Storage Manager client interfaces are: native Backup-Archive client, Web client, and API client.

Native Backup-Archive client

This client is installed on every Tivoli Storage Manager client node and provides the local interface to back up and restore operations on that node. It offers a GUI and command-line interface (CLI) to back up and restore files from that system only.

Web client

The Web client provides a remote interface to back up and restore operations on a Tivoli Storage Manager client node. This client is particularly suited for help desk operations.

API client

The Backup-Archive client is the software component that 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.

6.3.3 Code installation

The procedure for client code installation is generally the same across all platforms except for minor differences. The best way to distribute Tivoli Storage Manager client software and updates is to use an automated software distribution application.

For more information about installing and configuring the backup and archive client, refer to the Backup-Archive client documentation that is based on the operating system platform; these are listed in “Related publications” on page 293.

Tivoli Storage Manager client code fixes and enhancements are released on a regular basis. The fixes are available from this IBM Web site:

<http://www.ibm.com/software/sysmgmt/products/support/IBMTivoliStorageManager.html>

6.3.4 Customization

In this section, we describe the settings for the Backup-Archive client and the Web Backup-Archive client and the steps to follow to customize your client installation.

To customize your client installation, use these steps:

- ▶ Add variables to your client environment:
 - PATH: This is the default search path that the operating system uses to locate executable files. Set this variable to include the fully qualified paths of the Tivoli Storage Manager client directories.
 - DSM_CONFIG: Tivoli Storage Manager uses this environment variable to locate the client options `dsm.opt` file. It points to the client user options file for users who create their own personalized options file.
 - DSM_DIR: Tivoli Storage Manager uses this environment variable to locate all other client files. It points to the executable file `DSMTCA`, the resource files, and the `dsm.sys` file (on UNIX only).
 - DSM_LOG: This points to the directory where you want the `dsmerror.log`, `dsmwebc1.log`, and `dsmsched.log` files to reside. The error log file contains information

about any errors that occur during processing. The error log is intended to help you diagnose severe errors. The Web log file contains the errors that occur when the client is accessed through the Web interface. The schedule log contains the output of the scheduled command.

► Define client options files.

The Backup-Archive client has at least one configuration file, which contains the following parts:

- Communication options, which you set in the `dsm.opt` file:
 - **COMMETHOD:** This option specifies the communication method you are using to provide connectivity for client-server communication. The Tivoli Storage Manager server configuration file (`dsmserv.opt`) must have specified the same communication method with a valid port address, so that the server can accept client requests.
 - **TCPSERVERADDRESS:** This option specifies the TCP/IP address for a Tivoli Storage Manager server. This is either the IP address or the host name of the Tivoli Storage Manager server.
 - **TCPPORT:** This option specifies a TCP/IP port address for a Tivoli Storage Manager server. By default, this value is 1500.
 - **TCPWINDOWSIZE:** This option specifies the size, in kilobytes, of the TCP/IP sliding window for your client node. This setting is highly operating system specific. You must only use the allowed values for your TCP/IP implementation. This option can be customized at both server and client side.
 - **TCPBUFFSIZE:** This option specifies the size, in kilobytes, of the Tivoli Storage Manager internal TCP/IP communication buffer. This setting is specific to the operating system. You must only use the allowed values for your TCP/IP implementation.
 - **NODENAME:** This option assigns a new name to your client node if you do not want to use the default. The default is the host name of your client machine, which we recommend using.

Note: The settings for the communications options can be found in the *IBM Tivoli Storage Manager Performance Tuning Guide*, GC23-9788:

<http://publib.boulder.ibm.com/infocenter/tivihelp/v1r1/index.jsp>

- Operational options:
 - **PASSWORDACCESS:** This option specifies whether you want your Tivoli Storage Manager password automatically generated or always manually prompted for. A recommendation is to set **PASSWORDACCESS** to **GENERATE**.
 - **REPLACE:** This option specifies what you want Tivoli Storage Manager to do when it restores files that already exist on your workstation. This option applies to the restore and retrieve commands only.
 - **SUBDIR:** This option specifies whether you want Tivoli Storage Manager to include subdirectories of named directories. This option applies, for example, to selective, restore, archive, and retrieve.
 - **TAPEPROMPT:** This option specifies whether to wait for a tape to mount if it is required for a backup, archive, restore, or retrieve process, or to prompt you for a choice.

- **SCHEDMODE:** This option specifies whether you want to use the client-polling mode (your client node periodically asks the Tivoli Storage Manager server for scheduled work), or the server-prompted mode (the server contacts your client node when it is time to start a scheduled operation). All communication methods can use the client polling mode, but only TCP/IP can use the server prompted mode.
- Include-exclude options, which reside in different files depending on the platform:
 On all non-UNIX platforms, all options reside in the client options file, `dsm.opt` (or the Preferences file for Macintosh), which resides by default in the Tivoli Storage Manager client directory.
 On UNIX, you can set options in three different files:
 - **Client system options file (`dsm.sys`):** In the client system options file, a root user sets options that are required to establish communication with a Tivoli Storage Manager server, and options that authorize users on your workstation to use Tivoli Storage Manager services.
 - **Client user options file (`dsm.opt`):** In the default client user options file, a root user can set options that determine which Tivoli Storage Manager server your client node contacts and that specify the formats to use for date, time, and numbers. A root user can also set options that affect backup, archive, restore, and retrieve processing. In addition, users can also create their own personalized client user options file if they want to use different options. Users can overwrite an option contained in a client user options file by entering a different value for the option with an appropriate Tivoli Storage Manager command.
 - **Include-exclude options file:** In the include-exclude options file, a root user can set options to exclude specific files from backup services. In addition, a root user can set options to associate specific files with different management classes. This file can be named anything and be located in any directory, provided that you reference its full path name in the `dsm.sys` file.
- **Define include-exclude lists.**
 The include-exclude options must be placed as part of the client options file `dsm.opt` on non-UNIX platforms, or in the `dsm.sys` file or a separate include-exclude file on UNIX. Also, on UNIX, you must add the name of the file in your client system options file `dsm.sys` with the keyword `INCLEXCL` as follows:

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

 The **INCLUDE** option specifies files within a broad group of excluded files that you want to include for backup services. You 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 services. When you back up files, any files you exclude are not considered for backup. Include-exclude options are checked from the bottom 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. Example 6-19 on page 190 shows the list.

Example 6-19 Include and exclude

```
exclude /.../core
include /home/gibes/options.scr
include /home/ross/arianna
include /home/gibes/doodads/drivers
exclude /home/gibes/*
include /core/data/.../* sysdata
exclude.dir /home/ross
```

In this example, all directories and files in /core/data will be backed up. It will use the sysdata management class. The exclude /home/gibbs/* statement will back up all directories in the path. The exclude.dir statement does not backup any files in the directory structure. If the option is EXCLUDE, the file is not backed up.

6.3.5 Establishing the session

The Tivoli Storage Manager Backup-Archive client node is required to register with the Tivoli Storage Manager server. After registered, the Tivoli Storage Manager client can start its communication with the server by first completing a sign-on process. This sign-on process requires the use of a password that, when coupled with the node name of the client, ensures proper authorization when it connects to the server.

Multi-session

Tivoli Storage Manager exploits the multithreading capabilities of modern operating systems by transparently initiating multiple backup-archive or restore/retrieve sessions on the client where necessary for rapid processing and data transfers between the client and the server.

The administrator and the user each have controls to influence the number of sessions that a client can start. On the server, the global setting MAXSESSIONS limits the total number of sessions of any kind that may be present. The client node setting MAXNUMMP, in its server definition, controls how many mount points (for sequential devices, such as tape drives) a client may allocate. Finally, the RESOURCEUTILIZATION setting in the client option file increases or decreases the ability of the client to create multiple sessions.

Consolidating multiple clients under a single client node

Backups of multiple nodes that share storage can be consolidated to a common target node name on the Tivoli Storage Manager server. For example, several nodes in a GPFS cluster, NODE_1, NODE_2, and NODE_3, can back up to the same node (NODE_OLIV) on the server. This approach is useful if the machine responsible for performing the backup changes over time, such as with a cluster. Consolidating shared data from multiple machines under a single name space on the Tivoli Storage Manager server means that the directories and files can be easily found when restore operations are required. Backup time can be reduced and clustered configurations can store data with proxy node support.

Client nodes can also be configured with proxy node authority to support many of the systems that support clustering failover. By granting client nodes proxy node authority to another node, you gain the ability to back up, archive, migrate, restore, recall, and retrieve shared data on multiple clients under a single node name on the Tivoli Storage Manager server. When authorized as agent nodes, Tivoli Storage Manager nodes and HSM clients can be directed to back up or restore data on behalf of another node (the target node).

6.3.6 Transaction

All data sent to Tivoli Storage Manager storage during a backup or archive session is done within the bounds of a transaction. This means that not every single file is sent to the server separately. Tivoli Storage Manager combines multiple files in one transaction to reduce overhead and to increase performance.

The size of a transaction is controlled by the server setting TXNGROUPMAX, which specifies the maximum number of client files that can comprise a single transaction, and which increases the number of files that are backed up. The client setting TXNBYTELIMIT specifies the maximum number of bytes that can be sent. The limit that is reached first determines the complete transaction.

Note: The recommended settings for the transaction options can be found in the *IBM Tivoli Storage Manager Performance Tuning Guide*, which is located at:

<http://publib.boulder.ibm.com/infocenter/tivihelp/v1r1/index.jsp>

6.4 Backup

Tivoli Storage Manager can back up both files and raw logical volumes. When backing up files, the Tivoli Storage Manager server database keeps a list of all files and their attributes (for example, time, date, size, access control lists, and extended attributes). At each file backup operation, this list is compared to the current file system on the client workstation to determine new, deleted, and changed files. Raw logical volumes are treated as separate entities, and the management class policy is applied to the entire image as a whole.

During a backup, the client first establishes a session with the Tivoli Storage Manager server. After that, it sends the data using the transaction controls.

Tivoli Storage Manager stores a number of backup versions for each file or object on each client node. If and when the number of versions stored on the server exceeds the number set by the Tivoli Storage Manager administrator, older versions are deleted as newer versions are made. When you back up files, Tivoli Storage Manager also backs up all related directory information and access information.

The two types of file backups are:

- ▶ An *incremental backup* creates backups of files, directories, or subdirectories that are new or have changed since the last incremental backup.
- ▶ A *selective backup* creates backups of specific files or entire directories unconditionally.

A file-level backup can be extended for WAN-connected clients using subfile backup. Typically, the amount of bandwidth that these clients use to connect to the Tivoli Storage Manager server is small. Using subfile backup, only the parts of a file that have changed are transferred to the server.

Another method of backup is called image or volume backup. In this case, the backup process does not distinguish between single files, but sends the specified volume as one single object to the Tivoli Storage Manager server.

6.4.1 Traditional LAN and WAN backup

In a traditional LAN and WAN environment, the Tivoli Storage Manager backup and archive client or application reads data from locally attached disks and sends it over the LAN to the Tivoli Storage Manager backup server, as shown in Figure 6-18. The server receives the data, then writes it to its storage pool (tape, disk or optical media) based on predefined policies and server configuration. Data is read and written by both the Tivoli Storage Manager client and Tivoli Storage Manager server machines. In addition, control information is also sent over the LAN to the Tivoli Storage Manager server.

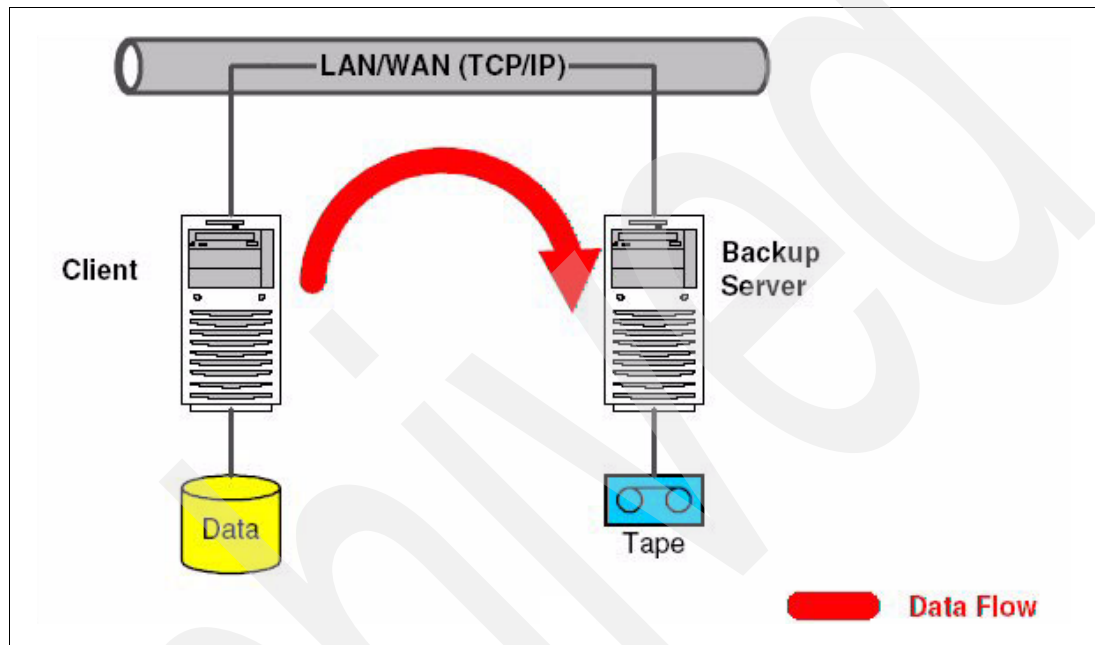


Figure 6-18 LAN and WAN backup

6.4.2 Progressive incremental backup

Tivoli Storage Manager is unique in offering an incremental (or progressive) backup methodology for backing up client data. This approach can remove the need for periodic full dumps because only the changed files are backed up. This can have significant benefits in backup time, least number of tapes used, reduced network traffic, size of backup servers, and manageability.

The incremental backup operation is a full scan of the client's file systems, which backs up all files and other information (and only those things) necessary to ensure that the Tivoli Storage Manager inventory matches the current state of the client's storage. This means that the first time this is run on a new client, everything is backed up. Each time after this, only new and changed files are sent.

During the incremental backup, the client queries the Tivoli Storage Manager server so that it knows what files are currently stored. The client uses this information to:

- ▶ Back up new files.
- ▶ Back up files whose contents have changed.
- ▶ Expire backup versions on the server for files that were deleted from the workstation.

6.4.3 Selective backup

During a selective backup, Tivoli Storage Manager sends copies of the files to the server even if they have not changed since the last backup. This is useful if you want to back up multiple files that are not in the same directory structure, regardless of their actual status in the Tivoli Storage Manager server. It may also apply where you want to enforce a complete backup.

However, remember that versioning still applies. If you back up a file multiple times when it has not changed, the result is that you will have multiple copies of exactly the same file on the server, instead of a number of different versions of the file.

This approach defeats the purpose of Tivoli Storage Manager version control. To avoid that, use the incremental backup technique command to back up only changed and new files. Typically, selective backup is only be used in special circumstances.

6.4.4 Logical volume backup

With Tivoli Storage Manager, you can back up a file system or raw logical volume as a single object from your client machine. The Tivoli Storage Manager client accomplishes this by dynamically loading an image plug-in utility that sends the object to the server with the Tivoli Storage Manager API.

This capability is currently available for the IBM AIX, HP-UX, Solaris, Linux, and Windows 2003 and Windows XP clients and can be used in a logical volume whether or not there is an associated file system. This approach ensures a clean backup. Windows clients require configuring by an additional service that is available with the Tivoli Storage Manager client.

6.4.5 Image backup

An image backup is a block-by-block copy of data from the Tivoli Storage Manager client to the Tivoli Storage Manager backup server. One important function of an image-restore is to accelerate recovery in a disaster recovery scenario.

With image backup, the Tivoli Storage Manager server does not track individual files in the file system image. File system images are tracked as individual objects, and the management class policy will be applied to the file system image as a whole.

Online image backup is possible for Windows 2003 and Linux clients by using the Tivoli Storage Manager snapshot function.

6.4.6 Open file support for backup operations

Tivoli Storage Manager looks for files that have changed between the start and the completion of the file's backup. Some files on your system might be in use, or open, when you try to back them up. Because an open file can change, a backup action might not reflect the correct contents of the file at a given time. Consider whether the file is important, and whether you can build the file again. If the file is not important, you might not want to back it up. Or, if the file is important, a root user on your workstation can ensure the file is closed before backup. If your backups run on a schedule, a root user can use the `preschedulecmd` option to enter a command to close the file. For example, if the open file is a database, use the database's quiesce command to shut down the database. A root user can use the `postschedulecmd` option to restart the application that uses the file after the backup completes. If you are not using a schedule for the backup, ensure that you close the application that uses the file before you start the backup. Tivoli Storage Manager can back up the file even if it is open and gets changed during the backup. This approach is only useful if

the file will be usable even if it changes during backup. To back up these files, assign the files a management class with the serialization dynamic or shared dynamic.

Two snapshot providers can be used for open file support: LVSA and VSS (VSS is not supported on Windows XP). VSS is the recommended solution, because it uses Microsoft's strategic snapshot solution. The LVSA is provided for customers migrating from prior versions of Tivoli Storage Manager, where LVSA was utilized, and as an alternative to VSS if issues exist with using VSS.

Certain applications can create files and open these files in a way that denies access to all other processes on a Microsoft Windows operating system. Although this is not a common practice, it is sometimes used by database vendors or other applications that might want to limit access to certain files. By restricting access to these files, backup products are prevented from backing up this data. These locked files are not the same as files that are open or in use. Tivoli Storage Manager, running without the Open File Support (OFS) feature, can back up open or in-use files, including files that are open for reading or writing, files that are changing during the backup, executable and DLL files that are running, log files that are being appended to, and others.

You can perform OFS or online image backups on machines with a single NTFS-based C: drive.

Example 6-20 on page 194 shows the error message that is written in the `dsmerror.log` when a Tivoli Storage Manager backup encounters one of these locked files without OFS support enabled.

Example 6-20 Error messages when files are in use

```
ANS4987E Error processing '\\machine1\d$\dir1\lockedfile.xyz': the object is in
use by another process
ANS1228E Sending of object '\\machine1\d$\dir1\lockedfile.xyz' failed
```

OFS should not be used for backing up locked Windows system files, such as system objects (Windows XP) and system state (Windows Server 2003 and Windows Vista). The Tivoli Storage Manager client has advanced features for backing up data contained within these files. The backup of the system data that is contained in these files requires additional processing and must be backed up in a group to allow for a successful restore. These files are excluded from the Tivoli Storage Manager file level backup.

For database applications that use certain files for transactional consistency (for example, a recovery log file), backing up and restoring these files without database coordination might not be possible. In these situations, do not back up these database files with the normal Tivoli Storage Manager file level backup. You can exclude these files from backup processing using an `exclude` or `exclude.dir` statement. Tivoli Storage Manager provides a number of Data Protection clients (IBM Tivoli Storage Manager for Databases, IBM Tivoli Storage Manager for Mail, IBM Tivoli Storage Manager for Application Servers) which provide this database coordination and backup along with other advanced database backup features. For a current list of Data Protection clients go to this Web site:

<http://www.ibm.com/software/tivoli/products/storage-mgr/product-links.html>

For private applications or other database products where a Data Protection client is not available, you can use the `preschedulecmd` option to signal the database or application to do one of the following tasks:

- ▶ Take the steps necessary to move these files to a consistent and unopen state.
- ▶ Bring down the database before the file level backup is started.

- Program or script another method to back up this data and exclude these files from the file level backup. In these cases, the OFS feature is not necessary because these files are no longer unavailable or locked by the application. After the file-level backup has completed, use the `postschedulecmd` option to bring the database back online or restart the application.

If the length of time to complete the file level backup is too long to have the open files off line (for example, having the database off line or holding up transactions), use the OFS feature to create a point-in-time snapshot of the volume. In this case, use the `presnapshotcmd` and `postsnapshotcmd` options to signal the database or application to coordinate with the backup of these open files. The snapshot, which occurs between the pre-snapshot command and post-snapshot command, should only take a few seconds to create. This approach allows the database or application to resume operations quickly while still allowing Tivoli Storage Manager to perform a full incremental backup of the volume, including the locked files. There are other situations where these application-locked files can be safely backed up and restored on a file-by-file basis. In these situations, you can enable the OFS feature for that volume where the open files exist. Tivoli Storage Manager file-level backup will then have access to these files and back them up using the Tivoli Storage Manager file level backup and archive operations.

For information about Tivoli Storage Manager Open File Support restrictions and issues, search for the Tivoli Storage Manager Client Open File Support document, which is Technote number 1248971, at the following Web site:

<http://www.ibm.com/software/sysmgmt/products/support/IBMTivoliStorageManager.html>

If Open File Support has been configured, Tivoli Storage Manager performs a snapshot backup or archive of files that are locked (or *in-use*) by other applications. The snapshot allows the backup to be taken from a point-in-time copy that matches the file system at the time the snapshot is taken. Subsequent changes to the file system are not included in the backup. You can set the `snapshotproviderfs` parameter of the `include.fs` option to `none` to specify which drives do not use open file support.

To control an open file support operation you can specify the following additional options in your `dsm.opt` file or as values of the `include.fs` option:

- `snapshotproviderfs`
- `presnapshotcmd`
- `postsnapshotcmd`

Additionally, when the LVSA is the snapshot provider, the following additional options can be specified:

- `snapshotcachelocation`
- `snapshotcachesize`
- `snapshotfsidleretries`
- `snapshotfsidlewait`

Notes:

- ▶ You can use the `include.fs` option to set snapshot options on a per file system basis.
- ▶ For the LVSA, use the `snapshotcachelocation` option to relocate the cache if necessary. You can specify a `snapshotcachelocation` for a specific drive using the `include.fs` option.
- ▶ Open file support is provided for both backup and archive. For backup, this includes incremental, incremental by date, selective, incremental image, adaptive subfile backup, and journal-based backup.
- ▶ Open file support is only available for local fixed volumes (mounted to either drive letters or volume mount points) formatted with FAT, FAT32, or NTFS file systems. This support includes SAN-attached volumes that meet these requirements.
- ▶ For the LVSA, if the client is unable to create a snapshot; for example, if the `snapshotfsidle` is not met or the `snapshotlocation` option is not valid, failover to a non-OFS backup will occur on the volumes where this problem exists.
- ▶ To enable OFS support in a cluster environment, all machines in the cluster must have OFS configured. If LVSA is being used as the snapshot provider, ensure it is installed and configured on each machine in the cluster. You can also use VSS by setting the `snapshotproviderfs` option.

The OFS feature can be selected at installation time or installed later using the Tivoli Storage Manager client GUI setup wizard. By default, the OFS feature is not installed. The installation program or the setup wizard perform all steps necessary to install, set up, and enable the OFS feature so that the next backup or archive operation will attempt to take advantage of the Open File Support. You can also use the installation program or setup wizard to install or remove the OFS feature.

If the LVSA is chosen as the snapshot provider, the installation or removal of this feature might require a machine reboot.

6.4.7 Adaptive subfile backup

As the number of mobile computers approaches 20% of the PC install base, many central support organizations will need to provide storage management services for their mobile and remote workers in their WAN environment.

Mobile and remote computers have limited access to the infrastructure that serves the rest of the company. Some limitations include being attached to the corporate network with reduced bandwidth, limited connect time, and minimal assistance to perform the backup.

This limited access both increases the criticality of storage management services and limits the applicability of traditional methods and policies. Tivoli Storage Manager helps resolve these problems with its adaptive subfile backup feature, shown in Figure 6-19 on page 197, which reduces the amount of data transferred while backing up changed files.

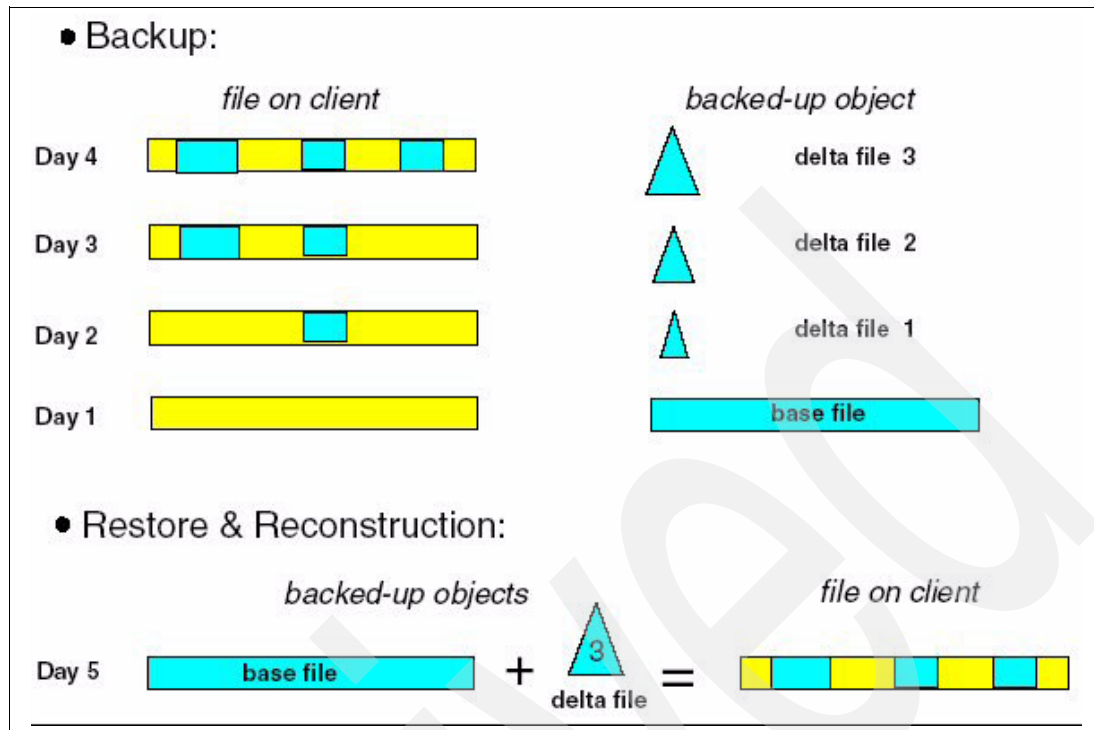


Figure 6-19 Adaptive subfile backup

Using this feature, the Backup-Archive client (Web client, CLI, or GUI) backs up only the changed portion of a file, either on byte level or on block level, instead of transferring the whole file to the server every time. The changed file portion is backed up as a differential backup relative to the last complete backup of the file (base or reference file). It is called a *delta file*. All changes since the last complete backup of the file are included in this delta file. In the case of a restore operation, this feature allows for restoring the whole file by restoring only two subfile components, one delta file, and the last complete backup of the whole file.

The adaptive subfile backup, and the restoring of a file consisting of a base file and the delta file, is completely transparent to the user. All necessary file data separations or reconstructions happen under the Backup-Archive client. Also, all other Tivoli Storage Manager features, such as policy management or fault-tolerant backup and restore, still fully apply.

Adaptive subfile backup is used for incremental and for selective backup. It is aware of multithreading and will work together with client data compression and encryption. This option is valid for Windows platforms only.

6.4.8 Journal-based backup

Journal-based backup provides an alternative to traditional progressive incremental backup, which under certain circumstances can dramatically increase overall backup performance. journal-based backup is supported on all AIX and Windows clients.

Use the `nojournal` option with the incremental command to specify that you want to perform a traditional full incremental backup, instead of the default journal-based backup.

Journal-based incremental backup differs from the traditional full incremental backup in the following ways:

- ▶ Tivoli Storage Manager does not enforce non-default copy frequencies (other than 0).
- ▶ UNIX special file changes are not detected by the journal daemon and are not, therefore, backed up.

Tip: Use the `nojournal` option periodically to perform a traditional full incremental backup to recreate the journal database.

The main difference between journal-based backup and progressive incremental backup is the method by which the list of backup candidate objects is derived. The backup candidate list specifies objects for a particular file system that are to be backed up, expired, or updated on the Tivoli Storage Manager server by a Tivoli Storage Manager Backup-Archive client.

Progressive incremental backup derives the backup candidate list by building and comparing the list of active, previously backed-up objects stored on the Tivoli Storage Manager server with the list of objects currently residing in the local file system.

6.4.9 Comparing full incremental, partial incremental, incremental-by-date, and journal-based backups

Full incremental, partial incremental, incremental-by-date, and journal-based backups can all back up new and changed files. An incremental-by-date backup takes less time to process than a full incremental backup and requires less memory. Journal-based backup applies only to AIX and Windows. The memory requirements for an initial journaling environment are the same as the memory requirements for a full file space incremental, because journal-based backups must complete the full file space incremental in order to set the journal database as valid, and to establish the baseline for journaling.

The memory requirements for subsequent journal-based backups are much less. Journal backup sessions run in parallel and are governed by the `resourceutilization` client option in the same manner as normal backup sessions. The size of the journal database file reverts to a minimal size (less than 1 KB) when the last entry has been deleted from the journal. Because entries are deleted from the journal as they are processed by the client, the disk size occupied by the journal should be minimal after a complete journal backup. A full incremental backup with journaling active takes less time to process than an incremental-by-date backup.

An incremental-by-date backup might not place exactly the same backup files into server storage because the incremental-by-date backup:

- ▶ Does not expire backup versions of files that you delete from the workstation.
- ▶ Does not rebind backup versions to a new management class if you change the management class.
- ▶ Does not back up files with attributes that change, unless the modification dates and times also change.
- ▶ Ignores the copy group frequency attribute of management classes (journal-based backups also ignore this attribute).

For NAS and N-Series filers running ONTAP 7.3 or later, you can use the `snapdiff` option when performing a full volume incremental backup. This option reduces memory usage and speeds up the processing. Similar to using incremental-by-date, you must consider certain items when performing a full-volume incremental backup.

There are also certain situations when data that should be backed up is not backed up:

- ▶ A file is excluded because of an exclude rule in the include-exclude file. Tivoli Storage Manager performs a backup of the current snapshot with that exclude rule in effect. This happens when you have not made changes to the file, but you have removed the rule that excluded the file. The snapdiff option does not detect this include-exclude change because it only detects file changes between two snapshots.
- ▶ If you have added an include statement to the option file, that include option does not take effect unless snapdiff detects that the file has changed. This is because Tivoli Storage Manager does not inspect each and every file on the volume during backup.
- ▶ You have used the **dsmc delete backup** command to explicitly delete a file from the Tivoli Storage Manager inventory. Snapdiff does not detect that a file has been manually deleted from Tivoli Storage Manager. Therefore, the file remains unprotected in Tivoli Storage Manager storage until it is changed on the volume and the change is detected by snapdiff, signalling Tivoli Storage Manager to back it up again.
- ▶ Policy changes such as changing the policy from `mode=modified` to `mode=absolute` will not be detected.
- ▶ The entire file space is deleted from the Tivoli Storage Manager inventory, causing snapdiff to create a new snapshot to use as the source, and a full incremental backup will be performed.
- ▶ Tivoli Storage Manager does not control what constitutes a changed object, that is controlled by the snapdiff option.

6.4.10 Group backup

A group backup enables you to create a consistent point-in-time backup of a group of files that is managed as a single logical entity as follows:

- ▶ All objects in the group are assigned to the same management class.
- ▶ Existing exclude statements for any files in the group are ignored.
- ▶ All objects in the group are exported together.
- ▶ All objects in the group are expired together as specified in the management class.

The group backup function also supports differential and full backup. You usually restore the entire group to get a consistent point-in-time restore, but Tivoli Storage Manager supports single file restore from a group as well.

The group backup function is similar to the well-established archive function of Tivoli Storage Manager.

6.4.11 SAN (LAN-free) backup

SAN technology provides an alternative path for data movement between the Tivoli Storage Manager client and the server. Shared storage resources (such as disk and tape) are accessible to both the client and the server through the SAN. Data is off-loaded from the LAN and from the server processor, which can create greater scalability. Tivoli SANergy must be used to send LAN-free backups to a disk storage pool.

LAN-free backups decrease the load on the LAN by introducing a storage agent. The storage agent can be perceived as a small Tivoli Storage Manager server (without a database or recovery log) that is installed and run on the Tivoli Storage Manager client machine. The storage agent handles the communication with the Tivoli Storage Manager server over the LAN but sends the data directly to SAN-attached tape devices, relieving the Tivoli Storage

Manager server from the actual I/O transfer. A LAN-free backup environment is shown in Figure 6-20.

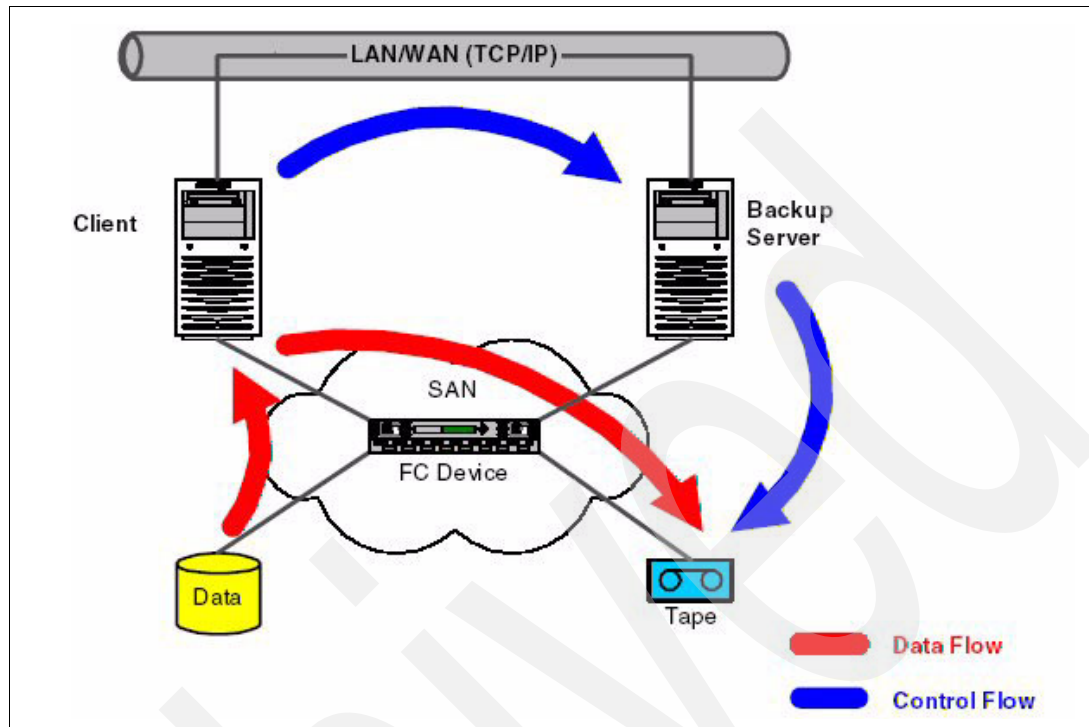


Figure 6-20 SAN backup

6.4.12 Split-mirror/point-in-time copy backup

A split-mirror/point-in-time backup occurs when a copy volume generated by operating system mirroring or a hardware-assisted instant copy function (found in many of today's high-end storage systems) is backed up to a Tivoli Storage Manager server, as shown in Figure 6-21.

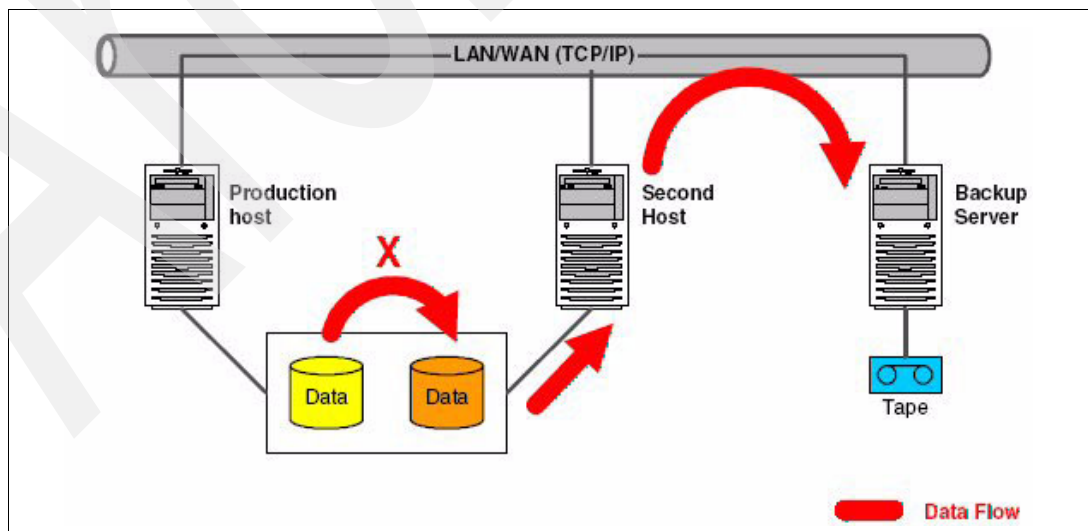


Figure 6-21 Point-in-time backup

Such a backup method almost eliminates the backup-related performance impact on the production host. This approach is facilitated and automated with the Tivoli Storage Manager for hardware components by coupling the FlashCopy function of IBM Enterprise Storage Server or SAN Volume Controller with Tivoli Storage Manager and its database protection capabilities for DB2, Oracle, and SAP R/3 databases.

6.4.13 NAS and NDMP backup

The IBM Network Attached Storage (NAS) products have been pre-installed with the Tivoli Storage Manager client, which enables an existing or planned Tivoli Storage Manager server to back up the data in the NAS system, as shown in Figure 6-22.

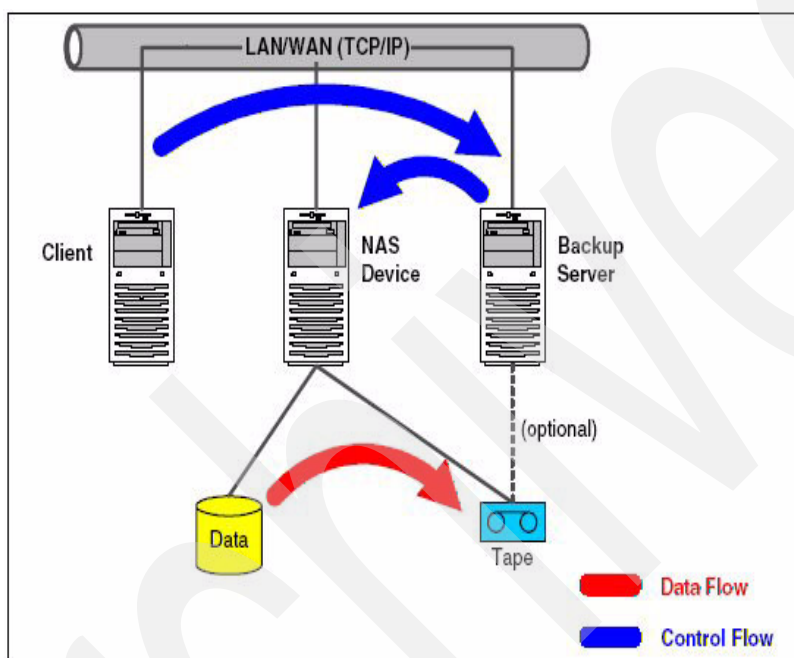


Figure 6-22 NAS and NDMP backup

This backup client is designed to provide file-level and subfile level backup and restore functionality. A Tivoli Storage Manager environment integrated with NAS systems can be used to manage a broad range of data storage, recovery, and availability functions across the entire computing infrastructure.

Based on the Tivoli Storage Manager server's configuration, the final destination of the NAS appliance backup may be located either in the disk storage of the Tivoli Storage Manager server or an attached tape subsystem. Data is sent direct to the storage pool, but the table of contents (or TOC) is sent to the Tivoli Storage Manager server. Automated scheduling to back up the NAS images can then be configured from the Tivoli Storage Manager server.

As with a standard Tivoli Storage Manager client, an option file is created and stored on the NAS system. Although a Network Data Management Protocol (NDMP) backup is usually started and controlled by a Tivoli Storage Manager server, the Tivoli Storage Manager Web client is also able to initiate and control an NDMP backup or restore. Using a TOC, the Tivoli Storage Manager Web client provides file-level access to the TOC so that it becomes browsable.

NDMP Filer to Server

With the filer-to-server configuration, the library is attached to the DMA (Tivoli Storage Manager server). The NAS device does not have access to the library, as shown in Figure 6-23. This configuration is also known as *3-way NDMP backup*. The backup data from the NAS device is transferred over the network (TCP/IP) to the Tivoli Storage Manager server.

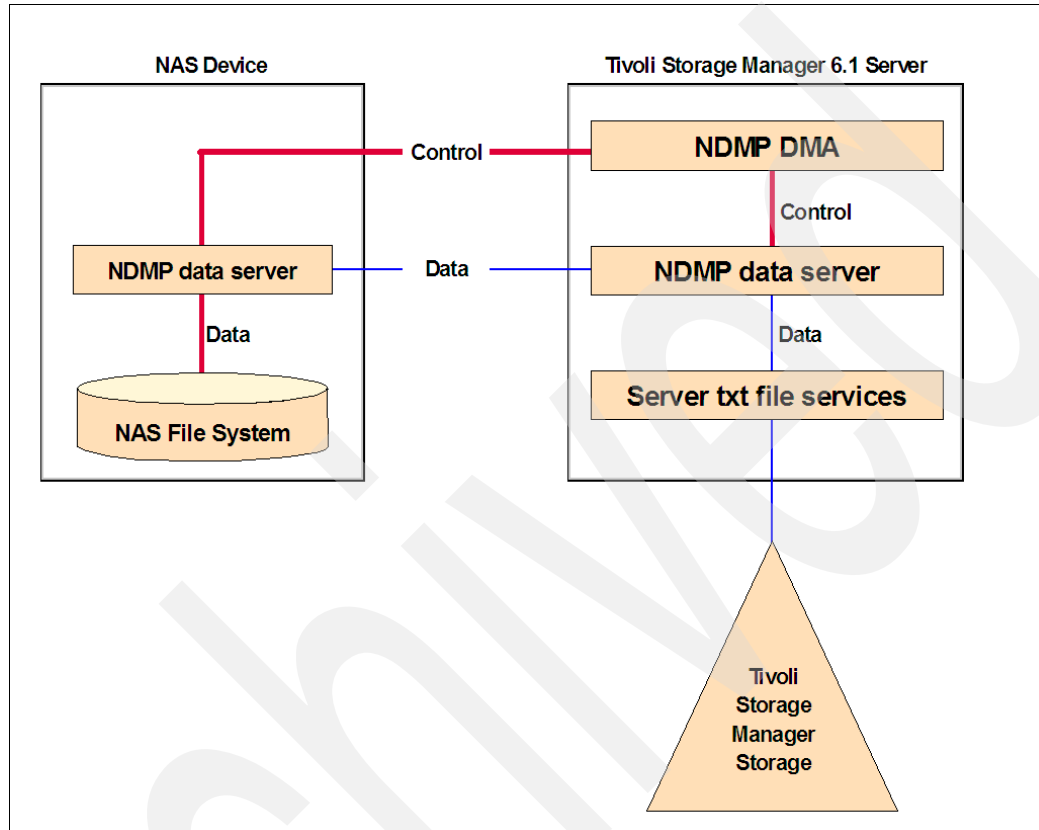


Figure 6-23 Filer-to-server configuration

For this configuration, several new server options are established.

The NDMPCONTROLPORT option specifies the port number to be used for internal communications for certain Network Data Management Protocol (NDMP) operations. The Tivoli Storage Manager server does not function as a general purpose NDMP tape server.

Specify the port number to be used for internal communications for certain NDMP operations. The port number must be in the range of 1024 - 32767. The default is 10000.

Firewall considerations are more stringent than they are for filer-to-attached-library because communications can be initiated by either the Tivoli Storage Manager server or the NAS file server. NDMP tape servers run as threads within the Tivoli Storage Manager server and the tape server accepts connections on port of 10001.

This port number can be changed through the following option in the Tivoli Storage Manager server options file:

```
NDMPPORTRANGE port-number-low,port-number-high
```

During NDMP filer-to-server backup operations, you can use the NDMPREFDATAINTERFACE option to specify which network interface the Tivoli Storage Manager server uses to receive NDMP backup data. The value for this option is a host name or IPv4 address that is

associated with one of the active network interfaces of the system on which the Tivoli Storage Manager server is running. This interface must be IPv4-enabled.

Before using this option, verify that your NAS device supports NDMP operations that use a different network interface for NDMP control and NDMP data connections. NDMP control connections are used by Tivoli Storage Manager to authenticate with an NDMP server and monitor an NDMP operation; NDMP data connections are used to transmit and receive backup data during NDMP operations. You must still configure your NAS device to route NDMP backup and restore data to the appropriate network interface.

When enabled, the `NDMPPREFDATAINTERFACE` option affects all subsequent NDMP filer-to-server operations. It does not affect NDMP control connections because they use the system's default network interface. You can update this server option without stopping and restarting the server by using the `SETOPT` command (set a server option for dynamic update).

NetApp file servers provide an NDMP option (`ndmpd.preferred_interface`) to change the interface used for NDMP data connections. Refer to the documentation that came with your NAS device for more information.

6.4.14 SnapMirror to Tape backup for N series NetApp Filers

For performance reasons, IBM agreed with NetApp to use their built-in SnapMirror to Tape function available in NetApp FAS Systems and IBM N-Series to do block-level backup for disaster protection for large Filers.

Tivoli Storage Manager integrates to issue the NDMP commands to move the SnapMirror image from the NetApp filer to a Tivoli Storage Manager server managed storage target for fast creation of a DR image. An overview is shown in Figure 6-24 on page 204.

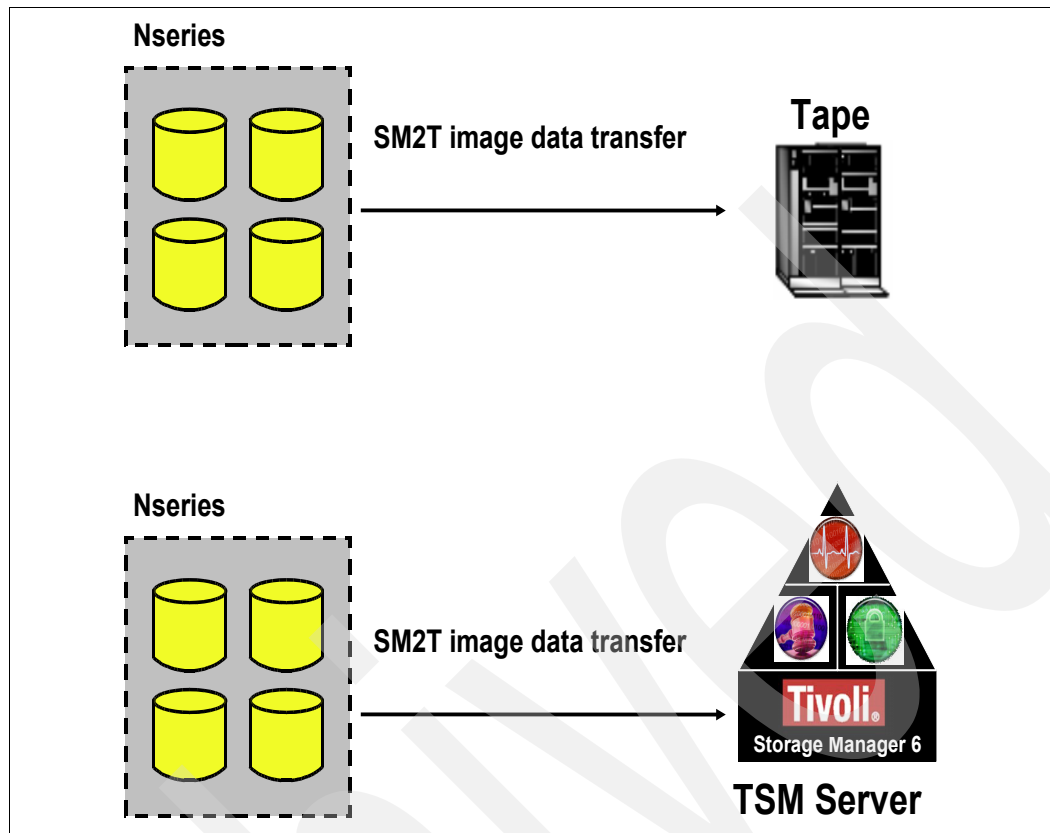


Figure 6-24 SnapMirror to tape support with Filer-to-Server and Filer-to-Tape

SnapMirror to Tape provides an alternative method for backing up very large NetApp file systems. Because this backup method has limitations, use this method when copying very large NetApp file systems to secondary storage for disaster recovery purposes. You can back up very large NetApp file systems using the NetApp SnapMirror to Tape feature. Using a block-level copy of data for backup, the SnapMirror to Tape method is faster than a traditional Network Data Management Protocol (NDMP) full backup and can be used when NDMP full backups are impractical.

Use the NDMP SnapMirror to Tape feature as a disaster recovery option for copying very large NetApp file systems to secondary storage. For most NetApp file systems, use the standard NDMP full or differential backup method, the new SnapDiff-API incremental backup, the snapshot functions of the filer or a combination of them.

Using a parameter option on the BACKUP and RESTORE NODE commands, you can back up and restore file systems using SnapMirror to Tape. There are several limitations and restrictions on how SnapMirror images can be used. Consider the following guidelines before you use it as a backup method:

- ▶ You cannot initiate a SnapMirror to Tape backup or restore operation from the Tivoli Storage Manager Web client, command-line client or the Administration Center.
- ▶ You cannot perform differential backups of SnapMirror images.
- ▶ You cannot perform a directory-level backup using SnapMirror to Tape, thus Tivoli Storage Manager does not permit an SnapMirror to Tape backup operation on a server virtual file space.

- ▶ You cannot perform an NDMP file-level restore operation from SnapMirror to Tape images. Therefore, a table of contents is never created during SnapMirror to Tape image backups.
- ▶ At the start of a SnapMirror to Tape copy operation, the file server generates a snapshot of the file system. NetApp provides an NDMP environment variable to control whether this snapshot should be removed at the end of the SnapMirror to Tape operation. Tivoli Storage Manager always sets this variable to remove the snapshot.
- ▶ After a SnapMirror to Tape image is retrieved and copied to a NetApp file system, the target file system is left configured as a SnapMirror partner. NetApp provides an NDMP environment variable to control whether this SnapMirror relationship should be broken. Tivoli Storage Manager always “breaks” the SnapMirror relationship during the retrieval. After the restore operation is complete, the target file system is in the same state as that of the original file system at the point-in-time of backup.

6.4.15 Snapdiff option for NFS data stored on NetApp filers

To backup your file systems on your NAS-File, you have several choices. One of them is to use the traditional way of incremental backups. Therefore, you have to mount the NFS or CIFS share to a Windows or UNIX system, where the Backup-Archive client is running.

The problem of doing backups in this way is that comparing objects to find what has changed and what needs to be backed up takes too long. For mounted file systems you cannot use journal-based backup.

Overview of NetApp snapshot difference

Incremental backup process leverages NetApp Snapshot Difference API. It uses snapshots to determine what files have changed since last backup. It is an alternative to the traditional incremental backup file-scan process. It identifies file changes since last backup in seconds.

The performance is independent of the number of files on volume. It has the ability to restore files on file level basis and use the traditional Tivoli Storage Manager storage hierarchy. This function is only available for N-Series or NetApp filers with ONTAP 7.3. It is limited to 7-bit ASCII characters in file and directory names. Global character set support requires an update to ONTAP and Tivoli Storage Manager client.

NetApp Snapshot Difference API is available with Tivoli Storage Manager Client 6.1 for Windows and AIX running against Tivoli Storage Manager Server Version 5.x or 6.1. See Figure 6-25.

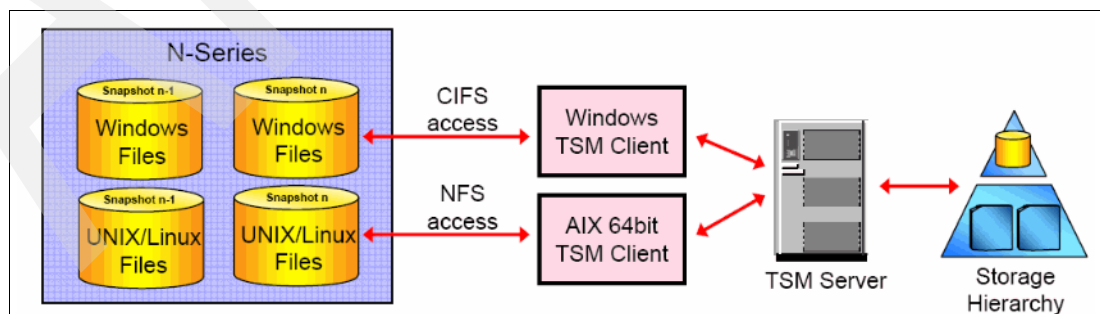


Figure 6-25 Overview of snapdiff option

The snapdiff option is for backing up NAS/N-Series file server volumes that are NFS or CIFS attached.

When used with the incremental command, snapdiff streamlines the incremental process by performing an incremental backup of the files that were reported as changed by the NetApp Snapshot Difference API, instead of scanning the volume looking for files that have changed.

Use this option with an incremental backup of an NAS filer volume instead of a simple incremental or incremental with snapshotroot whenever the NAS filer is running ONTAP V7.3 or later, for performance reasons. Do not use the snapdiff and snapshotroot options together.

The first time you perform an incremental backup with this option, a snapshot is created (the base snapshot) and a traditional incremental backup is performed using this snapshot as the source. The name of the snapshot that is created is recorded in the Tivoli Storage Manager database.

The second time an incremental backup is run with this option, a newer snapshot is either created or an existing one is used to find the differences between these two snapshots. This second snapshot is called the diffsnapshot. Tivoli Storage Manager then incrementally backs up the files reported as changed by snapdiff to the Tivoli Storage Manager server. The file space selected for snapdiff processing must be mapped or mounted to the root of the volume. You cannot use the snapdiff option for any file space that is not mounted or mapped to the root of the volume. After backing up data using the snapdiff option, the snapshot that was used as the base snapshot is deleted from the .snapshot directory. Tivoli Storage Manager does not delete the snapshot if it was not created by Tivoli Storage Manager. You can also perform a snapdiff incremental backup with the -DiffSnapShot=Latest option.

For NAS and N-Series filers running ONTAP 7.3 or later, you can use the snapdiff option when performing a full volume incremental backup. Using this option reduces memory usage and speeds up the processing. However, similar to using the incremental-by-date method, the following considerations and situations apply:

- ▶ A file is excluded because of an exclude rule in the include-exclude file. Tivoli Storage Manager performs a backup of the current snapshot with the exclude rule in effect. This happens when you have not made changes to the file, but you have removed the rule that excluded the file. The snapdiff option does not detect this include-exclude change because it only detects file changes between two snapshots.
- ▶ If you have added an include statement to the option file, that include option will not take effect unless the snapdiff option detects that the file has changed. The reason because Tivoli Storage Manager does not inspect each file on the volume during backup.
- ▶ You have used the **dsmdc delete backup** command to explicitly delete a file from the Tivoli Storage Manager inventory. The snapdiff option does not detect that a file has been manually deleted from Tivoli Storage Manager. Therefore, the file remains unprotected in Tivoli Storage Manager storage until it is changed on the volume and the change is detected by the snapdiff option, signalling Tivoli Storage Manager to back it up again.
- ▶ Policy changes such as changing the policy from mode=modified to mode=absolute are not detected.
- ▶ The entire file space is deleted from the Tivoli Storage Manager inventory. This causes the snapdiff option to create a new snapshot to use as the source, and a full incremental backup will be performed.
- ▶ The snapdiff option controls what constitutes a changed object.

6.4.16 Active and inactive file versions

One of the most important concepts in Tivoli Storage Manager data management is the difference between an active backup version and an inactive backup version.

Assume a new file is created on your workstation. The next time you run a backup operation (for example, Monday at 9 p.m.), Tivoli Storage Manager server stores this file. This copy of the file is known as the *active* version. When you run an incremental backup again (perhaps, Tuesday at 9 p.m.), Tivoli Storage Manager uses this active version already stored to check back with your workstation to determine whether the file has changed since the last backup. If it has, it is backed up again. This version now becomes the active version and the copy from Monday becomes an *inactive* version.

The most recent backed-up version of the file is always the active version, as long as it still exists on the original client. Tivoli Storage Manager will keep storing a new active version and making the previous active version inactive, up to the limit of the total number of versions defined to be retained in the management class. When this limit is exceeded, the oldest inactive version is deleted from Tivoli Storage Manager storage and can no longer be restored.

Tivoli Storage Manager controls the retention of its active and inactive versions of a file that exist on a client machine by using two criteria defined in the Management Class:

- ▶ **How many versions:** The parameter that controls the number of backup versions is called `verexist`. This may be set to a specific number or to `unlimited`.
- ▶ **How long to keep:** The `retextra` parameter controls how much time must elapse before an inactive file version is considered expired. This parameter controls how long to retain all remaining inactive files and may be set to a specific number of days or to `nolimit`, which means they will never be expired.

For a file deleted on a client machine, Tivoli Storage Manager uses different criteria:

- ▶ **How many files:** The parameter that controls the number of inactive backup versions is called `verdeleted`. This number is normally less than or equal to the number you have for `verexists`.
- ▶ **How long to keep files:** The `retextra` parameter controls how much time must elapse before an inactive file version is considered expired. This parameter controls how long to retain all remaining inactive files except for the last one and may be set at a specific number of days or to `nolimit`, which means they will never be expired.
- ▶ **How long to retain the last file:** The `retonly` parameter controls the last inactive copy of a file. As files get expired by `retextra`, you can configure Tivoli Storage Manager to manage the last inactive copy differently, so that you can keep that file for a longer period of time. It may be set at a specific number of days or to `nolimit`.
- ▶ Typically, configure `retonly` to be either the same value or longer than `retextra` because it functions as a grace period before expiring the file.

6.5 Archive function

The Tivoli Storage Manager archive function stores selected files unconditionally on the server according to the applicable management class limits. *Unconditionally* means that there is no version limit and they will be retained for the defined time period regardless of whether they are deleted on the client.

Archived files are useful if you want to take a snapshot of particular files, or if you want to delete files to free space, yet still have the ability to retrieve them if required. A common practice is to have legislative requirements to archive business records for long periods of time, and the archive function is ideal for this purpose.

6.5.1 Packages

Archive packages are groups of files archived together with a common description. The system automatically supplies a description consisting of the time and date stamp, but you can override this with your own meaningful description. This description is used for searching and selecting of archive packages to retrieve.

You can add to an existing package on a subsequent archive operation by supplying an existing archive package description. You can retrieve individual files within a package and delete files from a package.

6.6 Backup set

You can generate a copy of your client's most recent backup from the Tivoli Storage Manager server onto sequential media. This task is accomplished with the **generate backupset** command, which copies all active file versions of the file set from server storage onto the media. This copy of the backup, also called backup set or portable backup, is self-contained. It can be used independently of Tivoli Storage Manager to restore client data from a locally attached device that can also read this media, such as a CD-ROM.

This technique provides the Tivoli Storage Manager client with rapid recovery and no server and network dependency. You can also transfer the backup set from one server to another by generating the backup set on the source server, then transporting the backup set volume and defining it to the destination server, assuming both servers have the same media type,

6.7 Restore

To restore a file, a directory, or even the whole machine, you need to know two things: what you want to restore (file name or directory), and, optionally, from when (the point in time), and if you want to restore a file other than the most recent one. You do not need to know where the data actually is. When you request a file, Tivoli Storage Manager obtains the location of that particular file version from its database.

To restore files, specify the directories or selected files, or select the files from a list or GUI window. By default, only active file versions will be available for selection; however, inactive versions can be specified easily. You can restore files to their original location or specify a different directory. Collision options control whether existing files of the same name are replaced. No additional skill is needed to restore a file.

6.7.1 Restartable restore

When you are running a normal file-restore operation, Tivoli Storage Manager keeps track of the files that you have already restored, so that it can retry the operation if you have any network problems. If the restore operation terminates prematurely for any reason, such as network failure, the session state remains in the database so that it can be restarted from the last completed transaction.

This procedure (see Figure 6-26 on page 209) is called restarting the restore operation. Restarting the restore operation prevents you from having to resend files that were already restored to the client before the session aborted.

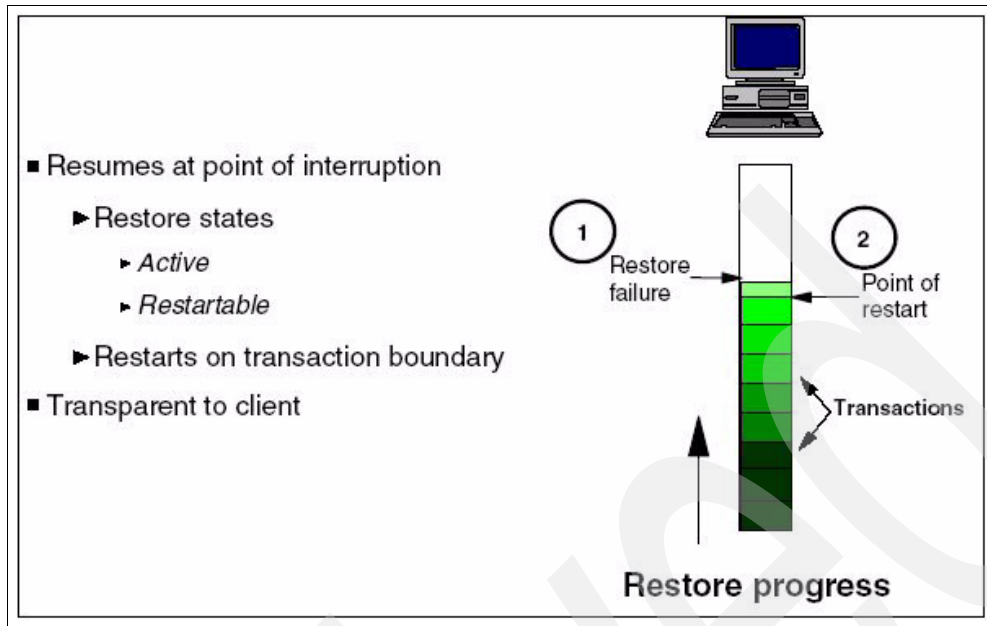


Figure 6-26 Restartable restore

6.7.2 Point-in-time restore

A point-in-time operation restores the specified objects to the state that existed at a specific date and time. A point-in-time restore is supported at the file space, directory, or file level. You must specify a sufficiently long retention period in the management class for this to occur.

To provide a point-in-time restore capability for, say, up to one month previously, set the `verexists` and `verdeleted` parameters to `no limit`; and set `retextra`, and `reonly` to at least that number of days. With this method, the number of times the files change in the restorable period does not matter because you will always have enough versions stored to perform the restore operation.

Figure 6-27 shows the point-in-time restore feature.

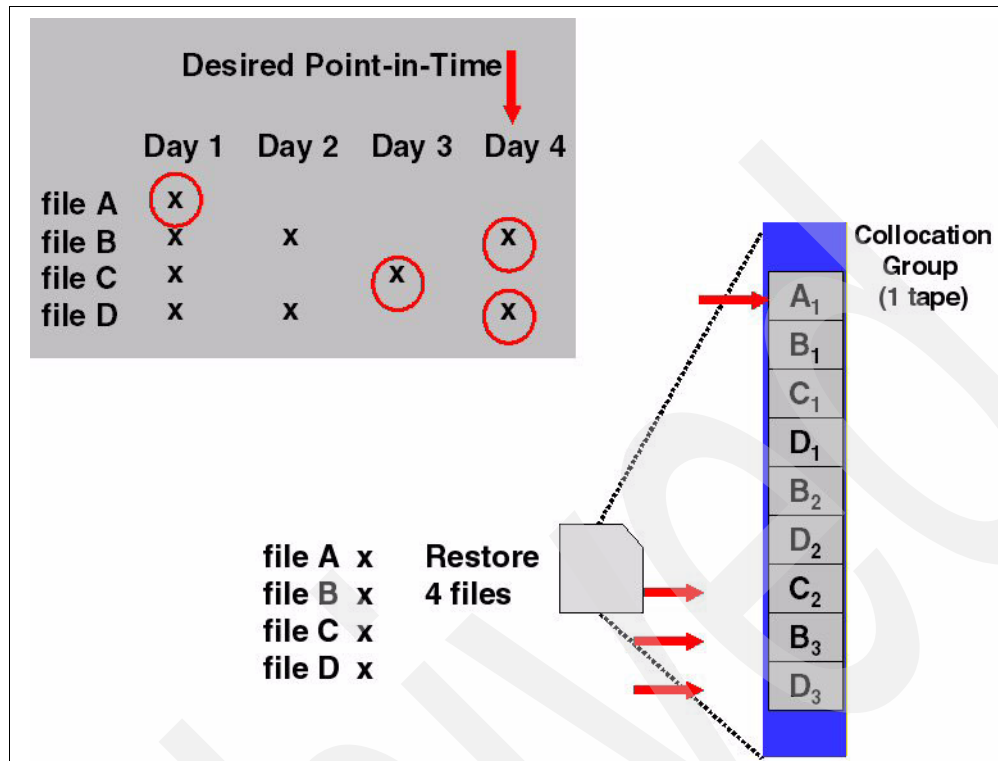


Figure 6-27 Point-in-time restore

Perform incremental backups to support a point-in-time restore. During an incremental backup, the client notifies the server when files are deleted from a client file space or directory. Selective and incremental-by-date backups do not notify the server about deleted files. Run incremental backups at a frequency consistent with possible restore requirements.

6.7.3 Multiple session restore

Multiple session restore allows the Backup-Archive clients to perform multiple restore sessions for no-query restore operations, increasing the speed of restores. This is similar to multiple backup session support.

Multiple session restore uses the mount points available on the server. If the data to be restored is on several tapes, there are sufficient mount points available, and the restore is done using the no-query restore protocol, then multiple sessions can be used to restore the data.

Note: Multiple session restore is enabled by the resourceutilization parameter.

6.7.4 Backup set restore

Restoration of a backup set can be performed on a complete file space level or by selecting individual files. You can restore from a backup set by using either:

- Server-based backup set restore from Tivoli Storage Manager server
- Local backup set restore directly through the Tivoli Storage Manager client from locally attached devices without contacting the server

To restore from the backup set, the node name of the client must match the one that was defined in the backup set. With LAN-free restore, the backup volumes are mounted by the Backup-Archive client through normal operating system device drivers and file system media, such as Optical ROM, tape, and disk.

6.8 Retrieve

The **retrieve** command obtains copies of archived files from the Tivoli Storage Manager server. You can specify either selected files or entire directories to retrieve archived files. The description option enables you to search for the descriptions assigned to the files when they were archived; you may decide to replace the files into the same directory from which they were archived, or into a different directory.

Again, archive packages are groups of files archived together with a common description. You can search for a specific file within a package, or even retrieve the whole package. When you retrieve one or multiple files, Tivoli Storage Manager locates the volume where both directories and files are, so you do not need to know which tape holds the data.

6.9 Scheduling

In a typical production environment, the backup and other operations that protect the client data should be scheduled, so that we can be sure they regularly execute and can see if or when something goes wrong. Tivoli Storage Manager provides you with a client scheduling interface, which interacts with the server's Central Scheduler for this purpose.

If you use Tivoli Storage Manager's own central scheduling, the administrator defines appropriate schedules on the server to perform the Tivoli Storage Manager tasks automatically. Central scheduling is a cooperative effort between the server and each client node in that the client must run its own scheduler process so that the client and server can contact each other to run the scheduled operation correctly.

Scheduled operations are recorded centrally in the event log at the server. You can view which schedules ran successfully, which were missed, and which are scheduled to run in the future. You can create an exception reporting list to view only those schedules that failed.

The client scheduling process normally should be configured to start automatically each time the client boots to avoid missing schedule execution and compromising data security. There are two methods used to control how the client and server make contact to run a schedule: client polling and server prompted. The client polling and server prompted methods can be configured in the client node configuration files or defining client option sets on the Tivoli Storage Manager server. The client node schedules can run using one to two methods. First, the classic schedule will run the action type on the specified day, Sunday - Saturday, weekday, or weekend. The enhanced schedule will run the action type on a specific day (1 - 31) of a specific month or a specific week of a month.

The classic and enhanced scheduling criteria can also be used for administrative schedules.

6.10 Compression

You have the option to specify that each client should compress its files or other objects before sending them to the Tivoli Storage Manager server. Compression is available for both backup and archive operations. Enabling client compression will decrease the network traffic between client and server (because you are sending a smaller quantity of data) at the expense of requiring more client processing resources to perform the operation. Therefore, the decision to enable client compressions must be made individually for each configuration.

If you are using client compression, then the client also automatically decompresses any objects that are sent back to it from the server when the reverse restore or retrieve operation is requested. Objects that are compressed also ultimately take up less storage space in the Tivoli Storage Manager server disk storage pools, reducing resource requirements. If compression is enabled on tape devices, the size of the compressed data could grow larger than the size of the compressed data.

6.11 Encryption

The Tivoli Storage Manager client implements an encryption function, which encrypts data before it is sent to the Tivoli Storage Manager server. This approach helps secure backed up data during transmission, and it means that the data stored on the Tivoli Storage Manager server cannot be read by any malicious administrators.

The function uses either AES 128-bit or DES 56-bit encryption. The user can choose which files are subject to encryption through include-exclude processing. The encryption uses a very simple key management system, which means that the user either must remember the encryption key password during restore or store it locally on the client system. The encryption processing is the last task on the client system before the data is sent to the server; other client operations, such as compression, happen before encryption is done. Encryption works for both backup and archive operations.

Current tape drive technology has encryption capabilities with the IBM LTO4 generation and TS1120 tape drives. The tape drives are supported to work with Tivoli Storage Manager. The encryption strengths for tape drives are AES128, AES192, or AES256. IBM offers Encryption Key Manager (EKM) to manage the encryption keys.

Unlike the Tivoli Storage Manager user password, the encryption key password is case-sensitive. If the password is lost or forgotten, the encrypted data cannot be decrypted, which means that the data is lost.

6.12 Windows issues

This section discusses Windows-specific issues as they relate to Tivoli Storage Manager.

6.12.1 Windows System Services

The Windows System Services contains the services required for the system to operate. The services can be backed up individually; however, backing up all the services ensures that the server can be restored to a consistent state. The components that are included are:

- ▶ Background Intelligent Transfer
- ▶ Event log (not applicable for Windows Vista)

- ▶ Removable Storage Management
- ▶ Cluster Database
- ▶ Remote Storage
- ▶ Terminal Server Licensing
- ▶ Windows Management Instrumentation
- ▶ Internet Information Services
- ▶ DHCP Database
- ▶ Wins Database

6.12.2 Windows System State

A System State is a collection of files or databases that represent a logical entity and help the system achieve a consistent state. System objects can be part of a larger, distributed entity known as System State.

You can back up Windows 2003 and Windows Vista system objects together or individually. Microsoft recommends that all system objects be backed up together to maintain a consistent system state. These are valid system objects:

- ▶ Active Directory (not applicable for Windows Vista)
- ▶ System Volume
- ▶ Certificate server database
- ▶ COM+ database
- ▶ Windows Registry
- ▶ System and boot files
- ▶ ASR (Windows XP / 2003 only)

To back up and restore all Windows system components, except the Windows Registry, a user must have administrator privileges. A member of the backup operators group can back up and restore the Windows Registry.

6.12.3 Automated System Recovery

Automated System Recovery (ASR) is a restore feature of Windows XP Professional and Windows Server 2003 that provides a framework for saving and recovering the Windows XP or Windows Server 2003 operating state in the event of a catastrophic system or hardware failure. Tivoli Storage Manager creates the files required for ASR recovery and stores them on the Tivoli Storage Manager server.

The goal of ASR is to return the operating system to the point of the last backup. ASR is not used to recover application or user data. Such data is recovered by normal Tivoli Storage Manager restore procedures after successful completion of ASR recovery. ASR is a two-phase process:

1. Windows installs a temporary operating system image using the original operating system media.
2. Windows invokes Tivoli Storage Manager to restore the system volume and system state information.

6.13 SAN environment

This section describes how to perform LAN-free client operations such as backups and restores. This includes instructions for configuring the Tivoli Storage Manager server and client to use both disk and tape as LAN-free storage destinations. It also presents important considerations for using LAN-free data transfers, either to disk or tape.

Tivoli Storage Manager provides a number of SAN solutions. Many other solutions are in development and will be released as SANs mature. These solutions address the need for efficient and reliable data protection:

- ▶ **Tape library sharing**

The tape resource sharing feature of Tivoli Storage Manager allows administrators to pool tape resources for use by many Storage Manager servers running on heterogeneous platforms. This can improve backup and recovery performance and tape hardware asset utilization.

- ▶ **LAN-free client data transfer**

At the direction of the Tivoli Storage Manager server, tape storage pools are dynamically allocated to Tivoli Storage Manager clients. This enables backup information to be sent across the SAN directly from the client to the server storage pools. The data path completely bypasses the LAN and the Tivoli Storage Manager server. LAN-free data transfer can significantly improve the data transfer speed. If your LAN environment is congested during the backup window, this is an excellent alternative.

6.13.1 Tape library sharing

SAN technology allows Tivoli Storage Manager to share its libraries. Multiple Tivoli Storage Manager servers can dynamically share the volume and tape drive resources of one connected tape library. The hosts can maintain high-speed connections to the same devices through the SAN fabric. Backup and restore applications benefit immediately from this, and the effect is pronounced for environments with large amounts of data to back up over shrinking windows of time and constrained LAN bandwidth.

6.13.2 LAN-free client data transfer on sequential media

In this section, we discuss LAN-free client data transfer solutions using Tivoli Storage Manager and storage agent. In particular, we discuss these topics:

- ▶ Setup and configuration of Tivoli Storage Manager server for LAN-free client data transfer
- ▶ Setup and configuration of storage agent for LAN-free client data transfer
- ▶ Operations and considerations when using client data transfer

Server setup for LAN-free client data transfer

Before setting up LAN-free data transfer, you should have a Tivoli Storage Manager V6.1 server configured and running, because it must be able to communicate with any tape device through the SAN. The storage agent software version must be the same as the Tivoli Storage Manager server or N-2. If the Tivoli Storage Manager server is at V6.1.1, the storage agent needs to be at V5.4.0.0 or later, but not later than V6.1.1. You can have any server platform running. For details go to:

<http://www.ibm.com/support/docview.wss?uid=swg21302789>

In a Tivoli Storage Manager SAN environment, the Tivoli Storage Manager server is referred to as the *library manager*. The library manager processes all mount requests from all library clients (storage agents).

The library must be defined as a *shared* library or the Storage Agent will not be able to communicate with it.

You also need to have labeled volumes checked in your library, a defined policy that uses the storage pool you defined as a backup or archive destination, and a client node registered to the appropriate policy domain.

Installing and configuring the storage agent

To use the storage agent, you must have a Tivoli Storage Manager V6.1 server properly configured for your SAN attached library.

A copy group definition in the appropriate management class, which is what you use for LAN-free backups, should point to the tape storage device connected in the SAN.

If you use disks for LAN-free backup, it can only be sequential disk with file deviceclass and shared=yes setting. This approach will generate a file-library and file-drives. For the sharing of the disk (SAN-LUN) you need additional software. This can be SANergy or GPFS.

You must also install the Tivoli Storage Manager Backup-Archive client and API, normally on the server on which you want to perform LAN-free data transfer.

The client options for LAN-free data transfer in the client option files `dsm.opt` (Windows) and `dsm.sys` (UNIX) are:

- ▶ `enablelanfree yes`
- ▶ `lanfreecommethod`
- ▶ `lanfreeshmport` or `lanfreetcpport`
- ▶ `lanfreetcpsserver`

With the `lanfreetcpsserver` option, you are able to send your data over LAN connection to any storage agent in your network, and the storage agent transfers the data through SAN to the device. It seems to be LAN-free, but it is not at all. The advantage of this method is to reduce the I/O load on your Tivoli Storage Manager server.

Note: If the option `tcpserveraddress` in your client option file (`dsm.opt` or `dsm.sys`) differs from the `tcpserveraddress` of the assigned storage agent, the `tcpserveraddress` of the storage agent will be used to establish a connection because the storage agent defines the communication path. If the storage agent is down or not accessible from the client, you will get an error message and the `tcpserveraddress` of the client will be used.

Configure the storage agent

The storage agent uses the `dsmsta.opt` options file when the application starts. Example 6-21 shows a `dsmsta.opt` option file.

Example 6-21 dsmsta.opt

```
* =====
* Tivoli Storage Manager
* Storage Agent
* =====
* Storage Agent Options File (dsmsta.smp)
* Platform: NT
*
* COMMmethod TCPIP
* TCPservertsm.server.one
* DEVCONFIG devconfig.out
```

Ensure that the DEVCONFIG option is set. The following example shows how the devconfig.out file is used to store device configuration information:

DEVCONFIG devconfig.out

To establish communication between the storage agent and the Tivoli Storage Manager server, issue the DSMSTA SETSTORAGESERVER command. After you have set the configuration, the devconfig.out file is similar to Example 6-22.

Example 6-22 devconfig.out of the storage agent

```
SET STANAME ORACLE1_SA
SET STAPASSWORD password
SET STAHLADDRESS my.oracle1.server
DEFINE SERVER server1 HLADDRESS=tsm.server.one LLADDRESS=1500 SERVERPA=password
```

The VALIDATE LANFREE command will check that the LAN-free configuration is configured properly. See Example 6-23 on page 216.

Example 6-23 Check the configuration with validate lanfree command

Node Name	Storage Agent	Operation	Mgmt Class Name	Destination Name	LAN-Free capable?	Explanation
-----	-----	-----	-----	-----	-----	-----
NODE1	STA1	BACKUP	NOLF	OUTPOOL	No	No available online paths.
NODE1	STA1	BACKUP	NOLF_SW	PRIMARY	No	Destination storage pool is configured for simultaneous write.
NODE1	STA1	BACKUP	STANDARD	SHRPOOL	Yes	
NODE1	STA1	ARCHIVE	NOLF	OUTPOOL	No	No available online paths.
NODE1	STA1	ARCHIVE	NOLF_SW	PRIMARY	No	Destination storage pool is configured for simultaneous write.
NODE1	STA1	ARCHIVE	STANDARD	SHRPOOL	Yes	

Verifying a LAN-free data movement

When the Tivoli Storage Manager server, client, and storage agent are completely configured, you can perform LAN-free backups, restore, archives, or retrieves. You have several options for verifying that the client transfer was LAN-free:

- ▶ Issue the query session command from the storage agent console, which should show you that the bytes received are increasing to the total amount of data being backed up. A query session from the Tivoli Storage Manager server shows a small number of bytes received for the same node, because this refers to the metadata.
- ▶ Issue the following command to verify that the storage agent has initiated communication with the Tivoli Storage Manager server. If you get an output from the commands in the example, then the client session established is LAN-free.

```
query actlog search=storage_agent_name msgno=8337
```

You can also use this command:

```
query actlog search=storage_agent_name
```

LAN-free data transfer considerations

Tivoli Storage Manager LAN-free data transfer effectively removes backup-archive data traffic from your LAN. It improves performance specifically when you are backing up large files.

Use LAN-free functions to back up large databases and file system images because there is a significant performance improvement. This approach also allows you to fully utilize your LAN for other application and communication processing.

For smaller file backups, you can use LAN-free capabilities, but performance improvement might not be significant. LAN data transfer is sometimes faster than LAN-free data transfer for small files.

6.14 Integrated Solutions Console and Administration Center

The Administration Center Web-interface provides an easy way to manage multiple server instances from a single browser window. It has been available since Tivoli Storage Manager V5.3, and is hosted within the Integrated Solutions Console (ISC) framework. The 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.

6.14.1 New installations

Both products, Administration Center and Integrated Solutions Console, are included in the Tivoli Storage Manager product distribution, and are installed with the Tivoli Storage Manager server, as an optional component. In previous versions these components were distributed separately.

The three ways in which the Integrated Solutions Console can now be installed are:

- ▶ During a first time installation of Tivoli Storage Manager
- ▶ Using the installation utility or wizard and selecting the Integrated Solutions Console and Administration Center component
- ▶ During the installation of the Tivoli Reporting and Monitoring installation

Note: If you plan to install Tivoli Reporting and Monitoring, the Integrated Solutions Console and Administration Center installation component is included. This means that the Reporting and Monitoring server would also act as the Integrated Solutions Console and Administration Center server in this scenario removing the requirement for a separate Integrated Solutions Console and Administration Center machine.

6.14.2 Upgrade and co-existence

When you install a Tivoli Storage Manager V6.1 server, you will have to install the matching Integrated Solution Console V7.1 and Administration Center V6.1. If you try and configure the Tivoli Storage Manager V6.1 server connection in the older Integrated Solutions Console and Administration Center, an error occurs, as shown in Figure 6-28 on page 218.

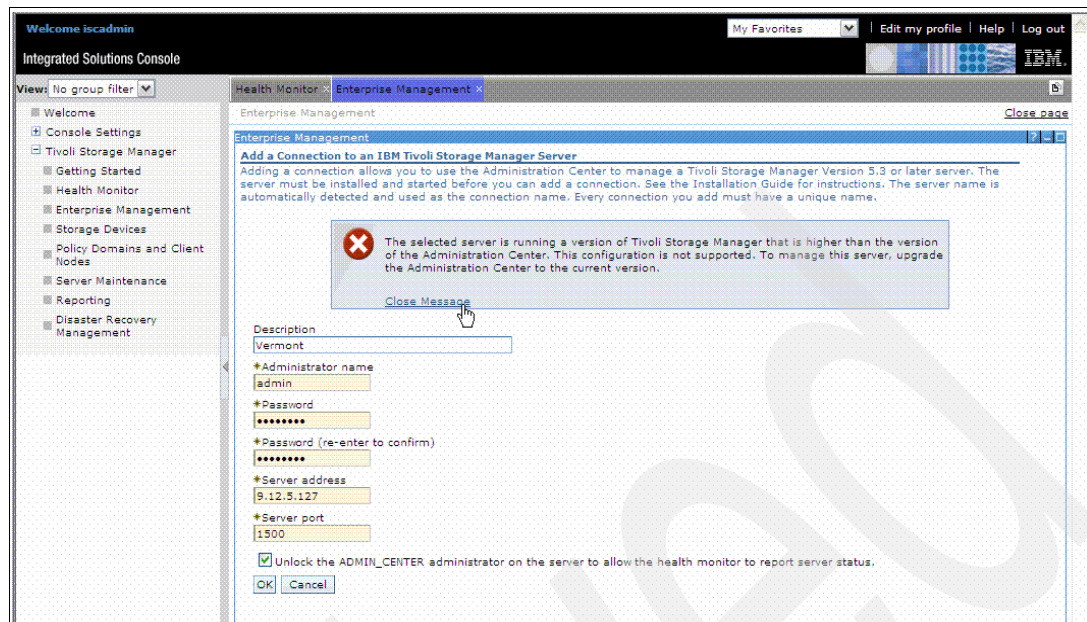


Figure 6-28 Down level ISC Error for Tivoli Storage Manager V6.1 Server

6.14.3 Upgrade from previous versions of ISC and AC

Both the new and previous versions of the Integrated Solutions Console and the Administration Center components coexist on the same system, using different port references.

A significant change has occurred in the technologies on which the both the Integrated Solutions Console V7.1 and the Administration Center V6.1 are built. As a consequence, you must manually complete the upgrade of both packages by collecting the configuration information and re-creating this in the new configuration from an earlier version of the Administration Center to Version 6.1. You must define your Integrated Solutions Console user IDs to the new Administration Center. In addition, you must provide credentials for each of the Tivoli Storage Manager servers.

If the current version of Administration Center is to be uninstalled, first obtain information about users and server credentials, then save the `tsmservers.xml` file which is located in the installation directory on the Administration Center. When installing the Administration Center Version 6.1, note the following information:

- ▶ ISC user IDs are not re-created in the new Administration Center.
- ▶ Tivoli Storage Manager server's database file and `tsmservers.xml` file are copied from the earlier Administration Center, if located. The file format is compatible between versions.
- ▶ Tivoli Storage Manager server credentials are not re-created in the new Administration Center, therefore, you must manually duplicate the user configuration of your earlier Administration Center. Ensure that you do the following tasks:
 - Obtain the information about users and server credentials from the earlier Administration Center.
 - Define each ISC user previously defined to the earlier Administration Center.
 - Define to each ISC user its set of Tivoli Storage Manager server connections.

Uninstall the earlier Administration Center.

6.14.4 Change to the ISC

A change has been made regarding policy domain configuration panels.

Policy Domain configuration panels

When making changes to the policy sets, the V6.1 Administration Center no longer validates and activates the changes.

6.14.5 New features

Many features in the Tivoli Storage Manager Administration Center Version 6.1 are new since V5.5; this section discusses the features.

Updated Integrated Solutions Console

In V6.1, the Administration Center is hosted by the IBM Integrated Solutions Console (ISC) Advanced Edition Version 7.1. After the ISC installation completes, open a Web browser and enter the following address, which displays the logon window for the ISC:

`https://local_host:9043/ibm/console`

This window indicates a successful installation of the Integrated Solutions Console.

To learn about console updates:

1. Start the ISC.
2. Click **Help** in the ISC banner.
3. In the Help navigation tree, click **Console Updates**.

WebSphere Windows service

In V6.1, the WebSphere Windows service is named TSM Administration Center - TsmAC.

Identify managing servers

The table of servers that is the hub of the enterprise-management work page has a column that identifies the managing server, if one exists, for each listed server. By sorting or filtering on the column, you can display the set of servers that are managed by a given server.

Hover help for table links

The Administration Center typically displays Tivoli Storage Manager objects in a table. In V6.1, when the cursor hovers over an object image, hover-help text is displayed. The hover help identifies the default action that results when you click the link that is associated with the object.

Links to information about server and Administration Center messages

When a problem or issue occurs with the server or Administration Center, you are immediately notified and provided with a brief message about the problem or issue. The message number is also provided. In V6.1, you can obtain detailed information about a message by clicking the link that is associated with the message number. The information is displayed in a new browser window.

Maintenance script enhancements

Tivoli Storage Manager utilizes a maintenance script to perform scheduled maintenance tasks. In V6.1, you can generate a maintenance script in either of the following two styles:

- ▶ A *predefined* maintenance script is one that is generated through a wizard. This script contains standard commands that cannot be altered. A predefined script can only be modified in the wizard.
- ▶ A *custom* maintenance script is created using the Administration Center maintenance script editor. To have more control of your maintenance tasks, you can modify the commands that you specify. You can also use the editor to update your custom maintenance script.

Client nodes and backup sets enhancements

The redesigned Administration Center displays information about backup sets, client nodes, and client-node groups in one portlet. The design includes search functions that you can use to find and display information more quickly. When you select a client node, a summary panel is displayed with the current operation status, server actions, and client-node actions. The “Client nodes and backup sets” work item appears in the ISC navigation tree.

Session and process information available in the health monitor

The Administration Center health monitor now includes information about server processes and sessions. The information is also available in the properties notebooks for servers.

Centralized server-connection management

In V6.1, server-connection tasks, such as adding a server connection, changing a password, and creating a server instance, are consolidated in a single location, “Manage Servers” work item, located in the ISC navigation tree. With actions available in this work item, you can quickly upload server-connection information to the Administration Center using an XML file. This file can optionally include a set of server credentials for multiple servers. To help create an XML file, you can download a list of server connections, without the credential information.

Changes to management-class activation

With V6.1, Tivoli Storage Manager no longer activates changes to existing management classes automatically. You must activate the changes manually. Before the changes take effect, they are validated. Results of the validation are displayed. You or another administrator can review them, and then either confirm or cancel the activation. Because changes are manually activated, you can prepare the management class in advance and activate the changes at an appropriate time.

DRM support for Active Data Pools

Changes to the Administration Center are related to the Disaster Recovery Manager, are:

- ▶ Disaster Recovery Management Property Notebook
 - New Tab Active Data Pools (with similar function to the Copy Pools Tab)
- ▶ Volume Property Forms for DRM or Remote DRM volumes
 - Display pool information for volumes associated with an active data pool
- ▶ (Long) Move DRMEDIA Wizard
 - Ability to overwrite active data pool settings in addition to copy pool settings
 - Relevant text updates at Welcome and Summary Panels
- ▶ Update panel description to include active data pools
 - Reference in addition to copy pools reference

- View Disaster Recovery Media/View Remote Disaster Recovery Media Main Portlets
Updated portlet table column header from Copy Pool to Destination Pool, referring to both Copy and Active data pools
- View Disaster Recovery Media/View Remote Disaster Recovery Media Main Portlets:
Advanced Filter Form
Added new input field for Active-data pool, similar to the one for Copy pool filtering

6.14.6 Configuring the Administration Center

After installing ISC and Administration Center, Tivoli Storage Manager servers should be added to the portal. Only Tivoli Storage Manager V5.3 and later releases can be added.

In this section we explain the configuration steps for the Administration Center.

Adding a new server instance in the Integration Solutions Console

Now, the Tivoli Storage Manager V6.1 instance is ready to associate within the ISC, and is currently running in the background.

Add the server instance by following these steps:

1. Log in to the ISC with the user ID and password that were defined during the installation process.
2. Expand the Tivoli Storage Manager option, in the left side panel shown in Figure 6-29.

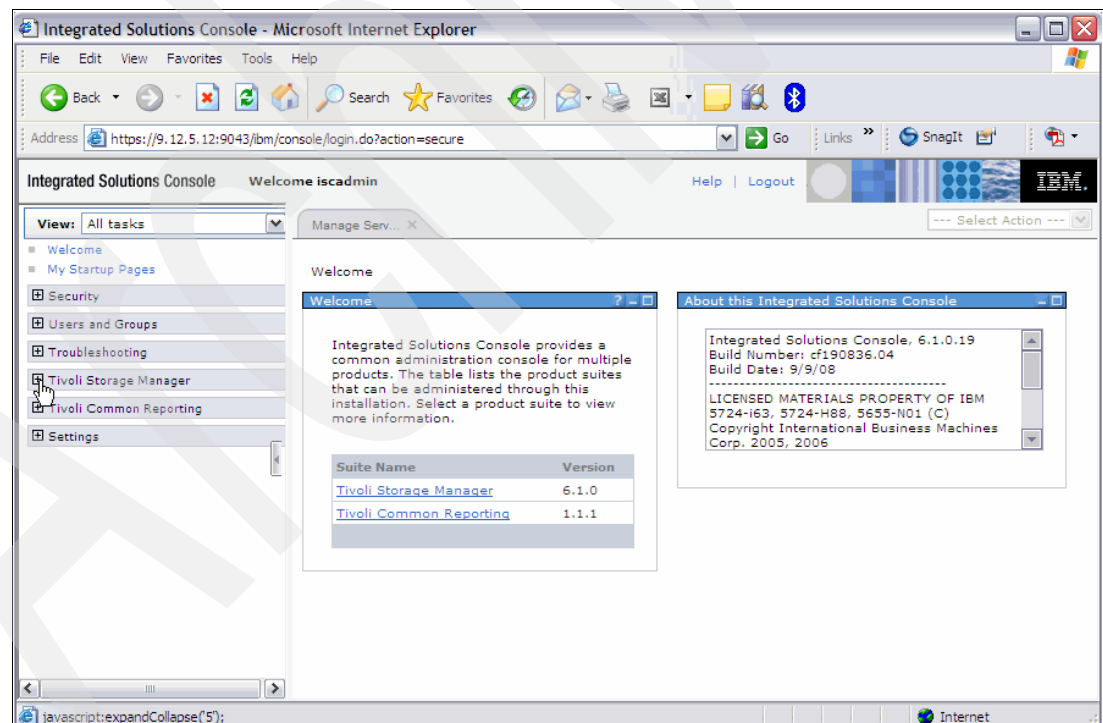


Figure 6-29 ISC - expand Tivoli Storage Manager Server section

3. Click **Manage Server** as shown in Figure 6-30.

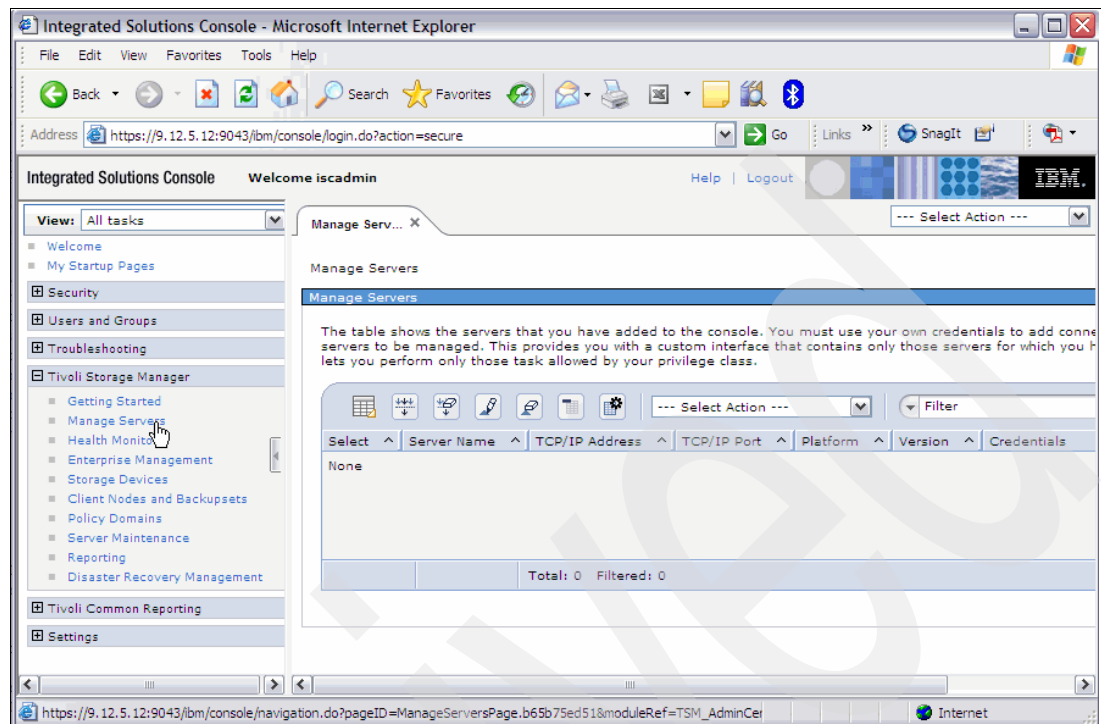


Figure 6-30 Manage Servers panel

From the Select Action drop-down menu, select **Add Server Connection**, as shown in Figure 6-31.

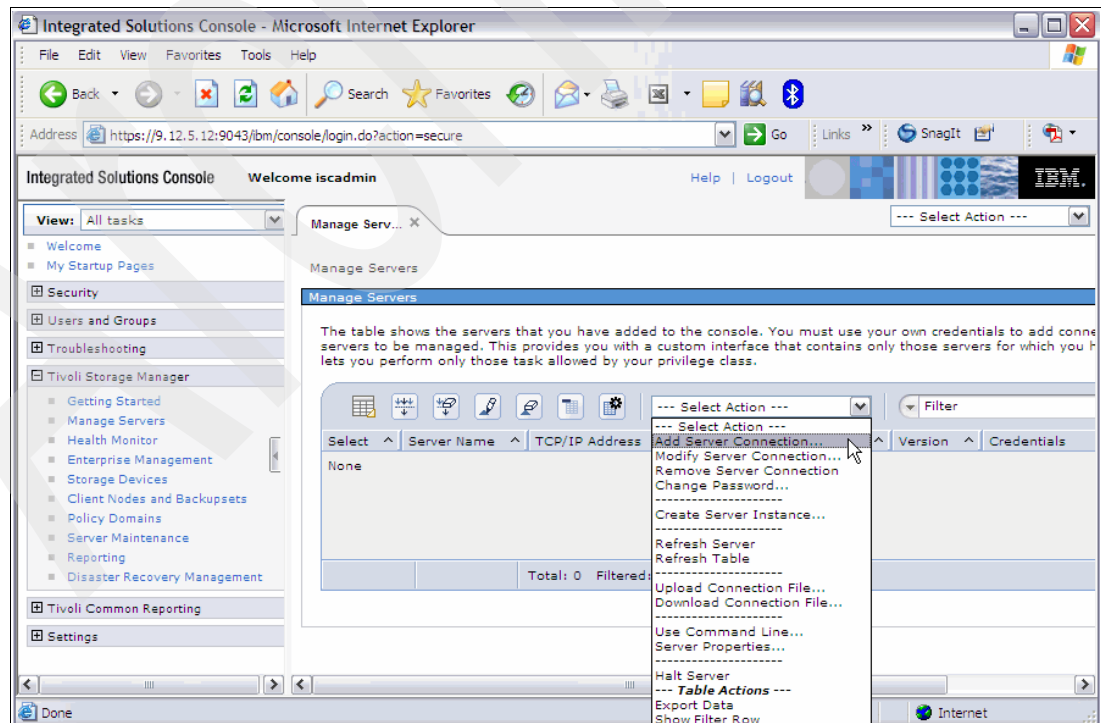


Figure 6-31 Choosing the Add a Server Connection

4. Enter the connection details for the new **TSM1** instance, as shown in Figure 6-32 and then click **OK**.

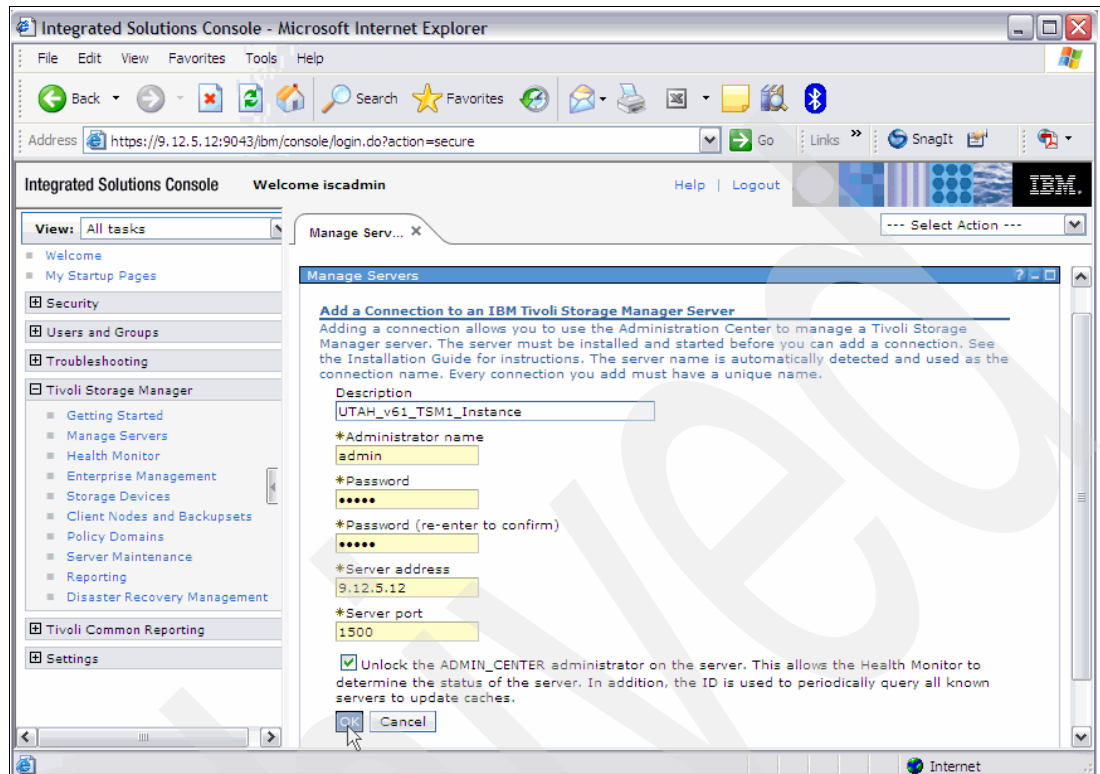


Figure 6-32 Adding a server connection for Tivoli Storage Manager V6.1 instance

- Wait for the successful completion panel shown in Figure 6-33 on page 224, and then click **OK**.

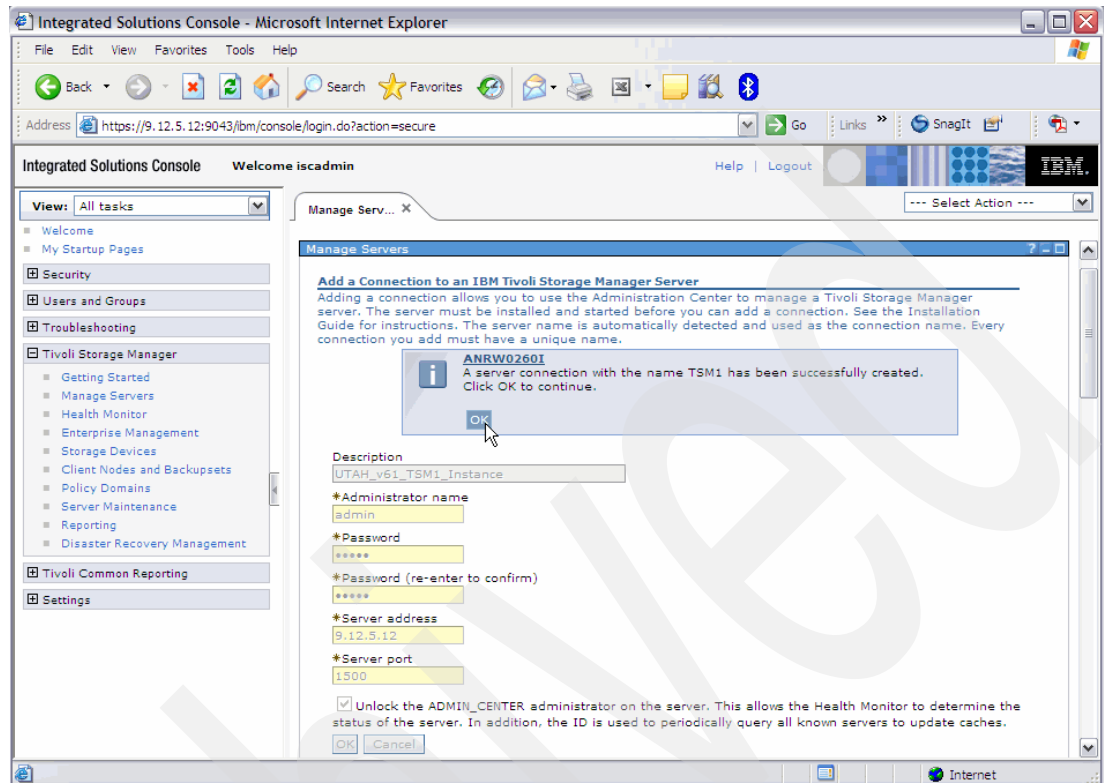


Figure 6-33 Summary page after adding a server connection in the Integrated Solutions Console

- Finally, for test and review of the server connection, click the **TSM1** server link, as shown in Figure 6-34.

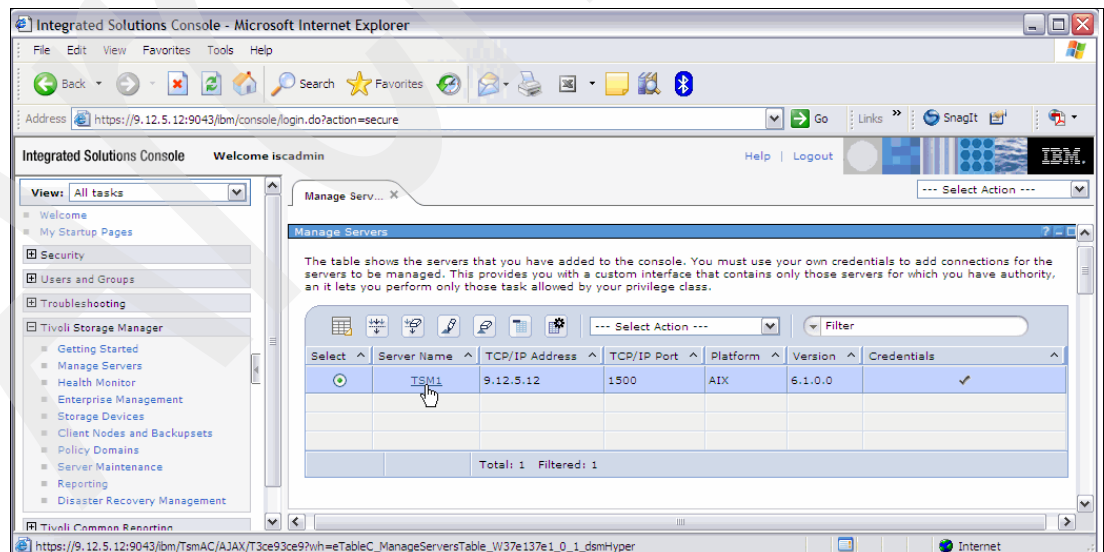


Figure 6-34 Tivoli Storage Manager V6.1 Manage Servers panel in the Integrated Solutions Console

6.15 Reporting utility of Tivoli Storage Manager

With Tivoli Storage Manager, you can monitor your storage management environment using security and usage reports that were previously part of Tivoli Storage Manager Express. They can be accessed from the Reporting item in the Administration Center navigation tree, as shown in Figure 6-35 and Figure 6-36

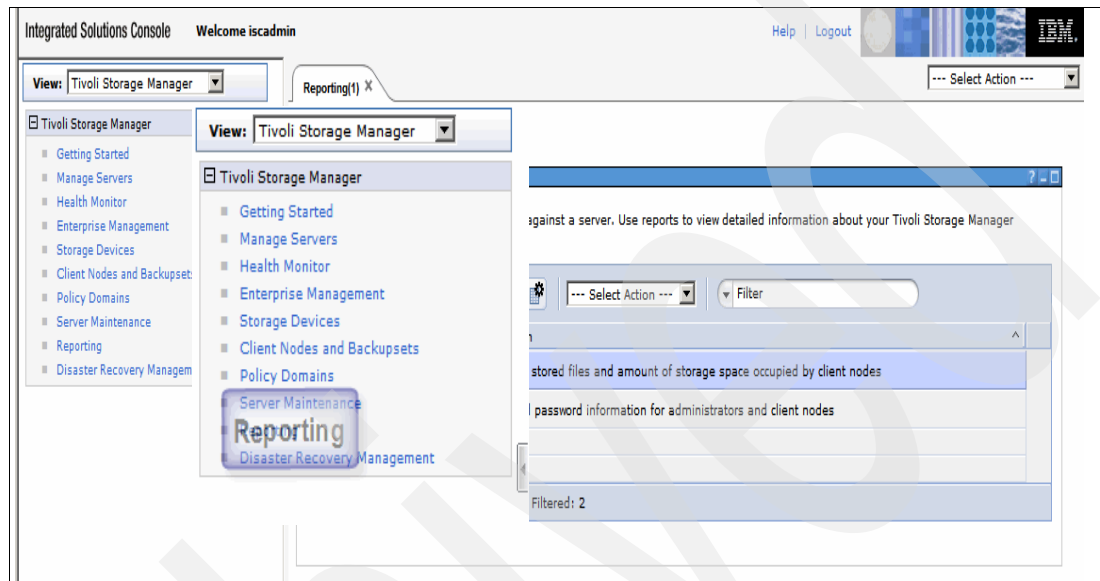


Figure 6-35 Reporting section in Administration Center

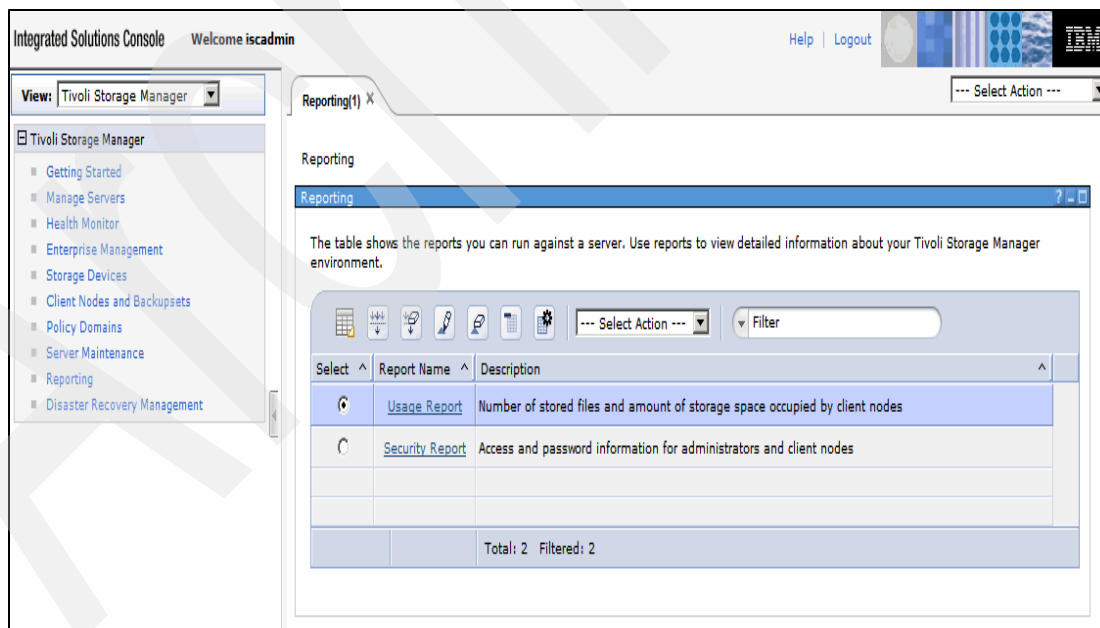


Figure 6-36 Usage and Security report sections of Reporting module

Note: To generate status reports for Tivoli Storage Manager, you have to install the Tivoli Storage Manager Reporting and Monitoring feature. For details about how to install this feature, see the Tivoli Storage Manager Installation Guide for your OS platform.

Select the Usage Report tab to view the Usage Report, as shown in Figure 6-37.

Usage Report

Usage Report for TSM61SRV

Client nodes backup usage

Name	Physical (MB)	Logical (MB)	Number of Files
TSM61CLIENT	5	5	7
Total: 1 Filtered: 1			

Client nodes archive usage

Name	Physical (MB)	Logical (MB)	Number of Files
None Found			
Total: 1 Filtered: 1			

Client nodes space management usage

Name	Physical (MB)	Logical (MB)	Number of Files
None Found			
Total: 1 Filtered: 1			

Figure 6-37 Usage Report view from ISC/Admin Center

Select the Security Report tab to view the Security Report, as shown in Figure 6-38.

Security Report

Security Report for TSM61SRV

Client nodes security report

Client Node Name	Last Access Date and Time	Days Since Last Password Update	Invalid Sign-On Count	Password Expiration Period (Days)	Locked
BASEIMAGESRV	3/19/09 7:11:58 AM EDT	92	0		--
TSM61CLIENT	3/19/09 12:23:26 PM EDT	92	0		--
Total: 2 Filtered: 2					

Administrators security report

Administrator Name	Last Access Date and Time	Days Since Last Password Update	Invalid Sign-On Count	Password Expiration Period (Days)	Locked	Authority Level
ADMIN	6/19/09 4:06:40 PM EDT	<1	0		--	System
ADMIN_CENTER	6/19/09 3:45:10 PM EDT	<1	0		--	
BASEIMAGESRV	3/19/09 7:11:58 AM EDT	92	0		--	Client Owner
SERVER_CONSOLE					--	System
TSM61CLIENT	3/19/09 12:22:00 PM EDT	92	0		--	Client Owner
Total: 5 Filtered: 5						

Figure 6-38 Security Report view from ISC/Admin Center

6.15.1 Client and server event reporting

To take advantage of standard systems management interfaces, Tivoli Storage Manager can send client and server events to external interfaces. The supported interfaces are:

- ▶ Simple Network Management Protocol (SNMP)
- ▶ Managers such as NetView® for IBM AIX, CA Unicenter, or HP OpenView
- ▶ Tivoli Enterprise Console®
- ▶ NetView for MVS
- ▶ Windows event log
- ▶ User-written exit
- ▶ Direct to a file

Interfaces that receive event data are called event receivers.

Each event message, whether client or server, can be enabled for any of the supported receivers. Enabling one message or a group of messages for more than one receiver is possible. As with client event logging, events are enabled for receivers by message number or severity.

6.16 Clustering support

A key benefit of clustering is high availability. Resources on clustered servers act as highly available versions of non-clustered resources. If a node (an individual computer) in the cluster is unavailable or too busy to respond to a request for a resource, the request is transparently passed to another node capable of processing it. Clients are therefore unaware of the exact locations of the resources they are using.

There are two clustering issues for Tivoli Storage Manager server and client clustering support:

- ▶ **IBM High-Availability Cluster Multi-Processing (Tivoli Storage Manager HACMP)**
HACMP detects system failures and manages Tivoli Storage Manager failover to a recovery processor with a minimal loss of user time. You can set up a Tivoli Storage Manager server on a system in a HACMP cluster so that, if the system fails, the Tivoli Storage Manager server will be brought back up on another system in the cluster. In both failover and fallback, it appears that the Tivoli Storage Manager server has crashed or halted and was then restarted.
- ▶ **Microsoft Cluster Server (Tivoli Storage Manager MSCS)**
Tivoli Storage Manager can be configured in a Tivoli Storage Manager MSCS high availability environment. The administrator uses the MSCS cluster administrator interface and Tivoli Storage Manager to designate cluster arrangements and define the Tivoli Storage Manager failover pattern. The systems are connected to the same disk subsystem, and they provide a high-availability solution that minimizes or eliminates many potential sources of downtime. Microsoft Cluster Server (MSCS) is software that helps configure, monitor, and control applications and hardware components that are deployed on a Windows cluster.

6.16.1 HACMP and client configuration

The Tivoli Storage Manager Backup-Archive client itself (including the administrator, backup/archive, HSM, and API pieces) is supported for use in an HACMP cluster environment. This configuration enables scheduled client operations to continue processing in the event of a system failure on a redundant clustered failover server.

You can install the Tivoli Storage Manager client locally on each node of an HACMP environment. You can also install and configure the Tivoli Storage Manager Scheduler Service for each cluster node to manage all local disks and each cluster group containing physical disk resources.

If a scheduled incremental backup of a clustered volume is running on machine-a and a system failure causes a failover to machine-b, machine-b then reconnects to the server.

If a failover occurs during a user-initiated (that is, non-scheduled) client session, the Tivoli Storage Manager client starts on the node that is handling the takeover. This allows it to process scheduled events and provide Web client access.

6.16.2 MSCS and client configuration

You can install the Backup-Archive client software locally on each node of a Microsoft Cluster Server (MSCS) or Veritas Cluster Server (VCS) environment cluster. Tivoli Storage Manager in a VCS environment is supported on Windows 2003 and 2008.

You can also install and configure the Scheduler Service for each cluster node to manage all local disks and each cluster group containing physical disk resources.

For example, an MSCS cluster contains:

- ▶ Two nodes: node-1 and node-2
- ▶ Two cluster groups containing physical disk resources: group-a and group-b

In this case, an instance of the Tivoli Storage Manager Backup-Archive Scheduler Service should be installed for node-1, node-2, group-a, and group-b. This approach ensures that proper resources are available to the Backup-Archive client when disks move (or fail) between cluster nodes.

The `clusternode` option ensures that Tivoli Storage Manager manages backup data logically, regardless of which cluster node backs up a cluster disk resource. Use this option for Tivoli Storage Manager nodes that process cluster disk resources, and not local resources.

Note: You must set the `clusternode` option to YES for all Tivoli Storage Manager-managed cluster operations. Inconsistent use of the `clusternode` option for a given Tivoli Storage Manager cluster node name can cause Tivoli Storage Manager to invalidate the cluster node name encrypted password, and prompt the user to reenter the password during the next Tivoli Storage Manager program invocation.

Use the `optfile` option to properly call the correct (cluster) `dsm.opt` file for all Tivoli Storage Manager programs to ensure proper Tivoli Storage Manager functionality for cluster related operations.

The `optfile` option specifies the client options file to use when you start a Tivoli Storage Manager session.

The `clusternode` option specifies how Tivoli Storage Manager manages cluster drives.

Installing the Backup-Archive client on the cluster nodes

Install the Backup-Archive client software on a local disk on each cluster node. The executables should reside in the same location on each local drive. The software can be installed in the following location:

C:\Program Files\tivoli\tsm\baclient

Configuring the Backup-Archive client to process local nodes

To back up the local (non-clustered) drives and process system state information, in a Microsoft Cluster Server (MSCS) or Veritas Cluster Server (VCS) environment, the Tivoli Storage Manager Client Scheduler Service should use the following combination of the options: `CLUSTERNODE NO` (default) and `CLUSTERDISKSONLY YES` (default).

The `clusternode` and `clusterdisksonly` options should be invoked before MSCS or VCS is started, because although the Tivoli Storage Manager Client Scheduler Service is configured to back up local drives, the scheduler depends on the cluster service. The Tivoli Storage Manager Scheduler communicates with the cluster service (MSCS or VCS) to build the cluster disks map, get the cluster name, and so on. To ensure that the MSCS or VCS loads before the Tivoli Storage Manager Client Scheduler service, a dependency should be added (for MSCS service or VCS service) to the Tivoli Storage Manager Client Scheduler service.

Follow these steps to add the service dependency:

1. Start the `regedt32.exe` executable.
2. Locate the following subkey in the registry (where `TSM SchedulerService` is the name of the Tivoli Storage Manager Scheduler):
`HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\TSM Scheduler Service`
3. Double-click the **DependOnService** value.
4. In the Value data box, type the `ClusSvc` for the MSCS environment or `HAD` for the VCS environment, and then click **OK**.
5. Quit the Registry Editor.
6. Restart your computer.

Note: After disabling or uninstalling the MSCS or VCS, the service dependency should be removed.

The `dsm.opt` file

You can edit your `dsm.opt` file on each local node to process local disk drives by using the following options:

► `nodename`

Use the `nodename` option in your client options file to identify your workstation to the server. If no value is specified, the Backup-Archive client uses the local machine name. You can use different node names to identify multiple operating systems on your workstation.

► `domain`

The `domain` option specifies what you want to include for incremental backup. If you do not specify a value for this option, the Backup-Archive client processes all local drives that are not owned by the cluster.

Domain objects are backed up only if you invoke the incremental command without a file specification.

► `clusternode`

The `clusternode` option specifies how Tivoli Storage Manager manages cluster drives. Do not specify this option when processing local drives. You can configure the Tivoli Storage Manager Backup-Archive Scheduler Service to back up the local cluster nodes.

Configuring Backup-Archive client to process cluster disk resources

Ensure that the Backup-Archive client manages each cluster group that contains physical disk resources as a unique node. This ensures that the Backup-Archive client correctly manages all disk resources, regardless of which cluster node owns the resource at the time of backup.

Step 1: Identify the cluster groups to manage

Use the Microsoft Cluster Administrator utility or VCS Configuration editor to determine which groups contain physical disk resources for the Backup-Archive client to process. Register a unique node name on the backup server for each group.

For example, MSCS cluster contains the following groups and resources:

- ▶ group-a: Contains physical disk q: (quorum), and physical disk r:

Note: VCS does not have quorum disk.

- ▶ group-b: Contains physical disk s: and physical disk t:

In this example, the administrator registers two node names:

- ▶ mscs-cluster-group-a
- ▶ mscs-cluster-group-b

So, to register mscs-cluster-group-a the administrator can enter the following command:

```
register node mscs-cluster-group-a <password>
```

Step 2: Configure the client options file

Configure the client options file (dsm.opt) for each cluster group. Locate the option file on one of the disk drives that are owned by the cluster group. For example, the option file for mscs-cluster-group-a should reside on either q: or r: disk.

To configure the dsm.opt file for each cluster group, specify the following options:

- ▶ nodename

Specify a unique name. For example:

```
mscs-cluster-group-a
```

- ▶ domain

Specify the drive letters for the drives which are managed by the group. For example:

```
q: r:
```

- ▶ clusternode

Specify the Yes value. If you set the clusternode option to yes, Tivoli Storage Manager does the following tasks:

- a. Checks for a cluster environment (MSCS or VCS).
- b. Uses the cluster name instead node name for file space naming and encryption. This allows the use of one password file for all nodes in the cluster.
- c. Builds a list of shared volumes and works only with shared volumes. Back up of local volumes not permitted if the clusternode option set to yes.

Note: For the VCS, cluster database processing is skipped because VCS does not have a cluster database. VCS stores all cluster configuration information in an ASCII configuration file called `main.cf`, which is located in the path pointed by `%VCS_HOME%conf/config` on each node in the cluster. If this file is corrupted, the cluster configuration will also be corrupted. Handle this file carefully. The `VCS_HOME` environment variable points to the directory where VCS is installed on the node.

► `passwordaccess`

Specify the generate value.

► `managedservices`

(Optional). Specify whether the Tivoli Storage Manager Client Acceptor daemon service (CAD) manages the scheduler, the Web client, or both. To specify that the CAD manages both the Web client and the scheduler, enter the following option in the `dsm.opt` file for each cluster group:

`managedservices webclient schedule`

► `errorlogname`

Specify a unique error log name.


Note: This is not the same `errorlog` file that the client uses for other operations. Ideally, this file should be stored on a cluster resource, but at the very least it should be stored in a location other than the client directory.

► `schedlogname`

Specify a unique schedule log name.

Note: This is not the same `schedlog` file that the client uses for other operations. Ideally, this file should be stored on a cluster resource, but at the very least it should be stored in a location other than the client directory.

Archived



Troubleshooting, problem determination, and performance tuning

This chapter discusses various methodologies for determining problems and tuning the performance of IBM Tivoli Storage Manager.

This chapter contains the following topics:

- ▶ Troubleshooting and support
- ▶ Problem determination
- ▶ Tivoli Storage Manager performance tuning basics

7.1 Troubleshooting and support

IBM provides support in the form of technical training, knowledge bases, and interactive problem support, which is available online or by phone. Procedures are also available for problem diagnosis and resolution. Messages, return codes, error codes, and suggested user actions are also discussed.

7.1.1 Technical training

Information about Tivoli technical training courses is available online at:

<http://www.ibm.com/software/tivoli/education/>

7.1.2 Searching knowledge bases

If you have a problem with Tivoli Storage Manager, several knowledge bases are available that you can search:

- ▶ Begin with the Tivoli Storage Manager information center, from where you can search all Tivoli Storage Manager documentation:
<http://publib.boulder.ibm.com/infocenter/tsminfo/v6>
- ▶ The main Tivoli Storage Manager support page provides links to supported hardware and software platforms:
<http://www.ibm.com/software/tivoli/products/storage-mgr/>
- ▶ Tivoli Storage Manager FastBack information is available from:
<http://www.ibm.com/software/tivoli/products/storage-mgr-fastback/>

7.1.3 Search the Internet for assistance and fixes

If you cannot find an answer to your question in the Tivoli Storage Manager information center, search the Internet for the latest, most complete information that might help you resolve your problem.

IBM Support Assistant

At no additional cost, you can install on any workstation the IBM Support Assistant, a stand-alone application. You can then enhance the application by installing product-specific plug-in modules for the IBM products that you use. For information, go to:

<http://www.ibm.com/software/support/isa/>

Product fixes

A product fix to resolve your problem might be available from the IBM Software Support Web site. Refer to 7.1.4, “Contacting IBM Support” on page 235. Also, go to the support site at:

<http://www.ibm.com/software/support/>

E-mail notification of product fixes

You can be notified about fixes and other news about IBM products. Go to:

http://publib.boulder.ibm.com/infocenter/tivihelp/v12r1/topic/com.ibm.itcdpf.doc/31/UG/comm on/t_find_fixes.html

7.1.4 Contacting IBM Support

You can contact IBM Software Support if you have an active IBM software maintenance contract and if you are authorized to submit problems to IBM.

Before you contact IBM Software Support, follow these steps:

1. Set up a software maintenance contract.
2. Determine the business impact of your problem.
3. Describe your problem and gather background information.

Then, submit the problem to IBM Software Support for information about contacting IBM Software Support:

1. Go to the IBM Software Support Web site at:
<http://www.ibm.com/software/support/probsub.html>
2. Enter your information into the appropriate problem submission tool.
3. Submit the problem to IBM Software Support.

To find the phone number to call in your country, go to the contacts page of the IBM Software Support Handbook at:

<http://www14.software.ibm.com/webapp/set2/sas/f/handbook/home.html>

If the problem that you submit is for a software defect or for missing or inaccurate documentation, IBM Software Support creates an Authorized Program Analysis Report (APAR). The APAR describes the problem in detail. If a workaround is possible, IBM Software Support provides one for you to implement until the APAR is resolved and a fix is delivered.

IBM publishes resolved APARs on the following Tivoli Storage Manager product support Web site, so that users who experience the same problems can benefit from the same resolutions:

<http://www.ibm.com/software/sysmgmt/products/support/IBMTivoliStorageManager.html>

7.2 Problem determination

Tivoli Storage Manager provides diagnostic tools and techniques for resolving problems that you might encounter with the server, Backup-Archive client, and related products. Online help is also available for all of the Tivoli Storage Manager products including server, client, storage area network client, data protection for database and mail clients and FastBack server and clients.

7.2.1 Problem determination steps

When a problem occurs, being able to describe the problem so you can begin resolving it is important. To describe the problem, answer the following questions:

- ▶ What is the problem?
- ▶ Where did it occur?
- ▶ When did it begin happening?
- ▶ What action was being performed?
- ▶ Were any messages issued?

- ▶ How frequently does this error occur?
- ▶ What do the system error logs say?
- ▶ Has anyone made changes to the environment that could affect Tivoli Storage Manager?
- ▶ What is in the Tivoli Storage Manager error logs?
- ▶ Are the required devices still accessible to the system and to Tivoli Storage Manager?
- ▶ Are any matching error messages or problem descriptions in the online Knowledge Base?
- ▶ Do any operating system logs show errors when Tivoli Storage Manager reports problems?

Also, test other operations to better determine the scope and impact of the problem. This approach might help you determine whether a specific sequence of events caused the problem.

The *Tivoli Storage Manager V6.1 Problem Determination Guide*, GC23-9789 can be found at:
http://publib.boulder.ibm.com/infocenter/tsminfo/v6/topic/com.ibm.itsm.nav.doc/t_p_robddeterm.html

7.2.2 Tivoli Storage Manager client problems

If you are experiencing problems with a Tivoli Storage Manager client, there are several ways to resolve them. Resolving problems with the client application can involve connecting to the server, changing policy settings, reproducing the error, or several other possible options. This section lists several suggestions for determining problems.

Examining error messages

One way to begin resolving problems is to examine the error messages that are generated during operation.

Examining the server activity log messages

Check for server activity log using QUERY ACTLOG command for messages issued for this Tivoli Storage Manager client session.

Identifying when and where the problem can occur

Problems with Tivoli Storage Manager client processing often occur only when you are performing specific operations, at certain times, or only on certain client computers.

Reproducing the problem

If the problem can be reproduced, try to minimize the circumstances under which it can occur.

Collecting documentation regarding the client application

The Tivoli Storage Manager client creates valuable information in a number of different sources. If any of the information in the documentation relates to your problem, provide it to support.

Determining why dsmc, dsmadmc, dsmj commands do not start

Tivoli Storage Manager uses the **dsmc**, **dsmadmc**, and **dsmj** commands in its startup procedures. A command occasionally does not start, keeping you from using Tivoli Storage Manager.

Resolving problems with client option sets

With client option sets, administrators can specify additional options that might not be included in the client's option file. The client uses these options during a backup, archive, restore, or retrieve process.

Resolving client authentication problems

Three common errors can occur in relation to your password or authentication method: authentication failure, login failure because of the NetWare target service agent, or login failure because of the NetWare file server.

Resolving client scheduling problems

The Tivoli Storage Manager administrator can schedule the Tivoli Storage Manager to perform tasks automatically.

Resolving errors including or excluding client files during backup

The include-exclude processing option affects which files are sent to the server for a backup or archive operation. If you implicitly or explicitly indicate that a file should be included or excluded during backup processing and it was not processed correctly, there are several possible causes. Refer to the *Tivoli Storage Manager V6.1 Problem Determination Guide*, GC23-9789 for specific details.

Resolving image backup errors

Errors that might occur with image backup processes are a Linux image backup failure, a Linux snapshot image backup failure, or errors occurring during AIX JFS2 snapshot-based backup-archive and image backup.

Journal Based Backup problem determination

Journal Based Backup (JBB) is appropriate for backing up files systems with small or moderate amounts of change activity between backup cycles.

Using open file support and the logical volume snapshot agent

Determine whether problems exist with the open file support (OFS) and logical volume snapshot agent (LVSA).

Using Windows Volume Shadow Copy Services

The Tivoli Storage Manager Windows client uses the Volume Shadow Copy Services (VSS) of Windows 2003 and Windows Vista to perform system state and system services backup. VSS can also be used as a snapshot provider for open file support (OFS) and online image operations.

SHOW commands for the Backup-Archive client

SHOW commands are unsupported diagnostic commands that are used to display information about in-memory control structures and other runtime attributes. The SHOW commands are used by development and service only as diagnostic tools. Several SHOW commands exist for the Backup-Archive client.

Tivoli Storage Manager client help

Tivoli Storage Manager V6.1 client help has been enhanced to include many more links to resources to help you resolve problems or queries for the Tivoli Storage Manager client.

Figure 7-1 shows the enhancements in the Help menu.

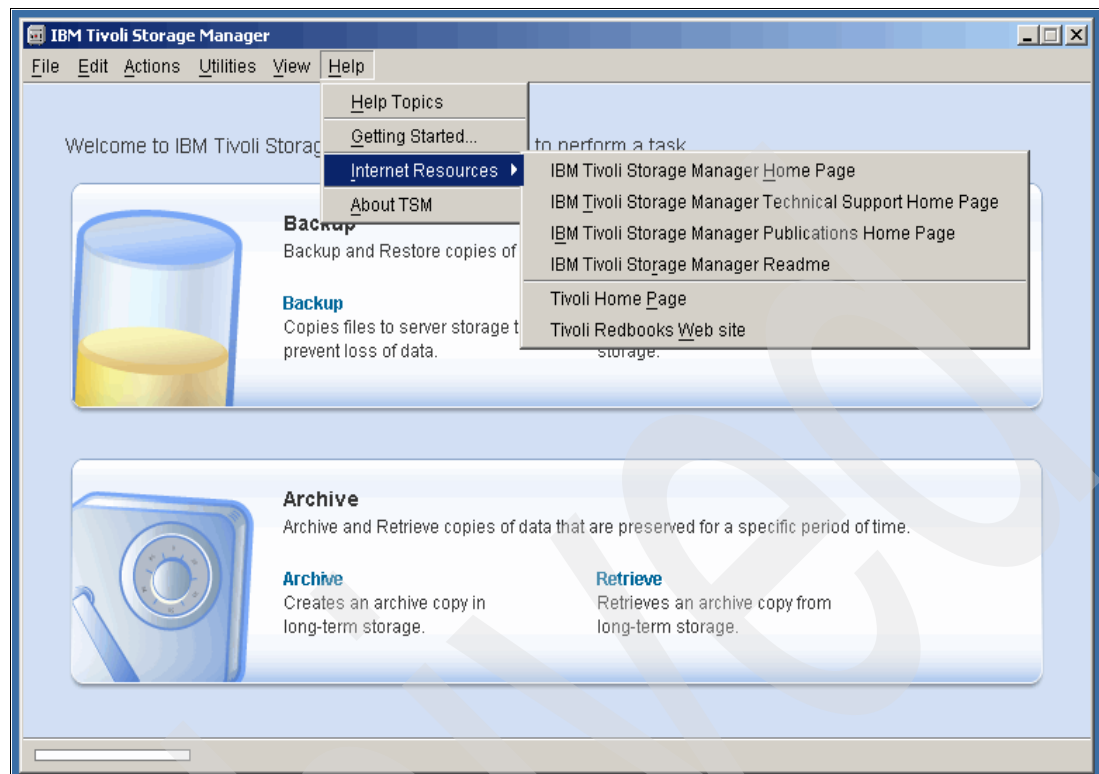


Figure 7-1 Tivoli Storage Manager V6.1 client Help options

7.2.3 Tivoli Storage Manager server problems

When working with the IBM Tivoli Storage Manager, you might experience problems specific to the Tivoli Storage Manager server. The Tivoli Storage Manager server diagnostic tips that you can perform vary from simple actions such as restarting your server, to more involved procedures. Perform the actions in this section to help you diagnose server problems.

Checking the server activity log

Check the server activity log 30 minutes before and 30 minutes after the time of the error for other messages.

Re-creating the problem

Re-create the problem to isolate its cause to a specific sequence of events, if the problem can be easily or consistently re-created.

Checking system error log files for device errors

If the problem is an error created by reading or writing data from a device, many systems and devices record information in a system error log.

Reverting server options or settings

If there were more configuration changes to the server, try reverting the settings back to their original values and retry the failing operation.

Restarting the scheduling service

Scheduled client operations are influenced by the schedule definitions on the server as well as the scheduling service (dsmsched) that runs on the client computer itself.

Resolving server space issues

The Tivoli Storage Manager server's primary function is to store data. If it runs out of space in the database or storage pools, operations might fail.

Changing the copy frequency

Tivoli Storage Manager server policy demands that an incremental copy frequency be a non-zero value.

Tracing to detect a code page conversion failure

The Tivoli Storage Manager server uses operating system functions to convert between Unicode and the server code page. If the system is not set up correctly, the conversion fails. This problem is most likely to occur when you are using the Administration Center to access the server.

Resolving server stoppages

If you know the source of your server stoppage, you can resolve several problems.

Resolving database errors

Server errors might be caused by database irregularities. Some more common issues are running out of space and errors caused by insert, update, or delete operations.

Resolving a stoppage or loop

A stoppage is a situation where the server does not start or complete a function and is not using any microprocessor power.

Issuing a process to resolve server problems

A server process is a task that is performed on the server. You can assign the task to perform a specific operation, such as migrating data from a storage pool to the next storage pool in the hierarchy. Issue the server processes to resolve problems that you are having with your server.

Processing messages to determine state of server operations

Server processes, whether run in the foreground or background, always issue a process-started message and a process-ended message in addition to the general process messages. You can use these messages to determine the status of your server operation.

Analyzing the process symptoms to resolve problems

The process symptoms sometimes can indicate where your errors occur.

Resolving storage pool issues

Storage pools are integral to a successful server operation. The Tivoli Storage Manager database contains information in storage pools about registered client nodes, policies, schedules, and the client data. This information must be available and valid in order for the Tivoli Storage Manager to function correctly.

7.2.4 Communication problems

The need for connectivity in Tivoli Storage Manager means that any communication error can render your application useless. Communication errors might be attributed to TCP/IP configuration, client and server connections, and other causes.

Resolving errors created when connecting to the server

Problems that are generated while you are connecting to the server might be related to your communication options.

Resolving failed connections by clients or administrators

The two main reasons for connection failures are: general failure, where no connections at all are allowed; an isolated failure, where some connections are allowed but others fail. If no connections are possible, running the server in the foreground might be necessary so that a server console is available, and additional diagnostic steps can be taken.

Determining SSL errors

Secure sockets Layer (SSL) errors might be attributed to an incorrect environment setup, a bad server certificate, connection problems, or other causes.

SAN device mapping errors

The SAN device mapping errors that are documented are the more common issues that you might have.

7.2.5 Administration Center problems

The Administration Center is a Web-based interface that can be used to centrally configure and manage Tivoli Storage Manager servers. You can resolve Administration Center errors through several methods, such as establishing a connection to a Tivoli Storage Manager server, reinstalling the Integrated Solutions Console, or by reviewing the log files that are generated during an error.

Establish connection between Administration Center and server

If you have a problem establishing a connection to a Tivoli Storage Manager server, use the Administration Center to isolate or resolve the problem.

Resolving Integrated Solutions Console user authority problems

Integrated Solutions Console users can access only the pages for which they are authorized.

Resolving an Integrated Solutions Console server stoppage

The Integrated Solutions Console is built on top of a WebSphere Application Server. If the WebSphere server stops running, the Integrated Solutions Console will not be accessible from a browser.

Resolving excessive memory consumption problems with ISC server

The Integrated Solutions Console is built on top of a WebSphere application server. If the WebSphere server is using a large amount of memory, several actions can be taken.

Configuring the IP address to align with the Administration Center

The Administration Center assumes that the host system uses 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 the domain name servers, which map the host name to the physical address of the system.

Resolving Administration Center performance tuning issues

You can fine-tune the performance of the Administration Center by sizing the number of Tivoli Storage Manager Administration Center installations.

Resolving server access problems

You might encounter a problem when you try to access the Integrated Solutions Console and the Tivoli Storage Manager Administration Center from a Web browser.

Resolving Administration Center health monitor problems

A health monitor presents a view of the overall status of multiple servers and their storage devices. From the health monitor, you can link to details for a server, including a summary of the results of client schedules, and a summary of the availability of storage devices.

Responding to Administration Center task failure messages

The Administration Center provides informational and error messages when a failure occurs. Most failure messages typically provide information about what went wrong.

Responding to messages that return unexpected results

There are several ways to determine the source of a problem when a task fails on the Administration Center with unexpected results.

Messages shown in the Administration Center are typically either Tivoli Storage Manager server messages or messages specific to the Administration Center.

You can determine the kind of Tivoli Storage Manager message being displayed by looking at the message format. The first three characters of each message define what kind of message you are receiving.

Resolving problems with the server command definition file

The Administration Center uses command definition files that specify the commands supported for each server operating system.

Administration Center support utility

The Administration Center Support Utility is a command-line utility designed to assist in performing basic support tasks with the Administration Center.

7.2.6 Determining data storage problems

Data storage issues can be resolved through several methods.

Using data storage diagnostic tips

If you are experiencing a problem in storing or retrieving data, review the diagnostic tips to try to isolate or resolve the problem.

Resolving SCSI device problems

Tape drives and libraries might report information back to the Tivoli Storage Manager about the error encountered. This information is reported in one or more of the messages. Further

details might be available in operating system logs, which sometimes indicate underlying hardware or operating system problems.

Sequential media volume (tape)

You might determine your sequential media volumes problem through error message ANR0542W or ANR8778W.

7.2.7 Messages, return codes, and error codes

Error messages can appear in the following places:

- ▶ Server console
- ▶ Administrative client
- ▶ Operator terminal
- ▶ Administrative GUI
- ▶ Backup-Archive client
- ▶ Space-management client
- ▶ Application clients

Explanations and suggested actions are available for messages issued by Tivoli Storage Manager products.

A simple method to obtain the meaning of an error code is to issue the help command along with the error code issued using the Tivoli Storage Manager command line.

The illustration in Figure 7-2 shows the components of a Tivoli Storage Manager error message.

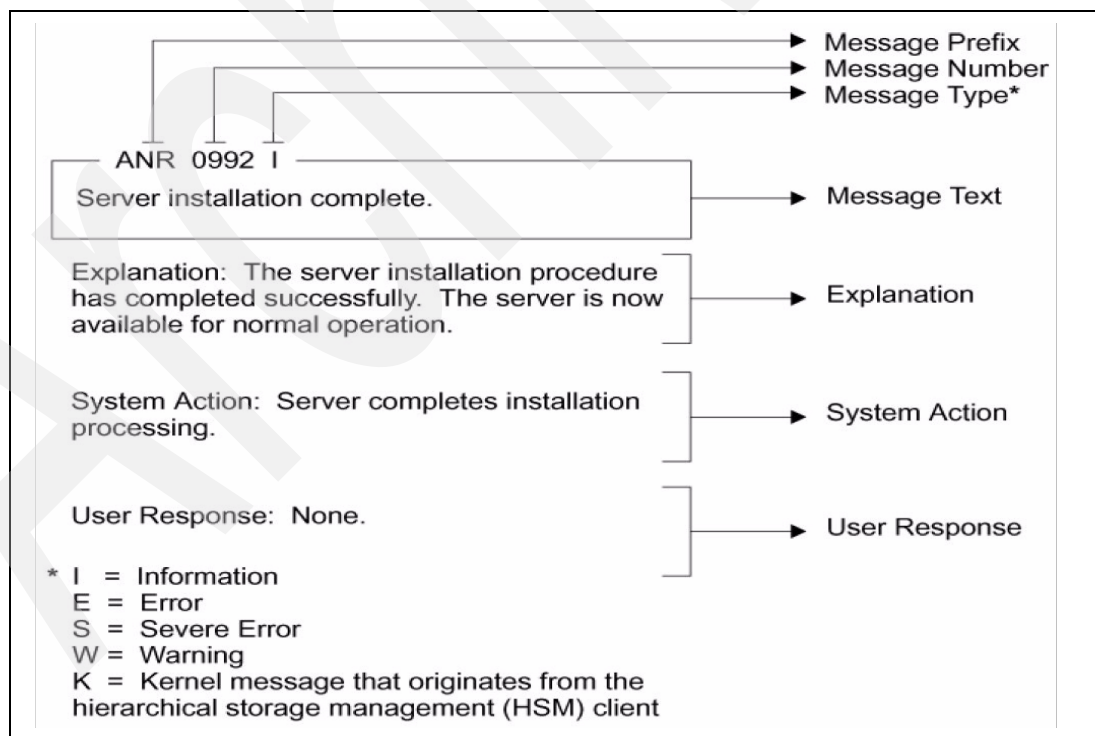


Figure 7-2 Error message components

The following formats are used for Tivoli Storage Manager messages:

- ▶ Messages that begin with the prefix ANE and are in the range of 4000 - 4999 originate from the Backup-Archive client. These messages (or events) are sent to the server for distribution to various event-logging receivers.

The client might send statistics to the server providing information about a backup or restore. These statistics are informational messages that can be enabled or disabled to the various event-logging receivers.

- ▶ Messages that begin with the prefix ANR originate from the server. These messages are related to common and platform-specific behavior.
- ▶ Messages that begin with the prefix ANS are from one of the following clients:
 - Administrative clients
 - Application program interface clients
 - Backup-Archive clients
 - Space Manager (HSM) clients
 - Data Protection for Lotus Notes®
- ▶ Messages that begin with the prefix ACD are from Data Protection for Lotus Domino.
- ▶ Messages that begin with the prefix ACN are from Data Protection for Microsoft Exchange Server.
- ▶ Messages that begin with the prefix ACO are from Data Protection for Microsoft SQL Server.
- ▶ Messages that begin with the prefix ANU are from Data Protection for Oracle.
- ▶ Messages that begin with the prefix BKI are from Data Protection for R/3 for DB2 Universal Database and Data Protection for R/3 for Oracle.
- ▶ Messages that begin with the prefix EEO and are in range 0000 - 7999 are from Data Protection for Snapshot Devices for mySAP for Oracle.
- ▶ Messages that begin with the prefix EEO and are in range 0000 - 9999 are from Data Protection for Disk Storage and SAN VC.
- ▶ Messages that begin with the prefix EEP and are in range 0000 - 7999 are from Data Protection for Snapshot Devices for mySAP for DB2 UDB.
- ▶ Messages that begin with the prefix IDS and are in range 0000 - 1999 are from Data Protection for Snapshot Devices for mySAP for Oracle.
- ▶ Messages that begin with the prefix IDS and are in range 0000 - 2999 are from Data Protection for Snapshot Devices for mySAP for DB2 UDB.

7.2.8 How to read a return code message

Many different commands can generate the same return code. The following examples are illustrations of two different commands issued that result in the same return code; therefore, you must read the descriptive message for the command.

In these examples, two different commands yield the same return code, but they also return descriptive messages that are unique to each command.

- ▶ The first command is:

```
q event standard dddd
```

This command yields a descriptive message:

```
ANR2034I: QUERY EVENT: No match found for this query.
```

- The second command is:

```
def vol cstg05 primary.
```

This command yields a unique, descriptive message:
ANRxxxx: DEFINE VOLUME: Storage pool CSTG05 is not defined.

Both commands yield a generic message with return code:
ANS5102I: Return Code 11.

Client return codes and QUERY EVENT

The backup-archive command-line interface and the scheduler exit with return codes that accurately reflect the success or failure of the client operation. Scripts, batch files, and other automation facilities can use the return code from the command-line interface. For operations that use Tivoli Storage Manager's scheduler, the return codes are shown in the output of the QUERY EVENT administrative command.

In general, the return code is related to the highest severity message during the client operation.

- If the highest severity message is informational (ANSnnnnI), the return code is 0.
- If the highest severity message is a warning (ANSnnnnW), the return code is 8.
- If the highest severity message is an error (ANSnnnnE or ANSnnnnS), the return code is 12.

The exception to the rules is warning or error messages that individual files could not be processed. For such a skipped file, the return code is 4. If return code is not 0, you can examine the dsmerror.log file (and, for scheduled events, the dsmsched.log file).

For a description of the return codes and their meanings, see Table 7-1.

Table 7-1 Client Return codes and their meanings

Code	Explanation
0	All operations completed successfully.
4	The operation completed successfully, but some files were not processed. There were no other errors or warnings. This return code is very common. Files are not processed for various reasons. The most common reasons are: <ul style="list-style-type: none"> ► The file satisfies an entry in an exclude list. ► The file was in use by another application and could not be accessed by the client. ► The file changed during the operation to an extent prohibited by the copy serialization attribute.
8	The operation completed with at least one warning message. For scheduled events, the status is Completed. Review dsmerror.log (and dsmsched.log for scheduled events) to determine what warning messages were issued and to assess their impact on the operation.
Windows 12	The operation completed with at least one error message (except for error messages for skipped files). For scheduled events, the status is Failed. Review the dsmerror.log file (and dsmsched.log file for scheduled events) to determine what error messages were issued and to assess their impact on the operation. As a general rule, this return code means that the error was severe enough to prevent the successful completion of the operation. For example, an error that prevents an entire drive from being processed yields return code 12.

Code	Explanation
UNIX 12	The operation completed with at least one error message (except for error messages for skipped files). For scheduled events, the status is <code>Failed</code> . Review the <code>dsmerror.log</code> file (and <code>dsmsched.log</code> file for scheduled events) to determine what error messages were issued and to assess their impact on the operation. As a general rule, this return code means that the error was severe enough to prevent the successful completion of the operation. For example, an error that prevents an entire file system or file specification from being processed yields return code 12.
Other	For scheduled operations where the scheduled action is <code>COMMAND</code> , the return code is the return code from the command that was executed. If the return code is 0, the status of the scheduled operation will be <code>Completed</code> . If the return code is nonzero, then the status is <code>Failed</code> . Some commands might issue a nonzero return code to indicate success. For these commands, you can avoid a <code>Failed</code> status by wrapping the command in a script that invokes the command, interprets the results, and exits with return code 0 if the command was successful (the script should exit with a nonzero return code if the command failed). Then, ask your Tivoli Storage manager server administrator to modify the schedule definition to invoke your script instead of the command.

The return code for a client macro will be the highest return code issued among the individual commands that comprise the macro. For example:

```
selective c:\Leighstuff\* -subdir=yes
incremental c:\MyPrograms\Grinchy\* -subdir=yes
archive e:\Jayke\* -subdir=yes
```

If the first command completes with return code 0; the second command completes with return code 8; and the third command completes with return code 4, the return code for the macro will be 8.

For more information about `QUERY EVENT`, refer to the Administrator's Reference that is specific for your operating system; documentation is listed in "Related publications" on page 293.

7.3 Tivoli Storage Manager performance tuning basics

Tivoli Storage Manager performance can be influenced by various factors. Tuning for optimal performance requires care and expertise.

Tuning Tivoli Storage Manager can be complex because of the many operating systems, network configurations, and storage devices that Tivoli Storage Manager supports. Performance tuning even for a single platform function is complex. The factors that can affect performance and have significant effects include:

- ▶ Average client file size
- ▶ Percentage of files changed since last incremental backup
- ▶ Percentage of bytes changed since last incremental backup
- ▶ Server hardware (processors, RAM, disk drives, network adapters)
- ▶ Server storage pool devices (disk, tape, optical)
- ▶ Server operating system
- ▶ Server activity (non-Tivoli Storage Manager workload)
- ▶ Client hardware (processors, RAM, disk drives, network adapters)
- ▶ Client operating system
- ▶ Client activity (non-Tivoli Storage Manager workload)

- ▶ Network hardware and configuration
- ▶ Network utilization
- ▶ Network reliability
- ▶ Communication protocols
- ▶ Communication protocol tuning
- ▶ Final output repository type (disk, tape, optical)

7.3.1 Tivoli Storage Manager server performance tuning

You can tune the performance of Tivoli Storage Manager servers through server options, command parameters, and other configuration settings.

The options are tunable on most Tivoli Storage Manager servers. To determine the options available for your platform, refer to the Administrator's Reference for your platform; documentation is listed in "Related publications" on page 293. You can change any option setting in the server options file (`dsmserv.opt`). If you change the server options file, you must stop and restart the server for the changes to take effect. You can change some settings with the server `SETOPT` command.

The performance guidelines for Tivoli Storage Manager are located at:

http://publib.boulder.ibm.com/infocenter/tsminfo/v6/topic/com.ibm.itsm.nav.doc/c_performance.html

7.3.2 Tuning server options

Certain server options can be tuned to improve Tivoli Storage Manager performance. Remember that tuning is an iterative process and that sometimes changes made to Tivoli Storage Manager settings may result in worse rather than better performance. Setting a baseline of settings and performance can help in this process.

The options listed in this section are tunable on most Tivoli Storage Manager servers. To determine the options available for your platform, refer to the Administrator's Reference for your platform; documentation is listed in "Related publications" on page 293.

You can change any option setting in server options file (`dsmserv.opt`). You can change some settings with the server `SETOPT` command. If you change the server options file, you must halt and restart the server for the changes to take effect.

DBMEMPERCENT

The `DBMEMPERCENT` server option sets a limit on the percentage of the system memory that is used for the database manager.

By default, the percentage of the virtual address space that is dedicated to the database manager processes is set to 70 - 80% of system RAM. To change this setting to a value from 10 - 99%, modify the `DBMEMPERCENT` server option. Ensure that the value allows adequate memory for both the Tivoli Storage Manager server and any other applications that are running on the system. The default value is `AUTO`.

Generally, changing this setting on a system that is dedicated to only a single Tivoli Storage Manager server is not necessary. If other applications require significant amounts of memory on a system, changing this setting to an appropriate amount reduces paging and improves system performance. For systems with multiple Tivoli Storage Manager servers, changing this setting for each server is recommended. For example, it could be set to 25% for each of

three servers on a system. Each server could also have a different value for this setting, as appropriate for the workload on that server.

DISKSTGPOOLMEMSIZE

The DISKSTGPOOLMEMSIZE server option specifies the size of the cache that the server can use to manage operations for storage pools with the device type of DISK.

The more memory available, the less disk storage pool metadata must be retrieved from the database server. Performance might be improved during operations that store data into or delete data from disk storage pools.

Specifies, in megabytes, the size of the memory available to manage disk storage pools. Each megabyte can manage 4 GB of disk storage. This option should be large enough to accommodate the maximum amount of data expected to be stored in or deleted from disk storage pools per second.

For example, if a maximum of 100 GBps of data is expected to be stored in or deleted from disk storage pools, a size of 25 is suggested. If this option is not specified, the size defaults to 320, which can manage 1280 GB of disk storage. For 32-bit servers, the size defaults to 80, which can manage 320 GB of disk storage.

EXPINTERVAL

Inventory expiration removes client backup and archive file copies from the server. EXPINTERVAL specifies the interval, in hours, between automatic inventory expirations run by the Tivoli Storage Manager server. The default is 24.

Backup and archive copy groups can 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 not deleted 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 processor- and I/O-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 set EXPINTERVAL to 0 and manually start the process with the EXPIRE INVENTORY server command. Expiration processing can also be scheduled in an administrative schedule.

When using the DURATION parameter on an administrative schedule, periodically check that expiration is actually completing within the specified time.

The setting should be:

EXPINTERVAL 0

This setting specifies that there is no expiration processing. Use an administrative schedule to run expiration at an appropriate time each day.

MAXNUMMP

The MAXNUMMP server option specifies the maximum number of mount points a node is allowed to use on the server.

The MAXNUMMP option can be set to an integer in the range of 0 - 999. Zero (0) specifies that the node cannot acquire any mount point for a backup or archive operation. However, the server still allows the node to use a mount point for a restore or retrieve operation. If the client

stores its data in a storage pool that has copy storage pools defined for simultaneous backup, the client might require additional mount points.

As a general rule, assign one mount point for each copy storage pool of sequential device type. If the primary storage pool is of sequential device type, assign a mount point for the primary storage pool also.

MAXSESSIONS

The MAXSESSIONS option specifies the maximum number of simultaneous client sessions that can connect with the Tivoli Storage Manager server.

The default value is 25 client sessions. The minimum value is 2 client sessions. The maximum value is limited only by available virtual memory or communication resources. This option 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.

MOVEBATCHSIZE and MOVESIZETHRESH

The MOVEBATCHSIZE and MOVESIZETHRESH options tune the performance of server processes that involve the movement of data between storage media. These processes include storage pool backup and restore, migration, reclamation, and move data operations.

MOVEBATCHSIZE specifies the number of files to be moved and grouped together in a batch, within the same server transaction. The default value for MOVEBATCHSIZE is 40, and the maximum value is 1000. The MOVESIZETHRESH option specifies, in megabytes, a threshold for the amount of data moved as a batch, within the same server transaction. When this threshold is reached, no more files are added to the current batch, and a new transaction is started after the current batch is moved. The default value for MOVESIZETHRESH is 500, and the maximum value is 2048.

The number of client files moved for each server database transaction during a server storage pool backup/restore, migration, reclamation or move data operation are 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 MOVESIZETHRESH 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.

When the MOVEBATCHSIZE or MOVESIZETHRESH parameters are increased from their default values, the server requires more space in the recovery log. The recovery log might require an allocation of space two or more times larger than a recovery log size which uses the defaults. In addition, the server requires a longer initialization time at startup. The impact of a larger recovery log size is felt while running the server with the log mode 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.

The settings should be:

```
MOVEBATCHSIZE 1000
MOVESIZETHRESH 2048
```

RESTOREINTERVAL

The RESTOREINTERVAL option specifies how long, in minutes, that a restartable restore session can be in the database before it can be expired. Restartable restores allow restores to continue after an interruption without starting at the beginning.

Restartable restores reduce duplicate effort or manual determination of where a restore process was terminated. The RESTOREINTERVAL option defines the amount of time an interrupted restore can remain in the restartable state.

The minimum value is 0. The maximum is 10080 (one week). The default is 1440 (24 hours). If the value is set to 0 and the restore is interrupted or fails, the restore is still put in the restartable state. However, it is immediately eligible to be expired. Restartable restore sessions consume resources on the Tivoli Storage Manager server. You should not keep these sessions any longer than they are needed.

Tune the RESTOREINTERVAL option to your environment.

TCPNODELAY

The TCPNODELAY server option specifies whether the server allows data packets that are less than the maximum transmission unit (MTU) size to be sent out immediately over the network.

When TCPNODELAY is set to NO, the server buffers data packets that are less than the MTU size. Note the following information about buffering:

- ▶ Buffering can improve network utilization.
- ▶ Buffering requires a delay that can impact session throughput greatly.

When set to YES, which is the setting, the option disables the TCP/IP Nagle algorithm, which allows data packets less than the MTU size to be sent out immediately. Setting this option to YES might improve performance in higher speed networks.

The setting should be:

TCPNODELAY YES

Note: This option also exists on the Tivoli Storage Manager client.

TCPWINDOWSIZE

The TCPWINDOWSIZE server option specifies the amount of receive data in kilobytes that can be on a TCP/IP connection at one time. The TCPWINDOWSIZE server option applies to backups and archives. The TCPWINDOWSIZE client option applies to restores and retrieves.

The sending host cannot send more data until an acknowledgement and TCP receive window update are received. Each TCP packet contains the advertised TCP receive window on the connection. A larger window allows the sender to continue sending data, and might improve communication performance, especially on fast networks with high latency.

The TCPWINDOWSIZE option overrides the operating system's TCP send and receive spaces. In AIX, for instance, these parameters are tcp_sendspace and tcp_recvspace and are set as *no* options. For Tivoli Storage Manager, the default is 63 KB, and the maximum is 2048 KB. Specifying TCPWINDOWSIZE 0, results in Tivoli Storage Manager using the operating system default. This is not recommended because the optimal setting for Tivoli Storage Manager might not be same as the optimal setting for other applications.

The TCPWINDOWSIZE option specifies the size of the TCP sliding window for all clients and all servers. On the server this applies to all sessions. Therefore, raising TCPWINDOWSIZE

can increase memory significantly when there are multiple, concurrent sessions. 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 might improve throughput.

For all platforms, rfc1323 option must be set to have window sizes larger than 64 KB-1, as listed in Table 7-2

Table 7-2 Platform settings for rfc1323 option

Platform	Description
AIX	Use no -o rfc1323=1
HP-UX	Using a window size greater than 64 KB-1 automatically enables large window support.
Sun Solaris 10	Use the following setting, which should be enabled by default: ndd set /dev/tcp tcp_wscale_always 1
Linux	This is on by default for recent kernel levels. Use the following command to check: cat /proc/sys/net/ipv4/tcp_window_scaling Recent Linux kernels use autotuning and changing TCP values might have a negative effect on autotuning. Make changes carefully.
Windows XP and 2003	Add or modify, with regedit , the registry name/value pair under: [HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\Tcpip\Parameters] Tcp1323Opts, REG_DWORD, 3 Attention: Before modifying the registry name and value pair, back up the entire registry.

Use one of the following settings:

- TCPWINDOWSIZE 63
- TCPWINDOWSIZE 128

Use this setting for a Gigabit Ethernet with jumbo frames (9000 MTU).

Note: This option is also on the Tivoli Storage Manager client.

TXNGROUPMAX

The TXNGROUPMAX server option specifies the number of objects that are transferred between a client and server in a single transaction. The minimum value is 4 objects, and the maximum value is 65000 objects. The default value has now been set 4096 objects. An object is a file or directory.

To affect the performance of client backup, archive, restore, and retrieve operations, use a larger value for this option. Note the following information:

- Increasing the value of the TXNGROUPMAX option can improve throughput for operations storing data directly to tape, especially when storing a large number of objects.
- If you increase the value of the TXNGROUPMAX option by a large amount, watch for possible effects on the recovery log. A larger value for the TXNGROUPMAX option can result in increased utilization of the recovery log, as well as an increased length of time for a transaction to commit. If the effects are severe enough, they can lead to problems with operation of the server. For more information about managing the recovery log, refer to

the Administrator's Reference for your platform; documentation is listed in "Related publications" on page 293.

- ▶ A larger value of the TXNGROUPMAX option can also increase the number of objects that must be resent if the transaction is aborted because an input file changed during backup, or because a new storage volume was required. The larger the value of the TXNGROUPMAX option, the more data that must be resent.
- ▶ Increasing the TXNGROUPMAX value affects the responsiveness of stopping the operation, and the client might have to wait longer for the transaction to complete.

You can override the value of this option for individual client nodes. See the TXNGROUPMAX parameter in the REGISTER NODE and UPDATE NODE commands.

This option is related to the TXNBYTELIMIT option in the client options file. TXNBYTELIMIT controls the number of bytes, as opposed to the number of objects, that are transferred between transaction commit points. At the completion of transferring an object, the client commits the transaction if the number of bytes transferred during the transaction reaches or exceeds the value of TXNBYTELIMIT, regardless of the number of objects transferred.

Set TXNGROUPMAX to 256 in your server options file. Settings higher than 4096 typically provide no benefit. If some clients have small files and go straight to a tape storage pool, then raising TXNGROUPMAX to the higher value can benefit those clients.

Hardware considerations

Performance improvements can be gained by adding devices:

- ▶ More tape drives means more backup capacity.
- ▶ More physical disks means more storage pool capacity and often better performance.
- ▶ Ensuring that volumes for database, log volumes and storage pools are separate will improve overall performance for each of those elements of Tivoli Storage Manager.
- ▶ More SCSI or Fibre Channel HBAs improve data throughput to the devices attached to them.
- ▶ More or higher capacity network interface cards (NIC) can increase the number of concurrent connections available to clients during data transfer.

7.3.3 Tivoli Storage Manager client performance tuning

You can tune the performance of Tivoli Storage Manager clients. Some Tivoli Storage Manager client options can be tuned to improve performance. Tivoli Storage Manager client options are specified in either the `dsm.sys` file or the `dsm.opt` file.

Note: Be aware that tuning is a balance between speed of backup and speed of restore operations. Improving backup speed can impact restore speed; ensure that an acceptable balance is maintained between the two.

COMMRESTARTDURATION and COMMRESTARTINTERVAL

The COMMRESTARTDURATION and COMMRESTARTINTERVAL options control the restart window of time and interval between restarts.

To make clients more tolerant of network connectivity interruptions, use the options COMMRESTARTDURATION and COMMRESTARTINTERVAL to control the restart window of time and interval between restarts. These options assist in environments which are subject to heavy network congestion or frequent interruptions, and eases the manageability of large

numbers of clients by reducing intervention on error conditions. In a sense, performance is improved if consideration is given to account for time to detect, correct, and restart as a result of an error condition.

Note: A scheduled event continues if the client reconnects with the server before the COMMRESTARTDURATION value elapses, even if the event's startup window has elapsed.

The COMMRESTARTDURATION option sets the maximum time for the client to try to reconnect with a server after a communication failure. The value is specified in minutes in the range of 0 - 9999 minutes. The default is 60 minutes.

The COMMRESTARTINTERVAL option sets the time for the client to wait between attempts to reconnect with a server after a communication failure. The value is specified in seconds in the range of 0 - 65535 seconds. The default is 15 seconds.

Tune the COMMRESTARTDURATION and COMMRESTARTINTERVAL options to your environment.

COMPRESSION

The COMPRESSION client option specifies whether compression is enabled on the Tivoli Storage Manager client. For optimal backup and restore performance with a large number of clients, consider using client compression.

Compressing the data on the client reduces demand on the network and the Tivoli Storage Manager server. The reduced amount of data on the server continues to provide performance benefits when this data is moved, such as for storage pool migration and storage pool backup. However, client compression significantly reduces the performance of each client, and the reduction is more pronounced on the slowest client systems.

For optimal backup and restore performance when using fast clients and heavily loaded network or server, use client compression. For optimal backup and restore performance when using a slow client, or a lightly loaded network or server, do not use compression. However, be sure to consider the trade-off of greater storage requirements on the server when not using client compression. The default for the COMPRESSION option is NO.

For maximum performance with a single fast client, fast network, and fast server, turn compression off.

The two alternatives to using compression include:

- ▶ If you are backing up to tape, and the tape drive supports its own compression, use the tape drive compression.
- ▶ Do not use compression if a client has built-in file compression support. Compression on these clients does reduce the amount of data backed up to the server. NetWare and Windows have optional built-in file compression.

Compression can cause severe performance degradation when there are many retries because of failed compression attempts. Compression fails when the compressed file is larger than the original. The client detects this and will stop the compression, fail the transaction and resend the entire transaction uncompressed. This occurs because the file type is not suitable for compression or the file is already compressed (.zip files, .tar files, and so on). Other than turning off compression, the two options you can use to reduce or eliminate retries because of compression are to:

- ▶ Use the COMPRESSALWAYS option, which eliminates retries because of compression.

- Use the EXCLUDE.COMPRESSION option in the client options file. This option disables compression for specific files or sets of files (for example, .zip files or .jpg files). Look in the client output (dmsched.log) for files that are causing compression retries and then filter those file types.

Use one of the following settings:

- For a single fast client, fast network, fast server:
COMPRESSION NO
- For multiple clients, slow network, slow server:
COMPRESSION YES

COMPRESSALWAYS

The COMPRESSALWAYS option specifies whether to continue compressing an object if it grows during compression, or resend the object, uncompressed. This option is used with the compression option.

The COMPRESSALWAYS option is used with the archive, incremental, and selective commands. This option can also be defined on the server. If COMPRESSALWAYS YES (the default) is specified, files continue compression even if the file size increases. To stop compression if the file size grows, and resend the file, uncompressed, specify COMPRESSALWAYS NO. This option controls compression only if your administrator specifies that your client node determines the selection. To reduce the impact of retries, use COMPRESSALWAYS YES.

A better approach is to identify common types of files that do not compress well and list these on one or more client option EXCLUDE.COMPRESSION statements. Files that contain large amounts of graphics, audio, or video files and files that are already encrypted do not compress well. Even files that seem to be mostly text data (for example, Microsoft Word documents) can contain a significant amount of graphic data that might cause the files to not compress well.

Using Tivoli Storage Manager client compression and encryption for the same files is valid. The client first compresses the file data and then encrypts it, so that there is no loss in compression effectiveness because of the encryption, and encryption is faster if there is less data to encrypt. For example, to exclude objects that are already compressed or encrypted, enter the following statements:

```
exclude.compression ?:\...\*.gif
exclude.compression ?:\...\*.jpg
exclude.compression ?:\...\*.zip
exclude.compression ?:\...\*.mp3
exclude.compression ?:\...\*.cab
```

The setting should be:

COMPRESSALWAYS YES

DISKBUFFSIZE

The DISKBUFFSIZE client 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 requires more memory and might not improve performance.

The default value is 32 for all clients except AIX. For AIX, the default value is 256 except when `ENABLELANFREE YES` is specified. When `ENABLELANFREE YES` is specified on AIX, the default value is 32. API client applications have a default value of 1023, except for Windows API client applications (Version 5.3.7 and later), which have a default value of 32.

For the setting, use the default value for the client platform.

MEMORYEFFICIENTBACKUP

The `MEMORYEFFICIENTBACKUP` client option specifies whether Tivoli Storage Manager backs up one directory at a time.

The default, which is `NO`, specifies that Tivoli Storage Manager backs up all the directories at once. The default option is very memory intensive. To save memory on clients with a limited amount of memory and large number of directories and files, set the option `MEMORYEFFICIENTBACKUP` to `YES`.

The amount of memory required by the client can be substantial when performing incremental backups of large file systems. We generally use the rule of about 300 bytes of inventory data per file, so that a file system of 1 million files would require about 300 MB of virtual memory in which to hold the server inventory data used to determine which files must be backed up. This memory requirement can be reduced by using the client option `MEMORYEFFICIENTBACKUP YES`. However, this can be expected to impact the incremental backup elapsed time significantly. Alternatives include:

- ▶ Partition the file system and process each partition sequentially; use the `VIRTUALMOUNTPOINT` option (UNIX only).
- ▶ Use an include/exclude list to back up only what is necessary.
- ▶ Use multiple file systems.
- ▶ Use journal-based backup for Windows (NTFS) and AIX (JFS2) only.

If the number of files you are backing up causes the backup to fail, consider specifying `MEMORYEFFICIENTBACKUP DISKCACHEMETHOD`, which is much faster than `YES`.

The setting should be the default, which is:

`MEMORYEFFICIENTBACKUP NO`

NQR

The no-query restore (NQR) function and the internal algorithms responsible for NQR were changed to take advantage of DB2 capabilities and to improve performance.

The NQR function has been rewritten to resolve a performance problem encountered when restoring a small number of objects for a client file system with a large number of backup objects spread across a large number of Tivoli Storage Manager server storage pool volumes. NQR performance is now comparable to that of the classic restore under these conditions. NQR now performs a volume determination phase that must be completed before any objects are restored from disk, file, or tape storage volumes.

An option to disable NQR is still available for troubleshooting and performance reasons. The setting for disabling NQR is:

`DISABLENQR NO`

If no option is specified the default is to use NQR.

PROCESSORUTILIZATION

The PROCESSORUTILIZATION option (only on the Novell client) specifies, in hundredths of a second, the amount of processor time the length of time Tivoli Storage Manager controls the processor. Because this option can affect other applications on your client node, use it only when speed is a high priority.

The default value is 1. The recommended values are in the range of 1 - 20. If set to less than 1, this parameter could have a negative impact on performance. Increasing this value increases the priority of Tivoli Storage Manager to the processor, lessening the priorities of other processes. Setting PROCESSORUTILIZATION greater than 20 might prevent other scheduled processes or NetWare requestors from accessing the file server.

QUIET

The QUIET client option prevents messages from being displayed during Tivoli Storage Manager backups.

The default is the VERBOSE option, and Tivoli Storage Manager displays information about each file it backs up. To prevent this, use the QUIET option. However, messages and summary information are still written to the log files. The two main benefits to using the QUIET option are:

- ▶ 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 throughput.

RESOURCEUTILIZATION

The RESOURCEUTILIZATION client option regulates the number of concurrent sessions that the Tivoli Storage Manager client and server can use during processing. Multiple sessions can be initiated automatically through a Tivoli Storage Manager backup, restore, archive, or retrieve command. Although the multiple session function is transparent to the user, there are parameters that enable the user to customize it.

The RESOURCEUTILIZATION option increases or decreases the ability of the client to create multiple sessions. For backup or archive, the value of RESOURCEUTILIZATION does not directly specify the number of sessions created by the client. However, the setting does specify the level of resources the server and client can use during backup or archive processing. The higher the value, the more sessions the client can start.

The range for the parameter is 1 - 10. If the option is not set, by default only two sessions can be started, one for querying the server and one for sending file data. A setting of 5 permits up to four sessions: two for queries and two for sending data. A setting of 10 permits up to eight sessions: four for queries and four for sending data. The relationship between RESOURCEUTILIZATION and the maximum number of sessions created is part of an internalized algorithm and, as such, is subject to change. This table lists the relationships between RESOURCEUTILIZATION values and the maximum sessions created. Producer sessions scan the client system for eligible files. The remaining sessions are consumer sessions and are used for data transfer. The threshold value affects how quickly new sessions are created.

Backup throughput improvements that can be achieved by increasing the RESOURCEUTILIZATION level vary from client node to client node. Factors that affect throughputs of multiple sessions include the configuration of the client storage subsystem (the layout of file systems on physical disks), the client's ability to drive multiple sessions (sufficient processor and memory), the server's ability to handle multiple client sessions

(processor, memory, number of storage pool volumes), and sufficient bandwidth in the network to handle the increased traffic.

The MAXSESSIONS parameter controls the maximum number of simultaneous client sessions with the Tivoli Storage Manager server. The total number of parallel sessions for a client is counted for the maximum number of sessions allowed with the server. You need to decide whether to increase the value of the MAXSESSIONS parameter in the server option file.

When using the RESOURCEUTILIZATION option to enable multiple client/server sessions for backup direct to tape, the client node maximum mount points allowed parameter, MAXNUMMP, must also be updated at the server (using the UPDATE NODE command).

If the client file system is spread across multiple disks (RAID 0 or RAID 5), or multiple large file systems, the RESOURCEUTILIZATION setting should be a value of 5 or 10. This setting enables multiple sessions with the server during backup or archive and can result in substantial throughput improvements in some cases. It is not likely to improve incremental backup of a single large file system with a small percentage of changed data. If a backup is direct to tape, the client node maximum mount points allowed parameter, MAXNUMMP, must also be updated at the server using the update node command.

RESOURCEUTILIZATION can be set to value other than default if a client backup involves many files and they span or reside on multiple physical disks. A setting of 5 or greater is a recommended. However, for optimal utilization of the Tivoli Storage Manager environment, you must evaluate the load of server, network bandwidth, client processor and I/O configuration, and take that information into consideration before changing the option.

When a restore is requested, the default is to use a maximum of two sessions, based on how many tapes the requested data is stored on, how many tape drives are available, and the maximum number of mount points allowed for the node.

The default value for the RESOURCEUTILIZATION option is 1, and the maximum value is 10. For example, if the data to be restored are on five tape volumes, and the maximum number of mount points for the node requesting the restore operation is five, and RESOURCEUTILIZATION is set to 3, then three sessions are used for the restore operation. If the RESOURCEUTILIZATION setting is increased to 5, then five sessions are used for the restore. There is a one-to-one relationship to the number of restore sessions allowed and the RESOURCEUTILIZATION setting.

The settings should be:

- ▶ For workstations:
RESOURCEUTILIZATION 1
- ▶ For a small server:
RESOURCEUTILIZATION 5
- ▶ For a large server
RESOURCEUTILIZATION 10

Note: Non-root UNIX is limited to one session.

TAPEPROMPT

The TAPEPROMPT client option specifies whether to prompt the user for tape mounts. The TAPEPROMPT option specifies whether you want Tivoli Storage Manager to wait for a tape to be mounted for a backup, archive, restore or retrieve operation, or to prompt you for your choice.

The setting should be:

TAPEPROMPT NO

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. The default size is 32 KB, and the maximum is 512 KB.

The setting should be:

TCPBUFFSIZE 32

TCPNODELAY

Use the TCPNODELAY option to disable the TCP/IP Nagle algorithm, which allows data packets of less than the maximum transmission unit (MTU) size to be sent out immediately. The default is YES. This generally results in better performance for Tivoli Storage Manager client/server communications.

The setting should be:

TCPNODELAY YES

Note: TCPNODELAY is also available as a server option.

TCPWINDOWSIZE

The TCPWINDOWSIZE client option specifies the size of the TCP sliding window in kilobytes.

The setting should be:

TCPWINDOWSIZE 63

TXNBYTELIMIT

The TXNBYTELIMIT client option specifies the maximum transaction size in kilobytes for data transferred between the client and server.

Multiple session backup and restore

Multiple session restore allows the Backup-Archive clients to perform multiple restore sessions for no-query restore operations, thus increasing the speed of restore operations. Multiple session restore is similar to multiple session backup support.

Multiple session restores can be used under the following conditions:

- ▶ The data to be restored resides on several tapes.
- ▶ Sufficient mount points are available.

The restore is done using the no-query restore protocol. For details about no-query restore, refer to the Backup-Archive Clients Installation and User's Guide for your platform; documentation is listed in "Related publications" on page 293.

Client command-line options

Two options can be used only on the command line and only with specific commands. When specifying options with a command, always precede the option with a dash (-). In general, the command-line interface is faster than the GUI and requires less overhead. Two command line options that might improve Tivoli Storage Manager performance are discussed here.

IFNEWER

This option is used in conjunction with the restore command and restores files only if the server date is newer than the date of the local file. This option might result in lower network utilization if less data travels across the network.

INCRBYDATE

In a regular incremental backup, the server reads the attributes of all the files in the file system and passes this information to the client. The client then compares the server list to a list of its current file system. This comparison can be very time-consuming, especially for clients on NetWare, Macintosh, and Windows. These clients sometimes have a limited amount of memory.

With an incremental-by-date backup, the server only passes the date of the last successful backup. It is not necessary to query every active file on the Tivoli Storage Manager server. The time savings are significant. However, regular, periodic incremental backups are still needed to back up files that have only had their attributes changed. For example, if a new file in your file system has a creation date previous to the last successful backup date, future incremental-by-date backups will not back up this file. This is because the client sees it as already backed up. Also, files that have been deleted are not detected by an incremental-by-date backup. These deleted files will be restored if you perform a full system restore.

Hierarchical Storage Manager tuning

If you must migrate a group of small files to the server, performance is better if the data moves to disk rather than to tape. After the files are migrated to disk, you can use storage pool migration to move the files to tape.

Performance tuning of hierarchical storage management (HSM) migration is poor for very small files that are grouped together with wildcard invocation of DSMMIGRATE command as an example. HSM works on one file at a time, unlike archive, retrieve, restore, and backup, which group files at a transaction boundary. There is one transaction for each file when you use HSM migration and recall. For a group of small files, it is better to use archive or backup to store them to the server.

Network protocol tuning

Tuning network protocols can improve the performance of IBM Tivoli Storage Manager operations.

TCP/IP communication concepts and tuning

To tune TCP/IP, the most significant performance improvements are found by modifying parameters that affect the data transfer block size, window values, and connection availability.

Networks

Tuning your networks can provide significant performance improvements.

Limiting network traffic

Several Tivoli Storage Manager server SET commands can limit the amount of network traffic because of client sessions.

AIX network settings

An important action is to minimize all performance constraints on AIX to achieve maximum throughput on the server. This action is accomplished by tuning the network option parameters on AIX.

NetWare client cache tuning

You can improve performance by tuning the NetWare client cache.

Sun Solaris network settings

Tuning TCP/IP settings for Sun Solaris servers and clients can improve performance.

z/OS network settings

You can configure the TCP/IP address space for IBM TCP/IP for z/OS and tune TCP/IP and z/OS UNIX system services.

Archived

Tips and information that is good to know

This chapter contains the following topics:

- ▶ Reporting and Monitoring in Tivoli Storage Manager V6.1
- ▶ Reporting and Monitoring installation
- ▶ VMware overview
- ▶ New commands and options
- ▶ Security issues for Backup-Archive clients
- ▶ Disaster recovery manager
- ▶ Migrating a client to a different server
- ▶ Scheduling
- ▶ Expiration

8.1 Reporting and Monitoring in Tivoli Storage Manager V6.1

This section explains Reporting and Monitoring in Tivoli Storage Manager V6.1. For this release, we introduce a new system for reporting, which is based on common Tivoli components. The Tivoli Storage Manager Reporting and Monitoring feature is designed as a stand-alone package, both reporting and monitoring functions on one system. The code for the system is a separate installable package: it is not built into the Tivoli Storage Manager Server code.

The Reporting and Monitoring feature supports connections with Tivoli Storage Manager Servers at version 5.4, 5.5, and 6.1. It replaces and improves upon the older Operational Reporting tool, which is not included in Tivoli Storage Manager V6.1. In addition, there are still the built-in tools within the Integrated Solutions Console (ISC) that enable a user to run basic reports for Tivoli Storage Manager.

8.1.1 Administration Center: Health Monitor

The Tivoli Storage Manager V6.1 Administration Center (Integrated Solutions Console) now provides improved functionality for many administrative tasks. One improved function is the ability to view much more detail when monitoring multiple Tivoli Storage Manager Servers. This is now a separate section in the Tivoli Storage Manager Administration Center as shown in Figure 8-1 (for the Health Monitor).

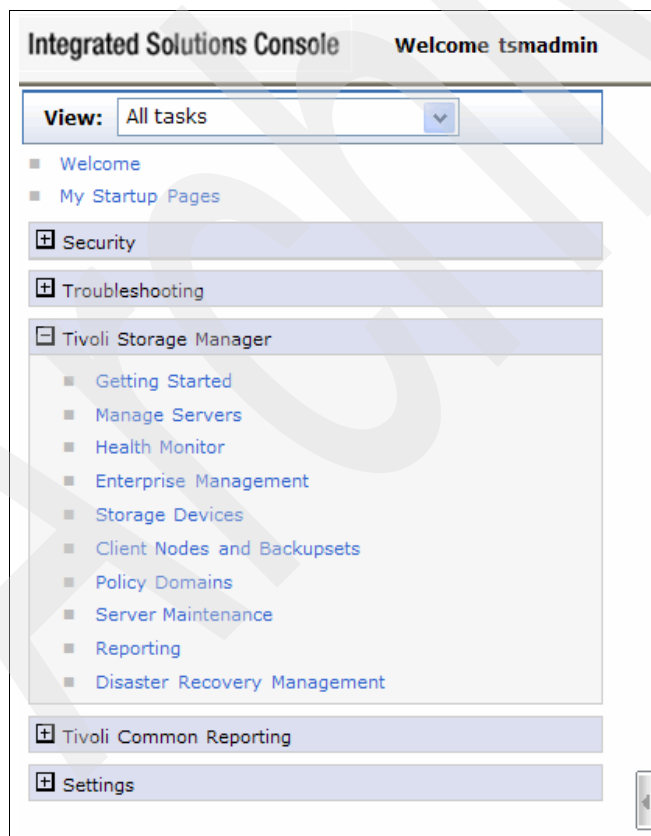


Figure 8-1 Health Monitor listed in Tivoli Storage Manager V6.1 ISC

The Health Monitor enables an administrator to quickly determine the health of a Tivoli Storage Manager Server. The Health Monitor GUI is a part of the ISC, and is separate from

the other Reporting and Monitoring features. It has not changed substantially since the V5.5 release of Tivoli Storage Manager. Figure 8-2 on page 263 shows the detailed view available in the Health Monitor section of the ISC.

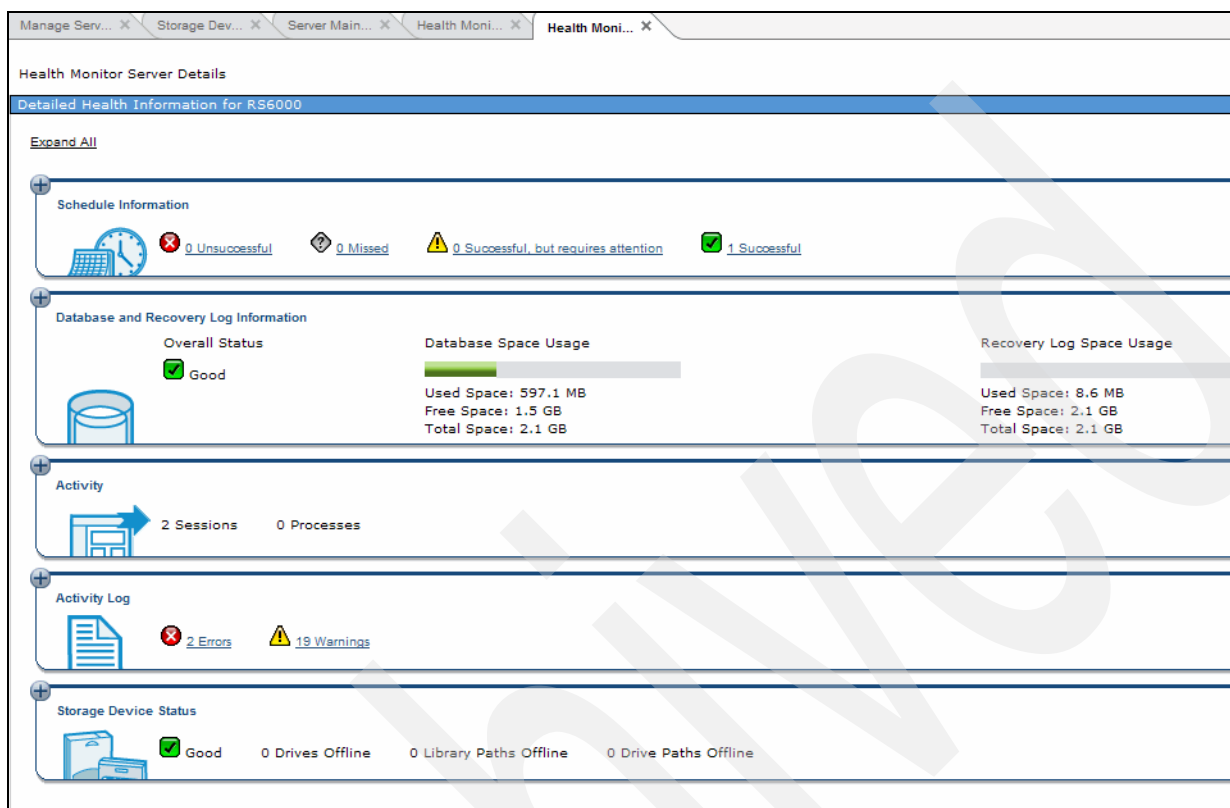


Figure 8-2 Health Monitor from the Administration Center

8.1.2 Administration Center: Reporting

As in previous versions, the Tivoli Storage Manager Administration Center has a section called Reporting. This has not been removed with the upgrade to Tivoli Storage Manager V6.1, however it is not related to the V6.1 Reporting and Monitoring package. The Reporting feature is most useful on stand-alone Tivoli Storage Manager Servers without the optional Reporting and Monitoring server installed. It provides a basic usage report, and separate basic security report. Because it works by connecting directly to the Tivoli Storage Manager Server through a Tivoli Storage Manager administrative connection, it does not require other infrastructure.

8.1.3 Tivoli Storage Manager Reporting and Monitoring

Tivoli Storage Manager V6.1 Reporting and Monitoring package consists of existing and new IBM products. It is a new stand-alone Reporting and Monitoring server based on IBM Tivoli Monitoring (ITM) and Tivoli Common Reporting (TCR).

Principal components of monitoring are:

- ▶ DB2
- ▶ IBM Tivoli Monitoring (ITM)
- ▶ IBM Tivoli Enterprise Portal (TEP)
 - TSM/TEP Workspaces

Principal components of reporting are:

- ▶ IBM Tivoli Data Warehouse (TDW)
- ▶ Tivoli Common Reporting (TCR)
 - TSM/TCR report definitions
 - BIRT, which enables users to create customized reports for use with TCR (optional)
- ▶ Tivoli Storage Manager Integrated Solution Console and Administration Center (ISC)
 - Hosts the TCR component, which reports on data in the TDW.

Reporting and Monitoring uses the standard Deployment Engine for installation, so although this list seems large, installation is actually straightforward. The basic components (DB2, ITM, TEP, TDW) are included in one installation package for your convenience. BIRT is a separate package and is only required if you want to create customized reports; it is not required if the built-in reports are sufficient, or if you are downloading preconfigured reports from another source.

Reporting and Monitoring setup

Setting up Reporting and Monitoring has two options:

- ▶ If you have an existing licensed ITM, Tivoli Storage Manager can use it, but it has to be at least at level 6.2 FP1.
- ▶ If there is no existing ITM setup, Tivoli Storage Manager provides a complete version, which is usable for monitoring Tivoli Storage Manager only. With this option, the Reporting and Monitoring system must comply with the requirements listed in the planning section of the Tivoli Storage Manager documentation: principally that the Reporting and Monitoring system has a server of its own. Installing Reporting and Monitoring on the same system as the Tivoli Storage Manager V6.1 server is not supported (although, a separate VM or LPAR is acceptable).

Reporting and Monitoring functions

Functions include:

- ▶ Is a stand-alone reporting and monitoring server based on IBM Tivoli Monitoring (ITM) and Tivoli Common Reporting (TCR).
- ▶ You can monitor and report on 5.4, 5.5 and 6.1 servers.
- ▶ Licensing DB2, ITM or TCR separately is not necessary.
- ▶ The server installs on Windows, AIX, and Linux86 platforms.
- ▶ You can manage Tivoli Storage Manager Servers on any supported platform.
- ▶ Monitoring agent installs directly on selected server platforms or runs on the monitoring server.
- ▶ Uses the Deployment Engine to easily install all components.
- ▶ Capable of reporting on any Tivoli Storage Manager server at or later than V5.3.
- ▶ Compliments and integrates with Tivoli Storage Manager Administration Center.
- ▶ *Light* enough to be installed to manage a single Tivoli Storage Manager server.
- ▶ Scalable enough to manage a farm of Tivoli Storage Manager servers.
- ▶ Integrates with reporting tools from other IBM products.
- ▶ Integrates with monitoring tools from other IBM products.

Reporting and Monitoring frequently asked questions

This section lists frequently asked questions or points to be aware of regarding Reporting and Monitoring package.

How does a user see Reporting and Monitoring?

- ▶ The Reporting GUI is the Tivoli Storage Manager Administration Center.
- ▶ The Monitoring GUI is Tivoli Enterprise Portal (TEP).

Can Monitoring be installed without Reporting?

- ▶ Yes

Can Reporting be installed without Monitoring?

- ▶ No

Is it supported and downloadable for Tivoli Storage Manager V5.x Servers?

- ▶ Yes

Can it be installed on the Tivoli Storage Manager Server?

- ▶ For Tivoli Storage Manager V5.x: Yes, but not recommended, because of resource consumption.
- ▶ For Tivoli Storage Manager V6.1: No, not supported, because of conflicting DB2 versions.
- ▶ Install the standard Tivoli Storage Manager Administrative Center and Reporting/Monitoring on the same server to manage multiple mixed Tivoli Storage Manager Servers.

Is it an all-in-one installation package?

- ▶ Yes, all required components are automatically be installed.

What about the old Tivoli Storage Manager Operational Reporting

- ▶ It will be discontinued. Tivoli Storage Manager V6.1 changes are incompatible with Operational Reporting.

Is scheduling built into the product?

- ▶ Not yet, it is under consideration for future releases.

Do I need extra licenses?

- ▶ No, licensing is part of Tivoli Storage Manager Base Enterprise Edition.

Do I need to write my own Monitors or Reports?

- ▶ No, we deliver pre-configured Monitors and predefined Reports.

Can I write my own reports?

- ▶ Yes, they can be developed with BIRT using Eclipse 3.3.1.1.

Note: We recommend a service engagement to create custom reports, because BIRT implementation is not trivial.

Can customers customize their own Monitors?

- ▶ Yes, customizing is very easy in TEP.

Does it plug in to an existing ITM installation?

- ▶ Yes, you can see Tivoli Storage Manager Monitoring as well as all other ITM Monitors (license is required).

Does it plug into an existing Administration Center installation?

- ▶ Yes, we recommend to use one server for managing, reporting, and monitoring Tivoli Storage Manager. It plugs into Tivoli Storage Manager V6.1 Administration Center only.

Can I monitor and report on multiple Tivoli Storage Manager Servers?

- ▶ Yes, you can even monitor and report on different Tivoli Storage Manager versions.

Note: The Tivoli Storage Manager V6.1 server for the AIX, HP-UX, Linux, and Sun Solaris platforms now allows other products that deploy and use DB2 to be installed on the same machine. The Tivoli Storage Manager V6.1 product publications originally listed this as being a restriction. After further evaluation, this restriction is removed, and a future revision to the publications will reflect this.

8.2 Reporting and Monitoring installation

Tivoli Storage Manager allows other products that use the DB2 product to be deployed and used on the same system if the following considerations are met:

- ▶ The other products that use the DB2 product are using DB2 V9 or later. The DB2 products introduced product encapsulation and segregation support beginning with DB2 V9 and later. This support allows for running multiple copies of DB2 on the same system and at different code levels.

For more information about DB2 support and other information, go to the following Web address:

<http://publib.boulder.ibm.com/infocenter/db2luw/v9r5/index.jsp?topic=/com.ibm.db2.luw.admin.dboobj.doc/doc/r0024057.html>

- ▶ When you install different DB2 products on the system that has the Tivoli Storage Manager V6.1 server, ensure that the user IDs, fence user IDs, installation location, other directories, and related information that you specify are different from all the IDs and locations that you used for the Tivoli Storage Manager server installation and configuration. If you used the dsmicfgx wizard or dsmupgdx wizard to configure or upgrade the server, these are values that you entered when running the wizard. If you used the manual configuration or upgrade procedures, review the procedures that you used, if necessary, to recall the values that were used for the server.
- ▶ Carefully consider the resources and capability of the system that is being used for Tivoli Storage Manager along with the requirements for other products that use the DB2 product. To provide sufficient resources for the other DB2 applications, you might have to change the Tivoli Storage Manager settings on the system to allow the server to use less system memory and resources. Similarly, if the workloads for the other DB2 applications compete for processor or memory resources with the Tivoli Storage Manager server, the performance of the Tivoli Storage Manager server might be adversely affected in its ability to service the desired client workload or other server operations that are needed.

An appropriate best practice might be to consider using LPAR, WPAR, or other virtual machine support to accomplish this approach. For example, running the other application that uses DB2 in its own virtualized machine segregates resources and provides more capability for the tuning and allocation of processor, memory, and other system resources to this application as well as the resources available to Tivoli Storage Manager.

Note for Windows systems: The current restriction that is documented in the Tivoli Storage Manager publications for the installation of other DB2 versions (or applications that deploy and use DB2) on the same Windows system as a Tivoli Storage Manager V6 server is still in place and not affected by the support discussed here. Similar support for Windows systems is currently being evaluated. The intention is to remove this restriction. Refer to the appropriate documentation and Support Flashes on the IBM Tivoli support Web site for the latest information..

8.2.1 Installation example

Before you can use Reporting and Monitoring, you must install it. This process currently requires a separate server for installation, on the Windows platform, which we use here as our example platform:

1. Start the installation wizard. Figure 8-3 is the first window that opens when the installation wizard is started. Click **Next** to continue.

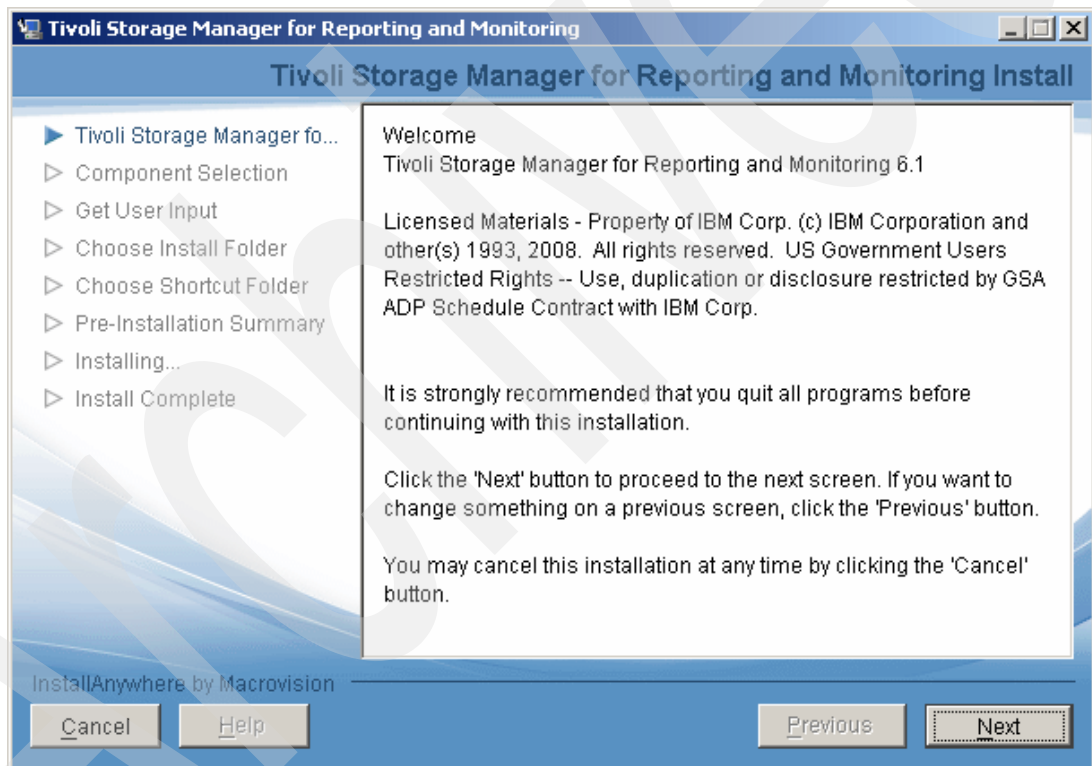


Figure 8-3 Tivoli Storage Manager for Reporting and Monitoring Install window

2. Figure 8-4 on page 268 shows the Component Selection option panel. Select the components to install and click **Next** to continue.

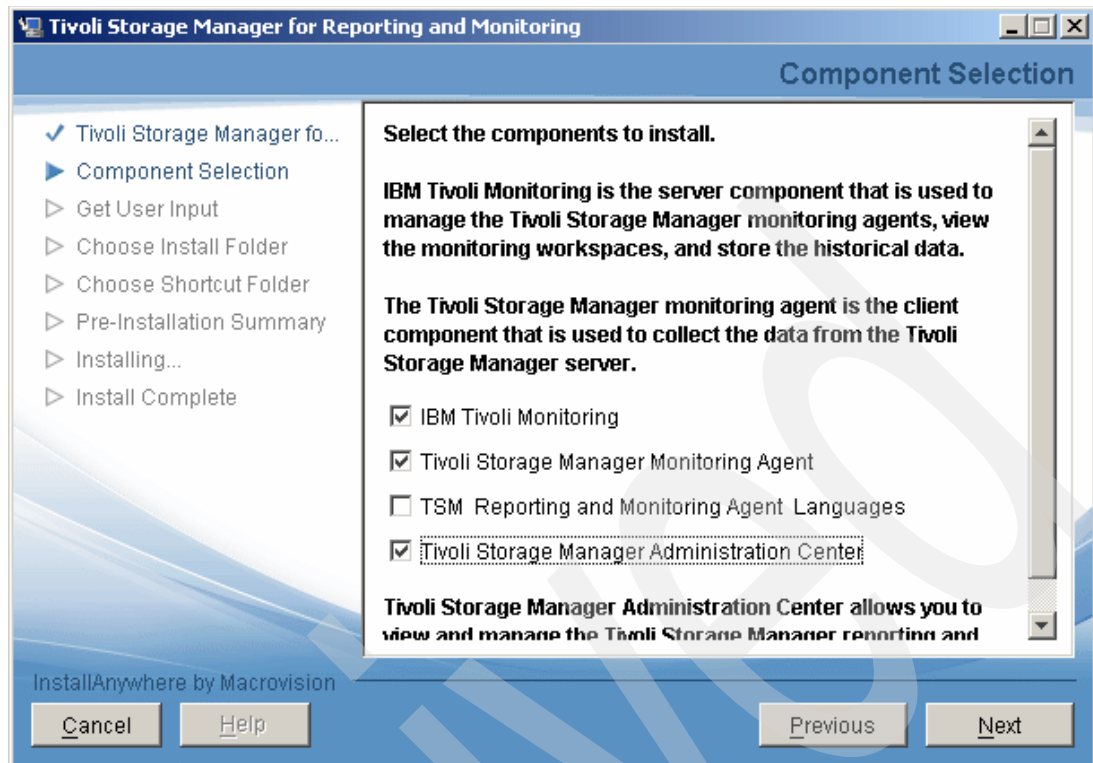


Figure 8-4 Component Selection panel

- Figure 8-5 shows the DB2 Configuration panel. Enter the required information and Click **Next** to continue.

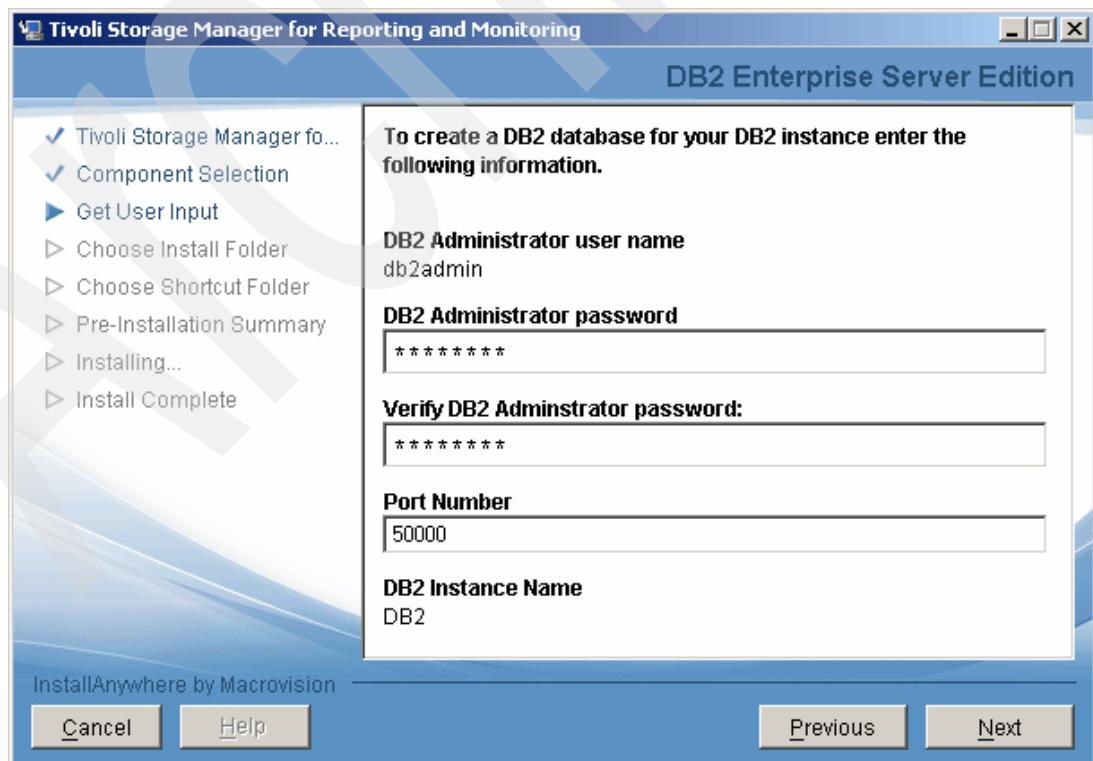


Figure 8-5 DB2 Configuration window

4. Figure 8-6 shows the Encryption key entry panel. Here, we accepted the default encryption key. Click **Next** to continue.

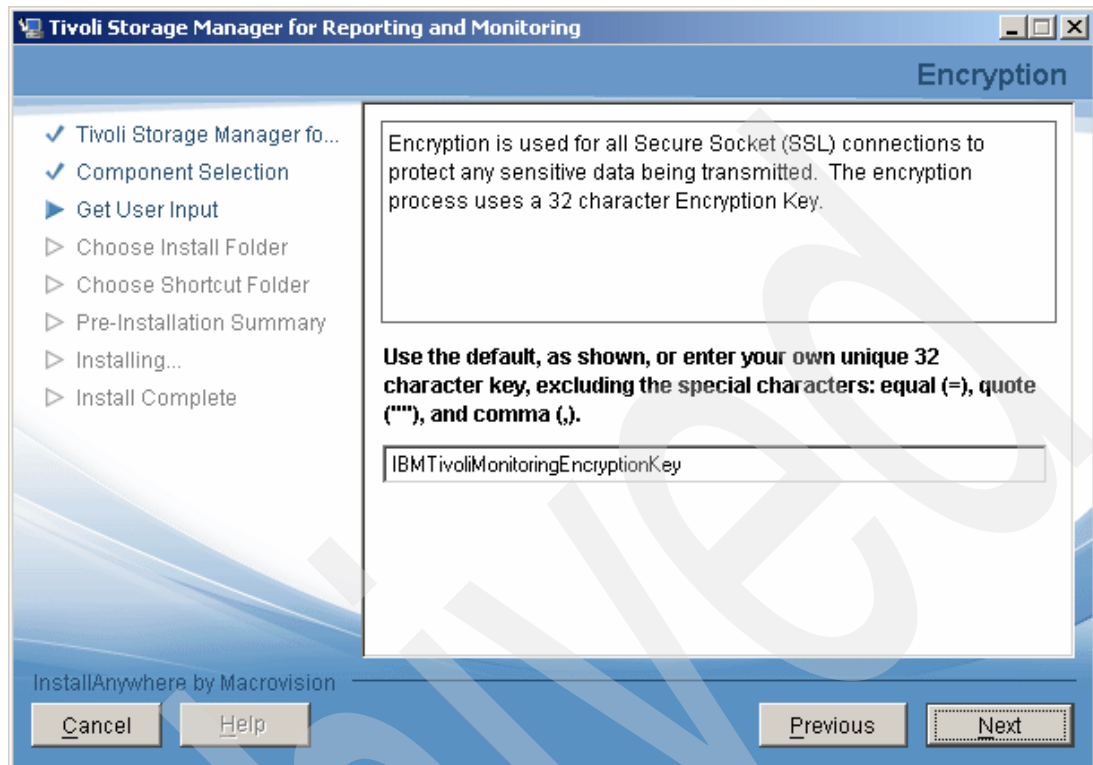


Figure 8-6 Encryption key entry

5. Figure 8-7 on page 270 shows the Database Access Setup panel. Enter the password for the TEPS and ITMUser user ID. Note it, and click **Next** to continue.

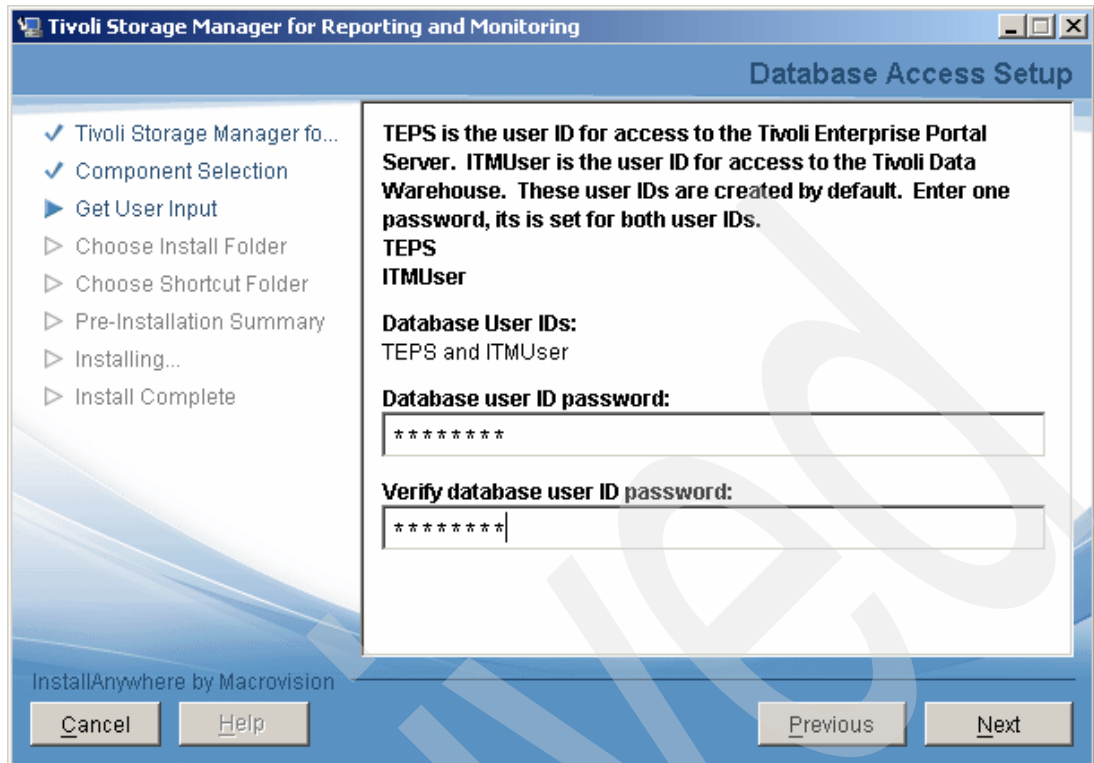


Figure 8-7 Database Access Setup window

6. Figure 8-8 shows the Administration Center credential entry window. Enter the required information and click **Next** to continue.

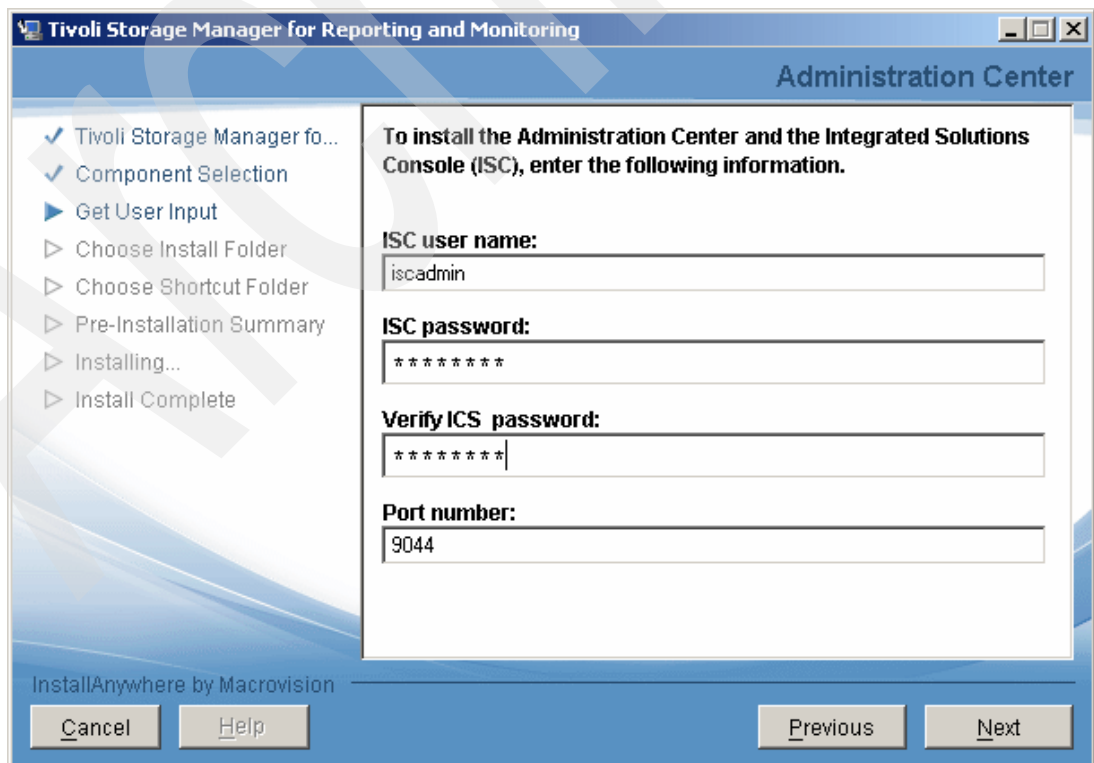


Figure 8-8 Administration Center credential entry

7. Figure 8-9 shows the location of the installation destination folder. Accept the default or specify the folder for your server. Click **Next** to continue.

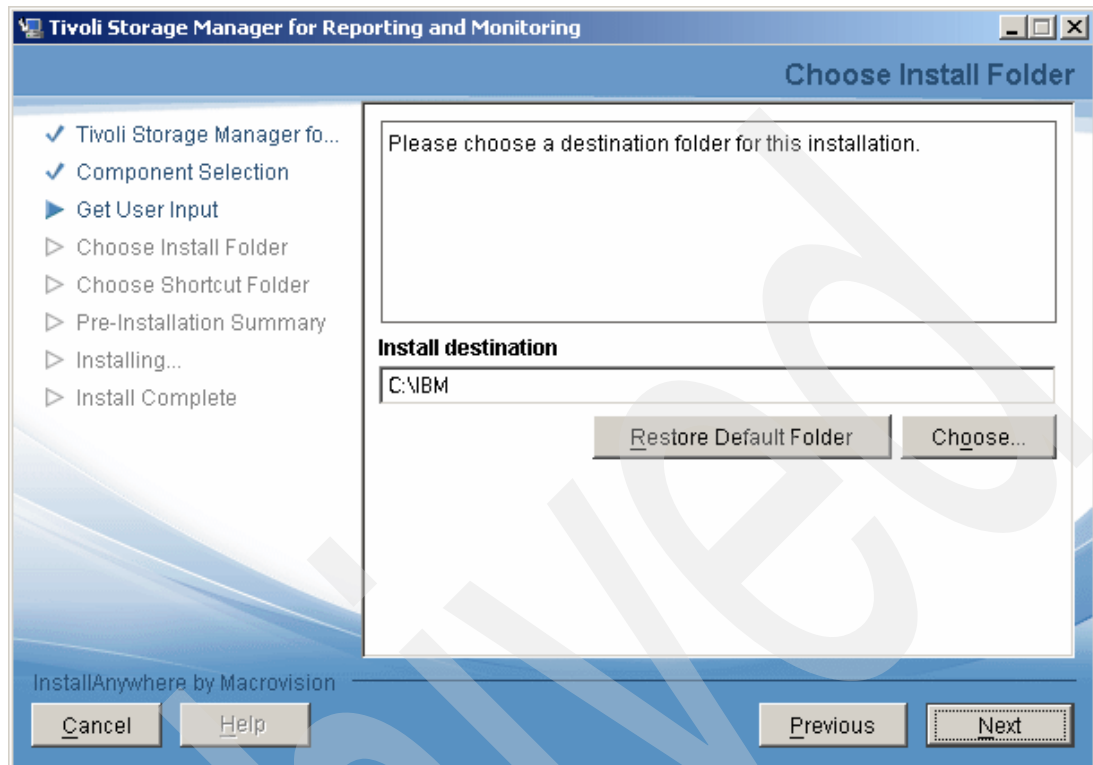


Figure 8-9 Installation folder destination

8. Figure 8-10 on page 272 shows the Pre-Installation Summary panel. Review the information. If you are satisfied with the information click **Install** to continue.



Figure 8-10 Pre-Installation Summary panel

Figure 8-11 shows the installation progress.

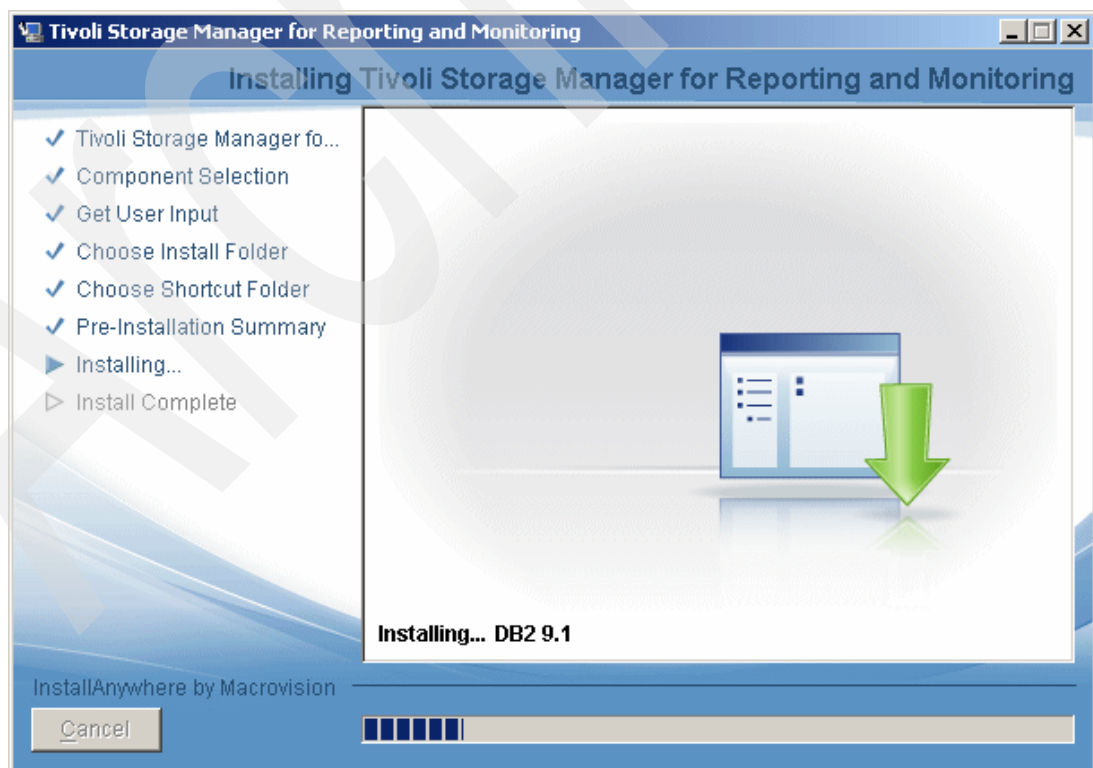


Figure 8-11 Installation in progress

9. Figure 8-12 shows the completion of the installation. The panel contains a summary of what was installed. Click **Done** to complete the installation and exit.

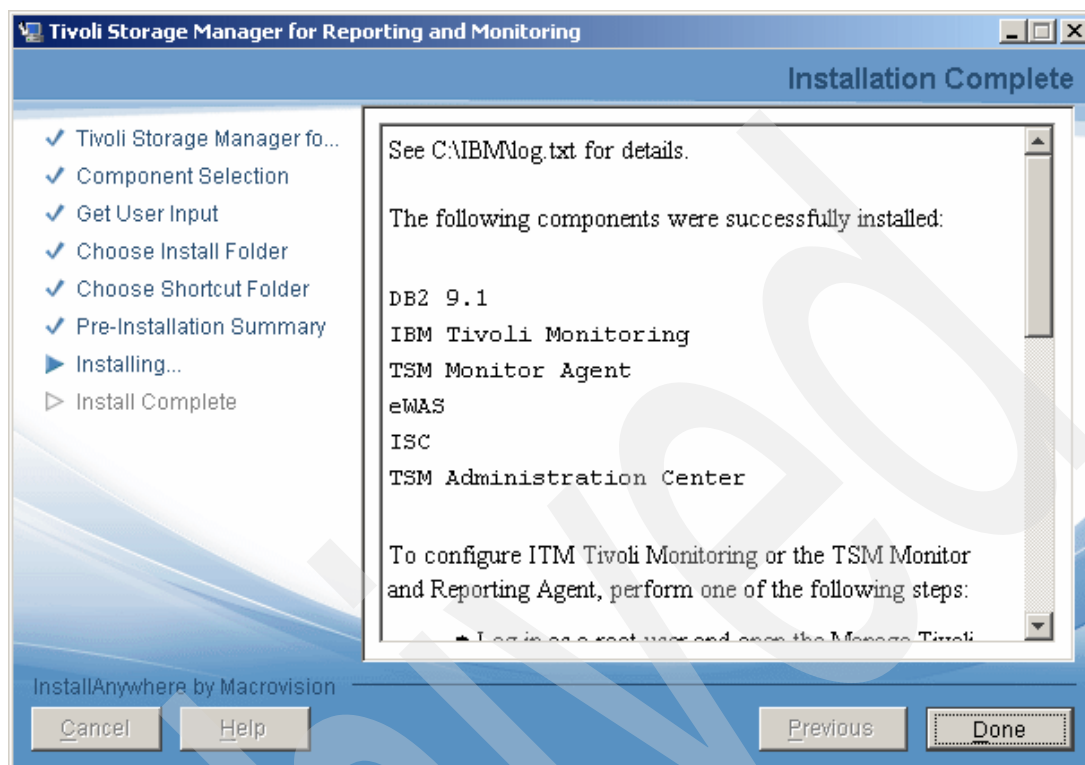


Figure 8-12 Installation Complete panel

8.2.2 Installing BIRT

Currently, the IBM JVM is not available as a stand-alone download. Therefore, we have to download a product containing the JVM, such as the Eclipse JDK, which is available from:

<http://www.ibm.com/developerworks/java/jdk/eclipse/index.html>

8.3 VMware overview

VMware provides software virtualization (*hypervisor*) support for Intel-based hardware. It allows the use of multiple operating system images and operating system types, hosted from the same physical hardware, which in turn generally allows greater overall utilization of that shared hardware. Each operating system image virtualized in this way is referred to as a *guest*.

A number of types of VMware servers are available. This section discusses the VMware ESX server, because that is the enterprise version that will most likely be used for production services.

A number of VMware guests hosted on the same ESX server usually run in parallel. Although this approach provides benefits for various types of application, it can cause issues with backup and recovery if traditional backup techniques are used without consideration of the underlying equipment.

Several approaches to backing up are available with VMware, which we summarize in this chapter. For more information about VMware see:

<http://www.vmware.com>

VMware consolidated backup with Tivoli Storage Manager

Beginning with Tivoli Storage Manager V5.5, support for VMware Consolidated Backup (VCB) environments was enhanced with a tighter integration between Tivoli Storage Manager and VMware. Previously, VMware's Integration Module to Tivoli Storage Manager was required. This is no longer true.

The Tivoli Storage Manager V5.5 client included features that allow easier setup and management of VCB-based infrastructures, and that allowed it to initiate backups in a VCB environment.

Tivoli Storage Manager V6.1 further leverages the functionality of VCB. It is a VMware backup solution for the ESX 3.0 and later server in a storage area network (SAN) and non-SAN environment. By offloading the backup away from the virtual machines and the ESX host, you can reduce the load on the production VMware ESX host for backup operations. It also allows backup in a LAN-free environment.

Before you can start using VMware Consolidated Backup for both file level and full VM support, prepare your systems by following these steps:

1. Implement your ESX server farm with SAN, NAS, or local attached storage so that all virtual disks for all virtual machines are stored at a location that is accessible from the backup proxy machine.
2. Plan for a dedicated Windows 2003 server with access to virtual machine data (located on SAN, NAS, or local storage) to act as the VCB backup proxy.

Important: If you want to use LAN-free, you must have an additional SAN connection so that tape traffic can be separated from disk traffic.

3. Zone your SAN and configure your disk subsystem host mappings so that all ESX servers and the backup proxy can access the same disk volumes.
4. Follow all prerequisite and configuration VMware Consolidated Backup setup requirements and limitations that are documented in the *VMware Virtual Machine Backup Guide*, at:

http://www.vmware.com/pdf/vi3_35/esx_3/r35/vi3_35_25_vm_backup.pdf

Be sure to check the software and hardware requirements.

5. Download and install the VMware Infrastructure 3, VMware Consolidated Backup framework from the VMware Web site:

<http://www.vmware.com/download/vi>

The integration module (Consolidated Backup Integration Module for Tivoli Storage Manager) is not required.

6. If you are doing a restore operation of full VM image files, download and install the VMware Converter tool (Starter or Advanced version) from the VMware Web site:

<http://www.vmware.com/download/converter/>

Without the tool, the full VM image files can be restored to the backup proxy, but you must use the VMware Converter or a similar tool to redefine the virtual machine to the Virtual Center or the ESX Server inventory.

7. On the Tivoli Storage Manager Server, register a single node for the backup proxy machine. For best results, use the default Tivoli Storage Manager node name, which is the value returned with the **'hostname'** command. This will be the Windows computer name or host name, for example:

```
register node VCBPROXY1 password
```

8. Install the Tivoli Storage Manager client and run the setup wizard to establish basic communication with the Tivoli Storage Manager server on the backup proxy.
9. Select the Preferences Editor **VM Backup** tab, and configure the required Tivoli Storage Manager options in dsm.opt file for a working VMware Consolidated Backup:
 - VMCHost

Note: VMCHost can be defined to point to the Virtual Center or ESX Server. Tivoli Storage Manager will recommend defining VMCHost to point to the Virtual Center for ease of setup when running multiple ESX Servers and to ensure that the use of VMotion will not affect the backups. There is no advantage to contacting the ESX Server directly.

- VMCPW
- VMCUSER
- VMLIST

Restriction: If you cannot use a Virtual Center server and you need to perform backups of multiple machines on multiple ESX servers, do not specify these options in the options file, but specify the options with the command so that it can be varied for each ESX server.

10. Ensure that the VMware tools are installed on each virtual machine, from the VMware virtual infrastructure client.
11. (Optional) For each virtual machine, configure the VMware pre-freeze and post-thaw scripts that are run within each virtual machine (for most operating systems). These files are located in a predefined directory (for example: C:\Windows\pre-freeze-script.bat and C:\Windows\post-thaw-script.bat). Among other functions, this can be used to achieve application-consistent backup in virtual machines. In addition to the pre-freeze and post-thaw scripts, VMware will quiesce NTFS and FAT file systems (only for Microsoft Windows virtual machines). This ensures that no file system writes are pending at the time the snapshot is taken, allowing the creation of file-system consistent backups.

Note: VMWare VCB is currently supported on a physical Windows 2003 Server only.

8.4 New commands and options

This section lists the new commands, utilities, and options introduced in Tivoli Storage Manager V6.1 for server and client.

8.4.1 Server

Because of the changes brought about by the change to a DB2-based database, Tivoli Storage Manager V6.1 introduces many new commands, functions, and utilities. These are listed in Table 8-1 on page 276.

Table 8-1 Commands

Command	Function	Comparable commands in previous versions
EXTEND DBSPACE	Makes additional storage space available for the server to use for its database. You can have multiple locations for the database storage space. After installation and initial use of DSMSERV FORMAT or DSMSERV LOADFORMAT, you can add more locations for the storage space for the database.	DEFINE DBVOLUME EXTEND DB
IDENTIFY DUPLICATES	Starts or stops processes that identify duplicate data in a storage pool.	None
QUERY DBSPACE	Displays the current locations for the database storage, along with total space, and used space.	Q DBVOLUME
SET DBRECOVERY	Sets the device class to use for backup of the server's database.	DEFINE DBBACKUPTRIGGER
SET DBREPORTMODE	Sets the amount of diagnostic information that is reported for the database.	None
SET DRMACTIVEDATASTGPOOL	Sets the active-data pools that are included in your recovery plans and procedures.	None

Table 8-2 lists the new utilities available.

Table 8-2 Utilities

Command	Function	Comparable commands in previous versions
DSMSERV DISPLAY DBSPACE	Offline utility to view the current locations for database storage.	DSMSERV DISPLAY DBVOLUMES
DSMSERV DISPLAY LOG	Offline utility to view information about the recovery logs (active log and archive logs).	DSMSERV DISPLAY LOGVOLUMES
DSMSERV INSERTDB	Offline utility used only for inserting data that has been extracted from a V5 server database into an empty V6.1 database.	None
DSMUPGRD PREPAREDDB	Offline utility used only on a V5 server to prepare the database for extraction. After this utility is run, the data can be extracted from the database using the DSMUPGRD EXTRACTDB utility. This is one of the upgrade utilities.	None
DSMUPGRD EXTRACTDB	Offline utility used only on a V5 server to extract the data from the database. The extracted data is inserted into a V6.1 database using the DSMSERV INSERTDB utility. This is one of the upgrade utilities.	None
DSMUPGRD EXTEND DB	Offline utility used only on a V5 server to extend the database when database space is insufficient to successfully complete the upgrade process. This is one of the upgrade utilities.	None

Command	Function	Comparable commands in previous versions
DSMUPGRD EXTEND LOG	Offline utility used only on a V5 server to extend the recovery log when recovery log space is insufficient to successfully complete the upgrade process. This is one of the upgrade utilities.	None
DSMUPGRD QUERYDB	Offline utility used only on a V5 server to display information about the database and recovery log. This is one of the upgrade utilities.	None

Finally, Table 8-3 lists the new server options.

Table 8-3 Server options

Command	Function	Comparable commands or options in previous versions
ACTIVELOGDIR	The new directory for the location where the active log is stored. Use this option to change the location of the active log. The location is originally specified during installation. There is only one location for the active log.	DEFINE LOGVOLUME
ACTIVELOGSIZE	The maximum size of the active log.	EXTEND LOG REDUCE LOG
ARCHFAILOVERLOGDIR	The directory in which the server stores archive log files if they cannot be stored in the archive log location.	None
ARCHLOGDIR	The directory in which the server stores the archive log.	None
DBMEMPERCENT	Sets a limit on the percentage of the system memory that is used for the database.	None
DEDUPREQUIRESBACKUP	Control for backup operations for primary sequential-access storage pools that are set up for deduplication.	None
DISKSTGPPOOLMEMSIZE	The size of the cache that the server can use to manage operations for storage pools with the device type of DISK.	None
MIRRORLOGDIR	The directory where the log mirror for the active log is stored.	DEFINE LOGCOPY

8.4.2 Client

Tivoli Storage Manager V6.1 offers a large number of functional improvements for the client:

- ▶ Mac OS X-specific information included in UNIX and Linux publication (refer to “Related publications” on page 293)
- ▶ Mac OS X NLS support
- ▶ Mac OS X API support

- ▶ Improved memory usage for backup of hierarchical storage management (HSM) managed file systems on UNIX platforms
- ▶ UTF-8 encoding support for Tivoli Storage Manager UNIX and Linux clients
- ▶ Availability of 64-bit Linux binaries
- ▶ NetApp Snapshot Difference API (SnapDiff API) support
- ▶ Full VM backup and restore support on Windows platforms
- ▶ Support for restoring Windows Active Directory individual objects
- ▶ The Windows Native GUI has been replaced with the Java GUI
- ▶ Support for querysummary option

You can use the querysummary processing option to extend the query archive and query backup commands. This support provides a restore preview so that you can determine whether to use the classic or no-query restore method.

- ▶ Support for srvoptsetencryptiondisabled option

You can use the srvoptsetencryptiondisabled processing option to ignore encryption options in a client options set from a Tivoli Storage Manager server.

- ▶ Enhanced help facilities

The command-line client `help` command is enhanced so that you can specify the command, option, or message on which you want help information.

In the GUI, message boxes are enhanced with a button that you can click to see detailed message information.

Further details are available from the information center at:

<http://publib.boulder.ibm.com/infocenter/tsminfo/v6/index.jsp>

Search for the following subjects to obtain more detail:

- ▶ Windows operating systems Adlocation
- ▶ Windows operating systems Backup VM
- ▶ UNIX and Linux operating systems Windows operating systems Diffsnapshot
- ▶ Help
- ▶ Windows operating systems Query Adobjects
- ▶ Query Archive
- ▶ Query Backup
- ▶ Querysummary
- ▶ Windows operating systems Restore Adobjects
- ▶ Windows operating systems Restore VM
- ▶ UNIX and Linux operating systems Windows operating systems Set Password
- ▶ UNIX and Linux operating systems Windows operating systems Snapdiff
- ▶ Srvoptsetencryptiondisabled option
- ▶ Windows operating systems Stagingdirectory
- ▶ Windows operating systems Vmbackdir
- ▶ Windows operating systems Vmbacknodelete
- ▶ Windows operating systems Vmbackuptype

8.5 Security issues for Backup-Archive clients

To protect your Backup-Archive client against unwanted security violations, you can define several options in the client option file. Three options are for unwanted schedules and another option is for unwanted encryption.

8.5.1 Preventing unwanted schedules

The three ways in which a Tivoli Storage Manager administrator, using the scheduler, can potentially execute an unwanted operation on a client machine are:

- ▶ Executing a scheduled operating system command operation (`action=cmd`).
- ▶ Executing a scheduled operating system command operation using the pre- or post-schedule or pre- or post-snapshot command defined in the Tivoli Storage Manager server client option set or define schedule command.
- ▶ Executing a scheduled restore or retrieve operation (`action=restore` or `action=retrieve`).

SRVPREPOSTSCHEDDISABLED option

The `SRVPREPOSTSCHEDDISABLED` option prevents a pre- or post-schedule command, defined by the Tivoli Storage Manager administrator, from executing on the client machine. If a pre- or post-schedule command is defined by both the client and the Tivoli Storage Manager administrator, the command defined by the Tivoli Storage Manager administrator will *not* override the corresponding command defined in the client option file.

SRVPREPOSTSNAPDISABLED option

The `SRVPREPOSTSNAPDISABLED` option prevents a pre- or post-snapshot command defined by the Tivoli Storage Manager administrator from executing on the client machine. If a pre- or post-snapshot command is defined by both the client and the Tivoli Storage Manager administrator, the command defined by the Tivoli Storage Manager administrator will *not* override the corresponding command defined in the client option file.

SCHEDRESTRETRDISABLED option

The `SCHEDRESTRETRDISABLED` option prevents the execution of a restore or retrieve schedule operation.

Option details

The options `SRVPREPOSTSCHEDDISABLED`, `SRVPREPOSTSNAPDISABLED`, and `SCHEDRESTRETRDISABLED` have the following aspects:

- ▶ These options *can* also be set from the preference editor for the JAVA GUI and the Windows GUI.
- ▶ Acceptable values for these options are YES or NO. The default value is NO.
- ▶ These options *cannot* be set from the server client options set, because that approach defeats the purpose of these options.
- ▶ These options are valid for all Tivoli Storage Manager clients that use the Tivoli Storage Manager client scheduler including Backup-Archive client, API, HSM and Data Protection clients. The server cannot define this option.

Options file

For UNIX, Linux, and Macintosh clients, place these options in the `dsm.sys` file within a server stanza for the scheduler. For all other clients, place this option in the `dsm.opt` file for the scheduler.

8.5.2 Prevent unwanted encryption

You can use the `srvoptsetencryptiondisabled` processing option to ignore encryption options in a client options set from a Tivoli Storage Manager server.

The `srvoptsetencryptiondisabled` option allows the client to ignore encryption options in a client options set from a Tivoli Storage Manager server. If the option is set to `yes` in the client options file, the client will ignore the following options in a client options set from a Tivoli Storage Manager server:

- ▶ `encryptkey generate`
- ▶ `exclude.encrypt`
- ▶ `include.encrypt`

Option details

Option `SRVOPTSETENCRYPTIONDISABLED` has the following aspects:

- ▶ The acceptable values for this option is `YES` or `NO`. The default value is `NO`.
- ▶ Tivoli Storage Manager client ignores the values of the listed encryption options in a client options set from a Tivoli Storage Manager server.
- ▶ This option is valid for all clients. The Tivoli Storage Manager client API does not support this option.
- ▶ For UNIX, Linux, and Macintosh clients, place these options in the `dsm.sys` file within a server stanza for the scheduler. For all other clients, place this option in the `dsm.opt` file for the scheduler.

8.6 Disaster recovery manager

Protection and recovery of your Tivoli Storage Manager servers and their data is essential to your business resiliency plans. This section contains a review of the changes implemented in Tivoli Storage Manager V6.1 with respect to your disaster recovery manager configurations. As in previous releases, the disaster recovery manager feature is included with Tivoli Storage Manager Extended Edition only.

Providing a secure disaster recovery environment encompasses the complete data protection spectrum. Although disaster recovery of your data is a small portion of the overall business continuity plan (BCP), this data protection is critical to your business survival in times of disaster.

Several enhancements in Tivoli Storage Manager V6.1 affect your disaster recovery planning:

- ▶ Active-data storage pools
- ▶ Deduplication storage pools
- ▶ DB2 database and recovery log enhancements

The disaster recovery manager (DRM) plays a role in management of your copy pools volumes, and building your recovery plans efficiently, and a central point of packaging

recovery information. This section discusses strategies around using Tivoli Storage Manager's DRM as part of the building blocks to provide secure disaster recovery capabilities within your company.

DRM enhancements for V6.1

An enhancement was added to support active-data storage pools (ADPs) within the current DRM framework. The design objectives were to ensure:

- ▶ ADPs can be used in DRM recovery plans, and procedures, to ensure that some, if not all, client machines can be restored more quickly and efficiently.
- ▶ All current DRM capabilities will be available to an ADP for management of on-site or off-site resources in preparation for a potential disaster.
- ▶ ADPs will emulate current DRM implementation of copy storage pools so existing methodologies and procedures can be easily expanded.

Note: The default behavior is that active-data pools are *not* DRM-managed.

Considerations for using ADP in a DRM scenario

An ADP typically is not used for restoring the primary storage pools because this might cause some, or all, inactive files to be deleted from the database if the server determines that an inactive file needs to be replaced but cannot find it in the ADP.

A typical scenario is for ADP volumes to be made available as soon as possible at a disaster site for high priority clients to begin immediate restoration followed by availability of copy pool volumes.

Clients restoring directly from ADP volumes can run concurrently with clients restoring from lower priority copy pools because ADPs have a higher priority. This means that clients restoring from ADPs will not access their data that exists in copy pools, preventing potential thrashing and mount-point conflicts.

SET DRMACTIVEDATASTGPOOL command

The new disaster recovery manager command is SET DRMACTIVEDATASTGPOOL, which is used to specify the active-data pools to be managed by DRM. Previously, no awareness of the active-data volumes existed in DRM. Using this command to specify names of the active-data pools to be recovered (or destroyed) after a disaster, will also create defaults if the PREPARE, MOVE DRMEDIA, or QUERY DRMEDIA commands do not include the ACTIVEDATASTGPOOL parameter. Note the following information about the command:

- ▶ It is modeled after the existing SET DRMCOPYSTGPOOL command.
- ▶ Multiple ADP names can be entered through a comma delimited list.
- ▶ Entering a NULL value removes all ADPs from DRM.
- ▶ System authority is required to issue the command.
- ▶ The SET action can be verified with QUERY DRMSTATUS.

The parameters included are the active-data pool names. The usage is separate multiple names with commas and no intervening spaces. You can use wildcard characters. The specified names overwrite any previous settings.

If you enter a NULL string (""), all current names are removed, and no active-data pool volumes in a MOUNTABLE state are processed if they were not explicitly entered as MOVE DRMEDIA, QUERY DRMEDIA, or PREPARE command parameters.

DRM updates to accommodate DB2

The primary objective of the DRM development team was to preserve the **move drmedia** function and command externals, and to make changes to the prepare recovery plan file for DB2. The changes to the stanza content and add and delete stanzas where required.

The externals of DRM are the same as V5.5 for DB and copy storage pool volumes. For the internals, copy storage pool volume tracking was untouched, and with regards to DB volume tracking, note the following information:

- ▶ Tivoli Storage Manager still responsible for tracking DB backup volumes, not DB2.
- ▶ Tivoli Storage Manager Volume History is still used to track DB backup volumes.
- ▶ DB backup volume expiration is the same as V5.5.
- ▶ AUTO_DEL_REC processing used for DB2 hygiene so DB2 keeps minimal records, ideally only the latest backup series.

The design objective was to keep DB2 backup volume records to a minimum, because DB2 has its own *volume history* called recovery history; however Tivoli Storage Manager does not use it for tracking database backup volumes and maintains use of its own volume history file.

Disaster recovery plan changes

The disaster recovery plan has been changed to accommodate the difference between the DB and Log directory functions, because Tivoli Storage Manager no longer formats the DB and Log volumes. This difference also meant that the development team had to change the **dsmserv restore db** command.

Recovery plan file stanza changes or deletions appear as bold type in the following list:

- ▶ **SERVER.REQUIREMENTS (changed)**
- ▶ RECOVERY.INSTRUCTIONS.GENERAL
- ▶ RECOVERY.INSTRUCTIONS.OFFSITE
- ▶ RECOVERY.INSTRUCTIONS.INSTALL
- ▶ RECOVERY.VOLUMES.REQUIRED
- ▶ **RECOVERY.SCRIPT.DISASTER.RECOVERY.MODE script (changed)**
- ▶ RECOVERY.SCRIPT.NORMAL.MODE script
- ▶ **LOG.VOLUMES (removed)**
- ▶ **DB.VOLUMES (removed)**
- ▶ **DB.STORAGEPATHS (added)**
- ▶ **LOGANDDB.VOLUMES.INSTALL (removed)**
- ▶ LICENSE.REGISTRATION macro
- ▶ COPYSTGPOOL.VOLUMES.AVAILABLE macro
- ▶ COPYSTGPOOL.VOLUMES.DESTROYED macro
- ▶ PRIMARY.VOLUMES.DESTROYED macro
- ▶ PRIMARY.VOLUMES.REPLACEMENT.CREATE macro
- ▶ PRIMARY.VOLUMES.REPLACEMENT macro
- ▶ STGPOOLS.RESTORE macro
- ▶ VOLUME.HISTORY.FILE
- ▶ DEVICE.CONFIGURATION.FILE
- ▶ DSMSEV.OPT.FILE
- ▶ LICENSE.INFORMATION

Further details regarding the changes to DRM, refer to the documentation at:

http://publib.boulder.ibm.com/infocenter/tsminfo/v6/topic/com.ibm.itsm.srv.doc/t_mng_drm.html

Select **Administering** → **Protecting the server**, and then select either:

- ▶ **Protecting and recovering your server**
- ▶ **Using disaster recovery manager**

8.7 Migrating a client to a different server

Certain considerations have to be made when planning an upgrade or new installation of Tivoli Storage Manager, regardless of version. With the improvements in data handling that Tivoli Storage Manager V6.1 brings, you may now use a Tivoli Storage Manager server for more clients with more objects and data.

To understand how many clients your Tivoli Storage Manager pre-V6.1 server has, use the following steps, which are tips to help plan a smooth transition between versions:

1. Use **QUERY NODE** command to show how many client nodes are registered on your Tivoli Storage Manager server.

This command displays all the nodes for which an administrative user ID has authority to perform operations.

2. Use **EXPORT SERVER** command to move server information to your new Tivoli Storage Manager server.

Use this command to export all or part of the server control information and client file data (if specified) from the server to sequential media.

When you export server information to sequential media, you can later use the media to import the information to another server with a compatible device type.

Important:

- ▶ If target and source server levels are not compatible, the operation might not work.
- ▶ Exporting data to a Centera device class is not supported. However, files stored in Centera storage pools can be exported.

You also have the option of processing an export operation directly to another server on the network. This results in an immediate import process without the need for compatible sequential device types between the two servers.

You can export the following types of server information by issuing the **EXPORT SERVER** command:

- Policy domain definitions
- Policy set definitions
- Management class and copy group definitions
- Schedules defined for each policy domain
- Administrator definitions
- Client node definitions

You can optionally export the following types of data:

- File space definitions
- Access authorization information pertaining to the file spaces exported
- Backed-up, archived, and files that were migrated by a Tivoli Storage Manager for space management client

3. Use **SET ACCESS** to allow data from multiple clients to be restored to one client.

Three function calls support cross-node, cross-owner access on the same platform: `dsmSetAccess`, `dsmDeleteAccess`, and `dsmQueryAccess`. These functions, with the `-fromnode` and `-fromowner` string options that are passed on `dsmInitEx`, permit a complete cross-node query, restore, and retrieve process through the API.

Security considerations

Several considerations exist that relate to accessing data from another node. One important consideration is security or confidentiality. After access is given to another node, that node is able to restore or retrieve all the currently stored data for the node it has access to.

Note: Ensure that no confidentiality or security rules are compromised by allowing one node access to another node's data.

8.8 Scheduling

In a typical production environment, the backup and other operations that protect the client data should be scheduled, so that we can be sure they regularly execute. Tivoli Storage Manager provides you with a client scheduling interface, which interacts with the server's central scheduler for this purpose.

If you use Tivoli Storage Manager's own central scheduling, the administrator defines appropriate schedules on the server to perform the Tivoli Storage Manager tasks automatically. Central scheduling is a cooperative effort between the server and each client node in that the client must run its own scheduler process so that the client and server can contact each other to run the scheduled operation correctly.

Scheduled operations are recorded centrally in the event log at the server. You can view which schedules ran successfully, which were missed, and which are scheduled to run in the future. You can create an exception reporting list to view only those schedules that failed.

The client scheduling process should normally be configured to start automatically each time the client boots to avoid missing schedule execution and compromising data security.

The two methods used to control how the client and server make contact to run a schedule are: *client polling* and *server prompted*. These methods can be configured in the client node configuration files or defining client option sets on the Tivoli Storage Manager server.

The client node schedules can run using one of two methods: *classic scheduling* and *enhanced scheduling*. The classic and enhanced scheduling criteria can also be used for administrative schedules. These schedules can also be created and updated using the ISC/Admin Center GUI.

Classic scheduling

The classic schedule runs the action type on the specified day, Sunday - Saturday, weekday, or weekend. Examples are as follows:

- To schedule the backup of the ARCHIVEPOOL primary storage pool periodically, use classic scheduling. Enter the following command:

```
define schedule backup_archivepool type=administrative
cmd='backup stgpool archivepool recoverypool'
active=yes starttime=20:00 period=2
```

This command specifies that, starting today, the ARCHIVEPOOL primary storage pool is to be backed up to the RECOVERYPOOL copy storage pool every two days at 8 p.m.

- To update the BACKUP_ARCHIVEPOOL schedule, enter:
`update schedule backup_archivepool type=administrative starttime=20:00 period=3`
 This command specifies that, starting today, the BACKUP_ARCHIVEPOOL schedule begins the backup every three days at 10 p.m.

Enhanced scheduling

Note the following examples:

- To schedule the backup of the CENTRALPOOL primary storage pool on specific days of the month, use enhanced scheduling. Enter the following command:
`define schedule backup_centralpool type=administrative
 cmd='backup stgpool centralpool auxiliarypool'
 active=yes starttime=22:00 schedstyle=enhanced dayofmonth=10,-1`
 This command specifies that the CENTRALPOOL primary storage pool is to be backed up to the AUXILARYPOOL copy storage pool on the tenth and last day of each month at 10 p.m.
- To update the BACKUP_CENTRALPOOL schedule, enter:
`update schedule backup_centralpool type=administrative starttime=19:00
 dayofmonth=-2`
 This command specifies that, starting today, the BACKUP_CENTRALPOOL schedule will begin the backup on the second-to-last day of the month at 7 p.m.

8.9 Expiration

The Tivoli Storage Manager expiration process deletes server objects from the database that no longer conform to the rules in associated management classes.

8.9.1 Legacy expiration algorithm

The Tivoli Storage Manager expiration processing, as available with previous versions of the product, historically suffers from two issues:

- Efficiency:
 Over the years that the Tivoli Storage Manager has been available, the amount of data managed by a single server instance grew significantly. This growth might be the number of clients supported by a server, the number of objects belonging to a given client, or both. Until now, expiration was a single process that was only able to use a pair of threads.
 The two threads used performed two tasks:
 - a. The first thread scans the `Expiring.Objects` table, trying to identify candidates that could be deleted.
 - b. The second thread deletes batches of files that the first thread identified as eligible for deletion.
- Flexibility:
 Many administrators expressed the desire to be able to run expiration on specific nodes. This would allow them to clean up from a policy error or change or to simply expire old data for a client node that was consuming a large amount of space in the storage hierarchy.

This flexibility is partly available in the legacy expiration processor. For instance, you are allowed to specify a sequential range of node IDs through undocumented options (begin node ID and end node ID). There is no ability to specify multiple nodes that are not sequentially aligned within the expiration table. This also requires that you have knowledge of node IDs. Because the procedure for retrieving the node IDs was not documented, often a service call was necessary to exploit the function.

8.9.2 Objectives of the new expiration process

With Tivoli Storage Manager V6 and the transition to the DB2 database, extensive changes were needed. In particular, changes to the server schema were done to exploit the DB2 capabilities and to eliminate redundancy in the base tables and the meta-data representation that the Tivoli Storage Manager server uses.

One significant change for Tivoli Storage Manager V6 and the inventory tables is the elimination of the `Expiring.Objects` database table. This table was used to represent objects that could be expired (deleted) through the expiration process. This table duplicated information from the base `Archive.Objects` and `Backup.Objects` tables. Similarly, the existing expiration algorithm and processing was tightly coupled to the layout of this table and the organization of the data within this table. As an example, the expiration processing relied upon the ordering of records in order to skip (exclude) records that could not be expired based on current policy settings. The algorithm and processing of the expiration code itself was coded to exploit this data ordering and some existing (legacy) database capability to exclude objects on a fetch records request.

8.9.3 New expiration algorithm

The new expiration algorithm provides the efficiency and flexibility Tivoli Storage administrators have requested for a long time. It is shown in Figure 8-13 on page 287.

New expiration algorithm

Dispatch thread

```
{
  setup expiration
  resolve command parameters {
    generate list of candidate
    NODES to process
    determine type of objects
    to process
    if restart records exist {
      retrieve restart records
    }
  }
  start expiration thread up to
  N nodes
}
```

Expiration thread(s)

```
{
  if there is a restart record available {
    load it and process
  } else {
    acquire NEXT Node from to-do list
  }
  for each filespace {
    for each management class {
      for each object type {
        find eligible file {
          call imDeleteObject
        }
      }
    }
  }
}
```

- Multiple threads are being run under a single expiration process.

Figure 8-13 New expiration algorithm

More information regarding the EXPIRE INVENTORY processing can be obtained using the command-line help and is summarized in Table 8-4. (Refer also to 3.1.1, “Server enhancements, additions, and changes in version 6.1” on page 44, and “EXPINTERVAL” on page 247.)

Table 8-4 Sample expiration process NODE and DOMAIN parameter combinations

Node value	Domain value	Result
None	None	All nodes for all domains will be processed. This is the default behavior.
*	*	If you use wild cards, the result is invalid.
*	None	All nodes for all domains will be processed.
None	DOMAIN=xxx	All nodes assigned to the specified domain will be processed.
None	DOMAIN=xxx*	If you use wild cards, the result is invalid.
NODE=DEPT_A*	DOMAIN=xxx	All nodes matching the pattern DEPT_A* that are assigned to domain xxx will be processed.
NODE=A,B,C,D*	None	Nodes A, B, C, and any matching the pattern D* will be processed.

The expiration process TYPE parameter allows to define which specific data types to expire. You can specify one of the four following values, with ALL being the default:

- ▶ ARCHIVE: process only archive data for the candidate nodes.
- ▶ BACKUP: process only backup data for the candidate nodes.
- ▶ OTHER: process remote DRM recovery plan files and database backups from the volume history.
- ▶ ALL: process all eligible data (Archive, Backup, and Other)

The expiration process RESOURCE parameter specifies the number of threads that can run in parallel. Specify a number in the range of 1 - 10.

The resources represent parallel work by the server within the single expiration process (expiration still runs as a single process).

For example, if you specify:

- ▶ NODE=X,Y,Z and RESOURCE=3 (or greater), then expiration processing for the three client nodes X, Y, and Z runs in parallel.
- ▶ NODE=X,Y,Z and RESOURCE=5, then expiration processing for the three client nodes runs in parallel, and the extra two resources are ignored.

Administration Center

The enhanced expiration processing options are available in the Administration Center.

From the Administration Center's Tivoli Storage Manager view, select the target server and click **Server Maintenance**.

From the Select Action drop-down list, lick **Expire Inventory**, as shown in Figure 8-14 on page 289.

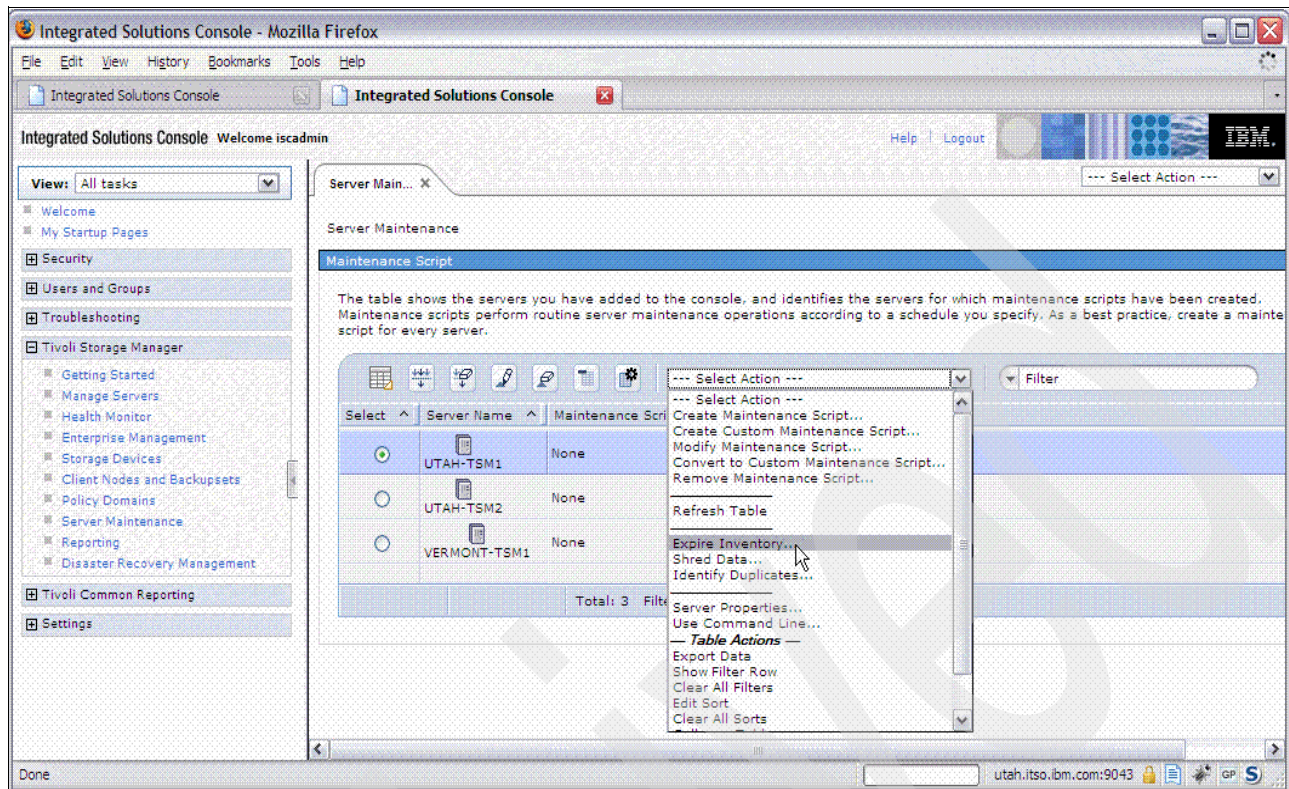


Figure 8-14 Administration Center: select action

In the Expire Inventory panel, shown in Figure 8-15 on page 290, you can specify all the options to meet your requirements. The panel supports all new parameters, the number of threads to be utilized, which data to process, domain and node selection. For the domain parameter, you can select the domain from a list of available domains configured to your system.

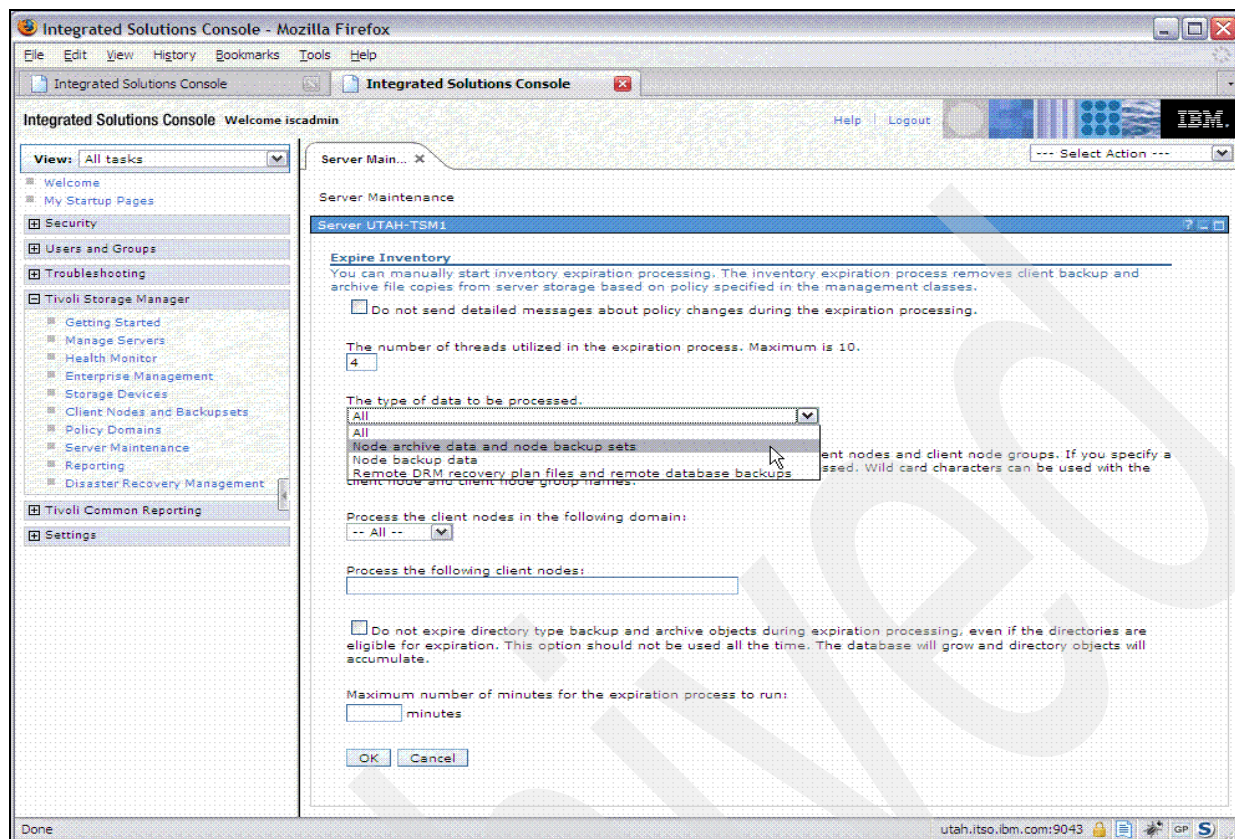


Figure 8-15 Administration Center: expiration options

The Tivoli Storage Manager V6 enhancements to the server expiration process integrate the new database schema and provide:

- ▶ Improved efficiency by abandoning the producer/consumer thread model. Each thread involved examines and deletes its own candidate list independent of the other threads that may be running. The workload is split across the available number of threads designated by the RESOURCE value on the command.
- ▶ Improved flexibility by giving you the ability to control for whom expiration is done and what is expired.

Further details about expiration (EXPIRE INVENTORY) are located at:

http://publib.boulder.ibm.com/infocenter/tsminfo/v6/index.jsp?topic=/com.ibm.itsm.srv.ref.doc/r_cmd_inventory_expire.html

8.9.4 Reclamation of volumes in active-data pools

Inactive files in volumes in an active-data pool are deleted by reclamation processing. The rate at which reclaimable space accumulates in active-data pool volumes is typically faster than the rate for volumes in non-active-data pools.

If reclamation of volumes in an active-data pool is occurring too frequently, requiring extra resources such as tape drives and libraries to mount and dismount volumes, you can adjust the reclamation threshold until the rate of reclamation is acceptable. The default reclamation threshold for active-data pools is 60%, which means that reclamation begins when the storage pool reaches 60% of capacity. Accelerated reclamation of volumes has more of an

effect on active-data pools that use removable media and, in particular, on removable media that is taken off-site.

Preventing off-site marking of partially-filled active-data pool volumes

To prevent marking partially-filled copy storage pool or active-data pool volumes as off-site, you can use storage on another Tivoli Storage Manager server (device type of SERVER) for storage-pool backups.

If the other server is at a different site, the copy-storage pool volumes or active-data pool volumes are already off-site, with no moving of physical volumes between the sites.

8.9.5 Tips for restoring

Tivoli Storage Manager uses versions of data to ensure protection and granularity of backups and archives. The latest version of an object is the active version and all others are considered inactive.

Certain commands can result in unexpected restore results especially if using the `-inact` flag when performing a restore operation. Be aware that restoring the inactive version of a file is what is actually intended.

Ensure that very specific terms are used to define the file required for restoring by using as many flags as possible to narrow the choice of file. The following parameters or options should be used, if possible:

- ▶ filename
- ▶ file location
- ▶ fromdate
- ▶ todate
- ▶ inactive
- ▶ replace
- ▶ fromtime
- ▶ totime

8.9.6 Planning your backups

The following checklist can be used for preliminary planning:

- ▶ Decide whether you want to back up or archive files.
- ▶ Create an include-exclude list to specify files and directories you want to exclude from backup services.

Note: Ensuring that appropriate data is protected can seriously improve storage use. Be aware that you are responsible for the data you store including any licensed or copyrighted material.

- ▶ Decide what type of backup you want according to your requirements:
 - Performing an incremental, selective, or incremental-by-date backup (Windows)
 - Group backup (Windows) for backing up files from one or more file spaces
 - Backing up system objects (Windows XP)
 - Backing up Windows system state

- Backing up Automated System Recovery (ASR) files (Windows XP, Windows Server 2003)
- Performing an image backup
- Backing up NAS file systems
- ▶ Additional Windows backup considerations
 - Backing up open files
 - Management class implications
 - Deleted file management
 - Removable media management
 - Backing up fixed and aliased drives
 - Backing up NTFS security and file descriptor considerations
 - UNC or share point names
 - Microsoft DFS considerations

How much data will be backed up?

Understand the data you are managing and protecting. Understanding the business implications of losing the data you protect is vital. Also vital is to be sure that backup and archive processes do not impact the running of the business processes you are protecting.

To ensure that your backups run within the correct backup window, you must estimate the amount of data being transferred per night. In an existing system this should already be a stable and reasonably reliable number.

With a known bandwidth such as 10/100 Fast Ethernet or Gigabit Ethernet, you divide the amount of data by the size of your network bandwidth to calculate how long your backups will take. Consider that your network might not always be the slowest part of the data flow. Older tape drives or low throughput HBA cards also affect performance.

Backup scenario

You have approximately 30 GB of changed data being backed up every night by one client to a Tivoli Storage Manager Server with a library with four LTO 4 tape drives, which are capable of a 240 Mbps transfer rate. The result of the following calculation is 1.44 Gb per hour:

$$240 \text{ Mb} \times 60 = 14400 \text{ Mb per hour}$$

This result would take approximately 20 hours using one drive but potentially only five hours if all four drives could be used.

Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this book.

IBM Redbooks

For information about ordering these publications, see “How to get Redbooks” on page 295. Note that some of the documents referenced here might be available in softcopy only.

- ▶ *IBM Tivoli Storage Management Concepts*, SG24-4877
- ▶ *IBM Tivoli Storage Manager Implementation Guide*, SG24-5416

Other publications

These publications are also relevant as further information sources:

- ▶ *IBM Tivoli Storage Manager Server Upgrade Guide*, SC23-9554
- ▶ *IBM Tivoli Storage Manager for Windows Backup-Archive Clients Version 6.1*, SC23-9792
- ▶ *IBM Tivoli Storage Manager for UNIX and Linux Backup-Archive Clients 6.1*, SC23-9791
- ▶ *IBM Tivoli Storage Manager for AIX Installation Guide V6.1*, GC23-9781
- ▶ *IBM Tivoli Storage Manager for AIX Administrator's Guide V6.1*, SC23-9769
- ▶ *IBM Tivoli Storage Manager for AIX Administrator's Reference V6.1*, SC23-9775
- ▶ *IBM Tivoli Storage Manager for SAN for AIX Storage Agent User's Guide V6.1*, SC23-9797
- ▶ *IBM Tivoli Storage Manager for HP-UX Installation Guide V6.1*, GC23-9782
- ▶ *IBM Tivoli Storage Manager for HP-UX Administrator's Guide V6.1*, SC23-9770
- ▶ *IBM Tivoli Storage Manager for HP-UX Administrator's Reference V6.1*, SC23-9776
- ▶ *IBM Tivoli Storage Manager for SAN for HP-UX Storage Agent User's Guide V6.1*, SC23-9798
- ▶ *IBM Tivoli Storage Manager for Sun Solaris Installation Guide V6.1*, GC23-9784
- ▶ *IBM Tivoli Storage Manager for Sun Solaris Administrator's Guide V6.1*, SC23-9772
- ▶ *IBM Tivoli Storage Manager for Sun Solaris Administrator's Reference V6.1*, SC23-9778
- ▶ *IBM Tivoli Storage Manager for SAN for Sun Solaris Storage Agent User's Guide V6.1*, SC23-9800
- ▶ *IBM Tivoli Storage Manager for Linux Installation Guide V6.1*, GC23-9783
- ▶ *IBM Tivoli Storage Manager for Linux Administrator's Guide V6.1*, SC23-9771
- ▶ *IBM Tivoli Storage Manager for Linux Administrator's Reference V6.1*, SC23-9777
- ▶ *IBM Tivoli Storage Manager for SAN for Linux Storage Agent User's Guide V6.1*, SC23-9799
- ▶ *IBM Tivoli Storage Manager for Windows Installation Guide V6.1*, GC23-9785

- ▶ *IBM Tivoli Storage Manager for Windows Administrator's Guide V6.1, SC23-9773*
- ▶ *IBM Tivoli Storage Manager for SAN for Windows Storage Agent User's Guide V6.1, SC23-9553*
- ▶ *IBM Tivoli Storage Manager Messages V6.1, GC23-9787*
- ▶ *IBM Tivoli Storage Manager Performance and Tuning Guide V6.1, GC23-9788*
- ▶ *IBM Tivoli Storage Manager Problem Determination Guide V6.1, GC23-9789*
- ▶ *IBM Tivoli Storage Manager for UNIX and Linux Backup-Archive Clients Installation and User's Guide V6.1, SC23-9791*
- ▶ *IBM Tivoli Storage Manager for Windows Backup-Archive Clients Installation and User's Guide V6.1, SC23-9792*
- ▶ *IBM Tivoli Storage Manager for Space Management for UNIX and Linux User's Guide V6.1, SC23-9794*
- ▶ *IBM Tivoli Storage Manager Using the Application Program Interface V6.1, SC23-9793*
- ▶ *IBM Tivoli Storage Manager for Mail Data Protection for Microsoft Exchange Server Installation and User's Guide V6.1, SC23-9796*
- ▶ *IBM Tivoli Storage Manager for Enterprise Resource Planning Data Protection for SAP Installation and User's Guide for Oracle V6.1, SC33-6340*
- ▶ *IBM Tivoli Storage Manager for Enterprise Resource Planning Data Protection for SAP Installation and User's Guide for DB2 V6.1, SC33-6341*
- ▶ *IBM Tivoli Storage Manager for Advanced Copy Services Data Protection for Snapshot Devices Installation and User's Guide V6.1, SC23-8331*

Online resources

These Web sites are also relevant as further information sources:

- ▶ IBM product announcement letters
<http://www.ibm.com/common/ssi/index.wss>
- ▶ Additional IBM Tivoli Storage Manager V6.1 products
<http://www.ibm.com/common/ssi/cgi-bin/ssialias?subtype=ca&infotype=an&appname=iSource&supplier=897&letternum=ENUS209-088>
- ▶ Tivoli Storage Manager V6.1 documentation
<http://publib.boulder.ibm.com/infocenter/tsminfo/v6/index.jsp>
- ▶ UNIX client installation media
<http://www.ibm.com/software/sysmgmt/products/support/IBMTivoliStorageManager.html>
- ▶ Tivoli Storage Manager V6.1 capacity planning information
http://publib.boulder.ibm.com/infocenter/tsminfo/v6/topic/com.ibm.itrm.srv.inst.all.doc/t_srv_plan_capacity.html
- ▶ Tivoli Storage Manager V6.1 support site
<http://www.ibm.com/software/sysmgmt/products/support/IBMTivoliStorageManager.html>
- ▶ Cygwin site
<http://cygwin.org>

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