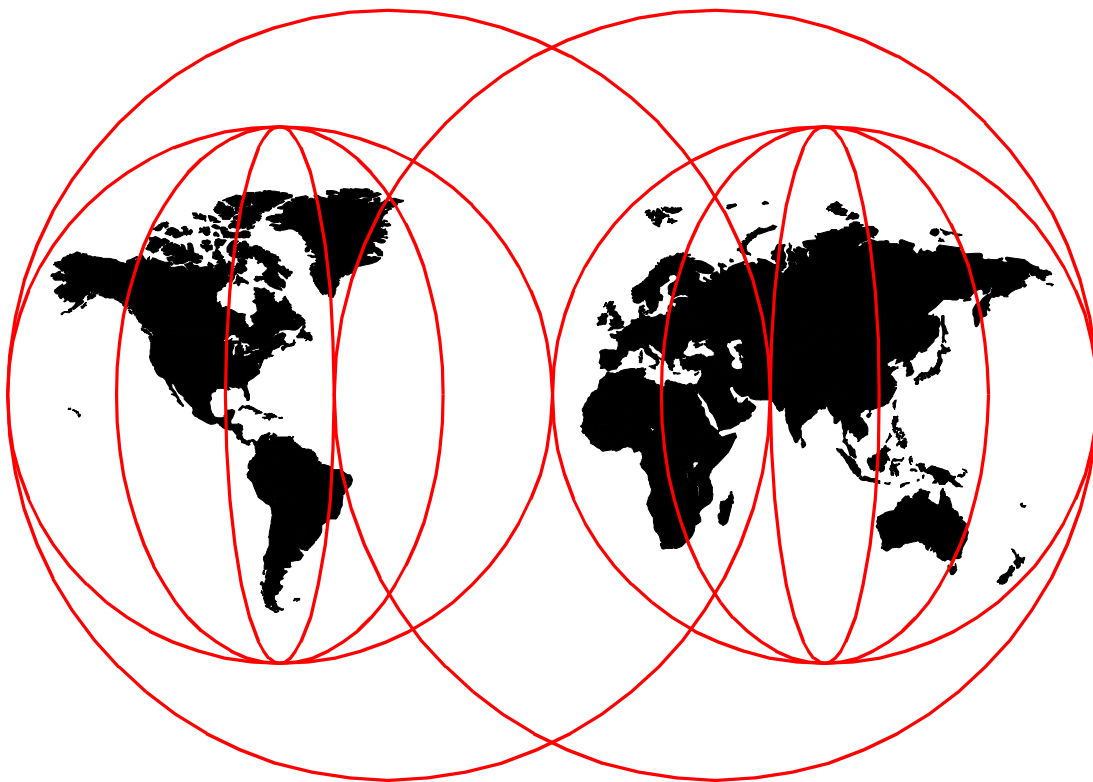


A Practical Guide to Implementing Tivoli Storage Manager on AS/400

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Take Note!

Before using this information and the product it supports, be sure to read the general information in Appendix C, "Special notices" on page 369.

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This edition applies to Version 3 Release 1 Modification 2 Tivoli Storage Manager for AS/400, program 5697-TSM and Version 4 Release 4 of Backup Recovery and Media Service for AS/400, program 5769-BR1 for use with the OS/400 Version 4 Release 4.

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Preface

This IBM Redbook provides a structured introduction to distributed data management within a heterogeneous AS/400 centric environment using Tivoli Storage Manager, Tivoli's strategic storage and data management solution. Its intent is to provide aid in installing, tailoring, and configuring the Tivoli Storage Manager software on an AS/400 system as well as integrating Tivoli Storage Manager with BRMS/400. Practical scenarios, including a complete AS/400 disaster recovery, are discussed in order to provide you with a variety of application examples.

The book is targeted at IT managers as well as AS/400 system or storage administrators who need to understand how Tivoli Storage Manager can be exploited for a complete data management solution. This includes backup and recovery of servers and workstations in a heterogeneous AS/400 centric environment on a conceptual and practical level. Useful prerequisites for reading this book are basic skills in AS/400 administration and data management as well as knowledge of BRMS/400 data management concepts.

The team that wrote this IBM Redbook

The first and second editions of this IBM Redbook were produced by two teams of specialists from around the world working at the International Technical Support Organization, San Jose Center.

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Part 1. Concepts

Chapter 1. Introduction to AS/400 data management

Tivoli Storage Manager, the base product of the Tivoli Storage Management product set, is an enterprise-wide network storage management solution. Tivoli Storage Manager Version 3.1.2 for AS/400 is the latest release and is the successor of Tivoli ADSTAR Distributed Storage Manager (ADSM) Version 3. It has been renamed and repackaged, and introduces many new functions. Please visit the Tivoli Storage Management Web site

<http://www.tivoli.com/products/solutions/storage> for more information.

The AS/400 machine architecture is different from that of most other machines in the industry, especially the usual systems at the workstation and PC level. For lack of understanding, these differences sometimes impede the porting of applications to the AS/400 system, or they can make non-AS/400 administrators hesitate to integrate these systems into an overall solution for their heterogeneous environments.

However, once these basic differences are understood, they can be viewed as benefits rather than stumbling blocks. This chapter gives non-AS/400 people an introduction to the AS/400 system environment and its data management concepts. The following topics are covered:

- Overview of AS/400 hardware and software architecture
- Data organization on an AS/400 system
- AS/400 device concepts
- Existing data management concepts and tools, including a high level overview of BRMS/400

If you are already familiar with these concepts and topics, you may want to skip this chapter.

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1.1 AS/400 system overview

The AS/400 system is designed as a multi-user open computer system. This design characteristic makes it capable of being a central part of the following computing environments.

Host-centric computing:

In this environment, computational capabilities reside on the central system, called the *host*.

Open-systems computing:

Applications developed on an open system have the characteristic of *interoperability*, which means both programs and users can exchange information; and *portability*, which makes it possible to move applications and data from one computer architecture to another without major changes. In general, this means that applications provide the same results from the same

data and present the same interfaces to users on different system architectures.

Client/server computing:

Programs and data stored on a centralized system, the *server*, are passed to another computer, called the *client*, for execution, and results are returned to the server system.

Distributed computing:

Instead of having a full copy of data and programs residing on the server, the data is fragmented and resides on several systems belonging to the same network. This is also called *clustering*.

Figure 1 illustrates the extensive family of various-sized AS/400 systems.



Figure 1. The AS/400 systems family

Before May 1995, the AS/400 system had a 48-bit processor using Complex Instruction Set Computing (CISC). But since then, the AS/400 system is based on the 64-bit PowerPC processor technology using Reduced Instruction Set Computing (RISC). This change became necessary because RISC technology provides the ability for extended future growth and offers several advantages, such as having multiple processors in one AS/400 system.

The AS/400 system distinguishes itself from all other computers in the industry in that its architecture results in a total independence of application and software layers from hardware and peripherals. Thanks to this advanced architecture, none of the existing application programs had to be modified during the move from CISC to RISC processor technology.

The following subsections provide overviews of some aspects of the AS/400 hardware architecture and software layers, and give short snapshots of the administration interfaces of those systems.

1.1.1 AS/400 hardware architecture

The term computer architecture has a meaning somewhat different for the AS/400 system than the way this term is traditionally used in computer science. AS/400 system architecture is defined by a fairly high-level machine interface (MI), which is, since Version 3 Release 6, referred to as a *Technology Independent Machine Interface* (TIMI) and highlights the fact that the application (and much of the operating system) of an AS/400 system is independent from the actual underlying system hardware.

Figure 2 illustrates the hardware architecture of an AS/400 system which underlies the TIMI. The hardware design of the AS/400 system emphasizes the use of I/O processors to off-load system tasks, such as disk I/O, LAN recovery, tape I/O, communication recovery, and terminal I/O, from the main application processors, therefore allowing them to continue to work on application execution.

Main processors and I/O processors are linked together using a bus system. A bus is simply an electrical pathway between hardware components. In addition to the usual System Product Division (SPD) bus, the AS/400 system now directly supports the Peripheral Component Interconnect (PCI) bus also. All of the smaller AS/400e-series models only support PCI bus and adapters; other AS/400 models support both bus types.

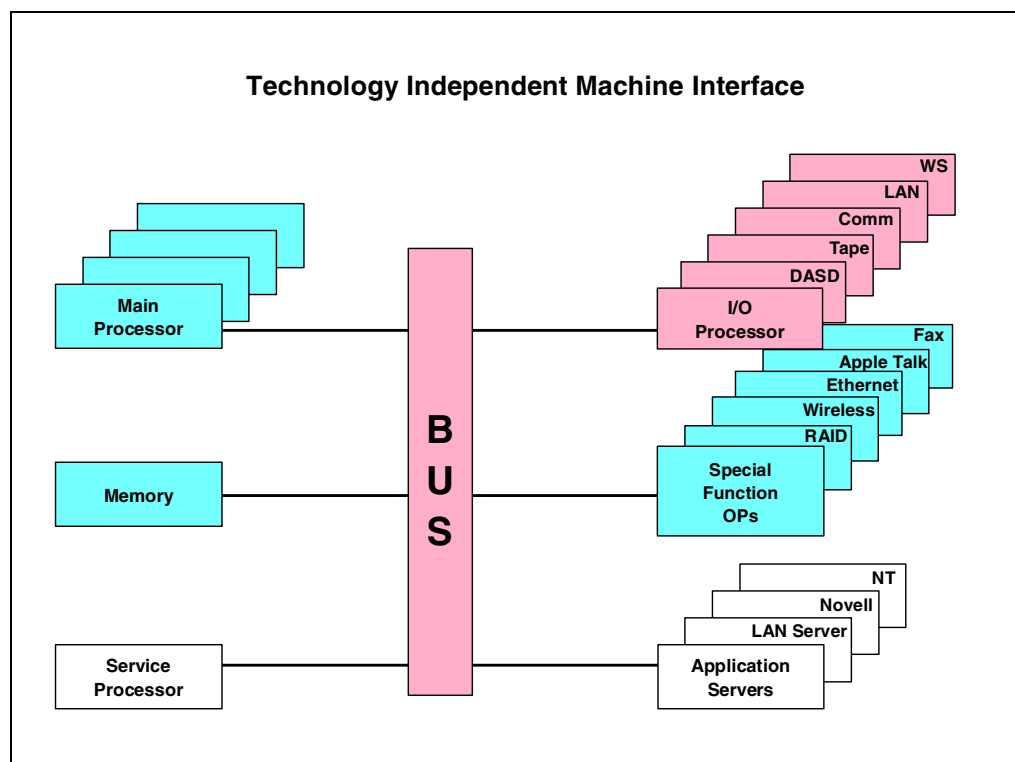


Figure 2. AS/400 hardware design

Currently, the AS/400 system supports up to twelve 64-bit PowerPC processors functioning as the main processor, and hundreds of Intel/Motorola/IBM dedicated I/O processors under the covers. Additionally, the AS/400 system implements I/O processors architected for *end user* technologies, including NT, OS/2 Warp Server, Novel Network, and facsimile support. The coexistence of OS/400 and all

these PC server systems on the AS/400 system allows a consolidation under one set of covers.

Several architectural features of the AS/400 system distinguish the system from other machines in the industry, including Intel based systems running Windows NT. These features include:

- Technology-independent machine interface
- Object-based system design
- Single-level storage
- Integration of application programs into the operating system

1.1.1.1 Technology-independent machine interface

In AS/400 systems, changes to AS/400 hardware and licensed internal code (LIC) do not affect the operating system (OS/400), middleware, or applications running over OS/400. The LIC is a set of specialized programs written by IBM and never tampered with by users or application programs. Only these programs directly communicate with hardware.

The heart of the AS/400 system's ability to change without disrupting customers and their applications is the TIMI. Applications do not have to be rewritten or even recompiled to migrate to new hardware. This permits the AS/400 system to make technology advances in the hardware (for example, storage, memory, and processor technology) and the LIC while protecting end users' investments in existing applications. Figure 3 shows how the AS/400 architecture is structured.

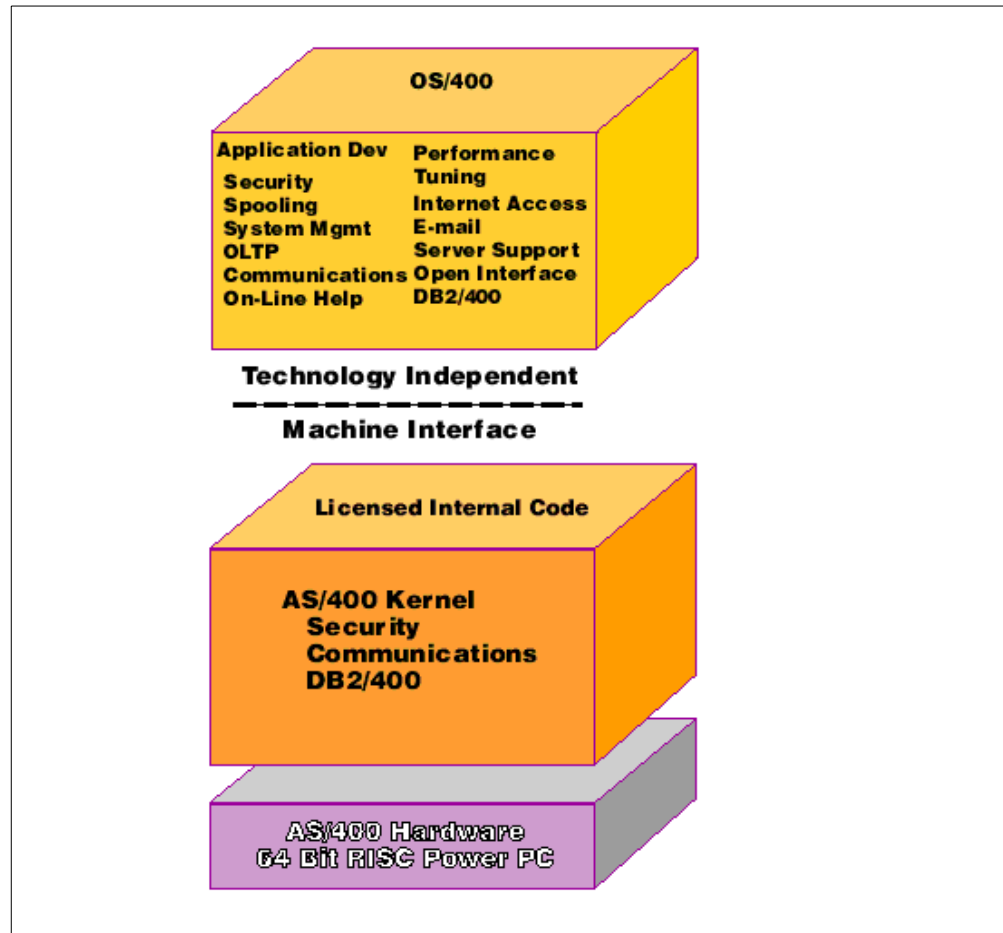


Figure 3. AS/400 architecture

This machine interface is behind the transition from a 48-bit processor to a 64-bit PowerPC-based central processor. The transition to a 64-bit processor did not require a rewrite of the operating system (although numerous changes were made for other reasons). From the standpoint of an application, the transition from the older 48-bit CISC processor to the newer 64-bit RISC processor was accomplished with the ease of a normal release upgrade (object code was obviously required so that machine instructions could be translated the first time a program was executed on the 64-bit processor).

All AS/400 models (from the smallest, accommodating a few users, to the largest, accommodating thousands of users) share the same architecture and the TIMI. This permits applications to scale across the entire product line from the smallest to the largest models. As a customer's needs expand from smaller models to the greater power and capacity of larger models, the application scales up as well.

1.1.1.2 AS/400 — an object-based system

The AS/400 system handles information as objects. This is different from the byte-string manipulation used by many systems. Object-based design, which is part of the architecture, affects operating implementation and high-level language interaction with the system. Object-based design supports system integrity, reliability, and authorization constraints.

Objects are addressed by 16-byte pointers. An address uses eight bytes, and the other eight bytes contain information about the object pointed to. A defined set of operations can be performed on any object. Object-based design provides the means to prevent illegal use of pointers and to detect invalid pointers. It is not possible to counterfeit or modify a pointer. The AS/400 system employs capability based addressing, which means that a user's level of access to an object is determined by the hardware at the time the object is requested.

All information stored on the AS/400 system, such as a user profile, database file, program, or printer queue, has its associated object type stored with the information. The specific object type determines how the object can be used. For example, it is impossible to corrupt a database file on the AS/400 system by incorrectly reading the data as if it were a program. Because the system knows the object is a file, it will only allow valid file commands on that object.

1.1.1.3 Single-level storage

In the AS/400's storage management, both main storage (memory) and secondary storage (disk) are treated as an extremely large virtual address space known as single-level storage (SLS). Storage is addressed with a 64-bit address. (As mentioned before, pointers on the AS/400 system are actually 128-bit, 64 bits of which are used for addressing).

Figure 4 compares AS/400 SLS addressing with the way NT or UNIX systems are working. Those systems are using process local storage. With 32-bit addressing, each process (job) has 4 GB of addressable memory. With SLS 64-bit addressing, over 18 million terabits of addressable storage is possible.

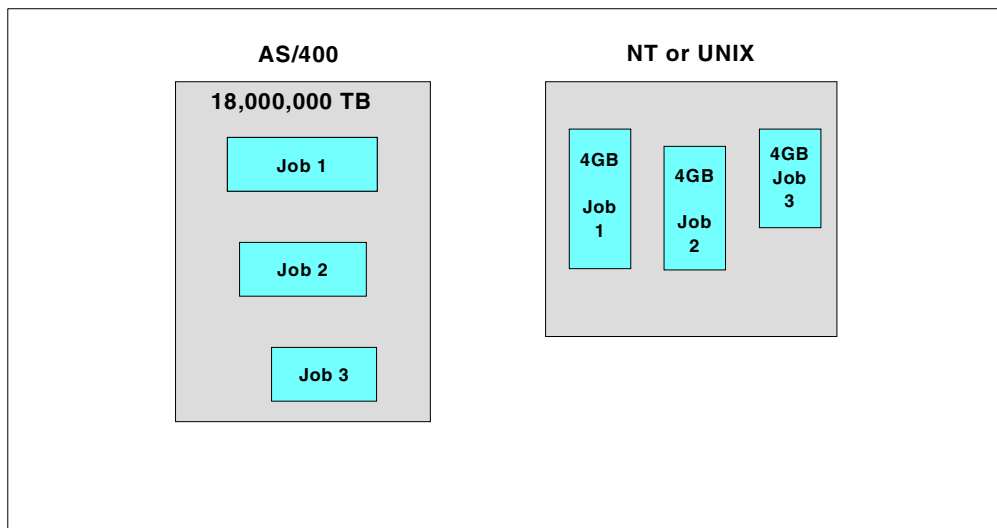


Figure 4. Addressable storage

Because a single page table maps all virtual addresses to physical addresses, task switching is very efficient. Furthermore, SLS eliminates the need for address translation when locating objects, therefore speeding up data access. In addition, OS/400 automatically scatters data across all available disk arms, eliminating the need for a database and/or systems administrator to manage the allocation of data.

1.1.1.4 Integration of applications in the operating system

Another defining characteristic of the AS/400 architecture is the high degree of integration both above and below the TIMI. For example, DB2 for OS/400 is a native relational database management system. That is, DB2/400 is shipped with every system and highly integrated into the licensed internal code and the operating system. Following are areas of AS/400 integration:

- Relational database management system (DB/2 for AS/400)
- Transaction monitor
- Communications
- Security, Internet, serving user and group, administration, printer management, job (process) management, backup and recovery, online help, electronic customer support, system and network management

AS/400's focus is to be an "open" system. The AS/400 system implements numerous industry standards which facilitate application portability from other platforms and interoperability with other hardware platforms.

The AS/400 strategy for implementing POSIX, Single UNIX Specification, and XPG4 functions has been to provide APIs and system interfaces that are the most valuable to most of the vendors developing commercial business applications. OS/400 portability support includes:

- Asynchronous signals
- BSD sockets
- Environment variables
- Interprocess communication (IPC)
- NFS
- POSIX file system
- Process control
- TCP/IP
- TI-RPC
- Threads (both POSIX and Java)
- X-windows and Motif Summary

1.1.2 Software layer overview

This section explains, on a high level, the different software layers existing on AS/400 system. The three basic software layers used on an AS/400 system are:

- Application programs
- Operating system
- Standard Licensed Internal Code (SLIC)

These can be understood through the simple software model shown in Figure 5.

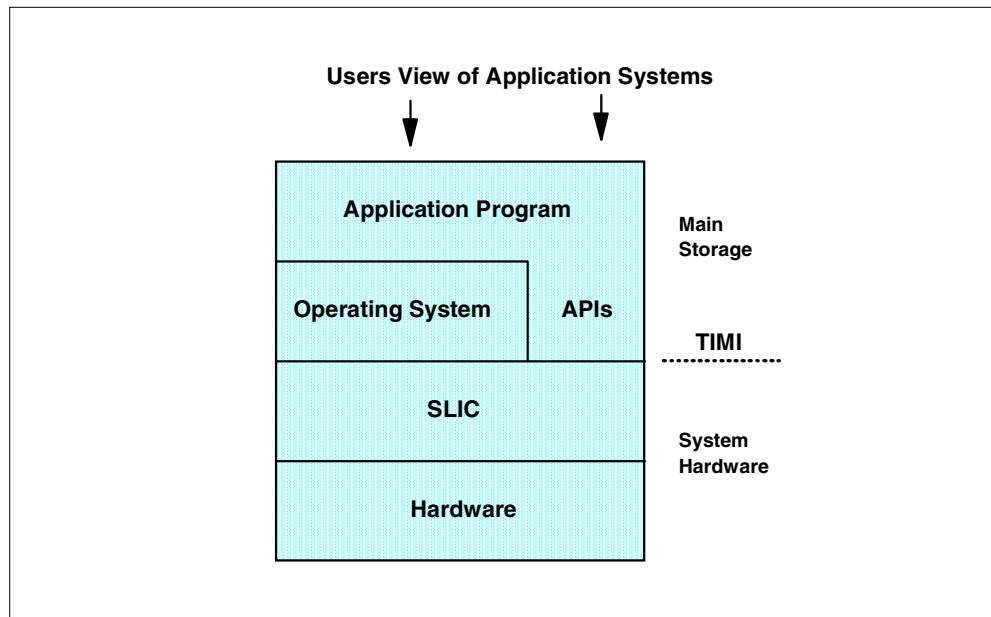


Figure 5. Conceptual view of AS/400 software layers

1.1.2.1 Application programs

The programs in this layer apply an AS/400 system to a specific task, for example, a payroll application. It is through this layer that users interact with the application programs. Sometimes, programs or users access the operating system layer.

There are several application programs interacting directly with the SLIC that are called Application Program Interfaces (APIs). APIs provide better performance but require programming skills to get them running.

1.1.2.2 Operating system

The operating system layer must manage the hardware resources of the computer system and perform tasks under the control of application programs and commands typed by the users.

The application program layer relies on the operating system layer to perform housekeeping tasks associated with the internal operation of the system. The operating system layer provides the environment in which application programs execute. Operating systems also accept commands directly from users.

1.1.2.3 SLIC instructions

The final layer, the SLIC, is made of instructions deeply embedded within the computer system and is, therefore, considered to be part of the machine itself rather than part of a program running on the system. SLIC is only used by other programs; it never interacts with users. It exists only to help application programs and operating systems perform their tasks.

It is the particularly rich SLIC layer of an AS/400 system that is different from other computers. The built-in database, single-level storage, and object-oriented architecture are all designed into the SLIC layer, therefore making them part of the machine itself.

With all the functionality implemented in the SLIC, it allows the AS/400 system to be more efficient by nature. On other platforms, database application is separated from the operating system, and you have to manage the operating system and the database package separately.

1.1.3 AS/400 interfaces

This section provides an overview of ways you can interact with the AS/400 system. In general terms, the AS/400 user and administrator interface is a highly-standardized alphanumeric interface. It is page-oriented and menu-driven. All of the menu functions are also available through commands.

The following section shows you the structure of AS/400 commands, the AS/400 menu system and the usage of the AS/400 online help.

1.1.3.1 Command structure

All AS/400 commands have a common structure made up of two or three parts:

- The *verb* indicating the action performed.
- The *object* on which the action is performed.
- The *keyword* identifying the parameter; its value is the information needed by the system for that parameter. You can specify the value you want, or, in many cases, you can use a predefined system default value. The value is enclosed in parentheses.

The commands are abbreviations. To make these abbreviations easier to understand, they have been standardized; so a user can tell what major function (*action*) each command performs and what item (*object*) the function is performed on. Table 1 shows some examples of the *action* portion of commands.

Table 1. Action portion of a command

Function (verb)	Command (prefix)
Create	CRT...
Work with	WRK...
Change	CHG...

A command also identifies the type of object you are working on. The *object* part of the name (suffix) is also abbreviated and easy to recognize, as shown in Table 2.

Table 2. Object portion of a command

Object	Suffix
Library	...LIB
Physical file	...PF
Job queue entry	...JOBQE

The combination of an action and an object makes an AS/400 command. The following example shows the use of a parameter. We will create a library called smith.

```
====> CRTLIB LIB(smith)
```

CRTLIB is the command, which is made up of a verb and an object. The parameter is LIB (library), and the value for this parameter is smith.

You do not need to remember all the AS/400 CL command keywords, their values, or their sequence. Each command has an entry display to assist you. To get the entry display, press **F4** after you type the command name on the command line. Using F4 is called *command prompting*.

1.1.3.2 AS/400 menu system

Each command that can be entered through the command line can also be initiated through the AS/400 menu system. The purpose of that menu system is to provide a convenient way to interact with the system. Using menus is easier than entering a long string of commands each time you want to get a particular program or file.

You access a menu using the AS/400 GO command followed by the name of the menu. The following screen shows how to access the SAVE menu.

```
====> GO SAVE

SAVE                                     Save                                     System: ASM12

Select one of the following:

  Save Data
    1. Files
    2. Libraries
    3. Documents and folders
    4. Programs
    5. Other objects
    6. Changed objects only
    7. Licensed programs
    8. Security data
    9. Storage
   10. Configuration
   11. Objects in directories

More...

Selection or command
====>

F3=Exit   F4=Prompt  F9=Retrieve  F12=Cancel  F13=Information Assistant
F16=AS/400 Main menu
```

1.1.3.3 Online help

The AS/400 system provides extensive online help and a simple method of accessing the help information. You access the online help by pressing the **Help** key or function key **F1**. Depending on the position of your cursor, a different type of help will be provided. In general, the following types of information are supplied:

- What the display is used for

- How to use the display
- How to use the command line if there is one
- How to use the entry fields and parameter line if any
- What function keys are active and what they do

If the displayed help is not enough, pressing function key **F2** presents you with an extended help function, as shown in the following screen.

```

Help                                     Volume - HELP

Specify the file to be created.

Specify the name of the file and the library where the file is to be
located.

Library

The possible values for library are:

*CURLIB
    The file will be created in the current library.

*LIBL
    The library list is used to locate the file. If the file exists
    and delete was specified, the file will be deleted. The file
    will be recreated in the current library.

Name

More...
F2=Extended help  F3=Exit help  F10=Move to top  F11=InfoSeeker
F12=Cancel        F13=Information Assistant  F14=Print help

```

1.2 Data organization on an AS/400 system

As discussed previously in 1.1.1.2, all the data on an AS/400 system is organized using an object-based approach. The following sections discuss in more detail these topics:

- Base data objects on an AS/400 system
- AS/400 built-in database support
- AS/400 Integrated File System (IFS)

1.2.1 Base data objects on an AS/400 system

On the AS/400 system, everything that can be stored or retrieved is stored in an object. There are many different object types, such as libraries, files, executable programs, queues, user profiles, and others. Each object has some common attributes, such as a name, type, size, description, date created, and owner. The object-oriented concept allows the system to perform certain standard operations, such as authorization management on all object types, in the same way. Also, as already outlined, it protects AS/400 information against accidental corruption, because only operations connected with the determined object type are allowed.

To organize AS/400 objects further, all objects are contained in a *library*. A library is an OS/400 object of type *LIBRARY, that is used to group other objects

together. Libraries are organized at a single-level hierarchy, unlike the directory structures found in PCs or in the UNIX operating system, which have a multi-level hierarchy. This means that no library can contain another library object, with one exception, the QSYS system master library. This library contains all other libraries on the AS/400 system. Basically, there are three different types of libraries:

- QSYS - System master library
- System supplied libraries (all IBM-supplied library names start with *Q* or *#*)
- User defined libraries

To locate an AS/400 object, it is referenced by the library name and the object name (LIBRARY/OBJECT). You also need the object type to uniquely identify the object. Two or more objects can have the same name, but they must be different types. In other words, in a library, we can have a program named MAY and a data file (physical file) named MAY, but we cannot have two programs with the same name MAY. Also, an object can only exist in one library.

Among all these objects, there is an object of type *FILE, also called a *physical file*, that contains data in the form of a database, device data, or a group of related records that are handled as a unit. These objects are divided into two entities: the *data description*, used to describe the object, and the *data portion*, which contains the actual data stored on the system. A physical file is record-oriented, and data records can be grouped into *members* within a physical file.

A physical file may contain one or more members. These members are not objects themselves; rather, they are subsets of an object. This implies that all members of an object share the same basic characteristics with other members of the object, such as ownership and security. With a member, you can associate an attribute, which determines how AS/400 system programs treat this member.

1.2.2 AS/400 integrated database support

To deal with large amounts of data (for example, the information found in a telephone book) efficiently, it is necessary to organize the data in a uniform manner. In a computer, an organized collection of information is called a *database*. A database provides a tool and data structures used to organize, manage, and work with large quantities of similarly-structured information.

On an AS/400 system, the database is deeply imbedded in the system architecture. The operating system, OS/400, works together with the SLIC layer to provide a *built-in* database. The fact that the AS/400 database, called DB/2 for AS/400, is designed into the basic functions of the AS/400 system sets it apart from most other computing systems. Other computers need to have separate application packages to handle databases.

There are various ways to organize the information in a database, depending on how you intend to use this information. The AS/400 database is implemented as a *relational database*. Each piece of information in a relational database is related to others using a tabular structure. Within the structure, information is organized in *records* and *fields*, exactly as it is in a telephone book. For example, in a telephone book, all information related to one person — name, address, telephone number — is analogous to a record. Also, all information exclusively

related to names, telephone numbers, or addresses is analogous to a field. Figure 6 shows the structure of an AS/400 relational database.

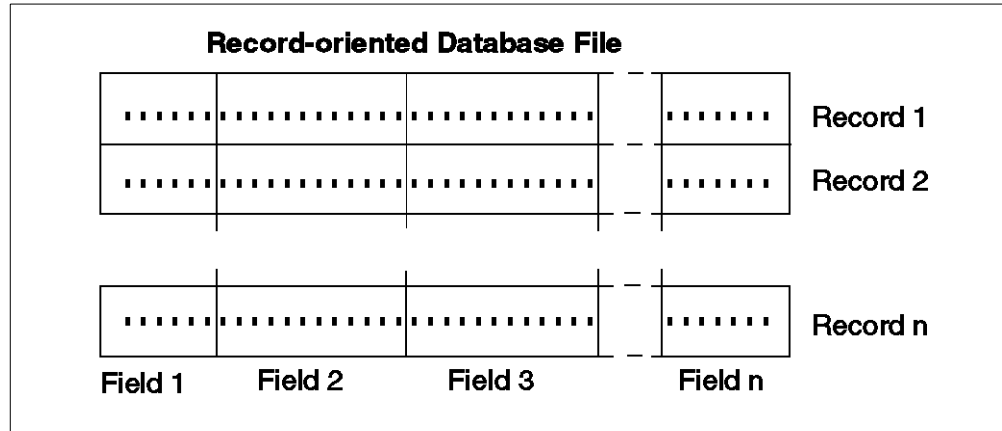


Figure 6. AS/400 relational database structure

Because the AS/400 database is deeply integrated into the architecture of the system, it is also used to store all the system data.

1.2.3 The integrated file system

The *integrated file system* is a part of an OS/400 program, beginning with Version 3 Release 1, that incorporates all types of information stored on AS/400 systems. This information includes libraries, documents, and folders (file systems that have previously existed on AS/400 systems), new file systems similar to those found on PC and UNIX operating systems, as well as the support of stream files and more.

The integrated file system integrates all this differently-stored data by providing one interface and one method of access to it. To the end user, it appears as one set of user interfaces (command, menus, displays) and application program interfaces, which can interact with objects in any file system that can be accessed through directory structures. (See Figure 7 on page 16).

The key features of the integrated file system are:

- Support for storing information in stream files that can contain long continuous strings of data. These strings of data might be, for example, the text of a document or the picture elements in a picture. The stream file support is designed for efficient use in client/server applications.
- A hierarchical directory structure that allows objects to be organized like leaves on the branches of a tree. Specifying the path through the directories to an object accesses the object.
- A common interface that allows users and applications to access not only the stream files, but also database files, documents, and other objects that are stored in the AS/400 system.
- A common view of stream files that are stored locally on the AS/400 system. Stream files can also be stored remotely on a Local Area Network (LAN) server, a Novell NetWare server, another remote AS/400 server, or a Network File System server as shown in Figure 7.

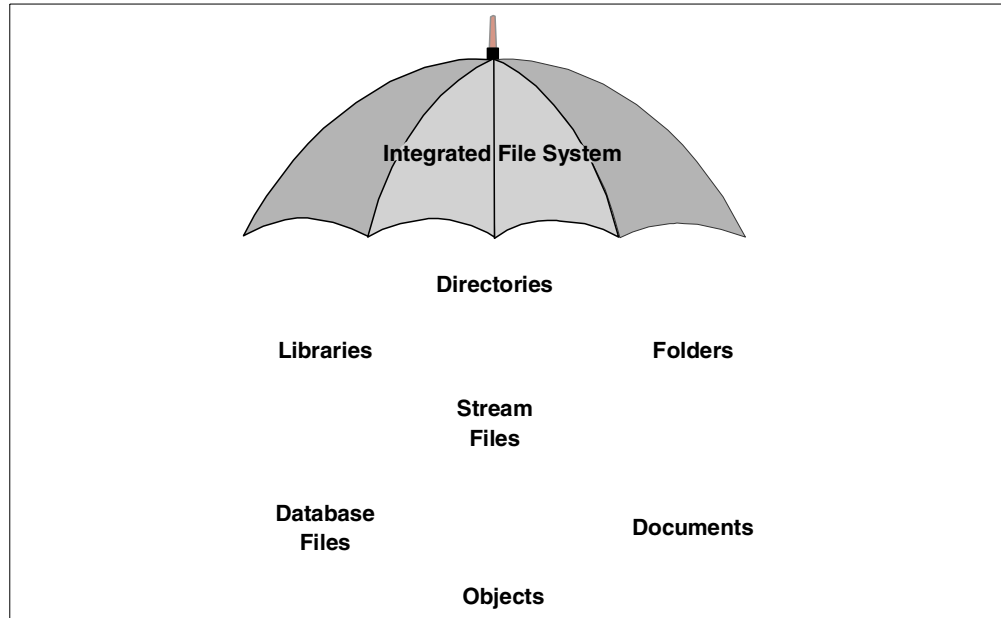


Figure 7. AS/400 integrated file system

1.2.3.1 Advantages of the integrated file system

The integrated file system enhances the already extensive data management capabilities of OS/400 with additional capabilities to better support emerging future forms of information processing, such as client/server, open systems, and multimedia. Some of the benefits provided by the integrated file system are:

- Provides fast access to OS/400 data, especially for applications such as Client Access, that use the OS/400 file server.
- Allows more efficient handling of the increasingly important types of stream data, such as images, audio, and video.
- Provides a file system and directory base for supporting UNIX-based open system standards, such as POSIX and XPG. This file and directory structure also provides a familiar environment for users of PC operating systems, such as Disk Operating System (DOS), IBM Operating System/2 (OS/2), and Windows 95.
- Allows file support with unique capabilities, such as record-oriented database files, UNIX-based stream files, and file serving, to be handled as separate file systems while allowing them all to be managed through a common interface.

1.2.3.2 Supported file systems on an AS/400 system

In general, a file system provides the support that allows users and applications to access specific segments of storage that are organized as logical units. These logical units are files, directories, libraries, and objects.

Each file system has a set of logical structures and rules for interacting with information in storage. These structures and rules may be different from one file system to another. In fact, from the perspective of structures and rules, the OS/400 support for accessing database files and various other object types through libraries can be thought of as a file system. Similarly, the OS/400 support

for accessing documents (that are really stream files) through the folders structure may be thought of as a separate file system.

The integrated file system does, indeed, treat the library support and folder support as separate file systems, as shown in Figure 8 on page 18. Other types of file management support that have differing capabilities are also treated as separate file systems. These file systems are:

- "root":** This is the / file system. This file system takes full advantage of the stream file support and hierarchical directory structure of the integrated file system. The root file system has the characteristics of the Disk Operating System (DOS) and OS/2 file systems.
- QOpenSys:** This is the open systems file system. This file system is compatible with UNIX-based open system standards, such as POSIX and XPG. Like the root file system, this file system takes advantage of the stream file and directory support that is provided by the integrated file system. In addition, it supports case-sensitive object names.
- QSYS.LIB:** This is the library file system. This file system supports the AS/400 library structure. This file system provides access to database files and all of the other AS/400 object types that the library support manages.
- QDLS:** This is the document library services file system. This file system supports the folders structure. It provides access to documents and folders.
- QLANSrv:** This is the OS/2 Warp Server for AS/400 file system. This file system provides access to the same directories and files that are accessible through the OS/2 Warp Server for AS/400 licensed program. It allows users of the OS/400 file server and AS/400 applications to use the same data as OS/2 Warp Server for AS/400 clients.
- QOPT:** This is the QOPT file system. This file system provides access to stream data that is stored on optical media.
- QFileSvr.400:** This is the QFileSvr.400 file system. This file system provides access to other file systems that reside on remote AS/400 systems.
- UDFS:** This is the user-defined file system. This file system resides on the Auxiliary Storage Pool (ASP) of the user's choice. The user creates and manages this file system.
- NFS:** This is the Network File System. This file system provides the user with access to data and objects that are stored on a remote NFS server. An NFS server can export a network file system that NFS clients will then mount dynamically.
- QNetWare:** This is the QNetWare file system. This file system provides access to local or remote data and objects that are stored on a server that runs Novell NetWare 3.12 or 4.10. A user can dynamically mount NetWare file systems over existing local file systems.

QNTC:

This is the Windows NT Server file system. This file system provides access to data and objects that are stored on a server running Windows NT 4.0 or higher. It allows AS/400 applications to use the same data as Windows NT clients. This includes access to the data on a Windows NT Server that is running on an Integrated PC Server. See *OS/400 - AS/400 Integration with Windows NT Server*, SC41-5439, for details.

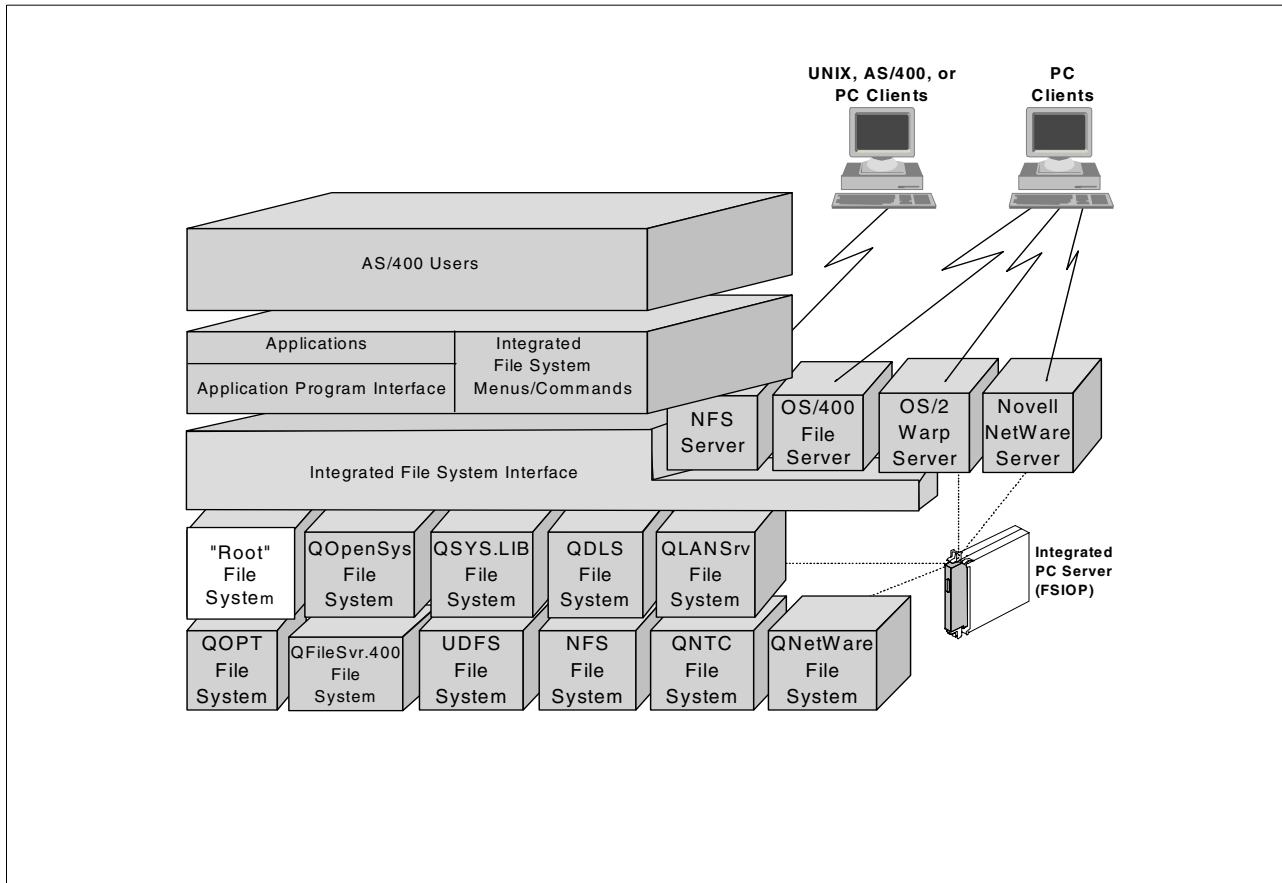


Figure 8. File systems on an AS/400 system

For more detailed information about the Integrated File System, refer to the book *AS/400e Series Integrated File System Introduction*, SC41-5711.

1.3 AS/400 device concept

The Input/Output (I/O) devices, such as disks, workstations, and tape drives, are attached to an AS/400 system through an I/O processor residing on an adapter card and I/O bus as shown in Figure 2 on page 5. The I/O processor is responsible for managing the attached devices. This means that all the I/O data to and from an internal device is buffered on an AS/400 system. The I/O processor deals with blocks of data completely independently of the main processor. Only certain I/O signals, such as function keys, enter, or system signals, send an interrupt to the CPU.

A device can be attached directly to an I/O adapter card; or it may be attached to an external controller, which, in turn, is attached to an adapter card. The controller may be able to attach many devices.

The OS/400 object used to describe a device is called a device description (DEVD) and the OS/400 object used to describe a controller is called controller description (CTLD).

Rather than only being locally attached to the system, devices and controllers can be remotely attached to the system. While configuring devices with OS/400, you are not required to install separate device drivers for different devices as you do in PC and UNIX environments. With OS/400, this support is integrated into the operating system. OS/400 does the automatic configuration of the locally attached devices and is controlled by system value QAUTOCFG. See 4.2.5, “Verifying system values” on page 76 for more information about this system value.

The device availability to users or applications is controlled by varying the device on or off. When you VARY ON the device, it becomes available, and VARY OFF makes it unavailable.

Commonly used devices for backup and restore purposes are automated tape libraries within the AS/400 environment called Media Library Devices (MLB's). The Library Resource Manager (LRM), an OS/400 function, is used to manage save or restore operations directed to or from tape libraries. The LRM receives tape requests from applications, queues them in the *media library resource queue*, prioritizes them, and then assigns them to a tape drive as soon as MLB tape resources become available. This means that, when there are one or two tape drives in an MLB, all the nightly saves could be requested at the end of the day, and the LRM would hold the requests until a tape device becomes available.

The LRM also asks the MLB to run a *media inventory* of tapes currently in the tape library to get information about them, such as their density and volume labels.

Beginning with OS/400 V4R3, the command, WRKMLBRSCQ, has been added to display requests that are awaiting drive assignments and allow adjustment of parameters. For example, if a daily backup job normally runs at priority 50 but needs to be rushed on a certain day, the MLB job attributes can be adjusted while the tape operation is still in the queue. Figure 9 shows a media library resource queue for an automated tape library named TAPMLB06.

Work with MLB Resource Queue					
Library Device: TAPMLB06					
Type options, press Enter.					
2=Change Request MLB Attributes 5=Work with job					
Opt	User	Priority	Wait Time	Media	Resource
---	JONES	35	*NOMAX	003347	TAP01
---	SMITH	8	*NOMAX	004129	TAP03
---	*SYSTEM	19	5	004697	
---	QSYSOPR	20	600	004115	
---	DOUGLAS	29	18	003987	

Figure 9. Work with media library resource queue

1.4 AS/400 data management concepts and tools

The AS/400 system provides comprehensive concepts and procedures to manage and protect data stored on an AS/400 system. The following section provides a short introduction to backup and recovery planning using local tools and procedures.

With the application Backup, Recovery, and Media Service/400 (BRMS/400), IBM introduced a complete solution for backup, recovery, data, and media management, as well as hierarchical storage management for AS/400 systems. In the final part of this section, you will find an introduction to BRMS/400 architecture, functionality, and operation.

1.4.1 Backup and recovery planning using AS/400 procedures

Depending on the computing environment or business requirements, you will find different approaches and procedures planning backup and recovery. This section will discuss parameters that can influence the strategy for backup and disaster recovery within the AS/400 systems environment and give an overview of established procedures.

1.4.1.1 Backup

Planning for a backup depends on a number of factors, such as the hardware used (tape drives, disk space), how often data is changing on your system, the amount of data to be backed up, the duration you need, and the time window that business processes allow for backup operations. Another important factor is the time you have for the restore.

The AS/400 system provides a set of backup methods that can accommodate all these requirements. Before you use these backup methods, you may want to consider differentiating your data into *static data* (data that is not changing frequently) and *dynamic data* (data that is changing frequently). Static data can be saved weekly or monthly. In contrast, dynamic data should be saved every day.

Now, depending on the amount of data to back up, you may decide to save all data at the end of day, which means doing a so-called *full backup*, or, to save data that has changed since the last backup, run an *incremental backup*. However, a full backup is still required to consolidate all the incrementals on a small number of tapes. Usually, you would do this during the weekend.

Choosing one procedure or another will influence the way you need to restore data, when needed. For example, saving all your data daily will only require the tapes from your last backup to recover. If you save only changed objects every day of the week, and a full backup during the weekend causes more restore operations, first restore data from the weekend backup tape, then restore data from Monday's backup, then Tuesday's, and so on, to the last backup containing changed objects.

Other parameters that influence backup times are:

- Whether you save data directly to magnetic tapes; to a savefile, which is an object on disk; or to optical disks
- Whether you save objects while they are in use, which can be done with the save-while-active function
- Whether you run concurrent backups to different tape drives, which can significantly reduce backup time
- Whether you use data compression, data compaction, or the optimal block size, a parameter that speeds up saves to tape drives supporting this function
- Whether you run incremental backups using the SAVCHGOBJ command, which saves changed objects; or full backups that save all selected objects, whether they have changed since the last backup or not

There is no dependency between each backup version of a file and the file itself. Each version of the file can be considered as a separate entity of the same file.

1.4.1.2 Disaster recovery

A disaster recovery of an AS/400 system is only made possible by using your backup tapes. OS/400 provides no reports or lists of tapes containing the most recent backups to help you to recover your system. You must manually manage your tape inventory to know what tapes are needed.

Option 21 from the SAVE menu allows you to save the entire system. This option saves in sequence:

- Licensed Internal Code
- System library (QSYS)
- Security objects, including user profiles
- Device configuration objects
- All IBM-supplied libraries, including those containing user data
- All user libraries
- All mail
- All folders
- All documents
- All objects in directories

Option 21 changes the system mode to *restricted mode* to ensure that no other operation running on the system will prevent the backup from completing. At the end of the backup, the system is restarted in operational mode.

Additional information about the implementation of a system recovery strategy can be found in the book *The System Administrator's Companion to AS/400 Availability and Recovery*, SG24-2161.

1.4.2 Native save/restore commands

The AS/400 system provides its own set of commands to back up objects from disk to tape or to a savefile, or to restore objects to disk. All commands have default values, which you can easily override.

Backup operations

Save commands always have the same prefix: SAV. There is one command for each type of object or group of objects. These commands can be run from a command line or by using the SAVE menu.

The following screen shows an example of saving a library named QUSRADSM to a tape drive named TAP02.

```
====> SAVLIB LIB(QUSRADSM) DEV(TAP02)
```

Restore operations

Restore commands also use the same structure: they begin with the RST prefix. The following screen shows an example of restoring an object named DB01, which was in the QUSRADSM library at the time of the save, from a tape drive named TAP03.

```
====> RSTOBJ OBJ(DB01) SAVLIB(QUSRADSM) DEV(TAP03)
```

You can find detailed information on all save and restore commands in the book *OS/400 Backup and Recovery V4R4*, SC41-5304.

1.4.3 Backup, Recovery, and Media services/400

BRMS/400 is the IBM strategic storage management product for AS/400 systems and servers supporting backup and recovery, data migration, and media management operations. This section presents an overview of BRMS/400, its functionality, architecture, and BRMS/400 operation.

1.4.3.1 BRMS/400 functionality

BRMS/400 is an application program that allows you to plan, control, and automate backup, recovery, and media management services for your AS/400 system. It allows you to define policies for backup, recovery, archival, retrieve, hierarchical storage management (HSM), and media to tailor backup recovery and media movement planning that meets your business requirements.

Figure 10 presents an overview of the BRMS/400 functionality. Following this, is a more detailed description of the particular functions.

BRMS - Media Management

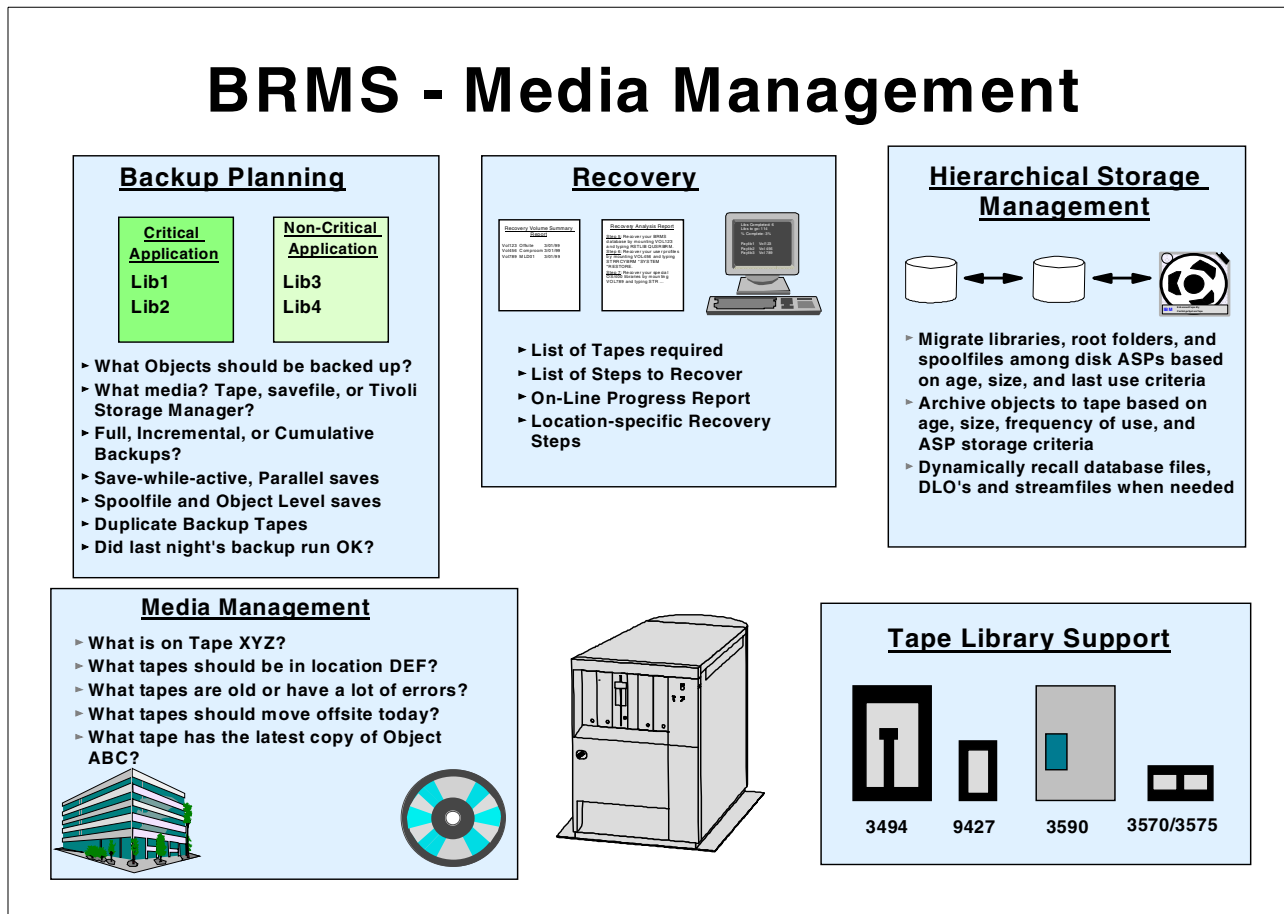


Figure 10. BRMS/400 overview

Backup

The BRMS service assists you in establishing a disciplined approach to designing and managing your backup operations. It helps you to define, process, monitor, and report your backup activities. BRMS offers a variety of options to tailor your backup, such as what to save, whether to use save-while-active, save retentions, full or incremental saves, access paths, and more. It automatically tracks what is saved and where it is located, and provides detailed reports about the success of save operations.

Recovery

The BRMS recovery service provides customized and detailed step-by-step instructions to perform a full system recovery. These reports not only contain restore instructions, but also indicate which tapes the system requires for recovery. For interactive restores, the user is allowed to select the required objects from a list of available backups and restore the object in an orderly fashion.

Media management

The BRMS media management service tracks all the movement of your tapes and the location of saved files. Media is tracked through the whole cycle from tape creation to expiration. The tracking process includes active use, storage

location, and return to scratch pool. This prevents media from being accidentally overwritten.

Tape library support

BRMS automates the use of a tape library by controlling the mounting, dismounting, and ejecting of tapes as required.

Hierarchical storage management/archival/auto-recall

HSM/Archive helps to ensure that you are using your storage space in an economical fashion by moving less-frequently used objects to less costly media. This is done using a migration process to move objects from faster disks to disks in a user ASP or by archiving objects from disk to tape.

BRMS Archival gives you the option to archive data based on your archival selection criteria, which can be the number of days since last use, the minimum object size, the minimum ASP filling percentage, or, beginning with V4R4, the average number of days used per month.

The Auto-recall function is enabled when you archive objects with the option *objects able to be freed*. Then, data is archived, but the descriptions of the archived objects still remain on the system. The object, when touched by a user or an application, is automatically recalled.

The recall can also be done interactively in a batch job, or it can be scheduled. At the time of writing this redbook, auto-recall is possible only for the following object types: *FILE, DLO, bytestream files.

1.4.3.2 BRMS/400 architecture and entities

BRMS/400 offers a set of entities that allow you to define policies for backup, archive, retrieve, and media management; and to tailor a backup, recovery, and media strategy that precisely meets your business requirements. One key building block is the media inventory, which contains all information about media used by BRMS, such as location, contents, policies, and much more.

BRMS/400 can be implemented on a single AS/400 or multiple AS/400 systems that are networked together. By grouping multiple AS/400 systems in a BRMS/400 network group, you are able to share BRMS/400 policies and media information, across the network. Physically, this will be done by exchanging updates on the media inventory among all the systems participating in a BRMS network group. For example, when a system adds a new scratch volume to its inventory, this information will be propagated to all other systems so that they can also access this volume.

Among multiple AS/400 systems that use BRMS/400 and that are connected to the same network, BRMS/400 also allows easy restoration of data on one system using a tape containing data from another system in the network.

Figure 11 shows the key BRMS entities, which are used to implement backup and recovery procedures within BRMS/400. The main procedures are covered in the following sections.

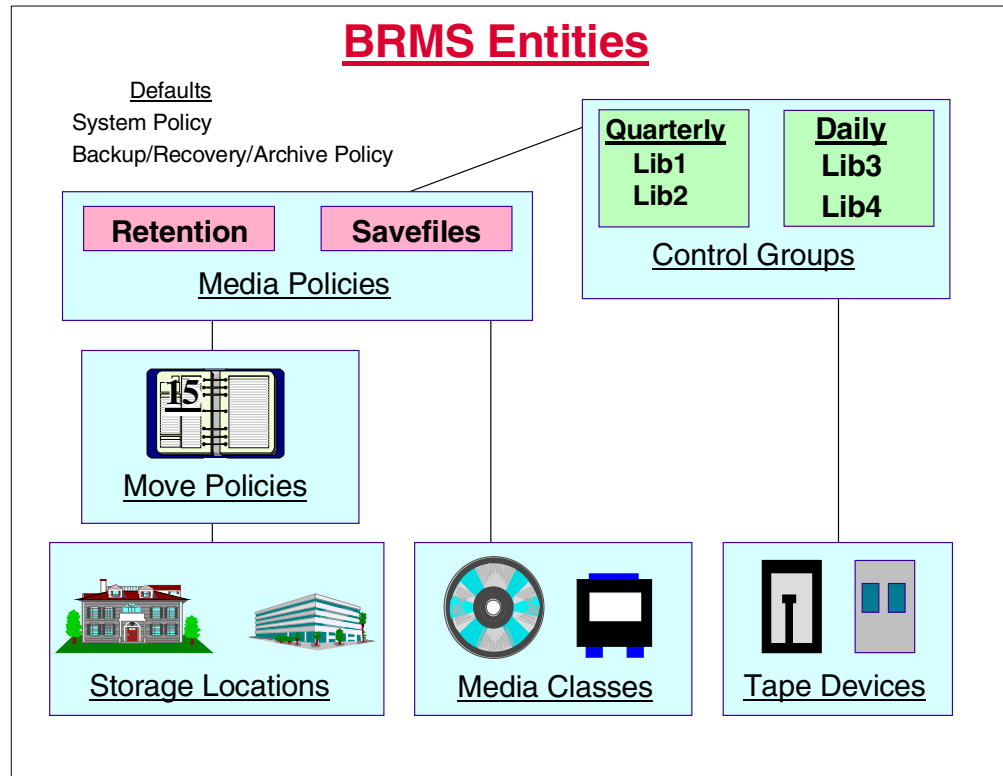


Figure 11. BRMS/400 entities

Control groups

Control groups are used to group together objects having the same requirements for backup, recovery, archive, retrieve, or migration. These requirements can be the media type used, the tape drive to which the backup is directed, the frequency the control group will execute, the number of days to keep the data active, whether several subsystems must be ended or job queues held, whether interactive users must sign off the system, or whether a system power-down is done after the control group has run.

Media policies — destination of the saves

BRMS/400 allows backup or data archival to save files to disk, tape device, or automated tape library directly attached to your AS/400 system. When used in conjunction with automated tape libraries, BRMS/400 automatically selects scratch tapes, mounts and dismounts tapes from the drive, and ejects them after the operation.

Devices and media classes

BRMS/400 device descriptions are created based on devices connected to the AS/400 system. For each different tape device, BRMS creates one or more *media classes* for tapes based on the tape device description. For example, a tape library D/T3570 model C will create two format classes: *FMT3570 for tape model B (*blue* tapes) and *FMT3570E for tape model C (*green* tapes).

Device pooling happens when several AS/400 systems share a single tape drive or set of tape drives. The intent is not to specify a particular device by name, but rather, to let BRMS pick any eligible device from a pool of devices that supports the density you are reading or writing. This permits several AS/400 machines to

access the pool at the same time for any eligible device. In this way, you do not have to wait for a specific device to become free, or fail the operation due to a busy device. If you are using non-MLB devices, BRMS manages device pooling for you. If you are using a MLB on a RISC AS/400 system, then OS/400 manages the device pooling for you. If you are using a MLB on a CISC AS/400 system or a non-MLB device, then BRMS can manage the device pooling for you.

Move policy

A Move policy describes the rotation cycle for the tapes.

Storage location

A Storage location describes a place where you keep tapes, such as COMPROOM, MLB3494, OFFSITE, LEFT_DRAWER. It allows you to track the movement of media.

1.4.3.3 BRMS/400 operation

As indicated in the previous section, a control group describes each save or archive operation of BRMS/400. A control group combines the objects you want to save with policies that are provided by the system or that you have previously defined. You can interactively run an operation you have defined using a control group, or you can schedule using the job scheduler.

In general, defining all options within a control group will answer the following questions, and therefore will adapt the backup or archive operation to your actual business needs.

- How long do I want to keep this data active?

The active life of data on backup media starts at the time of the backup and ends when the data becomes expired. You specify this duration in a *media policy*.

- What kinds of tapes will I use to store the data?

Media classes contain characteristics of tapes, for example, the tape density. There is one media class for each tape density. This directly influences the operation of tape drives used by the control group.

- Where shall I store tapes containing active data?

After the backup has completed, tapes will usually be moved to a safe location outside the machine room. You define this location, which can be local or off-site, in a *move policy*, which is the itinerary of tapes during the active life of data. An itinerary of tapes starts from the machine room where the AS/400 system is located and ends in the same machine room. At this point, tapes have passed their active life; therefore, they are expired and available for new backup.

- Will I run a full, incremental, or cumulative incremental backup?

A *full backup* saves all objects whether or not they have changed since the last backup. An *incremental backup* only saves objects that changed since the last incremental backup. A *cumulative incremental backup* saves objects that have changed since the last full backup. If no full backup was done before, it is executed now. The kind of backup you plan to run is defined in the *control group* entries as well as the day you want to run this backup.

In summary, you create a backup control group by associating to it a media policy containing a retention period, a media class, and a move policy. These

associations are defined in the control group attributes. Figure 12 presents a synopsis of the relation of BRMS/400 functions.

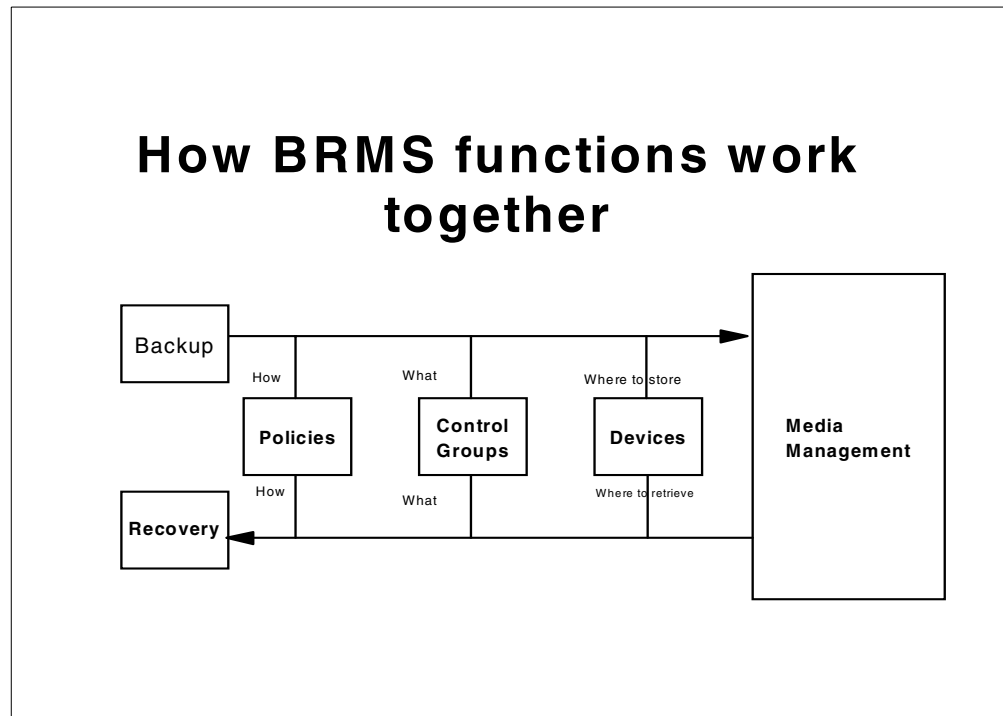


Figure 12. Putting it all together

For additional information about BRMS/400, refer to following books: *Backup, Recovery, and Media Services for AS/400*, SC41-5345, or *A Practical Approach to Managing Backup Recovery and Media Services for OS/400*, SG24-4840.

Chapter 2. Introduction to Tivoli Storage Manager

Tivoli Storage Manager is the core product of the Tivoli Storage Management product set. It provides a solution for distributed data and storage management in an enterprise network environment. Tivoli Storage Manager supports a wide variety of platforms for mobile, small and large systems, and delivers together with complementary products many data management functions, such as data protection for file and application data, record retention, space management, and disaster recovery.

This chapter gives a high-level technical introduction to Tivoli Storage Manager. It positions Tivoli Storage Manager within the Tivoli Storage Management solution, provides an overview of its architecture, the base concepts, the interfaces, and supported environments, and shows Tivoli Storage Manager's interaction with other products of the Tivoli Storage Management product set.

2.1 The Tivoli Storage Management solution

In today's connected world data has become the key asset of companies and one of its most important competitive differentiating factors. Temporary inaccessibility or the complete loss of data has a huge financial impact, and can drive companies out of business. The inability to manage data can have a negative impact on a company's profitability and limit their ability to grow. Storing, protecting, and managing the data growth has become one of the major challenges of today's businesses.

Based on this requirement, Tivoli defined its Information Integrity Initiative:

“The Tivoli Storage Management Initiative provides an end-to-end software management solution with proven methodologies to help costumers link storage management policies with key business practices, to enable them to use information to DRIVE business, rather than simply support it.”

Figure 13 shows the structure of the Tivoli Storage Management Solution and how it fits into the Tivoli Enterprise.

Tivoli Storage Management consists of four major solution components:

- Enterprise protection
- Application protection
- SAN management
- Workgroup protection

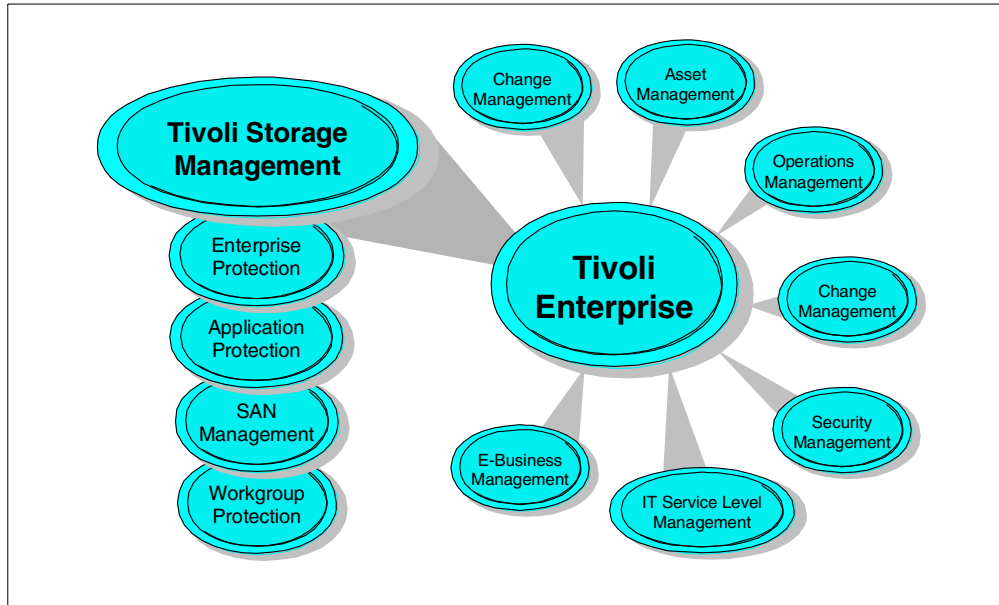


Figure 13. Tivoli Storage Management and Tivoli Enterprise

Enterprise protection implements an enterprise-wide solution for data protection, disaster recovery, space management, and record retention. It covers all types of heterogeneous system platforms starting from mobile systems up to large scale enterprise servers and supports all types of storage resources, locally attached as well as network or SAN attached storage. Flexible storage management policies are supporting business needs and powerful automation features by eliminating labor and cost intensive manual storage management tasks.

Strategic business applications are typically complex collections of interdependent components from both commercial and proprietary software, and they span desktop, distributed, and mainframe computing environments. Application protection is concerned with the data availability, performance and recoverability and integrates the application data management into enterprise data protection.

Storage Area Network (SAN) is a new architecture that puts storage on a separate dedicated network to allow businesses of all sizes to provide access to and share data, regardless of operating systems, as a significant step towards helping customers cope with the explosive growth of information in the e-business age. SAN management is concerned with the efficient management of the Fibre Channel based SAN environment. Physical connectivity mapping, switch zoning, performance monitoring, error monitoring, and predictive capacity planning are among the most important features.

Workgroup protection provides a reliable, easy to use, backup, recovery, and disaster recovery solution for stand-alone mobile, desktop and small server systems. It is targeted to small and medium businesses (under 800 nodes) and any enterprise with large numbers of remote, stand-alone servers.

Combined with Tivoli Enterprise, Tivoli Storage Management becomes an integrated management suite that transforms information technology into a strategic business resource.

2.2 Tivoli Storage Manager

Tivoli Storage Manager is the core product of the Tivoli Storage Management product set. It provides a solution for distributed data and storage management in an enterprise network environment. It is the next generation of the product originally released by IBM as ADSTM (ADSTAR Distributed Storage Manager). Tivoli Storage Manager protects and manages data on more than 30 operating platforms, covering mobile, desktop and server systems over the entire distributed world. It is integrated with hundreds of storage devices as well as LAN, WAN and emerging SAN infrastructures.

The base functions provided by Tivoli Storage Manager and its complementary products are:

- **Data Protection**, including:

Operational Backup and Restore of Data: The backup process creates a copy of the data to protect against the operational loss or destruction of file or application data. The customer defines how often to back up (frequency) and how many numbers of copies (versions) to hold.

The restore process places the backup copy of the data back into a customer-designated system or workstation.

Disaster Recovery: All activities to organize, manage and automate the recovery process from a major loss of IT infrastructure and data across the enterprise. This includes processes to move data off-site into a secure vault location, to rebuild IT infrastructure, and to reload data successfully in an acceptable time frame.

- **Storage Resource Management**, including:

Vital Record Retention, Archive and Retrieval: The archive process creates a copy of a file or a set of files representing an end point of a process for long term storage. Files can remain on the local storage media or can be deleted. The customer controls how long (retention period) an archive copy is to be retained.

The retrieval process locates the copies within the archival storage and places them back into a customer-designated system or workstation.

Hierarchical Space Management: This process provides the automatic and transparent movement of operational data from the user system disk space to a central storage repository. If the user accesses this data, it is dynamically and transparently restored to the client storage.

The solution is network based, which means that these functions are available to the whole network environment. All the functions can be automated to run in a 24X7 lights-out environment. Administration costs are minimized by centralization of all of the management of Tivoli Storage Manager components.

2.2.1 Tivoli Storage Manager architecture

Tivoli Storage Manager is implemented as a client server software application, consisting of a Tivoli Storage Manager server software component, Tivoli Storage Manager Backup/Archive client and other complementary Tivoli and vendor software products. Figure 14 shows the main components of Tivoli Storage Manager.

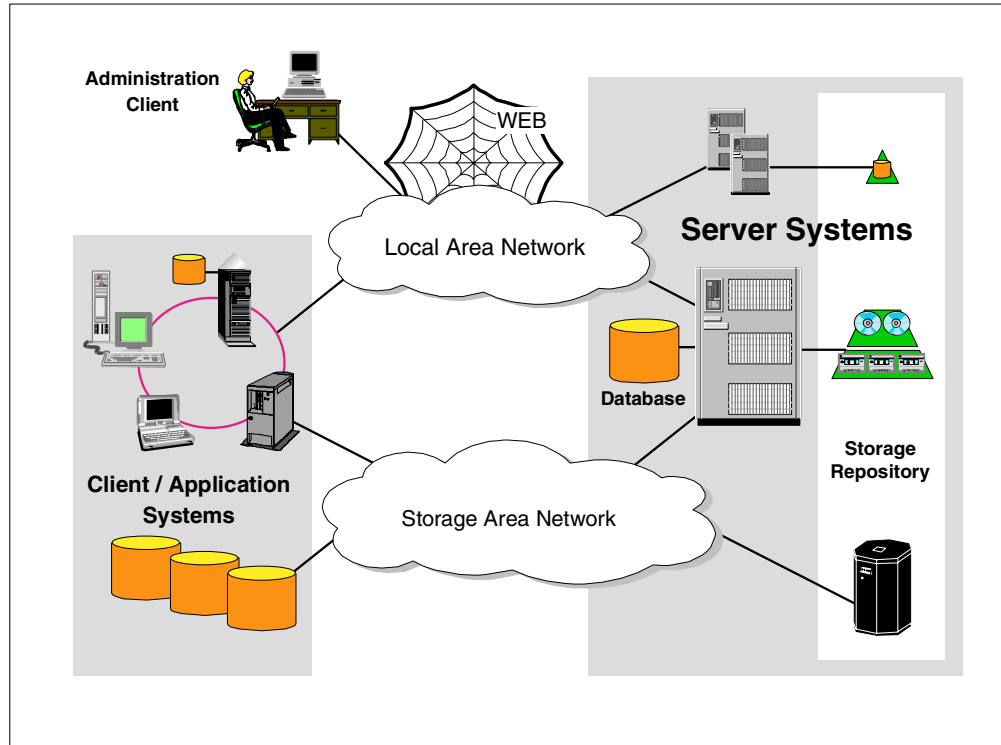


Figure 14. Tivoli Storage Manager architecture

The *Tivoli Storage Manager server software* builds the data management backbone by managing the storage hardware, providing a secure environment, providing automation, reporting and monitoring functions, and implementing the storage management policies and by storing all object inventory information in the *Tivoli Storage Manager database*. The *Tivoli Storage Manager client software* and complementary products implement data management functions like data backup and recovery, archival, hierarchical space management or disaster recovery.

The client software can run on different systems, including laptop computers, PCs, workstations, or server systems. The client and server software can also be installed on the same system for a local backup solution, or to implement LAN-free backup solutions exploiting SAN infrastructure. It is also possible to define server hierarchies or multiple peer-to-peer servers in order to provide a multi-layer storage management solution or an electronic vaulting solution.

2.2.1.1 Tivoli Storage Manager server

One of the principal architectural components of the Tivoli Storage Manager server software is its in-built relational database. The storage manager database was especially designed for the task of managing data, and it implements zero-touch administration. All policy information, logging, authentication and security, media management and object inventory is managed through this database. Most of the fields are externalized through Tivoli Storage Manager high level administration commands, SQL SELECT statements or for reporting purposes, by using an ODBC driver.

For storing the managed data, the Tivoli Storage Manager server uses the *storage repository*. The storage repository is designed from any combination of

disk, optical, tape or robotic storage devices, which are locally connected to the server system or which are accessible through a SAN. The server software provides built-in drivers for more than 300 different device types from every major manufacturer.

Within the storage repository the devices can operate stand-alone or can be linked together to form one or more storage hierarchies. The *storage hierarchy* is not limited in the number of levels and can also span over multiple servers using so-called *virtual volumes*. See 2.2.2.2, “Storage and device concepts” on page 42 for storage management function defined on the storage repository.

2.2.1.2 Tivoli Storage Manager backup/archive client

Data management functions are implemented using Tivoli Storage Manager client software and complementary Tivoli and non-Tivoli products, which work together with the Tivoli Storage Manager server backbone product.

The *Tivoli Storage Manager backup/archive client*, included with the server program provides the operational backup and archival function. The software implements the patented *progressive backup methodology* and unique record retention methods as described in 2.2.2.1, “Backup, and archival concepts” on page 40.

All version 3.7 and above backup/archive clients are implemented as multi-session clients, which means that they are able to exploit the multi-threading capabilities of modern operating systems. This enables the running of backup and archive operations in parallel to maximize the throughput to the server system. Full exploitation of multi-threading on the client also requires a Version 3.7 or higher Tivoli Storage Manager server.

Depending on the client platform the backup/archive client may provide a graphical, command line or Web user interface. (see Figure 15). Many platforms provide all three interfaces. The command line interface is useful for experienced users and allows generation of backup or restore scripts for scheduled execution. The graphical interface is designed for ease of use for the end user for ad hoc backups and restores. 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, for example in a help desk environment.

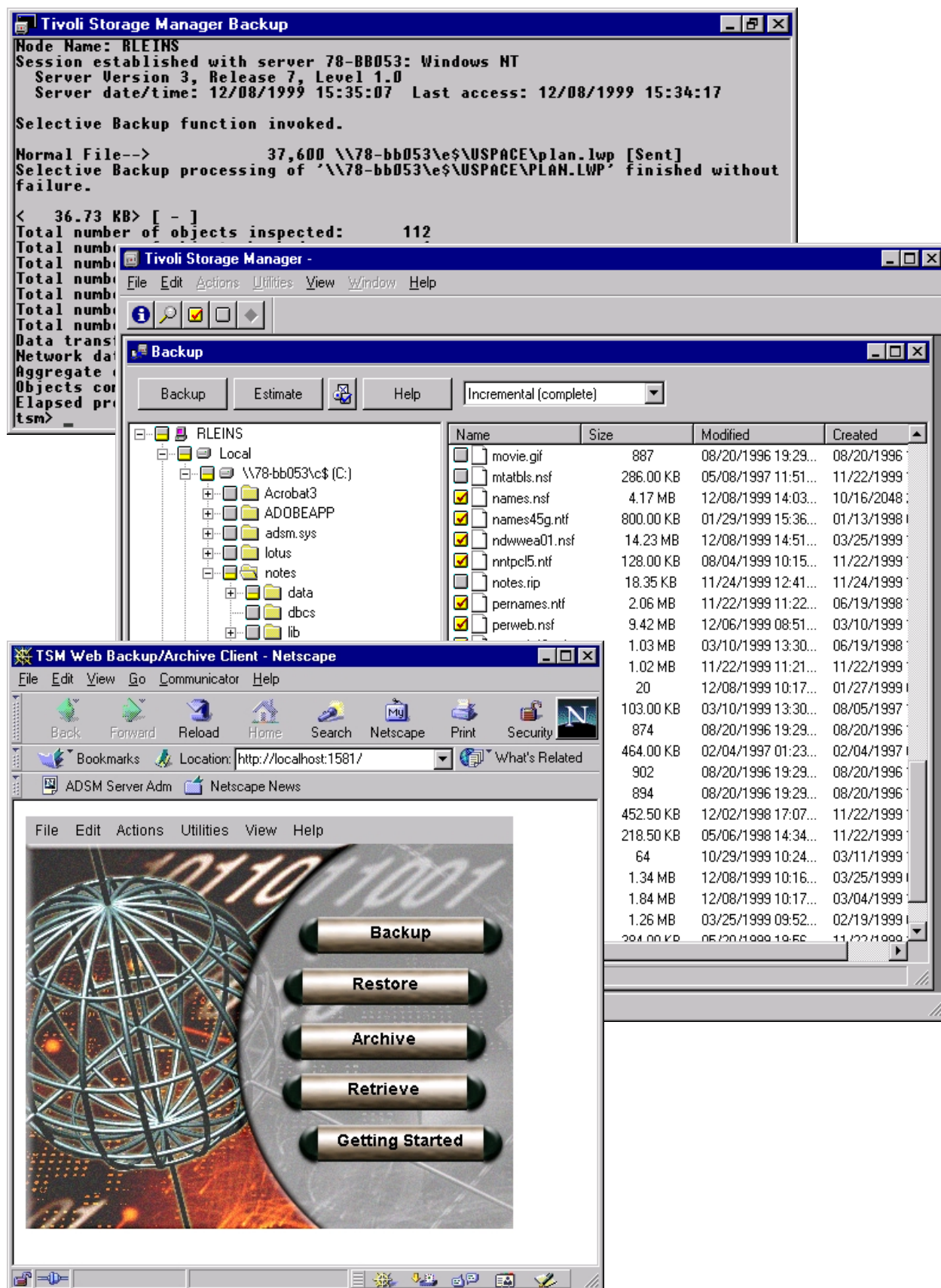


Figure 15. Backup/Archive client user interfaces

2.2.1.3 Tivoli Storage Manager Administrative interfaces

Tivoli Storage Manager also provides different types of interfaces for the administrator, as you can see in Figure 16.

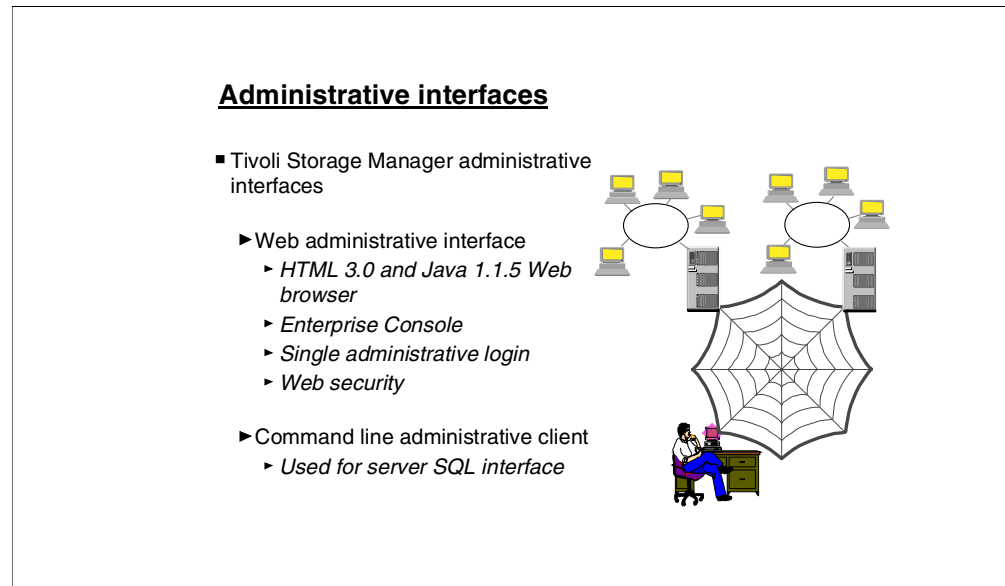


Figure 16. Administrative interface

Web administrative interface — The Tivoli Storage Manager administrator can control all functions and features across all platforms within the enterprise with a single interface. Using the browser interface (see Figure 17, which shows the interface for Tivoli Storage Manager/400 V3.1.2), any Tivoli Storage Manager server can be controlled from any workstation capable of running an HTML 3.0 and JAVA 1.1.5 or higher compliant Web Browser, such as Microsoft Internet Explorer 4.01 or Netscape 4.06.

The Web administrative interface provides a single administrative login capability. This allows administrators to log in once to Tivoli Storage Manager and then move from one server to any other suitably configured Tivoli Storage Manager server and/or client without having to re-enter administrator user IDs and passwords.

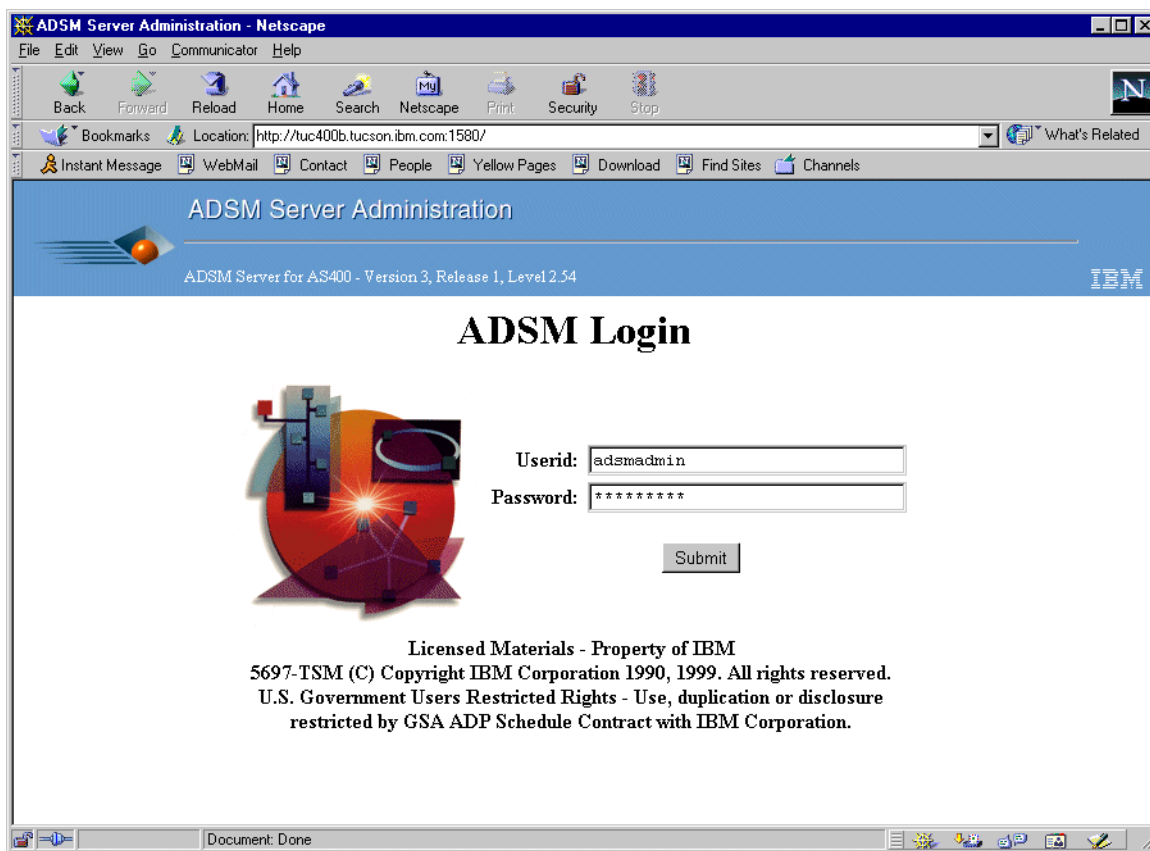


Figure 17. Tivoli Storage Manager/400 Web administrative interface

2.2.1.4 Tivoli Storage Manager administration

For the central administration of one or multiple Tivoli Storage Manager instances, and the entire data management environment, Tivoli Storage Manager provides command line or java-based administration interfaces, (see Figure 18, which shows the interfaces for a Tivoli Storage Manager V3.7 level server), also called *administration clients*.

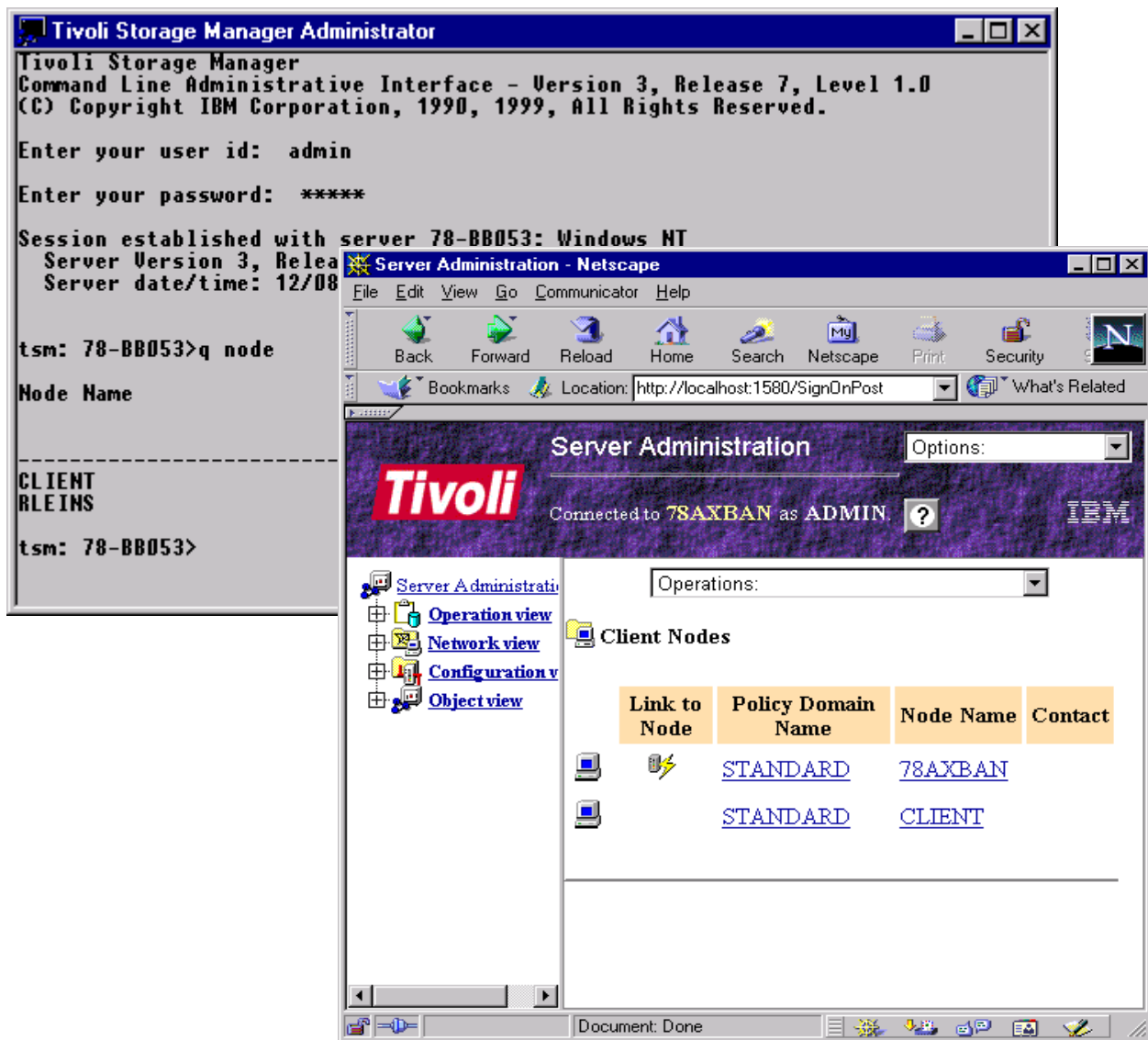


Figure 18. Tivoli Storage Manager administration interfaces

Using the unique *enterprise administration* feature it is possible to configure, monitor and manage all server and client instances from one administrative interface, known as the *enterprise console*. It includes:

- Enterprise configuration
- Administrative command routing
- Central event logging functions

Enterprise configuration allows server configurations to be defined centrally by an administrator and then propagated to other servers. This simplifies the configuration and management of multiple Tivoli Storage Manager servers in an enterprise significantly.

Administrative command routing allows administrators to issue commands from one server and route them to other target servers. The commands are executed

on the target servers, and the command output is returned and formatted on the server where the command was issued.

In an enterprise environment with multiple Tivoli Storage Manager servers, client and server events can be logged to a central management server through server-to-server communications, thereby enabling centralized event management and automation.

2.2.1.5 Tivoli Storage Manager externalized interfaces

Tivoli Storage Manager provides a data management *application programming interface* (API), which can be used to implement *application clients* to integrate popular business applications such as databases or groupware applications into the Tivoli Storage Management solution. The API is also published to allow customers or vendors to implement specialist clients for special data management needs or non-standard computing environments. In general, we distinguish between *Tivoli Data Protection for application* software products and the API exploitation through vendor applications.

Tivoli Data Protection for application clients are separate program products delivered by Tivoli to connect business applications to the Tivoli Storage Manager data management API. Such applications, for example, Oracle, Lotus Notes and Domino, Microsoft Exchange, and Microsoft SQL server, have their own storage management interfaces. For more information see 2.4, “Tivoli Data Protection for applications” on page 48.

On the other hand, many vendor applications also exploit the Tivoli Storage Manager data management API by integrating it directly into their software product to implement new data management functions, or to provide backup and archival functionality on additional system platforms. Some examples are IBM’s CommonStore for R/3 data archival, IBM’s BRMS/400 to provide an AS/400 backup solution, and SSSI’s ABC OpenVMS for data backup and recovery.

In addition to the externalized interfaces to the server database as described in 2.2.1.1, “Tivoli Storage Manager server” on page 32, Tivoli Storage Manager offers multiple interfaces for event logging, reporting and monitoring the data management environment. In general, activities of the Tivoli Storage Manager server and client are logged in the server database and can be sent for reporting and monitoring purposes to external *event receivers* using *event filter* mechanism. Potential event receivers are the Tivoli Enterprise framework, SNMP based systems management software packages, the NT event log, user written applications or others.

To integrate Tivoli Storage Manager storage management with external library management applications Tivoli Storage Manager offers an *external library manager interface*. Using this interface it is possible to integrate the Tivoli Storage Manager server into third-party storage management environments.

2.2.1.6 Tivoli Storage Manager supported environment

Tivoli Storage Manager server and client software is available on many different operating system platforms and can exploit different communication protocols. Figure 19 gives an overview of the supported environment.

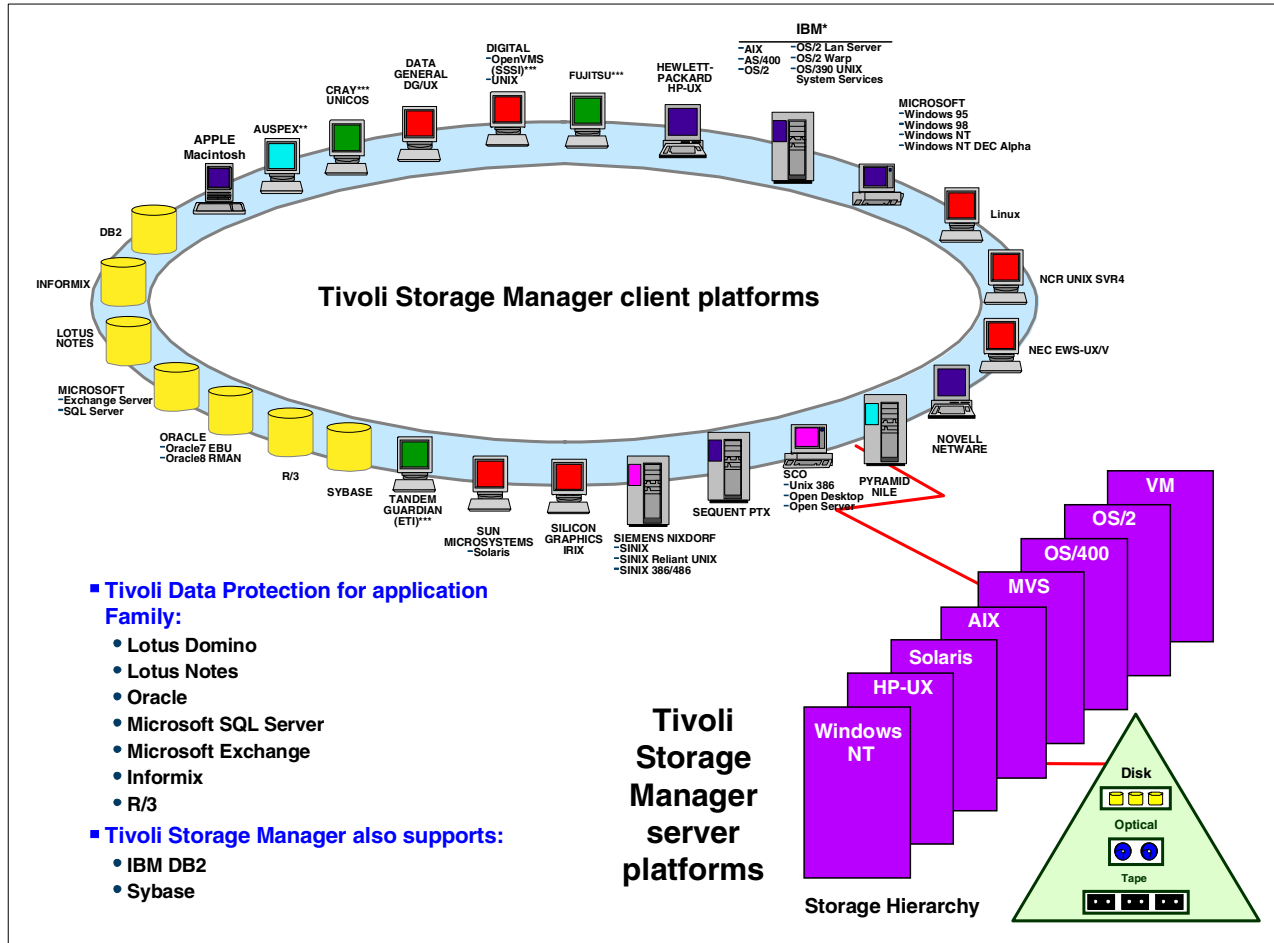


Figure 19. Tivoli Storage Manager supported environment

The Tivoli Storage Manager server software runs on eight different operating platforms plus the IBM Network Storage Manager (NSM). At this time, the software is available in the most recent Version 3.7 on the platforms as shown in Table 3, illustrating server platforms, operating system, and Tivoli Storage Manager version.

Table 3. Version 3 servers

Server platforms	Operating system level	Server version
AIX	4.3.1, 4.3.2, 4.3.3	3.7
HP-UX	10.20, 11.0	3.7
MVS/ESA OS/390	4, 5.1 or higher 1 or higher	3.7
Sun Solaris	2.6, 7	3.7
Windows NT	Workstation 4.0 (SP3/4) Server 4.0 (SP3/4)	3.7
OS/400	V4R3 or higher	3.1.2
VM/ESA	2.2,2.3,2.4	3.1

Server platforms	Operating system level	Server version
OS/2	WARP 4.0 or higher WARP Server 4.0	2.1

The following tables provide an overview of all available Version 3.7 clients at the time of publishing this book. Other operating system clients (available at pre-3.7 levels) may be updated in the future. Check the product information on the Tivoli Storage Manager home page for the latest complete client availability information:

http://www.tivoli.com/products/index/storage_mgr/

There are several variations of UNIX client. Table 4 details the UNIX clients and the operating system levels that are supported.

Table 4. Version 3.7 UNIX clients

Client Platforms	Operating System
AIX	4.3.1, 4.3.2, 4.3.3
HP-UX	11.0
Sun Solaris	2.6, 7

There are three different PC clients available. Table 5 details the PC systems and the operating systems that are supported as clients.

Table 5. Version 3.7 PC clients

PC Clients Platforms	Operating Systems
Novell NetWare	3.12, 3.20, 4.11, 4.20, 5.0
Microsoft Windows (Intel)	NT 4.0, Win 95, Win 98, Win 2000
Microsoft Windows (Alpha)	NT 4.0

2.2.2 Base concepts

This section gives a high level introduction to the base data and storage management paradigms used by Tivoli Storage Manager to implement its functionality. We will cover data protection or backup, record retention or archive, storage management, policy, and security.

2.2.2.1 Backup, and archival concepts

Backup, in Tivoli Storage Manager terms, means creating an additional copy of a data object to be used for recovery. A data object can be a file or a user defined data object like a database table. The backup version of this data object is stored separately in the Tivoli Storage Manager server storage repository. Potentially, you can make several backup versions of the data, each version at a different point-in-time. These versions are closely tied together and related to the original object as a group of backups.

If the original data object is corrupted or lost on the original client, *restore* is the process of sending a backup version of the data from the server back to the client. The most current version of the data is normally restored, but you can choose to restore from any of the existing backup versions. The number of backup versions is controlled by server definitions. Old backup versions may be

automatically deleted as new versions are created. You may also delete them after a certain period of time.

For file level based backup the main difference from many other backup applications is that Tivoli Storage Manager uses the *progressive backup methodology*. As shown in Figure 20, after the first necessarily full backup, Tivoli Storage Manager then operates with incremental backups only. In consequence, only those files that have changed since the last backup will be backed up.

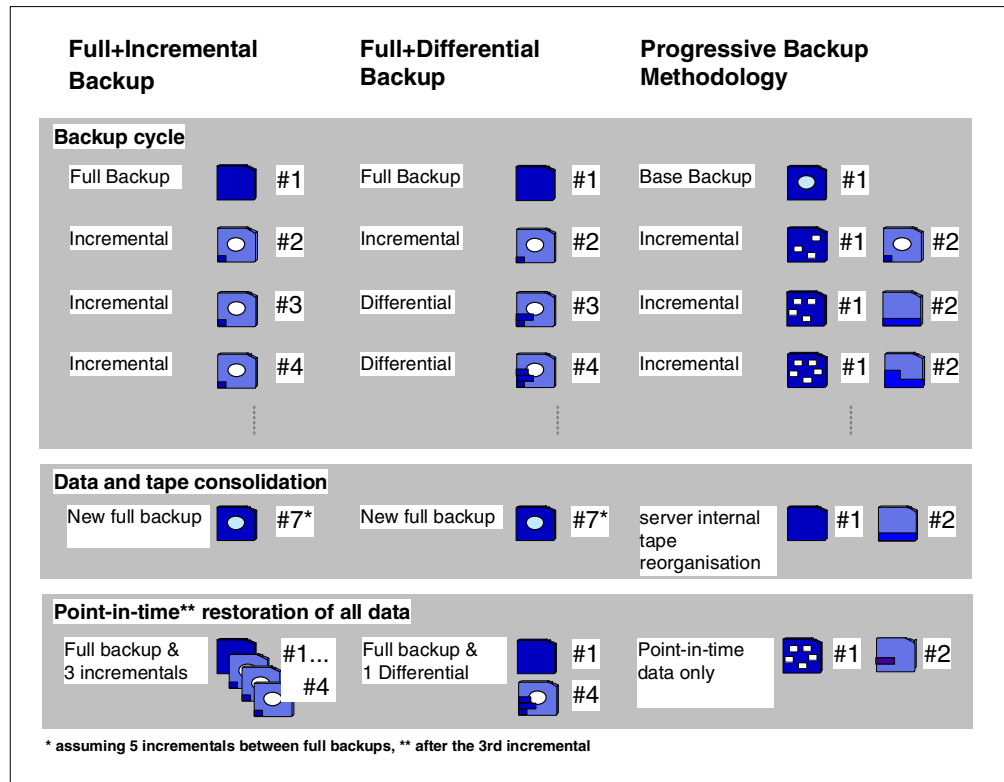


Figure 20. Progressive Backup Methodology vs. other backup schemes

The reorganization of the physical storage media to store each client's data physically together on a small number of media—in order to provide faster access in the case of a complete system recovery—is done transparently to the client, and is completely automated on the server using metadata information stored in the server database.

Tivoli Storage Manager's file level progressive backup methodology, in comparison with other methods like Full+Incremental or Full+Differential backup schemes, prevents unnecessary backups of unchanged data and reduces and consolidates the recovery tape-set. It offers also a more efficient use of storage resources by not storing redundant data and a faster recovery by not restoring multiple versions of the same file.

File *Archive* with Tivoli Storage Manager means creating a copy of a file as a separate object in the storage repository to be retained for a specific period of time. Typically you would use this function to create an additional copy of data to be saved for historical purposes. Vital records (data that must be kept for legal or other business reasons) are likely candidates for the archive process. You can

specify to delete the original copy of the data on the source system once the archive copy is created on the server. Therefore, you can use *archive* to make additional space available on the Tivoli Storage Manager client. However, *archive* should not be thought of as a complete space management function, because automatic recall is not available.

You can access archived data by using *retrieve* to return it to the Tivoli Storage Manager client, if the data is needed at some future time. To locate the archived data within the storage repository, Tivoli Storage Manager allows you to add a description to the data and to form archive packages of related files. You can then use this description to search the server database for matching packages, to determine which data to retrieve.

Therefore, the difference between backup and archive is that backup creates and controls multiple backup versions that are directly attached to the original file; whereas, archive creates an additional file that is normally kept for a specific period of time, as in the case of vital records.

2.2.2.2 Storage and device concepts

All Tivoli Storage Manager-managed client data are stored in the Tivoli Storage Manager storage repository, which can consist of different storage devices, such as disk, tape, or optical devices, and controlled by the Tivoli Storage Manager server. Tivoli Storage Manager uses its own model of storage to view, classify, and control these storage devices, and to implement its storage management functionality (see Figure 21).

The main difference between the storage management approach of Tivoli Storage Manager and other commonly used systems is that Tivoli Storage Manager storage management concentrates on managing *data objects* instead of managing and controlling backup tapes. Data objects can be files or directories that are backed up from the client systems; they can be objects like tables or records from database applications, or simply a block of data that a client system wants to store on the server storage.

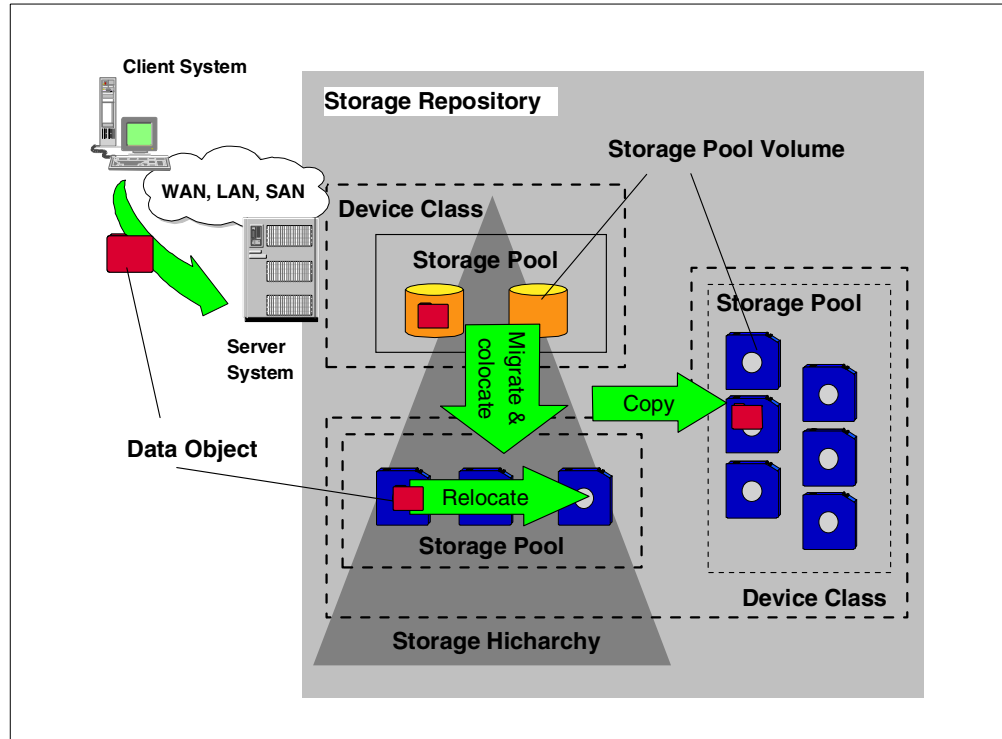


Figure 21. Tivoli Storage Manager storage management concepts

To store these data objects on storage devices and to implement storage management functions, Tivoli Storage Manager has defined some logical entities to classify the available storage resources. Most important is the logical entity called a *storage pool*. A storage pool describes a storage resource for one single type of media; for example, a disk partition or a set of tape cartridges. Storage pools are the place where data objects are stored.

A storage pool is built up from one or more *storage pool volumes*. For example, in the case of a tape storage pool, this would be a single physical tape cartridge. To describe how Tivoli Storage Manager can access those physical volumes to place the data objects on them, Tivoli Storage Manager has another logical entity called a *device class*. A device class is connected to a storage pool and specifies how volumes of this storage pool can be accessed.

Tivoli Storage Manager organizes storage pools in one or more hierarchical structures. This *storage hierarchy* can span over multiple server instances and is used to implement management functions to *migrate* data objects automatically—completely transparent to the client—from one storage hierarchy level to another; or in other words, from one storage device to another. This function may be used, for example, to cache backup data (for performance reasons) onto a Tivoli Storage Manager server disk space before moving the data to tape cartridges. The actual location of all data objects is automatically tracked within the server database.

Tivoli Storage Manager has implemented additional storage management functions for moving data objects from one storage volume to another. As discussed in the previous section, Tivoli Storage Manager uses the progressive backup methodology to backup files to the Tivoli Storage Manager storage

repository. The reorganization of the data and storage media for fast recovery happens completely within the server. For this purpose, Tivoli Storage Manager has implemented functions to *relocate* data objects from one volume to another and to *co-locate* data objects that belong together, either at the client system level or at the data group level.

Another important storage management function implemented within the Tivoli Storage Manager server is the ability to *copy* data objects asynchronously and to store them in different storage pools or on different storage devices, either locally at the server system or on another server system. It is especially important for disaster recovery reasons to have—in the event of losing any storage media or the whole storage repository—a second copy of data available somewhere in a secure place. This function is fully transparent to the client, and can be performed automatically within the Tivoli Storage Manager server.

2.2.2.3 Policy concepts

A data storage management environment consists of three basic types of resources: client systems, rules, and data. The client systems contain the data to be managed, and the rules specify how the management must occur; for example, in the case of backup, how many versions should be kept, where they should be stored, and so on.

Tivoli Storage Manager policies define the relationships between these three resources. Figure 22 illustrates this policy relationship. Depending on your actual needs for managing your enterprise data, these policies can be very simple or very complex.

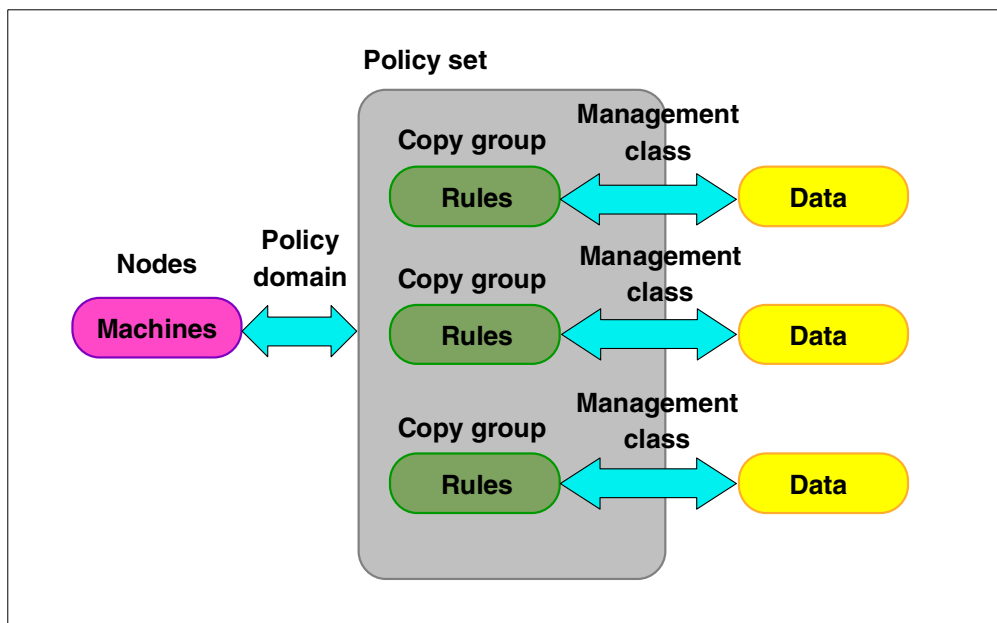


Figure 22. Policy relationships and resources

Tivoli Storage Manager has certain logical entities that group and organize the storage resources and define relationships between them. Client systems, or nodes in Tivoli Storage Manager terminology, are grouped together with other nodes with common storage management requirements, into a *policy domain*.

The policy domain links the nodes to a *policy set*, a collection of storage management rules for different storage management activities. A policy set consists of one or more *management classes*. A management class contains the rule descriptions called *copy groups*, and links these to the data objects to be managed. A copy group is the place where all the storage management parameters, such as number of stored copies, retention period, storage media, and so on, are defined. When the data is linked to particular rules, it is said to be bound to the management class that contains those rules.

Another way to look at the components that make up a policy is to consider them in the hierarchical fashion in which they are defined. That is to say, consider the policy domain containing the policy set, the policy set containing the management classes, and the management classes containing the copy groups and the storage management parameters.

2.2.2.4 Security concepts

Because the storage repository of Tivoli Storage Manager is the place where all the data of an enterprise are stored and managed, security is a very vital aspect for Tivoli Storage Manager. To ensure that data can only be accessed from the owning client or an authorized party, Tivoli Storage Manager implements, for authentication purposes, a *mutual suspicion algorithm*, which is similar to the methods used by Kerberos authentication.

Whenever a client (backup/archive or administrative) wants to communicate with the server, an authentication has to take place. This authentication contains *both-sides* verification, which means that the client has to authenticate itself to the server, and the server has to authenticate itself to the client.

To do this, all clients have a password, which is stored at the server side as well as at the client side. In the authentication dialog these passwords are used to encrypt the communication. The passwords are not sent over the network, to prevent hackers from intercepting them. A communication session will be established only if both sides are able to decrypt the dialog. If the communication has ended, or if a timeout period without activity is passed, the session will be automatically terminated and a new authentication will be necessary.

2.3 Tivoli Storage Manager complementary products

Tivoli Storage Manager complementary products use the Tivoli Storage Manager server software package as a backbone product to implement additional data and storage management functions. The following section introduces Tivoli Space Manager for hierarchical space management, Tivoli Disaster Recovery Manager as an enterprise-wide solution for disaster recovery and Tivoli Decision Support for Storage Management Analysis for a comprehensive reporting and monitoring solution to plan the growth and collect vital management information for an efficient enterprise data management deployment.

2.3.1 Tivoli Space Manager

Tivoli Space Manager uses the framework services of Tivoli Storage Manager in combination with the industry standard *Data Management Application Programming Interface (DMAPI)* to deliver a fully integrated solution for open systems *Hierarchical Space Management (HSM)*. Tivoli Space Manager provides

an HSM client, which interfaces with DMAPI and implements the functionality outlined in Figure 23.

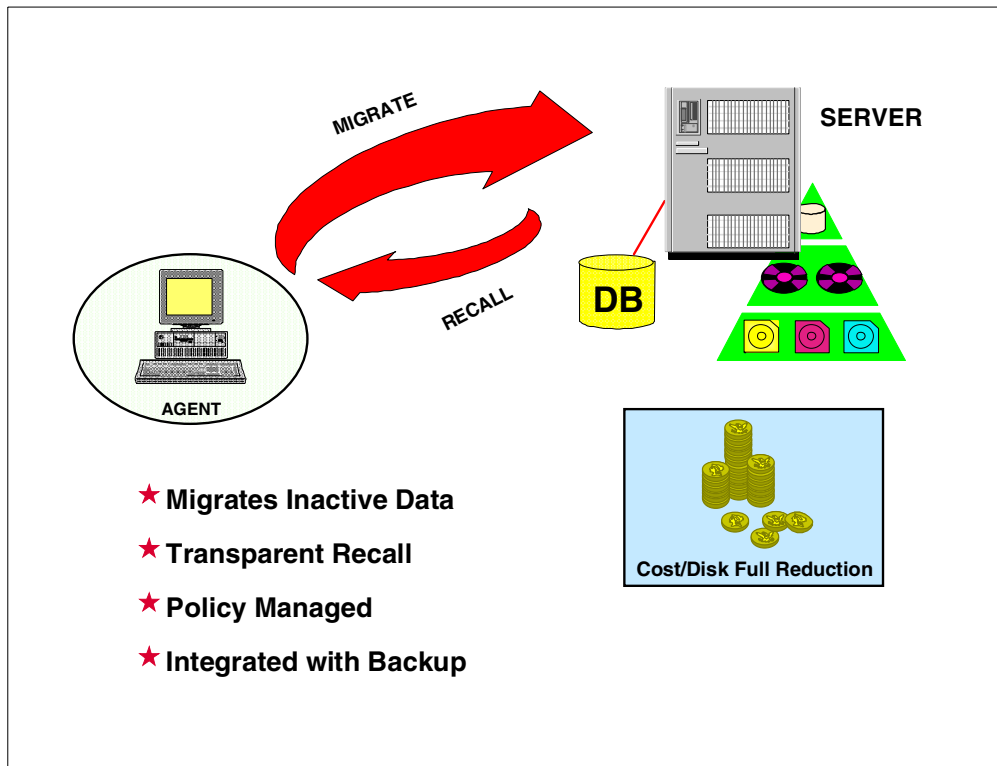


Figure 23. Hierarchical storage management

Tivoli Space Manager maximizes usage of existing storage resources by transparently migrating data from client hard drives to the Tivoli Storage Manager storage repository based on size and age criteria. When the migrated data is accessed, Tivoli Space Manager transparently recalls it back onto the local disk.

The migration of files and the management of migrated files is controlled by policies. However, user controlled migration and recall is also possible.

Tivoli Space Manager's HSM function is fully integrated with Tivoli Storage Manager operational backup. It is possible to specify not to migrate a file until it has a backup version in the server storage repository. If a file is migrated and then a backup is done the next day, Tivoli Storage Manager copies the file from the space migration pool to the backup pool, instead of requiring a recall to the client system to back it up again, which would cause multiple transfers of the same file across the network.

2.3.2 Tivoli Disaster Recovery Manager

Tivoli Disaster Recovery Manager coordinates and automates the process of recovering from a disaster. It integrates with Tivoli Storage Manager and the rest of the Tivoli data management portfolio to provide for off-site media management, automated restore and managed recovery. It complements the already implemented robust protection features of Tivoli Storage Manager and automates many already facilitated protection functions.

Tivoli Disaster Recovery Manager automatically captures information required to recover the Tivoli Storage Manager server after a disaster. It assists in preparing a plan that allows recovery in the most expedient manner. This *disaster recovery plan* contains information, scripts, and procedures needed to automate server restoration, and helps ensure quick recovery of your data after a disaster.

Tivoli Disaster Recovery Manager also manages and tracks the movement of off-site media to reduce the time required to recover in the event of a disaster. It is able to track media that are stored on-site, in-transit, or off-site in a vault, no matter whether it is a manual or electronic vault, so your data can be easily located if disaster strikes.

Client recovery information can also be captured by Tivoli Disaster Recovery Manager to assist with identifying what clients need to be recovered, in what order, and what is required to recover them.

2.3.3 Tivoli Decision Support for Storage Management Analysis

Tivoli Decision Support for Storage Management Analysis uses the framework services of Tivoli Decision Support to deliver important decision-making information about your enterprise data management deployment.

Tivoli Decision Support is a stand-alone product that provides a ready-to-use view into the wealth of data gathered by Tivoli enterprise products. The product consolidates this data from Tivoli products and transforms it into accessible IT business-relevant information. This information, presented in a variety of graphical formats can be viewed interactively (slice, dice, drill down, drill through) and posted on a URL. Tivoli Decision Support provides insight and the ability to better answer IT business-relevant questions. Tivoli Decision Support is available on Windows NT.

The Tivoli Decision Support Discovery Guides are a set of best practices guides provided for various applications. To use these guides Tivoli Decision Support has to be installed and available. The Tivoli Decision Support for Storage Management Analysis is the guide used to produce the following analyses:

- Storage Event Analysis
- Storage Performance Analysis
- Storage Capacity Analysis

The architecture and the information flow is shown in Figure 24.

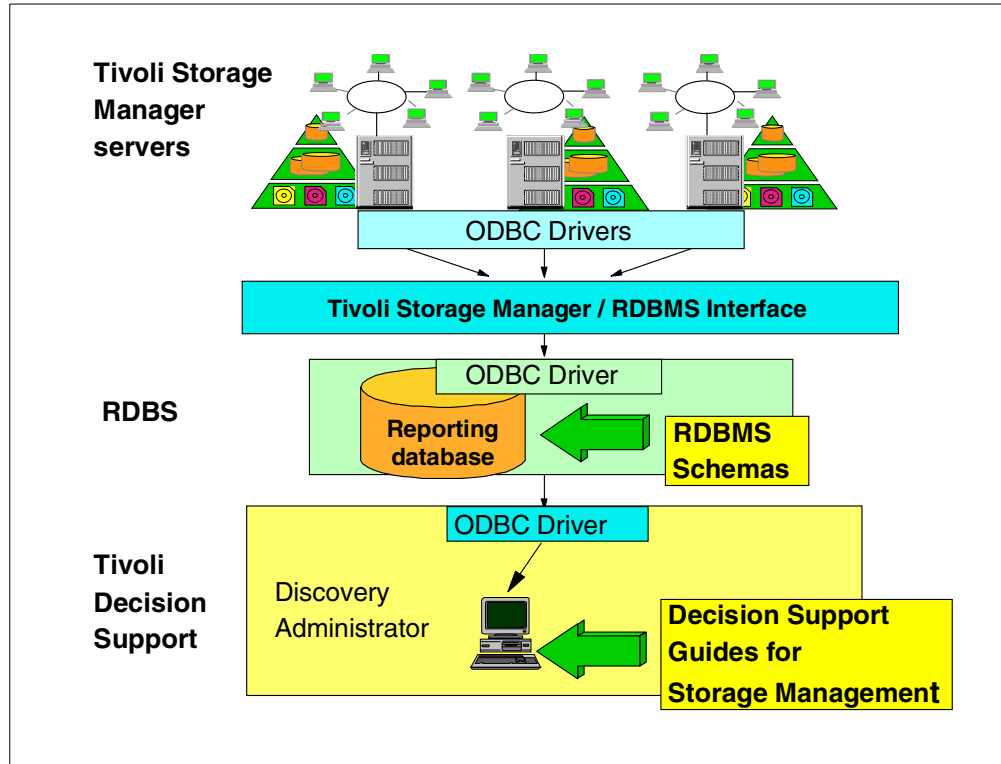


Figure 24. Tivoli Decision Support for Storage Management Analysis

The information used by the guide is obtained directly from the Tivoli Storage Manager server with the use of the ODBC interface. The information is then transferred to a relational database, another requirement for Tivoli Decision Support for Storage Management Analysis. The databases supported for the information feed are DB2, MS SQL, Oracle, and Sybase. The database can reside on the same system as Tivoli Storage Manager or Tivoli Decision Support or on a separate system. The database is used to for queries to generate the Tivoli Decision Support reports.

2.4 Tivoli Data Protection for applications

Tivoli Data Protection for applications is a group of solutions integrated to Tivoli Storage Manager, which protect data used by business applications. They are interface programs between a storage management API provided by the vendor application, and the Tivoli Storage Manager data management API. Typical applications providing such interfaces are databases and groupware applications, such as Lotus Notes or Microsoft Exchange.

Figure 25 shows Tivoli Data Protection for Lotus Domino as a typical example of the architecture and the data flow of a Tivoli Data Protection for application solution.

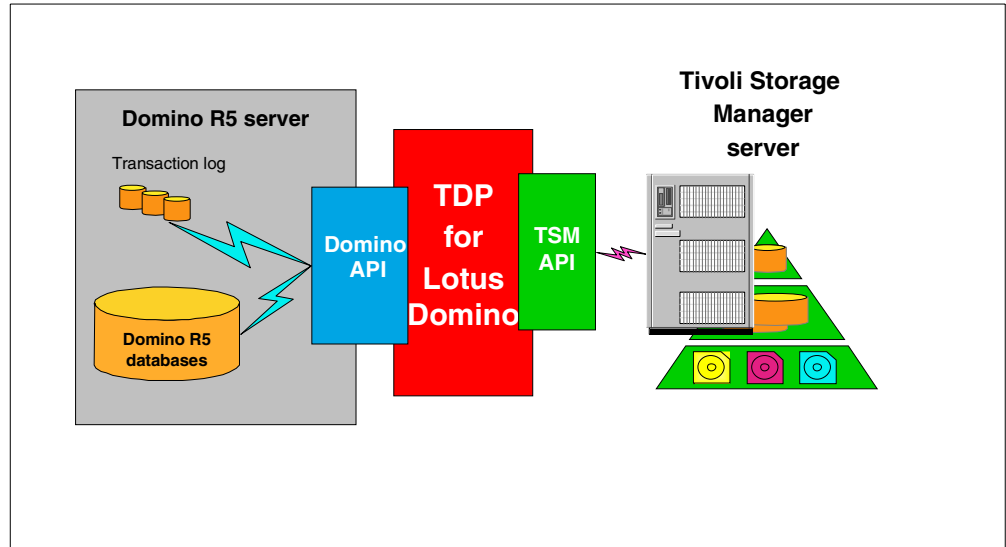


Figure 25. Tivoli Data Protection for Lotus Domino

The function of the Tivoli Data Protection for applications solutions is to receive application backup and restore requests and to translate them into Tivoli Storage Manager backups and restores. The activity is always initiated from the application. This means that backups or restores can also be done while the application is on line. The TDP application client therefore implements the intelligence and function of the backup interface provided by the application itself.

Table 6 shows the available Tivoli\ Data Protection for application solutions and the platforms, operating system level and application level they cover at the time of publishing this book.

Table 6. Tivoli Data Protection for application

TDP solution	Application level	Operating system	Operating system level
TDP for Lotus Notes	4.5.x, 4.6.0, 4.6.1, 4.6.3	AIX NT	4.2.x, 4.3.x 4.0 SP3
TDP for Lotus Domino	5.0.1	AIX NT Windows2000 Solaris	4.3.1, 4.3.2 4.0 SP4 2.6,7
TDP for Lotus Domino, S/390 Edition	5.0.1	OS/390	2.6, 2.7 with UNIX System services
TDP for MS Exchange	4.0, 5.0, 5.5	NT Windows2000	3.5.1, 4.0 SP3
TDP for MS SQL Server	6.0, 6.5	NT Windows2000	3.5.1, 4.0
TDP for Informix	IDS 7, UDO 9	AIX Sun Solaris	4.3.1, 4.3.2 2.6, 7

TDP solution	Application level	Operating system	Operating system level
TDP for Oracle	7.3.4, 8	AIX NT Sun Solaris HP-UX Windows2000	4.3.1 4.0 2.6 10.20, 11.0
TDP for R/3	3.0C to F, 3.1 up to Z, 4.0 up to 4.5	AIX HP-UX Sun Solaris Tru64 UNIX NT (Intel)	4.2, 4.3 10.20, 11.0 2.51, 2.6 4.0 4.0

For the latest information on Tivoli Data Protection solutions check the following Tivoli Storage Management Web page:

<http://www.tivoli.com/products/solutions/storage/>

2.5 Tivoli Data Protection for Workgroups

Tivoli Data Protection for Workgroups provides a complete disaster and bare metal recovery solution for Windows NT servers.

It uses Stac's unique *Object Replication Technology* to ensure backup of all disk contents, such as partition information, boot records, FAT and NTFS partitions, while allowing full read and write access to the system during backup. It can backup entire Windows NT servers or volumes at near maximum device speed to local tape or disk drives.

Tivoli Data Protection for Workgroups also provides the function to create a set of bootable diskettes that may be used in the event of hard drive failure or other disaster.

The restore operation can be performed using the Windows File Explorer for single file restores by simply drag and drop files from the mounted backup medium to their original location or for more complex restores by utilizing a Tivoli Data Protection for Workgroups administrative tool. In the event of a complete disk failure the set of bootable diskettes can be used to perform a bare-metal restore of the entire system.

The product can be either used stand-alone or integrated in a Tivoli Storage Manager environment for the following functions:

- Message logging to a Tivoli Storage Manager server, using the Tivoli Storage Manager API client
- Automate operations with the scheduler component provided by the Tivoli Storage Manager backup-archive client.

Chapter 3. Tivoli Storage Manager and the AS/400 system

Tivoli Storage Manager provides complete data management solutions for a heterogeneous network environment covering backup, archival, space management, and disaster recovery for more than 30 different computing platforms, and storing this managed data on eight different Tivoli Storage Manager server platforms.

In the past, the AS/400 system could be used as a Tivoli Storage Manager server to store the Tivoli Storage Manager managed data and re-centralize the data of a scattered network environment on an AS/400 system. Since the introduction of the BRMS/400 Tivoli Storage Manager application client, AS/400 data can be stored and managed using a Tivoli Storage Manager server.

This chapter will discuss, on a high level, the different aspects of using Tivoli Storage Manager in an AS/400-centric network environment, covering both the application of an AS/400 system as a Tivoli Storage Manager server, and the integration of an AS/400 system in an existing Tivoli Storage Manager environment. It will also give you an overview of unique solutions when using Tivoli Storage Manager in an AS/400 environment, such as managing data in a partitioned AS/400 system or the application of Tivoli Storage Manager at the AS/400 Integrated Netfinity server.

3.1 Terminology

Since BRMS/400 is the strategic data management solution for the AS/400 world, there is also a specific terminology established when talking about managing data in this context. Unfortunately, this terminology uses the same terms as Tivoli Storage Manager, but occasionally with different meanings.

Table 7 gives you a comparison of terms used in both worlds for the same data management concept. It will be particularly useful for persons with AS/400 and BRMS experience who want to become familiar with Tivoli Storage Manager, or for Tivoli Storage Manager administrators who need to integrate an AS/400 system into a Tivoli Storage Manager environment.

Table 7. BRMS and Tivoli Storage Manager terminology

Concept	BRMS term	Tivoli Storage Manager term
Saving only changed objects, keep a set number of versions of each object	Incremental backup with version expiry	Normal incremental backup
Saving all objects, keep a set number of versions of each object	Full backup with version expiry	Selective backup
Saving all objects, keep each object for a set number of days	Full backup with days expiry	Archive
Freeing space by moving files off disk while keeping stub file on disk	Archive, with storage freed	Space management

Concept	BRMS term	Tivoli Storage Manager term
Saving objects while they are in use	Save while active	Copy serialization

3.2 How does an AS/400 fit into a Tivoli Storage Manager environment?

An AS/400 system can easily be integrated into your Tivoli Storage Manager data management solution as both client and server. To act as a Tivoli Storage Manager API client, the AS/400 system needs to be running backup, recovery, and media services for AS/400 (BRMS). That is why we give you a short overview about BRMS/400 in the next section. If you need more information, refer to:

- 1.4.3, “Backup, Recovery, and Media services/400” on page 22
- *Backup, Recovery, and Media Services for AS/400*, SC41-5345
- *A Practical Approach to Managing Backup Recovery and Media Services for OS/400*, SG24-4840

3.2.1 What is BRMS?

BRMS is an IBM product for the AS/400 that uses a set of rules to fully automate the backup, recovery, and tape management of an AS/400. BRMS will work with a single tape drive or a multitude of different tape libraries. BRMS can be used in a network of AS/400 systems to share a pool of scratch tapes, although it cannot back up data across a network to another AS/400 system. Figure 26 shows the different elements of BRMS.

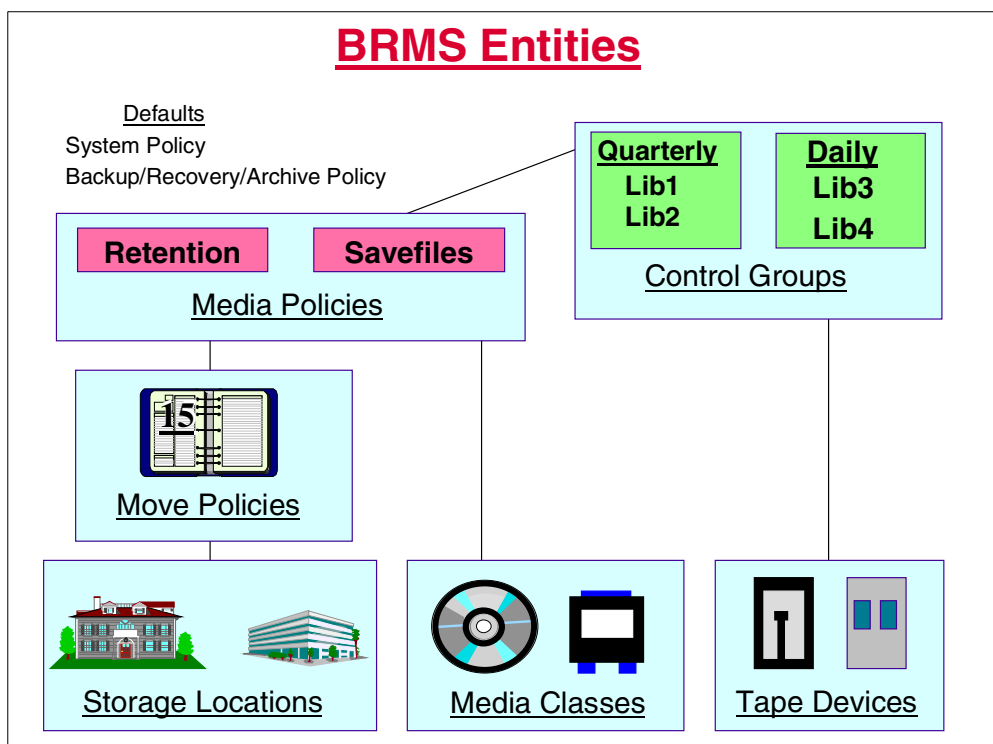


Figure 26. Backup, recovery, and media services for AS/400

Many AS/400 systems already use BRMS. The Tivoli Storage Manager server for AS/400 can be integrated with BRMS to share tape resources with BRMS if that is required. But a more common application is using the BRMS application client to act as a limited-function Tivoli Storage Manager backup-archival solution.

With BRMS, a recovery plan can be produced that details exactly what must be done step-by-step to recover an AS/400 after a disaster.

3.2.2 AS/400 as a Tivoli Storage Manager API client

A set of application program interfaces (APIs) can be obtained for BRMS. These form the BRMS application client to a Tivoli Storage Manager server. This allows BRMS to save and restore data on any Tivoli Storage Manager server. See Figure 27.

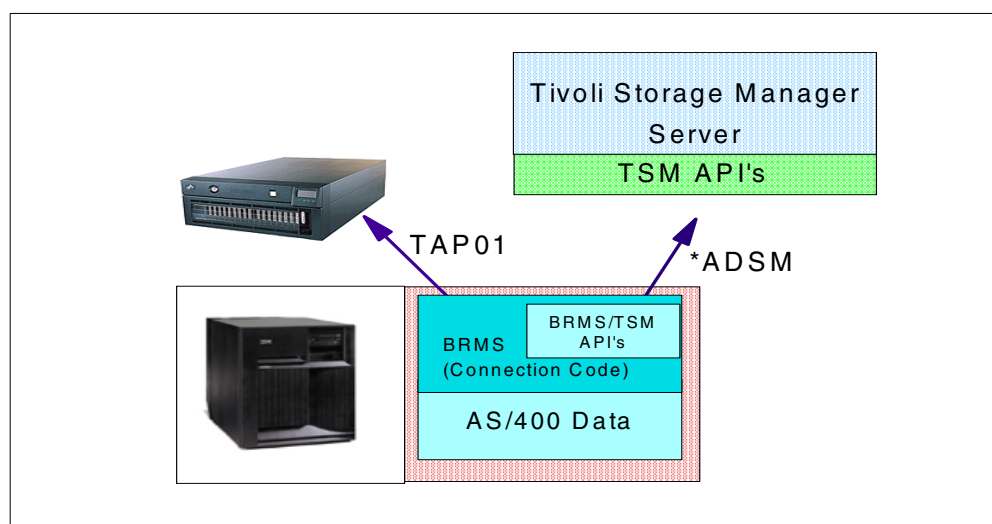


Figure 27. BRMS application client

The BRMS application client was initially developed to cater to remote AS/400 sites that had little or no AS/400 knowledge. The idea was that once a system administrator had performed a complete backup of the system using BRMS or the native save commands, the user data could then be transferred across a network to a Tivoli Storage Manager server at a remote site. This ensures that the user data is backed up on a regular basis rather than having to rely on unskilled staff to change tapes and perform backups.

A typical AS/400 system will already be running BRMS to automate the backup and restore of that AS/400 system and user data. With the addition of the BRMS application client software, BRMS can be used to save user data to a Tivoli Storage Manager server across the network. System data must still be saved to a local tape device using BRMS or OS/400 commands.

Note

It is not recommended that the Tivoli Storage Manager/400 server and BRMS are used together to back up a stand-alone AS/400 system. Using Tivoli Storage Manager in this manner is not only more costly, but unnecessarily complicates the backup plan, and can degrade backup performance. The best results can be achieved by using BRMS to back up the system directly to local media.

The BRMS application client is not intended for use when large amounts of data must be backed up in short periods of time. If this is the requirement, then BRMS should be used to save the data directly to tape.

3.2.2.1 What do you need?

To use the BRMS application client to save and restore items from a Tivoli Storage Manager server, you need to be running OS/400 V4R3 or higher with the Media Storage Extensions option and BRMS for AS/400 V4R3. You also need to obtain a copy of the BRMS application client API. This comes on a CD that accompanies the BRMS product, or you can download it from the Internet. See Chapter 5, “Setting up a BRMS API client on an AS/400 system” on page 111, for more details.

3.2.2.2 How does it work?

Backups are defined using BRMS control groups. These are groupings of objects from the AS/400 system that are to be saved to specific media and kept for a specific period. A control group can be set up that saves this data to a Tivoli Storage Manager server rather than to a local tape device. When objects are saved to a Tivoli Storage Manager server, they are saved in the form of an AS/400 savefile. A savefile is like an archive that contains one or more other files.

To restore objects from a Tivoli Storage Manager server, you use the BRMS recovery menu or BRMS recovery commands specifying that you want to include Tivoli Storage Manager in this list of possible storage locations. You can restore anything from a single AS/400 object to all of the user data contained in many libraries and IFS directories.

Unlike data saved from a conventional Tivoli Storage Manager backup/archive client, the Tivoli Storage Manager server does not know what has been saved to it from the AS/400 client (the inventory of saved data is kept within BRMS on the client system). It only sees one or more save files. Because of this, it is important to set up a special Tivoli Storage Manager policy domain to cope with the specific needs of AS/400 clients and to ensure that the best use is made of Tivoli Storage Manager server storage space.

3.2.3 AS/400 as a Tivoli Storage Manager server

Tivoli Storage Manager for AS/400 combines unattended network backup and archive with disaster recovery planning functions in an integrated software solution. Tivoli Storage Manager for AS/400 backs up and archives data from more than 30 multi-vendor platforms storing data on a Tivoli Storage Manager server running on an AS/400 system. In addition to multiple client platforms, Tivoli Storage Manager for AS/400 supports leading devices and communication

protocols. This broad range of support makes Tivoli Storage Manager for AS/400 a comprehensive storage management solution.

A typical example of how the Tivoli Storage Manager server can fit in with an AS/400 system is the increasingly common distributed computing environment. Here, there may be an application that is divided into three parts. The data for the application is kept on an AS/400 system, the logic for the application may be kept on a Windows NT server, and the user interface for the application is stored locally on desktop PCs. If a disaster occurs on the logic or data machines, then the whole application is unavailable. If a disaster occurs on a desktop PC, then just that PC is affected. Tivoli Storage Manager can be used to back up all the desktop PCs and the Windows NT server to the AS/400 system, therefore creating a complete storage management solution.

3.2.3.1 Why choose an AS/400 system?

The AS/400 system is a very secure and reliable machine with at least 99.9% reliability (according to IBM figures collected over the last two years) provided by a single AS/400 system. Other operating systems currently cannot even match these figures while using so-called high-availability technology.

This high reliability makes an AS/400 system the ideal platform for running mission critical systems, including Tivoli Storage Manager, especially when you consider the implications of not having a reliable backup strategy in place when you need it most.

3.2.3.2 How does it work?

Tivoli Storage Manager /400 will support all manual and automatic OS/400 supported disk drives, a wide range of tape devices and libraries, and optical jukeboxes. The Tivoli Storage Manager /400 support for automated libraries is slightly different from other platforms, in that drives are not defined in Tivoli Storage Manager. Drive parameters are sorted out by OS/400 instead.

It is also possible to utilize an external tape management system, such as BRMS, to handle tape libraries as well. When these libraries are defined to Tivoli Storage Manager, they are given a media library device parameter; this is used to point to the BRMS device name used for the tape drive or library.

Exit programs are created (the samples supplied work with BRMS without any modifications) that take Tivoli Storage Manager commands and pass them onto the tape management system (such as BRMS) for processing. These commands allow BRMS to handle tape mount, dismount, expiration, and deletion processes. This allows BRMS and Tivoli Storage Manager to share a pool of scratch tapes if required.

3.3 Disaster recovery

Tivoli Disaster Recovery Manager is available as an optional extra software product.

The AS/400 client does not support bare metal restore. Recovery of an AS/400 system relies upon the recovery plan available through BRMS. This uses a step-by-step approach that explains exactly what must be done to recover the

entire machine. It automatically uses *ADSM to recover objects wherever necessary.

Recovery of a Tivoli Storage Manager /400 server depends on how the AS/400 system has been backed up. Recovering a Tivoli Storage Manager server running on an AS/400 system is a relatively straightforward process. BRMS (if installed) can be used to aid in the recovery of the server so as to make it a simple step-by-step procedure.

For a practical guide on how to recover a Tivoli Storage Manager /400 server or client, see Chapter 10, "AS/400 backup and recovery scenarios" on page 261.

Note

*ADSM specifies the recording format of the data to be written on the tape for this BRMS media class.

3.4 Hierarchical storage management on an AS/400 system

Tivoli Space Manager is an optional software product, which uses hierarchical storage management (HSM) mechanisms to migrate rarely accessed files, automatically and transparently, to the Tivoli Storage Manager storage repository. This frees administrators and users from manually performing file system pruning tasks, and ensures that sufficient free storage is available at the workstation or server system. Tivoli Space Manager is supported with Tivoli Storage Manager/400 V3.1.2

There is no AS/400 HSM client for Tivoli Storage Manager. However, this capability does exist in BRMS as dynamic archival and retrieval. This allows certain types of AS/400 objects, such as files, to be archived to storage locations while leaving the object description on disk. The object is saved with storage freed as shown in Figure 28. The storage location can be any BRMS defined location, such as a BRMS tape or Tivoli Storage Manager server. When the file is accessed, BRMS is invoked to retrieve the data part of the file (the storage freed part), and, if the object was last saved to a Tivoli Storage Manager server, it will be retrieved using the BRMS Application Client.

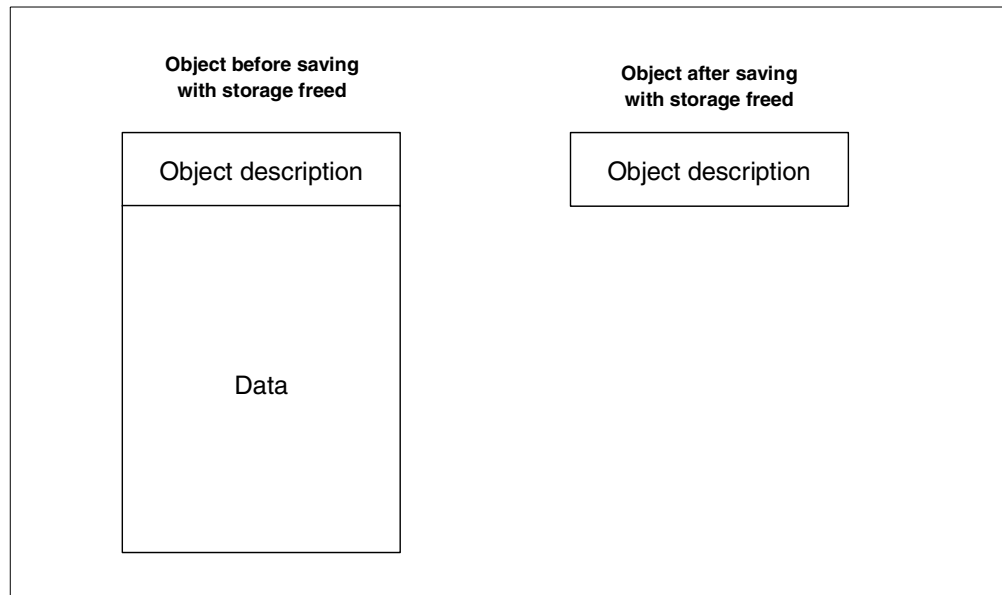


Figure 28. AS/400 object before and after save with storage freed

3.5 Large database and application support on an AS/400 system

Backing up very large databases can take a long time. That is why IBM and other vendors have created various agents that integrate with different database applications. These allow individual records to be backed up instead of the whole database file, therefore, saving a lot of time and storage pool space. This can also occur while databases are in use.

At the time of writing, all Tivoli Data Protection (TDP) agents for the application clients are supported by all Tivoli Storage Manager servers, including the AS/400. However, there are currently no TDP application clients that run as a client on the AS/400.

The BRMS Application Client has not been designed with large database support in mind. If a single byte of information has changed in a database file, that whole database file has to be backed up.

The recommended method for backing up database files on the AS/400 system is to ensure that they are not in use. With something like Lotus Domino, it is preferable that the Domino server be temporarily shut down while the backup occurs, in order to ensure that all mail files do not have any locks on them so that they may be backed up correctly.

Using a function of BRMS, it is possible to write into the backup control group that the Domino server should be shutdown. After the backup has completed, another function can be called that starts the server up again.

3.6 Logical partitions

OS/400 V4R4 allows the 7xx, 6xx, and Sxx machines to support logical partitions (LPARs). With LPARs, it is possible to divide up a single physical AS/400 system into smaller logical partitions (LPARs).

Figure 29 shows a single AS/400 system on the left (SYS A) and an example LPAR configuration on the right (SYS A1, SYS A2, and SYS A3). Each LPAR contains a proportion of the total available resources that are available to the single partition AS/400 system on the left (SYS A).

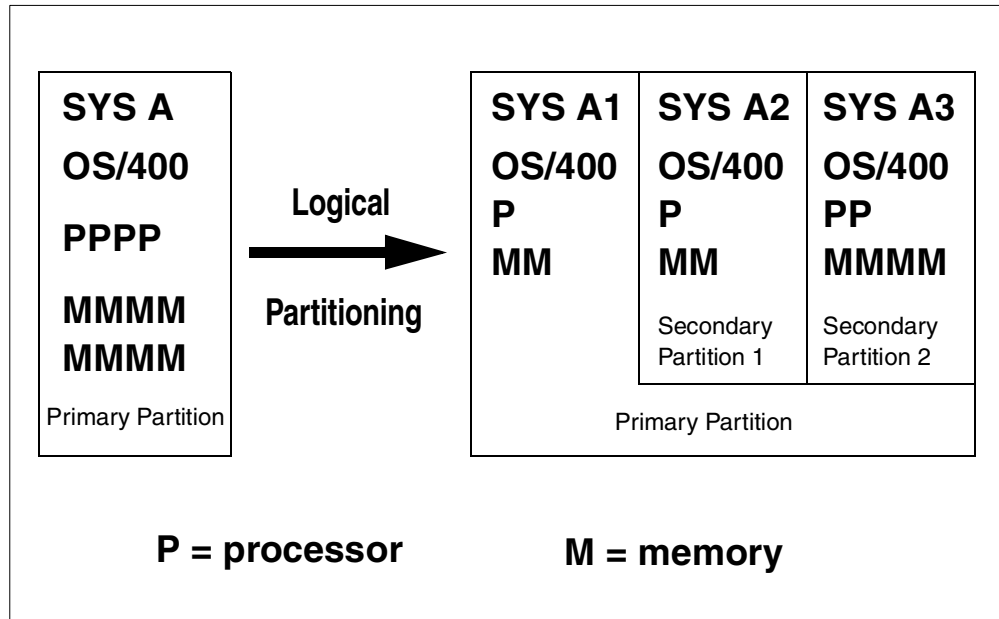


Figure 29. Logical partition overview

Using software called Virtual OptiConnect/400, it will be possible to achieve very high data transfer rates between the different LPARs. With a Tivoli Storage Manager server on one partition and BRMS Application client on another, rates of 26 GB/hour have been achieved.

This would lend itself very well to installing a Tivoli Storage Manager server on one partition and backing up all of the user data from the other partitions to the Tivoli Storage Manager server at high speed. For more details on logical partitions on an AS/400 system, see the book *Slicing the AS/400 with Logical Partitioning*, SG24-5439. A scenario using Tivoli Storage Manager to back up a partitioned AS/400 system is shown in Chapter 12, "Tivoli Storage Manager and AS/400 logical partitions" on page 317.

3.7 Integrated Netfinity server

Many AS/400 systems have an Integrated PC Server (IPCS) or the newer Integrated Netfinity Server installed. These hardware products (shown in Figure 30) allow you to run Microsoft Windows NT in the same footprint as the AS/400 system using different Intel Pentium processors, depending on model. There are

integration features that allow you to share resources, such as tape and optical devices, and data between NT and the AS/400 system as shown in Figure 30.

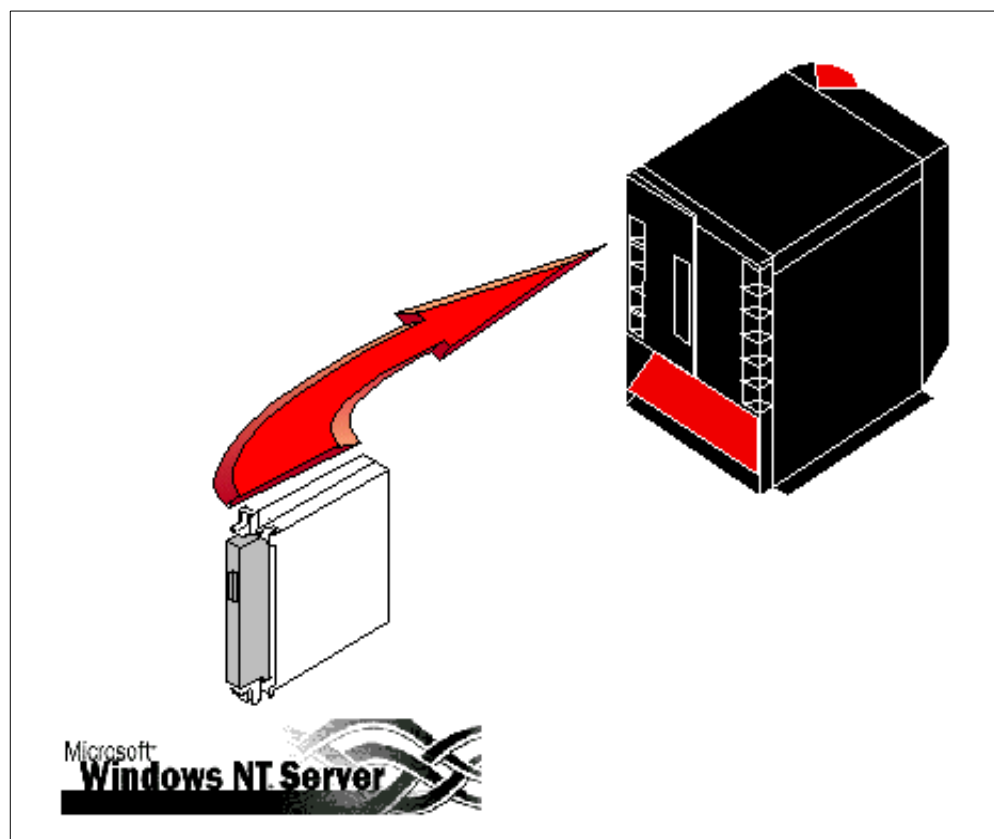


Figure 30. Windows NT server running on IPCS

Careful thought has to be put into the backup and recovery strategy employed when protecting these NT installations. Without Tivoli Storage Manager, you can use BRMS (or native OS/400 save and restore commands) to back up the whole server storage space at once. However, you cannot back up and restore individual objects within the storage areas unless the built-in Windows NT commands are used. Also, in order to back up the server storage areas, the NT server must be shut down. This obviously means that users will not be able to access the NT server while the backup operation is taking place. It is also feasible that on some smaller NT installations, the network card is shared between the AS/400 and NT. When the NT server is shut down, it also means that the network card becomes unavailable for use by the AS/400 system, therefore, rendering LAN access to the AS/400 system impossible.

Tivoli Storage Manager backup-archive client code can be installed on the NT server just as if it were a conventional Windows NT machine. This will allow individual files and programs to be backed up. The target Tivoli Storage Manager server can be the AS/400 system that has the IPCS installed, or it can be any Tivoli Storage Manager server on the network. It is also possible to run a Tivoli Storage Manager NT server code on the IPCS card. The application of a Tivoli Storage Manager NT as either a client or a server in an IPCS environment will be discussed further in Chapter 11, "AS/400 Integrated Netfinity Server" on page 297.

Part 2. Installing and configuring Tivoli Storage Manager

Chapter 4. Setting up a Tivoli Storage Manager/400 server

This chapter describes the base setup of the Tivoli Storage Manager Tivoli V3.1.2 server on an AS/400 system. It discusses prerequisites for hardware, software, and communication protocols on your AS/400 system, which you should review before starting to install the Tivoli Storage Manager software.

Then this chapter gives a step-by-step guide for the installation of the Tivoli Storage Manager server code on your system covering installation of new code or upgrading from a former level or from the Tivoli Storage Manager Try&Buy code. This chapter also discusses how to initialize the Tivoli Storage Manager server and how to perform base administration tasks, such as starting and stopping the server, registering both Tivoli Storage Manager administrators and backup/archive clients, and setting up disk storage.

Since it is the intent of this book to be a practical guide, you can find more detailed information and exact syntax for several commands we have used, by referring to these manuals:

- *Tivoli Storage Manager for AS/400 Administrator's Guide Version 3*, GC35-0315
- *Tivoli Storage Manager for AS/400 Quick Start Version 3*, GC35-0317
- *Tivoli Storage Manager for AS/400 Administrator's Reference Version 3*, GC35-0316

4.1 Prerequisites

Before you start installing the Tivoli Storage Manager server code, you should review your system and check whether it meets the following base requirements to run a Tivoli Storage Manager server. Review the:

- Hardware requirements, including disk space requirements and tape drives
- Software requirements
- Supported communication protocols

Also, this section tells you where you can obtain the latest fixes for Tivoli Storage Manager to upgrade your installation to the latest available software level, get functional updates, and incorporate problem fixes.

4.1.1 Hardware requirements

For the installation of the Tivoli Storage Manager Version 3.1.2 code, the recommended hardware requirements for an AS/400 system are:

- 90 MB available disk space for the Tivoli Storage Manager server and administrative client code.
- About 600 MB of disk space for the Tivoli Storage Manager database to keep configuration data and metadata about Tivoli Storage Manager managed data for a production-level system. See 4.4.2.1, “Estimating the database size for Tivoli Storage Manager” on page 89.
- You need to check the compatibility of the tape devices you intend to use with the Tivoli Storage Manager support. To see a complete list of Tivoli Storage

Manager for AS/400 Version 3.1.2 supported storage devices, you can refer to the Web page: www.tivoli.com/support/storage_mgr/ad40dev.htm

- To ensure efficient use of Tivoli Storage Manager/400 and full exploitation of its functionality, it is recommended to have available at least two tape drives mounted in an automated tape library. However, Tivoli Storage Manager will also work with manual and/or single tape drives.
- Especially in backup environments with a lot of small files or a large number of clients, it is recommended to allocate some disk storage to be used as a cache in front of the tape or optical device. Files backed up will be stored first in the disk pool and will be automatically moved to tape when the disk fills. To size this disk cache, you should allow enough space to back up one day's worth of changed client data per workstation. See 4.4.5.1, "Estimate disk storage needs" on page 105, for complete sizing instructions.

Your disk space requirements will change as you expand the scope of your Tivoli Storage Manager system:

- The Tivoli Storage Manager database size is largely determined by the number of client files and versions of those files being stored on server storage. As you add clients, you will need to increase your database size.
- Storage space is largely determined by number and size of client files (including versions) and the backup destination (disk or sequential access media). You should reserve enough disk space to hold each day's changed data and allow migration to tape.

4.1.2 Software requirements

In order to run Tivoli Storage Manager/400 Server Version 3.1.2 on an AS/400 system, you need to have the OS/400 operating system running at Version 4 Release 3 or higher.

To use automated tape libraries, you need to install the Media and Storage extension (option 18 of the operating system) contained in library QMSE.

You also need one of the following Tivoli Storage Manager server distributions:

- The 5697-TSM licensed program product, Tivoli Storage Manager. It is shipped on a CD-ROM. This CD-ROM is named LCD4-0410-01.
- The Tivoli Storage Manager Try&Buy code. It is a 60-day evaluation code of Tivoli Storage Manager also available on CD-ROM. This Try&Buy version provides the same functions as the standard licensed product. The only difference is that with the Try&Buy product, the licensing package is not available and installed. You are limited to 50 Tivoli Storage Manager clients.
- To get a copy of the Tivoli Storage Manager Try&Buy code for AS/400, contact your Tivoli/IBM representative, or Business Partner or reseller.

Optionally, you should apply the latest fixes of the Tivoli Storage Manager software, also called program temporary fixes (PTF). You will find instructions on how to obtain and apply these fixes in 4.1.3, "Latest Tivoli Storage Manager server fixes" on page 65.

You can obtain the latest level of Tivoli Storage Manager client software at this Web site:

<ftp://service.boulder.ibm.com/storage/tivoli-storage-management/maintenance/client/v3r7/>

Then select the platform you require. To get information about the recent client software level available for each platform and to learn about requirements for installing these, visit this Web page:

http://www.tivoli.com/support/storage_mgr/adsercli.htm

You can find more detailed information about installing and configuring the Tivoli Storage Manager client for the AS/400 in Chapter 5, “Setting up a BRMS API client on an AS/400 system” on page 111. For information on how to install and configure Tivoli Storage Manager clients on other platforms, refer to the manual *Tivoli Storage Manager: Installing the Clients*, SH26-4102.

4.1.3 Latest Tivoli Storage Manager server fixes

This section will discuss in detail which PTFs are available for the Tivoli Storage Manager server, how to obtain them, and how to load and apply them on your system.

IBM periodically creates *program temporary fixes* (PTFs) to correct problems or potential problems found within a particular IBM licensed program. PTFs may fix problems that appear to be hardware failures, or they may provide new functions.

PTFs are designed to replace one or more objects in the licensed programs. Tivoli Storage Manager server PTFs are always cumulative fixes, which means they contain all the changes from earlier fixes relative to the base code.

For the AS/400 Tivoli Storage Manager server, there are two ways to get the PTFs:

- Order the PTF on the AS/400 system by running the `SNDPTFORD` command. You will receive the PTF electronically or on a CD-ROM, depending on the size. See the book *AS/400 Basic System Operation, Administration and Problem Handling*, SC41-5206, for additional details about this command.

You can also obtain the PTFs from the following Web site:

<ftp://service.boulder.ibm.com/storage/tivoli-storage-management/maintenance/server/v3r1/as400/LATEST>

Note that Figure 31 on page 66 shows an old directory for Tivoli Storage Manager fixes, however by the time of publication, the location indicated above should be active.

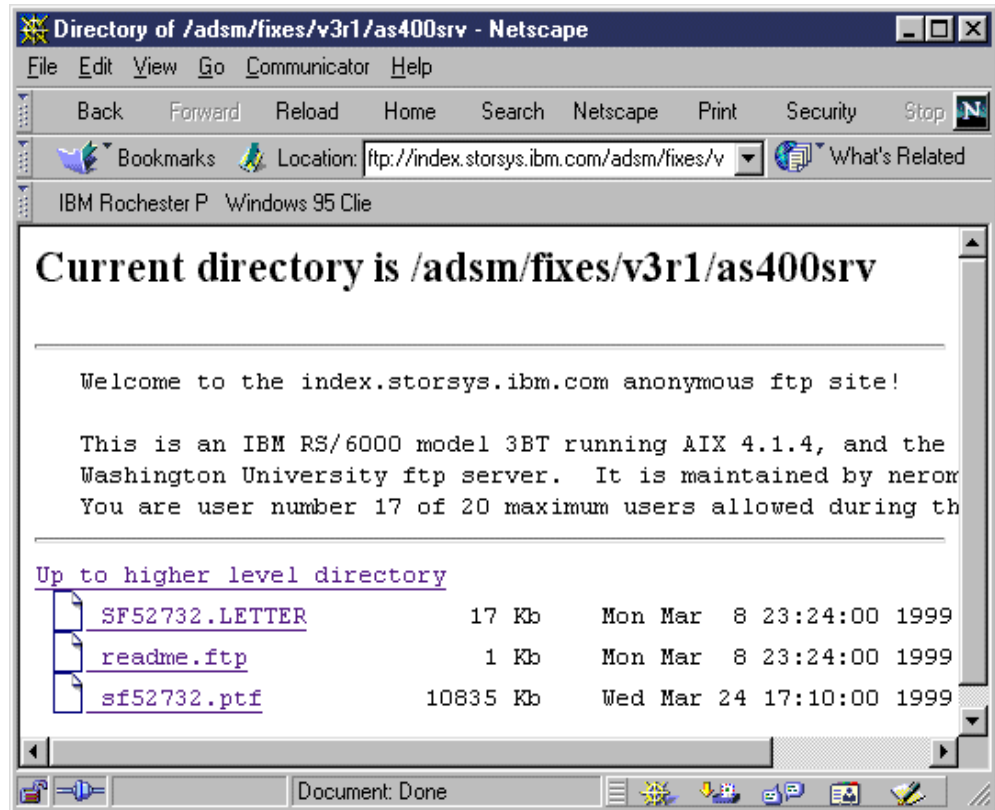


Figure 31. FTP site for latest Tivoli Storage Manager server fixes

In general, three files are associated with each PTF:

SFxxxxx.ptf

This is the fix itself.

SFxxxxx.LETTER

This file contains the description of the problem that the fix solves, the functional correction included in the fix, and, if necessary, any special instructions before applying the fix.

readme.ftp

This file contains step-by-step instructions to download the fix to an AS/400 system or workstation, to load it, and apply the PTF.

If you are downloading the PTF from the Internet, follow all steps as shown in the current readme file in Figure 32.

```

On AS/400:
  1) Create savefile in QGPL to receive PTF
      CRTSAVF FILE(QGPL/SPxxxxx)

If you can FTP directly from the AS/400:
-----
  1) FTP to IBM system and logon on as user anonymous (follow prompts)
      ftp index.storsys.ibm.com
      anonymous
      enter password (follow prompt)
  2) Put FTP session into binary mode
      bin
  3) Go to directory /adsm/fixes/v3r1/as400srv
      cd /adsm/fixes/v3r1/as400srv
  4) Obtain file SPxxxxx.ptf
      get SPxxxxx.ptf QGPL/SPxxxxx (replace)
  5) Quit to terminate FTP

If you must first FTP to a workstation:
-----
From a PC/Workstation with access to the Internet:
  1) FTP to IBM system and logon on as user anonymous (follow prompts)
      ftp index.storsys.ibm.com
      anonymous
      enter password (follow prompt)
  2) Put FTP session into binary mode
      bin
  3) Go to directory /adsm/fixes/v3r1/as400srv
      cd /adsm/fixes/v3r1/as400srv
  4) Obtain file SPxxxxx.ptf
      get SPxxxxx.ptf
  5) Quit to terminate FTP

If PC/Workstation used earlier does not have connectivity to
AS/400, use some method to get the file on to a machine that
can reach the AS/400.

From PC/Workstation with FTP access to AS/400:
  1) Ftp to the AS/400 and logon
      ftp xx.xx.xx.xx (your AS/400 IP address)
      user (user must authority to files in QGPL)
      password
  2) Put FTP session into binary mode
      bin
  3) Place file on AS/400
      put SPxxxxx.ptf QGPL/SPxxxxx (replace)
  4) Quit to terminate FTP

```

Figure 32. Content of readme.ftp

After getting the code, you must load the PTF and then apply it. These operations are described here:

Load Program Temporary Fix (LODPTF) command: This command loads program temporary fixes (PTFs) for a specified product from a diskette, tape, CD-ROM, or save file into the product PTF library. Each PTF contains one or more objects, including programs, that can be applied to a product by the Apply Program Temporary Fix (APYPTF) command.

Apply Program Temporary Fix (APYPTF) command: This command completely replaces the affected objects in the product. PTFs can be applied temporarily or permanently. If they are applied temporarily, the replaced objects are saved by the system and can later be restored to the program by the Remove Program Temporary Fix (RMVPTF) command. If PTFs are applied permanently, the replaced objects are deleted from the system.

To load the PTF, follow these steps:

1. First, enter the Load PTF (LODPTF) command in the AS/400 command line and press **F4** for prompting additional values. You will get the following screen:

```
Load Program Temporary Fix (LODPTF)

Type choices, press Enter.

Product . . . . . LICPGM      > 5697TSM
Device . . . . . DEV          > *SAVF
PTF numbers to select . . . . SELECT  > SFxxxxx
                                + for more values
PTF numbers to omit . . . . . OMIT
                                + for more values
Superseded PTFs . . . . . SPRPTF      *APYPERM
Release . . . . . RLS          *ONLY
Save file . . . . . SAVF        > SFxxxxx
Library . . . . .             > QGPL

Bottom
F3=Exit  F4=Prompt  F5=Refresh  F12=Cancel  F13=How to use this display
F24=More keys
```

2. Enter these parameters:

- 5697TSM for the LICPGM parameter.
- *SAVF (save file) for the DEV (device) parameter.
- In this case, SFxxxxx for the SELECT parameter.
- For the SAVF parameter, SFxxxxx as savefile name and QGPL as library name.

3. Press **Enter**. It can take up to several minutes for this function to complete.

To apply the PTF, follow these steps:

1. First, enter the Apply PTF (APYPTF) command and press **F4** to prompt for additional values. You will get the Apply Program Temporary Fixes screen:

```
Apply Program Temporary Fix (APYPTF)

Type choices, press Enter.

Product . . . . . > 5697TSM      F4 for list

Bottom
F3=Exit  F4=Prompt  F5=Refresh  F12=Cancel  F13=How to use this display
F24=More keys
```

2. The system prompts you to enter the product; in this case, it is 5697TSM. Press **Enter**. The next screen appears:

Apply Program Temporary Fix (APYPTF)		
Type choices, press Enter.		
Product	> 5697TSM	F4 for list
Release	*ONLY	*ONLY, VxRxDx
PTF numbers to select	> SFxxxxx	Character value, *ALL
+ for more values		
PTF numbers to omit		Character value
+ for more values		
Extent of change	*TEMP	*TEMP, *PERM
Delayed PTFs	*NO	*NO, *YES, *IMMDLY
Apply requisite PTFs	> *NO	*NO, *YES
		Bottom
F3=Exit	F4=Prompt	F5=Refresh
F24=More keys	F12=Cancel	F13=How to use this display

3. Fill in the name of the PTF numbers to select parameter with SFxxxxx, and press **Enter**. This can take up to several minutes to complete.

You can verify the successful loading and applying of the PTF by running the DSPJOBLOG command to display all messages related to your job. Follow the steps below:

1. Enter the DSPJOBLOG command in the OS/400 command line from the same display, which you have used for the APYPTF command, then press **Enter**.
2. Press **F10** (Display all messages).
3. Scroll down to see all the messages. You should see output similar to that shown in the following screen.

Display All Messages		
		System: ASM12
Job . . . : QPADEV0001	User . . . : DRIESENA	Number . . . : 001038
Object QPZR000026 in QADSM type *PGM renamed QANRPLNXPL.		
Object QANRINSERT in QADSM type *PGM renamed QPZA000027.		
Object QPZR000027 in QADSM type *PGM renamed QANRINSERT.		
Object QANRCFGCLT in QADSM type *PGM renamed QPZA000028.		
Object QPZR000028 in QADSM type *PGM renamed QANRCFGCLT.		
Object QANRCFGSVR in QADSM type *PGM renamed QPZA000029.		
Object QPZR000029 in QADSM type *PGM renamed QANRCFGSVR.		
PTF 5697TSM -SFxxxxx VxRxDx temporarily applied to library QADSM.		
3 > dspjoblog		
Press Enter to continue.		
F3=Exit	F5=Refresh	F12=Cancel
	F17=Top	F18=Bottom

If you need additional information on how to load and apply a program temporary fix, refer to the book *AS/400 Basic System Operation, Administration and Problem Handling*, SC41-5206.

4.1.4 Communication protocols

The Tivoli Storage Manager server uses APPC, TCP/IP, IPX/SPX, or any combination of these protocols to communicate with the clients. The AS/400

Tivoli Storage Manager administrative client defaults to APPC, but can also be configured to work with TCP/IP.

These communication protocols are shipped in the base Operating System/400.

4.2 Installing Tivoli Storage Manager/400 server and administrative client

Now, if your AS/400 system is in compliance with all previous requirements, you can continue with this section, which describes how to install the Tivoli Storage Manager for AS/400 server and administrative client code. It covers both the licensed product and the evaluation product.

If you already use a former version of Tivoli Storage Manager, look at the following section before installing the code; otherwise, you can go directly to 4.2.3, "Installing the server code" on page 72.

4.2.1 Upgrading to Tivoli Storage Manager 3.1.2

If you want to upgrade from a previous version of ADSM to Tivoli Storage Manager Version 3.1.2, review the following notes:

4.2.1.1 Before installing Tivoli Storage Manager Version 3.1.2

Before the upgrade, perform the following steps:

1. Move any data in disk storage pools to the secondary storage pool to make sure the disk pools are flushed. Halt the previous version of ADSM server.
2. To prevent data loss, save the library containing all recovery log, database, and storage pool files by entering the `SAVLIB LIB(QUSRADSM) DEV(TAPxx) AS/400` command.

`TAPxx` is the tape device and `QUSRADSM` is the library name where the database, the recovery log, and other important files of the Tivoli Storage Manager server are stored. Make sure that these names match your current installation.

3. Before upgrading from Version 1 to Version 3, be aware of the following:
 - Tivoli Storage Manager now runs in the QSYSWRK subsystem in contrast to the QADSM subsystem in previous releases.
 - Several Tivoli Storage Manager commands are now shipped with restricted access (the public authority is set to *EXCLUDE). You may need to have a higher authority level to run these commands. For details about authorizing other users to Tivoli Storage Manager commands, see Appendix F, "Server Authority" in the book *Tivoli Storage Manager for AS/400 Quick Start Version 3*, GC35-0317.
 - The AS/400 administrative client has been converted to use the mode description QADSM. A *mode* describes a group of sessions with a common set of characteristics and is used by advanced program-to-program communications (APPC) and advanced peer-to-peer networking (APPN). For information on configuring your own communication subsystem, see 4.2.6, "Enabling server communications" on page 77.

4. If your current OS/400 operating system level is below Version 4 Release 3, upgrade your OS/400 operating system to at least this level. You can find explanations on how to upgrade your AS/400 system from OS/400 level V3R7, V4R1, or V4R2 in the book *AS/400 Software Installation V4R4*, SC41-5120. If your OS/400 is at level V3R2, you need the following book: *AS/400 Road Map for Changing to PowerPC Technology*, SA41-5150.
5. See 4.2.3, “Installing the server code” on page 72 to upgrade your current version of Tivoli Storage Manager.

4.2.1.2 After the upgrade to Tivoli Storage Manager version 3.1.2

After the successful installation of the new code, make sure that you keep the following points in mind:

1. The upgrade *may* delete the APPC communication entry that you created during Tivoli Storage Manager Version 1 or Version 2 installation. If it does not exist, you must recreate that entry. See 4.2.6, “Enabling server communications” on page 77 for more information.
2. *After* the upgrade, *do not* initialize the Tivoli Storage Manager server. This will create a new database overwriting the old one and you will lose all the metadata stored in your original database and recovery log.
3. If you plan to extend the database and/or the recovery log file, start the Tivoli Storage Manager server in *SERVICE mode.
4. Starting from Tivoli Storage Manager Version 3.1.2, we recommend the administrator access the Tivoli Storage Manager server using the new Web administrative client interface. If you plan to use this new interface, the PRPWEB parameter default of the INZSVRADSM is *YES.

4.2.2 Upgrading from a Tivoli Storage Manager Try&Buy version

If you plan to use Tivoli Storage Manager after evaluating the Try&Buy version, you need to install the Tivoli Storage Manager licensed product over it. In that case, only those files that are not part of the Try&Buy product will be installed, and no server or user data will be lost. However, the notes from 4.2.1, “Upgrading to Tivoli Storage Manager 3.1.2” on page 70 still apply.

After installing the standard licensed product as outlined in the following section, you must register any licensed features that you plan to use. See “How to update the server options file” on page 81 for license registration.

Note

You cannot run the Tivoli Storage Manager Version 3 Try&Buy product and a previous version of Tivoli Storage Manager simultaneously. You must first save the previous version, and then install the Try&Buy product. As part of the installation of the Try&Buy product, your database is upgraded to Version 3. If you decide to go back to the previous version of Tivoli Storage Manager, you would have to restore the previously saved database.

4.2.3 Installing the server code

The default installation procedure of the Tivoli Storage Manager code creates several objects on your AS/400 system. At the start of installation, you are able to change several values; as a consequence, some of the locations and file names shown below will also change. By default, the installation procedure creates these objects:

- The QADSM and the QUSRADSM. QADSM libraries contain all the commands, programs, and other objects used by Tivoli Storage Manager. The QUSRADSM library contains the options file, the Tivoli Storage Manager database, the Tivoli Storage Manager recovery log, and the disk backup storage that you will create later on.
- An options file for both the Tivoli Storage Manager server and the AS/400 Tivoli Storage Manager administrative client is named QOPTADSM and is located in the library QUSRADSM. It has two members; one of these is the OPTIONS member and contains the server options file, and the other one is the AS/400 administrative client option file, the CLIENTOPT member. See 4.4, “Base setup of the Tivoli Storage Manager server” on page 81 for details on these files.
- Tivoli Storage Manager uses a default AS/400 user profile named QADSM for its operations.
- An AS/400 mode description named QADSM.
- Some base Tivoli Storage Manager configurations, such as an administrator ID (ADSMADMIN), a client node registration (CLIENT), and several Tivoli Storage Manager default policy definitions for storing and version control Tivoli Storage Manager-managed client data (STANDARD policies). To adapt these default configurations to your actual needs, see Chapter 7, “Tivoli Storage Manager policy and automation” on page 173 for details.
- An AS/400 administrator profile used to set up your Tivoli Storage Manager environment.

The Tivoli Storage Manager installation also performs these tasks:

- It copies all Tivoli Storage Manager commands and Tivoli Storage Manager menus to library QSYS.
- It installs the Tivoli Storage Manager/400 administrative client code.
- It adds a routing entry in the QSYSWRK subsystem and communication entries in both QBASE and QCMN subsystems. See 4.2.6, “Enabling server communications” on page 77.

The following procedure provides a step-by-step description of the installation and verification of the Tivoli Storage Manager server code. You need QSECOFR (Security Officer) authority to perform the procedure.

1. Ensure that the QSYSOPR message queue delivery setting is in *BREAK mode and that the severity code filter is set to 95. This will prevent unrelated messages from interrupting the installation. Type:

```
CHGMSGQ MSGQ(QSYSOPR) DLVRY(*BREAK) SEV(95)
```

Press **Enter**.

2. Insert the Tivoli Storage Manager licensed program CD-ROM into your AS/400 optical drive.

- If the Tivoli Storage Manager language CD-ROM *does NOT* match the primary language of your system, go to *Step 9 on page 74*.

If the Tivoli Storage Manager language CD-ROM *matches* the primary language of your system, Type `GO LICPGM`. Press **Enter**.

The Work with Licensed Programs menu appears.

- Select option 11 **Install licensed programs** from the Work with licensed programs menu.

```

                                Install Licensed Programs
                                System:  ASM12

Type options, press Enter.
  1=Install

Option  Licensed Program  Option  Product  Description
  1      5697TSM          *BASE
      5769SS1
      5769SS1          OS/400 - Library QGPL
      5769SS1          OS/400 - Library QUSRSYS
      5769SS1          1      OS/400 - Extended Base Support
      5769SS1          2      OS/400 - Online Information
      5769SS1          3      OS/400 - Extended Base Directory Support
      5769SS1          4      OS/400 - S/36 and S/38 Migration
      5769SS1          5      OS/400 - System/36 Environment
      5769SS1          6      OS/400 - System/38 Environment
      5769SS1          7      OS/400 - Example Tools Library
      5769SS1          8      OS/400 - AFP Compatibility Fonts
      5769SS1          9      OS/400 - *PRV CL Compiler Support
      5769SS1          11     OS/400 - S/36 Migration Assistant

More...

F3=Exit  F11=Display status/release  F12=Cancel  F19=Display trademarks

```

- Select the program **5697TSM Tivoli Storage Manager** from the list and press **Enter**.

If the program 5697TSM you want to install is not listed, you can enter a licensed program ID and product option in the blank fields at the top. This product will be added.

- Press **Enter** again to confirm your choice. You will be prompted to fill in the install options on the Install Options screen.

```

                                Install Options
                                System:  ASM12

Type choices, press Enter.

Installation device . . . . . Name

Objects to install . . . . 1      1=Programs and language objects
                                2=Programs
                                3=Language objects

Automatic IPL . . . . . N      Y=Yes
                                N=No

F3=Exit  F12=Cancel

```

- On the Install Options menu, fill in the name of the optical device and the Objects to install field depending on the following:

- If Tivoli Storage Manager is on a single CD-ROM, select option 1, Programs and language objects, on the Objects to install field, and press **Enter**.

After Tivoli Storage Manager is installed, continue with 4.2.5, “Verifying system values” on page 76.

- If you have a second CD-ROM with language objects, first install program objects in this step, and then install the language objects in the next step.

Select option 2, *Programs*, and press **Enter**. Go to one of the following steps:

- Go to step 8 if the Tivoli Storage Manager language CD-ROM matches the primary language on your system, or
- Go to Step 9 if the Tivoli Storage Manager language CD-ROM *does not* match the primary language on your system.

8. If the Tivoli Storage Manager language CD-ROM matches the primary language of your system, perform these steps:

- Insert the language CD-ROM, and select option 11, **Install licensed programs**.
- Select product **5697TSM**.
- Fill in the name of the optical device.
- Select option 3, **Language objects**, and press **Enter**.

Skip the next step (step 9), and continue with 4.2.4, “Installation completion steps” on page 75.

9. If the Tivoli Storage Manager language CD-ROM *does NOT* match the primary language of your system, perform these steps:

- Insert the Tivoli Storage Manager language CD-ROM, use the `RSTLICPGM` command and click **F4**. The *Restore Licensed Program* screen will appear.

Restore Licensed Program (RSTLICPGM)

Type choices, press Enter.

Product	> 5697TSM	Character value
Device	> OPT01	Name, *SAVF
+ for more values		
Optional part to be restored . .	*BASE	*BASE, 1, 2, 3, 4, 5, 6,
Type of object to be restored .	*ALL	*ALL, *PGM, *LING
Language for licensed program .	> *SAVVOL	Character value, *PRIMARY
Output	*PRINT	*NONE, *PRINT
Release	*FIRST	Character value, *FIRST
Replace release	*ONLY	Character value, *ONLY, *NO
More...		
F3=Exit	F4=Prompt	F5=Refresh
F10=Additional parameters	F12=Cancel	
F13=How to use this display	F24=More keys	

b. Specify:

- **5697TSM** for Product
- The name of the optical device
- ***ALL** for Type of object to be restored
- ***SAVVOL** for Language for licensed program as shown
- ***PRINT** to specify whether a listing that shows information about the status of the objects is created.

- c. A secondary language library is created if it does not already exist on your system. For example, if you have ordered the language 2924, the Tivoli Storage Manager panels and messages are stored in library QSYS2924.
- d. Add the secondary language library to your library list by using the CHGSYSLIBL LIB(QSYS2924) OPTION(*ADD) command.

4.2.4 Installation completion steps

Now, the Tivoli Storage Manager server is completely installed. To verify the installation and to check for possible problems, check the installation history log contents for messages belonging to the Tivoli Storage Manager server installation. Follow these steps:

1. Open the Work with License Program menu by entering the `go licpgm` command.
2. Then, select option 50, **Display logs for messages**. This will display the following screen:

Display Install History

Type choices, press Enter.

Start date 02/09/00 MM/DD/YY

Start time 09:30:13 HH:MM:SS

Output * *, *PRINT

F3=Exit F12=Cancel
(C) COPYRIGHT IBM CORP. 1980, 1999.

This screen presents three input fields that you can use to select a start time from which you want to get all log messages up to now. To see Tivoli Storage Manager installation-related log messages, fill in the start date and the start time of the installation of the Tivoli Storage Manager-licensed program.

3. After pressing **Enter**, you will get the screen shown below:

Display History Log Contents

V4R3M0 version, release and modification level installed.
Licensed program installation process started.
***PGM objects for product 5697TSM option *BASE release V4R3M0 restored.**
***LNG objects for NLV 2924 for product 5697TSM option *BASE release V4R3M0 restored**
Licensed program installation process completed successfully.

Press Enter to continue.

F3=Exit F10=Display all F12=Cancel

If the installation was successful, you should see a similar message on your screen.

Now, the installation process is mainly completed. Next, you should consider applying the latest fixes to Tivoli Storage Manager/400 code. For information on

how to get, load, and apply the fixes to your system, refer to 4.1.3, “Latest Tivoli Storage Manager server fixes” on page 65.

If you upgraded from a previous version of ADSM, you should continue with 4.2.1.2, “After the upgrade to Tivoli Storage Manager version 3.1.2” on page 71. If you came from the Try&Buy version, you should make sure that you have done everything as outlined in 4.2.2, “Upgrading from a Tivoli Storage Manager Try&Buy version” on page 71.

4.2.5 Verifying system values

You should now verify two system values: `QALWUSRDMN` (allow user domain objects in libraries) and `QSYSLIBL` (system part of the library list). This verification checks:

- The permission – whether or not several libraries can contain domain user objects.
- The presence of several libraries in the list of libraries associated with all user profiles existing on the AS/400 system.

The system value `QALWUSRDMN` determines which library on the system may contain user domain objects of type `*USRSPC` (user space), `*USRIDX` (user index), or `*USRQ` (user queue) versions of `*USRxxx` objects. In other words, this system value allows the presence of user created objects in libraries. If `QUSRADSM` is not in the list, the Tivoli Storage Manager server will not be able to create objects such as the Tivoli Storage Manager database, the recovery log or storage pool volumes.

If the `QALWUSRDMN` system value is used, update it to include the `QUSRADSM` library. Follow these steps:

1. Verify that the `QALWUSRDMN` system value uses the `*ALL` setting by entering the `WRKSYSVAL QALWUSRDMN` command.
2. Select option 5, **display**, to display it.
3. If the system value is not set to `*ALL`, add the `QUSRADSM` library by selecting 2 to include it in the list.

The system value `QSYSLIBL` defines the system part of the library list. When searching for an object in the library list, the libraries in the system part are searched before any other libraries in the user part. The list can contain as many as 15 library names. Follow these steps:

1. Verify the `QSYSLIBL` system value by entering the `WRKSYSVAL QSYSLIBL` command.
2. Select option 5, **display**, to display the system value.

Display System Value

System value : QSYSLIBL

Description : System part of the library list

Sequence number	Library	Sequence number	Library
0			
10	QSYS		
20	QSYS2		
30	QHLP SYS		
40	QUSR SYS		

Bottom

Press Enter to continue.

F3=Exit F12=Cancel

3. Check that the `QSYS2` library is part of your system library list.
4. If the `QSYS2` library does not appear in the system library list, change it by selecting option 2, **change**, to add it.

4.2.6 Enabling server communications

The Tivoli Storage Manager server uses APPC, TCP/IP, IPX/SPX, or any combination of these protocols to communicate with the Tivoli Storage Manager clients. The AS/400 administrative client defaults to APPC, but can be changed.

This section explains how these communication methods can be enabled in order to work with the Tivoli Storage Manager server.

4.2.6.1 APPC

During Tivoli Storage Manager installation, routing entries are added to subsystem `QSYSWRK`, and communication entries are added to communication subsystems `QCMN` and `QBASE`. You have to stop and restart these subsystems to activate the changes.

If you created your own communication subsystem, add the following communication entry to that subsystem, and then stop and restart the subsystem:

```
==> ADDCMNE SBSDB(yoursubsystem) DEV(*APPC) JOBD(*USRPRF) DFTUSR(QADSM)
      MODE(QADSM)
```

If you upgraded from a previous version of Tivoli Storage Manager to Version 3 and you have used a communication entry with the `#INTER` mode, recreate that entry or update your clients to the new communication mode (`QADSM`) that is automatically created with Version 3.

If controller and device descriptions are already defined for clients using APPC, then APPC configuration is complete. You can continue now with the other communication protocols. If the controller and device descriptions are not defined, follow the description “Verifying the AUTOCONFIG facility” on page 78.

Verifying the AUTOCONFIG facility

The AUTOCONFIG facility specifies whether devices that are added to the system will configure automatically. This is helpful if a client tries to connect to the server for the first time, or if the APPC device descriptions were deleted during an OS/400 upgrade.

If the AUTOCONFIG facility is set on and the controller and device descriptions do not exist, they will be automatically created the first time a client contacts the server.

1. Verify that the `QAUTOCFG` (Auto configure devices) system values is set to one (*on* status) by entering `DSPSYSVAL QAUTOCFG`.
2. Ensure that the `QCRTAUT` (Create default public authority) system value is set to `*CHANGE` or `*ALL`. This system value specifies, whether a user can sign on to a newly created device description. If this system value is set to `*USE` or `*EXCLUDE`, the AUTOCONFIG facility will not provide the proper authority to the device. Check this by entering the command `DSPSYSVAL QCRTAUT`.

The following screen appears:

```
Display System Value

System value . . . . . : QCRTAUT
Description . . . . . : Create default public authority

Create default public
authority . . . . . : *CHANGE      *CHANGE
                                     *ALL
                                     *USE
                                     *EXCLUDE

Press Enter to continue.

F3=Exit  F12=Cancel
```

3. If the automatic configuration facility cannot be used, you have to manually configure the controller and device descriptions for each APPC attached workstation that will use Tivoli Storage Manager and that is not already configured. See the book *OS/400 Communications Configuration V4R1*, SC41-5401, for information on how to create controller and device descriptions.
4. If the communication subsystem used with Tivoli Storage Manager/400 is not active when a Tivoli Storage Manager client node initially attempts to contact the server, you may have to vary off the controller and device associated with that client node.
5. Vary on the controller description after you create the device and controller description. The status changes to `VARY ON PENDING` until the client node contacts the server. The status should then change to `ACTIVE`.

After the client node has been idle for a while, the status returns to `VARY ON PENDING` status until the client issues a Tivoli Storage Manager command. For more information, refer to the book *OS/400 Work Management*, SC41-5306.

4.2.6.2 TCP/IP

Before using TCP/IP with Tivoli Storage Manager, ensure that TCP/IP is installed and operational. The basic TCP/IP communications function is included with the OS/400 operating system.

TCP/IP must be started before the Tivoli Storage Manager server is started. You can start it interactively by running the `STRTCP` command.

You can also incorporate the `STRTCP` command into the start-up program. The start-up program is a program executed at each IPL and contains several commands needed to bring up your AS/400 system.

See Appendix A, "Setting up TCP/IP on an AS/400" on page 349 to configure TCP/IP on your AS/400 system. For more information on TCP/IP, see the *TCP/IP Fast Path Setup*, SC41-5430, or *OS/400 TCP/IP Configuration and Reference Guide*, SC41-5420, for instructions and guidelines.

4.2.6.3 IPX/SPX

Before using IPX/SPX with Tivoli Storage Manager, ensure that IPX/SPX is installed and operational. See the *IPX/SPX Install Administrator's Guide*, SC23-2547, and *IBM AnyNet/2 Version 2.0.2 Guide to Sockets over IPX*, SV40-0112, for instructions and guidelines.

IPX must be started before the Tivoli Storage Manager server is started.

4.2.7 Supporting multiple network adapters

Multiple network adapter support lets you increase server throughput by providing multiple connections to the same network or to several physically distinct networks with the same Tivoli Storage Manager server.

TCP/IP

No additional Tivoli Storage Manager server configuration is required for TCP/IP support of multiple adapters. Each adapter must have a separate TCP/IP address. Clients are given one address for their client options file. The server accepts sessions from each of the adapters. The session limit is placed on the accumulated count from all of the adapters.

APPC

No additional Tivoli Storage Manager server configuration is required for APPC support of multiple adapters. However, ensure that the controller description for a client workstation contains the desired line description in the switched line list parameter `SWTLINLST`.

4.3 The Tivoli Storage Manager main menu

The Tivoli Storage Manager Main menu is a unique AS/400 interface to configure, manage, and control the Tivoli Storage Manager server. You can start the Tivoli Storage Manager main menu by entering the command `GO ADSM` on the AS/400 command line.

The following menu will appear:

```
ADSM                      ADSTAR Distributed Storage Manager          System: ASM12

Select one of the following:

    1. Utilities
    2. Recovery tools
    3. Display console messages
    4. Verify server status
    5. Start administrative client

    10. Start server
    11. End server

Selection or command
====>

F3=Exit  F4=Prompt  F9=Retrieve  F12=Cancel  F13=Information Assistant
(C) COPYRIGHT IBM CORP. 1994, 1998.
```

From this menu, you have access to the following submenus, or you can start several actions directly.

Utilities menu:

From this submenu, you can invoke several Tivoli Storage Manager configuration and initialization functions, such as base initialization of the server, work with devices, change the server options file, change the administrative options file, create and format storage volumes, and initialize these volumes.

Recovery tools menu:

From this submenu, you can start external Tivoli Storage Manager server recovery commands, such as dump and load the Tivoli Storage Manager database, audit the database, display the Tivoli Storage Manager database and recovery log volumes, and recover these volumes. However, it is strongly recommended to use Tivoli Storage Manager internal methods as outlined in Chapter 8, "Protecting the Tivoli Storage Manager/400 server" on page 193 to secure the Tivoli Storage Manager server against disk failure.

Display console message:

With this option, you can display and reply to messages related to Tivoli Storage Manager server operations.

Verify server status:

With this option, you can verify whether the server is running or not

Start AS/400 administrative client:

From this option, you can start a Tivoli Storage Manager administrative session.

Start server:

This options starts the Tivoli Storage Manager server.

End server:

This option stops the Tivoli Storage Manager server.

You can use the submenus to invoke all the base setup steps for the Tivoli Storage Manager server. Nevertheless, all options can also be reached through AS/400 command line commands.

4.4 Base setup of the Tivoli Storage Manager server

Before the first client can access the Tivoli Storage Manager server, you need to perform several base configuration steps. These topics are covered step-by-step:

- Configuration of the option file used by the Tivoli Storage Manager server.
- Initialization of the Tivoli Storage Manager server, including the sizing of both the Tivoli Storage Manager database and the recovery log
- Starting and stopping of the server.
- Configuration of the AS/400 administrative interfaces and registering Tivoli Storage Manager administrators.
- Sizing and base setup of the Tivoli Storage Manager server disk storage.
- Registering clients for backup and archive access.

All these configuration steps allow you to perform the first experimental backup with the Tivoli Storage Manager server. To exploit all the functionality, you need to run through the additional configuration steps as outlined in subsequent chapters.

4.4.1 Server option file

Tivoli Storage Manager provides a server option file with a set of default options to start the server. You can find the server option file, with object name QOPTADSM and the member name OPTIONS in the QUSRADSM library.

Here are the major options you can find in the server options file:

- License terms where you specify the number of clients licensed to use the server.
- Server communication methods, which let you specify what communication protocol you plan to use between the Tivoli Storage Manager server and the clients.
- Mount Message queue, which lets you specify in which AS/400 message queue you want to receive the Tivoli Storage Manager volume mount or dismount messages for operator-based tape handling instructions.
- Volume history and device configuration file names, Tivoli Storage Manager database and recovery log parameters, to tailor the operation of Tivoli Storage Manager.

The next section shows you different methods of updating these options.

4.4.1.1 How to update the server options file

This section shows different methods of setting server options *before* you start the Tivoli Storage Manager server. When you start the server, the new option values go into effect. If you modify your server options while the server is running, you will need to stop and restart the server to activate these changes.

You can add or update options to the server option file by using any of these methods:

- From the command line, type `chgsvradsml`.
Press the function key **F4**, and then press **Enter** to accept the default server work library `QUSRADSM`.
- From the Tivoli Storage Manager Main menu (see 4.3, “The Tivoli Storage Manager main menu” on page 79), select option 1 to open the Tivoli Storage Manager Utility Menu shown below.

```
ADSMUT          ADSTAR Distributed Storage Manager Utilities
                                     System:  ASM12

Select one of the following:

    1. Initialize server
    2. Work with devices
    3. Change server options
    4. Change administrative client options
    5. Create and format volume
    6. Initialize a tape

Selection or command
===>

F3=Exit  F4=Prompt  F9=Retrieve  F12=Cancel  F13=Information Assistant
(C) COPYRIGHT IBM CORP. 1994, 1998.
```

Select option 3, **Change server options**, from the Tivoli Storage Manager utility menu, and press **Enter** to accept the default server work library, `QUSRADSM`.

Both options bring you to the Change Server Options for Tivoli Storage Manager (`CHGSVRADSM`) screen as shown below.

Change Server Options for ADSM (CHGSVRADSM)

Type choices, press Enter.

Server working library	QUSRADSM	Name, *CURLIB
License terms:		
Licensed clients	1	Number, *SAME
MVS Open Edition clients . . .	*NO	*SAME, *YES, *NO
Space management	*NO	*SAME, *YES, *NO
Server to server	*NO	*SAME, *YES, *NO
Disaster recovery manager . .	*NO	*SAME, *YES, *NO
Enterprise administration . .	*NO	*SAME, *YES, *NO
TCP/IP communication method:		
Enable TCP/IP	*NO	*SAME, *YES, *NO
TCP/IP port	1500	1024-32767, *SAME
TCP/IP buffer size	32	1-256 kilobytes, *SAME
TCP/IP no delay	*YES	*SAME, *YES, *NO
APPC communication method:		
Enable APPC	*YES	*SAME, *YES, *NO
SNA buffer size	15	1-31 kilobytes, *SAME
IPX communication method:		
Enable IPX	*NO	*SAME, *YES, *NO
IPX socket number	8522	0001-FFFF, *SAME
IPX buffer size	32	1-256 kilobytes, *SAME
HTTP communication method:		
Enable HTTP	*NO	*SAME, *YES, *NO
HTTP port	1580	1024-32767, *SAME
Client connection parameters:		
Communication timeout	60	0-2147483647 seconds, *SAME
Idle timeout	15	0-2147483647 minutes, *SAME
Recovery log parameters:		
Log pool size	128	128-2147483647 kilobytes ...
Mirror read	*NORMAL	*SAME, *NORMAL, *VERIFY
Mirror write	*PARALLEL	*SAME, *SEQUENTIAL, *PARALLEL
Volume history:		
File	VOLHISTORY	Name, *SAME, *NONE
Library	QUSRADSM	Name, *WRKLIB
Member	VOLHISTORY	Name, *FILE
+ for more values		
Device configuration:		
File	DEVCONFIG	Name, *SAME, *NONE
Library	QUSRADSM	Name, *WRKLIB
Member	DEVCONFIG	Name, *FILE
+ for more values		

More...

F3=Exit F4=Prompt F5=Refresh F12=Cancel F13=How to use this display

To change an option, overtype the value in the input field or use the F4 function key to get valid values prompted. Once you have changed the options, press **Enter**. The values you entered will take effect the next time the Tivoli Storage Manager server starts.

Another way to update the server options file is to manually edit it by using the source entry utility (SEU). To open the server option file, enter the command:

```
WRKMBRPDM FILE(QUSRADSM/QOPTADSM) MBR(OPTIONS)
```

You have direct access to the file QOPTADSM member OPTIONS in library QUSRADSM. Select option 5 to display it. This one looks like the screen below.

```

Columns . . . :   1  71          Browse          QUSRADSM/QOPTADSM
SEU==>                                OPTIONS
FMT **   ...+... 1 ...+... 2 ...+... 3 ...+... 4 ...+... 5 ...+... 6 ...+... 7 .
***** Beginning of data *****
0001.00 LICENSES CLIENTS 1                                000000
0002.00 COMMETHOD TCPIP                                000000
0003.00 COMMETHOD HTTP                                000000
0004.00 COMMETHOD APPC                                000000
0005.00 TCPBUFFERSIZE 32                                000000
0006.00 TCPNODELAY YES                                000000
0007.00 TCPPORT 1500                                000000
0008.00 SNABUFFERSIZE 15                                000000
0009.00 IPXSOCKET 8522                                000000
0010.00 IPXBUFFERSIZE 32                                000000
0011.00 HTTPPORT 1580                                000000
0012.00 COMMTIMEOUT 60                                000000
0013.00 IDLETIMEOUT 15                                000000
0014.00 MAXSESSIONS 25                                000000
0015.00 MSGINTERVAL 1                                000000
0016.00 EXPINTERVAL 24                                000000
0017.00 RESTOREINTERVAL 1440                                000000
0018.00 TXNGROUPMAX 16                                000000
0019.00 MAXMEMORY 1                                000000

F3=Exit   F5=Refresh   F9=Retrieve   F10=Cursor   F11=Toggle   F12=Cancel
F16=Repeat find       F24=More keys

```

Note

Both methods show the contents of the same file. The first one is from an AS/400 system point of view. The second one is similar to Tivoli Storage Manager screens on other platforms.

4.4.1.2 Main server options file values

This paragraph will focus on the main parameters Tivoli Storage Manager needs to start. Also, initially, we will give you a short introduction to Tivoli Storage Manager license terms.

License terms

The base Tivoli Storage Manager server license supports an unlimited number of administrators, one backup-archive client, and a selection of removable media devices.

You must register a new license if you want to add support for any of the following separate Tivoli Storage Manager features or products: additional backup-archive clients, support of the MVS Open Edition client, Tivoli Space Manager, or Tivoli Disaster Recovery Manager. Note that features which are available on other Tivoli Storage Manager platforms, such as Network Edition and Extended Device Support, do not apply to the AS/400 environment. The base AS/400 Tivoli Storage Manager license is enabled for network-attached clients and all supported devices.

The enrollment certificate files for all Tivoli Storage Manager licenses are on the Tivoli Storage Manager installation CD-ROM. Licenses are platform-specific; so, the licenses that are to be purchased will depend on what platform you want to run your Tivoli Storage Manager server.

Note

If the server uses a licensed feature that is not registered, the function will fail. When you issue a command associated with an unlicensed feature, Tivoli Storage Manager does not issue a warning message.

Setting the licenses

You can license additional features in the following ways:

- Issue the `CHGSVRADSM` command from the OS/400 command line or select the Change Server Options screen (`CHGSVRADSM`) from the Tivoli Storage Manager Utilities menu.
- Issue the `REGISTER LICENSE` administrative command after you have started the Tivoli Storage Manager server.

If you use the `CHGSVRADSM` command or options screen, you *must* stop and restart the server for the new licenses to become effective. The license portion of the options screen follows:

```
Change Server Options for ADSM (CHGSVRADSM)

Type choices, press Enter.

Server working library . . . . . QUSRADSM      Name, *CURLIB
License terms:
  Licensed clients . . . . . 10                Number, *SAME
  MVS Open Edition clients . . . *no           *SAME, *YES, *NO
  Space management . . . . . *yes             *SAME, *YES, *NO
  Server to server . . . . . *yes             *SAME, *YES, *NO
  Disaster recovery manager . . *yes           *SAME, *YES, *NO
  Enterprise administration . . *yes           *SAME, *YES, *NO
TCP/IP communication method:
  Enable TCP/IP . . . . . *YES                *SAME, *YES, *NO
  TCP/IP port . . . . . 1500                  1024-32767, *SAME
  TCP/IP buffer size . . . . . 32              1-256 kilobytes, *SAME
  TCP/IP no delay . . . . . *YES              *SAME, *YES, *NO
APPC communication method:
  Enable APPC . . . . . *yes                  *SAME, *YES, *NO
  SNA buffer size . . . . . 15                1-31 kilobytes, *SAME
More...

F3=Exit  F4=Prompt  F5=Refresh  F12=Cancel  F13=How to use this display
F24=More keys
```

For example, if you have purchased a license for 10 backup-archive clients, Tivoli Space Manager, and Tivoli Disaster Recovery manager, do the following:

- Change Licensed clients field to 10.
- Change Space management, and Disaster recovery support fields to `*yes`

The Server to server and Enterprise administration licenses are included in the base Tivoli Storage Manager license so you may set these to `*yes` without requiring an extra license purchase if you plan to use these features. Note that server to server virtual volumes now come in two components. The use of virtual volumes for primary storage pools is enabled by selecting the Server to server license. However if you want to use virtual volumes for copy storage pools, and database backups, then you need to purchase and license Tivoli Disaster

Recovery Manager. If you want to learn more about licensing, refer to the book *Tivoli Storage Manager for AS/400 Administrator's Guide Version 3*, GC35-0315.

Communication methods

The Tivoli Storage Manager server uses APPC, TCP/IP, IPX/SPX, or any combination of these, to communicate with the clients.

The first and second CHGSVRADSM screens show communication fields:

```

Change Server Options for ADSM (CHGSVRADSM)

Type choices, press Enter.

Server working library . . . . . QUSRADSM      Name, *CURLIB
License terms:
  Licensed clients . . . . . 10                Number, *SAME
  MVS Open Edition clients . . . *NO           *SAME, *YES, *NO
  Space management . . . . . *YES             *SAME, *YES, *NO
  Server to server . . . . . *YES             *SAME, *YES, *NO
  Disaster recovery manager . . *YES           *SAME, *YES, *NO
  Enterprise administration . . *yes           *SAME, *YES, *NO
TCP/IP communication method:
  Enable TCP/IP . . . . . > *YES               *SAME, *YES, *NO
  TCP/IP port . . . . . 1500                  1024-32767, *SAME
  TCP/IP buffer size . . . . . 32             1-256 kilobytes, *SAME
  TCP/IP no delay . . . . . *YES             *SAME, *YES, *NO
APPC communication method:
  Enable APPC . . . . . > *YES                 *SAME, *YES, *NO
  SNA buffer size . . . . . 15                1-31 kilobytes, *SAME
IPX communication method:
  Enable IPX . . . . . > *NO                  *SAME, *YES, *NO
  IPX socket number . . . . . 8522            0001-FFFF, *SAME
  IPX buffer size . . . . . 32                1-256 kilobytes, *SAME
HTTP communication method:
  Enable HTTP . . . . . > *YES                *SAME, *YES, *NO
  HTTP port . . . . . 1580                   1024-32767, *SAME

More...
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display

```

In our example, we decided to use TCP/IP and APPC, but not IPX/SPX.

- The TCP/IP server port address defaults to 1500.
- The IPX socket number defaults to 8522.
- If you plan to use the administrative client Web interface, set the server options for the HTTP communications method to *YES. The HTTP port address defaults to 1580. For more information, see 2.2.1.3, “Tivoli Storage Manager Administrative interfaces” on page 35.

Console output and console output message queue

The *console output* function specifies whether to route all of the Tivoli Storage Manager server console output to a single print file. The information contained in this print file is similar to what you find in the online Tivoli Storage Manager activity log. The print file cannot be viewed until the server is halted. The recommended setting should be set to *off. This is also the default value.

The *console output message queue* is the AS/400 message queue where console messages will be routed to. The message queue must already exist. By

default, console messages are routed to the message queue `ADSMMSGQ` in library `QUSRADSM`.

Mount message queue

The *mount message queue* is the message queue to which only tape operation related messages are sent (for example, requests to mount a volume on a tape drive).

If you choose to route all volume-mount messages to a message queue, the message queue must already exist. The default mount message queue is `QUSRADSM/ADSMMSGQ`.

Volume history

The volume history file contains information about the following:

- Sequential access storage pool volumes that were added, reused, or deleted
- Database backup volumes
- Export volumes for administrator, node, policy, and server data

This information is stored in the database, but, during a database restore, information is not available from the database. Therefore, to perform a restore, Tivoli Storage Manager must get the information from the volume history file.

The default is to create a volume history file named `VOLHISTORY`, member `VOLHISTORY`, within the `QUSRADSM` library. To point to this file, you need to change the name of the volume history file within the server option file using the `CHGSVRADSM` command as shown in the following screen:

```
Change Server Options for ADSM (CHGSVRADSM)

Type choices, press Enter.

Recovery log parameters:
  Log pool size . . . . . 128          128-2147483647 kilobytes ...
  Mirror read . . . . . *NORMAL        *SAME, *NORMAL, *VERIFY
  Mirror write . . . . . *PARALLEL      *SAME, *SEQUENTIAL, *PARALLEL
Volume history:
  File . . . . . VOLHISTORY           Name, *SAME, *NONE
  Library . . . . . QUSRADSM          Name, *WRKLIB
  Member . . . . . VOLHISTORY         Name, *FILE
                                + for more values
More...
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Device configuration

The device configuration file contains information needed to read backup data. This information includes:

- Devices classes
- Libraries
- Drives
- Information related to the server definitions needed for virtual volumes

Whenever Tivoli Storage Manager updates device configuration information in the database, it also updates the device configuration file. During a database restore, this information is not available from the database. Therefore, to perform a restore, Tivoli Storage Manager gets the information from the device configuration file.

The default is to create a device configuration file, named `DEVCONFIG`, member `DEVCONFIG`, in the `QUSRADSM` library. To change or update the device configuration file name within the server option file, use the `CHGSVRADSM` command as shown in the following screen:

```

Change Server Options for ADSM (CHGSVRADSM)

Type choices, press Enter.

Device configuration:
  File . . . . . DEVCNFIG      Name
  Library . . . . . QUSRADSM    Name, *WRKLIB
  Member . . . . . DEVCNFIG      Name, *FILE
                    + for more values

More...
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys

```

4.4.2 Initialize the Tivoli Storage Manager server

Now, you need to initialize the server. At initialization, you will create and format physical files to be used as *Tivoli Storage Manager database* and *recovery log*.

The database and the recovery log are closely related. The Tivoli Storage Manager database contains information needed for server operations and information about client data that has been backed up, archived, and space-managed. The database contains pointers to the locations of all client files in the Tivoli Storage Manager storage pools. The client data itself is stored in storage pools, not in the database.

The recovery log contains information about updates that have not yet been committed to the database. For example, when a client is running backups, all transactional data that controls this operation is first written to the recovery log.

The sizes of the database and recovery log can be extended by creating other streamed file volumes (STMF) and assigning them to Tivoli Storage Manager. At the Tivoli Storage Manager server initialization both of them will be created. However, before you can do this, you need to determine what size they should be. This is primarily based on the amount of client data to be saved and the way in which you implement Tivoli Storage Manager. Check the following sections for examples to estimate their size.

Another part of the initialization is to load the initial server options file, which makes the values you entered in the Tivoli Storage Manager server options files active. Also, at initialization, the Tivoli Storage Manager server will create initial Tivoli Storage Manager configurations that:

- Define a policy definition
- Register an administrator ID `ADSMADMIN` with the password `ADSMADMIN`

- Register a client with the node name `CLIENT`

4.4.2.1 Estimating the database size for Tivoli Storage Manager

The Tivoli Storage Manager database size is mainly based upon how many files are managed with Tivoli Storage Manager and how often the files are duplicated in the Tivoli Storage Manager storage repository for disaster recovery and availability reasons. The database also holds all the configuration information of Tivoli Storage Manager, but compared with the amount of meta information about the managed data, this is not significant for the sizing of the Tivoli Storage Manager database.

Keeping this in mind, to size the database, we need to estimate the number of entries for each Tivoli Storage Manager managed file (backed up, archived or duplicated because of disaster recovery and availability reasons - see also Chapter 8, “Protecting the Tivoli Storage Manager/400 server” on page 193) and multiply them by an average size of a database entry.

The calculation is based upon two types of information usually available, the number of files that should be backed up from a client or the amount of data which is stored on the client and that should be managed by Tivoli Storage Manager. In the second case, the database size will be estimated using a percentage of this amount. Steps 1, 2, 3, and 6 are based on the number of files. Steps 4 and 7 are based on the amount of data being backed up.

1. Sum the number of files backed up for all clients where known.
2. Multiply this number by the number of versions kept by Tivoli Storage Manager giving a total number of files backed up.
3. Multiply this number by 600 bytes to give database size used for all known files backed up. Note that each version of a file that Tivoli Storage Manager stores requires about 400 to 600 bytes of database space.
4. Sum the amount of data in GB for all clients where the number of files is unknown. Take five percent of this number to get the estimated database size for that files.
5. Add the results from steps 3 and 4 to get the total database size for backed up files.

If Tivoli Storage Manager-managed data objects should be duplicated for availability reasons, then you should consider using copy storage pools. For further details, see Chapter 8, “Protecting the Tivoli Storage Manager/400 server” on page 193.

6. Multiply the known total number of files backed up calculated in step 2 by 200 bytes giving the database size needed for this duplicated data. Note that each duplicated file within the Tivoli Storage Manager storage repository requires about 100 to 200 bytes of additional database space.
7. For clients where the total number of files is unknown, use the amount of data used in step 4. Take one percent of this number to get the estimated database size for this portion of duplicated data objects.
8. Add the results of steps 6 and 7 to get the total database size needed for meta information about duplicated data objects.

9. Add the database size needed for backed-up files (the result of step 5) to the total database size needed for duplicated data (the result of step 8) to get the total size for the database needed.
10. Calculate 135 percent of total bytes calculated for the database to have some room for further database growth.
11. The minimum size of a Tivoli Storage Manager database is 12 megabytes and the database can only be created in increments of $4n+1$ MB (for example, 13 MB, 17 MB, 21 MB, and so on). The additional one megabyte is used for control information.

For example, let us suppose you have three Tivoli Storage Manager clients A, B and C, where C is a file server. We know that for clients A and B, the number of files is 5000 and 15000 respectively, but, for client C, you only know that there are 2.5 GB of data stored at this system. Let us also assume you want to keep seven backup versions for each file, and you plan to duplicate each file locally as well as for disaster recovery reasons in an off-site location. Now let us calculate the database size using the previous steps:

1. Client A + client B: $5,000 + 15,000 = 20,000$ files
2. $20,000 * 7$ (number of versions) = 140,000 files
3. $140,000 * 600$ (database space needed for entry) = 84,000,000 bytes
4. 2,500 MB (file server C) * 0.05 = 125 MB
5. 84 MB + 125 MB = 209 MB for backed up files (sum of step 3 + step 4)
6. $140,000 * 200$ (additional space for off-site duplication) = 28,000,000 bytes
7. 2,500 MB * 0.01 = 25 MB
8. 28 MB + 25 MB = 53 MB (sum of step 6 + step 7)
9. 209 MB + 53 MB = 262 MB
10. $262 \text{ MB} * 1.35 = 354 \text{ MB}$ database size.
11. Verify whether 354 MB is compliant to the formula $4N + 1$. The most approaching compliant numbers with the formula are 353 and 357. You can use 357 MB.

4.4.2.2 Estimating recovery log size for Tivoli Storage Manager

In the recovery log, all incomplete Tivoli Storage Manager database transactions are logged until they are committed to the database. In the case of recovery log mode *roll forward* (see 8.4.3, “Setting the recovery log mode” on page 204), committed transactions are also held in the recovery log until the next database backup, to ensure a complete roll forward recovery of Tivoli Storage Manager is possible in the case of a corruption in the database or loss of one or more database volumes.

Therefore, the recovery log needs to be sized depending on the log mode setting and the frequency of database backups. If using roll forward log mode, a Tivoli Storage Manager database backup clears the Tivoli Storage Manager recovery log. If the recovery log fills up completely, Tivoli Storage Manager stops, and you have to manually increase the size of the recovery log.

It may take some time to properly recognize and correct this condition so it is best to take the appropriate precautions to avoid this happening. See 8.4.4, “Defining

database backup trigger” on page 205 and 8.4.7, “Recovery log space trigger” on page 206 for more information on protecting the recovery log from overfilling.

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

For example, if the database size is 350 MB, and five percent of the data changes every backup cycle, then the estimated size for the recovery log would be 350 MB x 0.05 x 2 = 35 MB. Then, adjust the size to comply with the 4N + 1 format; in this case, it is 37 MB. You can find more information on sizing the database and recovery log in *Tivoli Storage Manager for AS/400 Administrator's Guide Version 3*, GC35-0315, as well as in the redbook *Getting Started with Tivoli Storage Manager: A Practical Implementation Guide*, SG24-5416.

4.4.2.3 Using the root file system for database and recovery log

Previously, Tivoli Storage Manager only supported use of the original AS/400 library file system, which is record oriented to enhance AS/400 database operations. This file system forces record I/O of 4096K blocks, and in addition, record-level locking on each disk write.

With the release of Tivoli Storage Manager Version 3.1.2, use of the root file system is supported, which can significantly improve performance. We recommend using the root filesystem for all new installations. Database, recovery log, and disk storage pool volumes can all be defined in the root file system.

4.4.2.4 Create directories in the IFS

Create the directories in the Integrated File System (IFS) to store your STMF volumes with the following command:

To create a main directory use the `CRTDIR` command:

Create Directory (CRTDIR)

Type choices, press Enter.

Directory /tsmvol

Public authority for data . . . *EXCLUDE Name, *INDIR, *RWX, *RW...

Public authority for object . . *NONE *INDIR, *NONE, *ALL...

+ for more values

Auditing value for objects . . . *SYSVAL *SYSVAL, *NONE, *USRPRF...

Bottom

F3=Exit F4=Prompt F5=Refresh F12=Cancel F13=How to use this display

F24=More keys

This creates a directory in the IFS called "tsmvol"

To create a subdirectory for database volume use the CRTDIR command:

```

                                Create Directory (CRTDIR)

Type choices, press Enter.

Directory . . . . . /tsmvol/database

Public authority for data . . . *EXCLUDE      Name, *INDIR, *RWX, *RW..
Public authority for object . . *NONE      *INDIR, *NONE, *ALL...
                               + for more values
Auditing value for objects . . . *SYSVAL      *SYSVAL, *NONE, *USRPRF...

                                                                Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys

```

To create a subdirectory for recovery log volume use the CRTDIR command:

```

                                Create Directory (CRTDIR)

Type choices, press Enter.

Directory . . . . . /tsmvol/log

Public authority for data . . . *EXCLUDE      Name, *INDIR, *RWX, *RW..
Public authority for object . . *NONE      *INDIR, *NONE, *ALL...
                               + for more values
Auditing value for objects . . . *SYSVAL      *SYSVAL, *NONE, *USRPRF...

                                                                Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys

```

When creating a directory, the owner ID (UID) is the user creating the directory. The Change Owner (CHGOWN) command transfers object ownership from the user creating the directory to the QADSM user:

```

                                Change Owner (CHGOWN)

Type choices, press Enter.

Object . . . . . > '/tsmvol/*'

New owner . . . . . > QADSM      Name
Revoke current authority . . . *NO      *NO, *YES
Symbolic link . . . . . *NO      *NO, *YES

```

A user with *ALLOBJ has complete authority for all objects and can transfer the ownership of any object. All users have add and delete authorities for their own user profiles; that is, users can add objects to or delete objects (that they created)

from their own user profiles by transferring the ownership of the object. For more information about integrated file system commands, see *AS/400e Integrated File System Introduction*, SC41-5711.

You can start the Tivoli Storage Manager server initialization two ways:

- Use the `INZSVRADSM` command.
Press **Enter** to accept the default server work library, `QUSRADSM`.
- Select option 1, **Initialize the server**, from the Tivoli Storage Manager Utilities menu, and press **Enter** to accept the default work library.

The following command screen appears:

```

                                Initialize Server for ADSM (INZSVRADSM)

Type choices, press Enter.

Work library . . . . . > QUSRADSM      Name, *CURLIB
Volume specification method . . > *VOLSTMF  *VOLLIST, *VOLSTMF, *FILE
Recovery log volume:
  Volume stream file . . . . . > '/tsmvol/log/rlog01'

  Volume size . . . . . 37             Megabytes
  Replace volume . . . . . *NO         *YES, *NO
    + for more values
Database volume:
  Volume stream file . . . . . > '/tsmvol/database/db01'

  Volume size . . . . . 353            Megabytes
  Replace volume . . . . . *NO         *YES, *NO
    + for more values
Prepare web . . . . . *YES             *YES, *NO

                                                                Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys

```

Fill in the names of the database and the recovery log and the sizes we estimated in the previous section. Tivoli Storage Manager formats volumes and assigns space to the database and the recovery log by increments of four megabytes. In our example, we chose `DB01` and `RLOG01` as names.

The `PREPARE WEB` option specifies whether the Tivoli Storage Manager server database will be prepared for the administrative Web interface. This option must be specified `*YES` in order to use the Web administrative function.

Now, press **Enter**.

Depending on the size of the volumes to be formatted, this process can take from five minutes to *much* longer. The initialization formats the Database, Recovery log, and Prepare web in a way that they can be used by Tivoli Storage Manager. If you are in break mode, you will receive the following messages when initialization starts and completes:

```
ADSM server started processing INZSVRADSM command.
ADSM server completed processing INZSVRADSM command.
```

Note

- Issue this command only once. Re-running this command re-initializes the server, and any data that was previously backed up is lost.
- Do not perform the initialization if you have installed Version 3.1.2 over a previous version of ADSM, refer to migration scenarios, 13.6, "Migration from earlier implementation to IFS usage" on page 339.

4.4.2.5 Verifying the initialization

To verify whether the initialization is successful, you should check the message console queue to see the results by using option 3 "Display console messages" from the Tivoli Storage Manager Main menu.

```
                                Display Messages
                                System:   ASM12
Queue . . . . . : ADSMMSGQ           Program . . . . : *DSPMSG
  Library . . . : QUSRADSM           Library . . . . :
Severity . . . . : 00                Delivery . . . . : *HOLD

Type reply (if required), press Enter.
ANR0900I PROCESSING OPTIONS FILE QOPTADSM(OPTIONS).
  ADSTAR Distributed Storage Manager for AS400
Version 3, Release 1, Level 2.41
Licensed Materials - Property of IBM
5697-TSM (C) Copyright IBM Corporation 1990, 1999. All rights reserved.
U.S. Government Users Restricted Rights - Use, duplication or disclosure
restricted by GSA ADP Schedule Contract with IBM Corporation.
ANR7800I QANRSESV generated at 18:04:48 on 07/30/99.
ANR7809I Formatting file /tsmvol/log01 at size 37.
ANR7809I Formatting file /tsmvol/db01 at size 353.
ANR0200I Recovery log assigned capacity is 36 megabytes.
ANR0201I Database assigned capacity is 352 megabytes.
ANR2803I License manager started.
ANR2560I Schedule manager started.
ANR2200I Storage pool BACKUPPOOL defined (device class DISK).
ANR2200I Storage pool ARCHIVEPOOL defined (device class DISK).
ANR2835I Server is licensed for 10 clients.
ANR2855I Server is licensed to support space-managed clients.
ANR2860I Server is licensed to support disaster recovery manager.
ANR2863I Server is licensed to support Enterprise Administration
ANR2200I Storage pool SPACEMGPOOL defined (device class DISK).
ANR2864I Server is licensed to support Server-to-Server Virtual Volumes.
ANR0993I ADSM server initialization complete.
```

The messages appearing in the console message queue show all the initialization steps. The last message you see shows that the initialization process was successful and complete.

Note

Tivoli Storage Manager does not clear the console message queue. You should clear it periodically. You can automate this by using the AS/400 GO CLEANUP function.

4.4.3 Starting and stopping the server

After the initialization, the Tivoli Storage Manager server is ready to start. The following section describes how you can start, stop, and verify the status of the server manually.

4.4.3.1 Starting the server

You must start the Tivoli Storage Manager server program before any client can connect. Before the server starts, the communication methods specified in the server option file should already be active. If they are not active, start them. For example, issue the `STRTCP` command to start TCP/IP or the `STRIPX` command to start IPX.

To start the server, either select option 10, **Start Server**, from the Tivoli Storage Manager Main Menu or enter the `STRSVRADSM` command in the AS/400 command line.

The next screen is displayed. Press **Enter** to accept the default work library and start the server.

```
Start Server for ADSM (STRSVRADSM)

Type choices, press Enter.

Work library . . . . . QUSRADSM      Name, *CURLIB
Server mode . . . . . *NORMAL      *NORMAL, *PRPWEB, *SERVICE
Expire inventory . . . . . *YES      *YES, *NO
Reset administrator . . . . . *NO      *NO, *YES

Bottom
F3=Exit  F4=Prompt  F5=Refresh  F12=Cancel  F13=How to use this display
F24=More keys
```

The server takes a few minutes to start. When the start-up is complete, the system sends to the message queue of the user who started the Tivoli Storage Manager server, a message saying that the server is ready to communicate with client, as shown below:

```
Display Messages

Queue . . . . . : HGROSS              System:  ASM12
Library . . . . : QUSRSYS             Program . . . . : *DSPMSG
Severity . . . . : 00                  Library . . . . :
Delivery . . . . :                     *BREAK

Type reply (if required), press Enter.
Server is ready to communicate with clients.

Bottom
F3=Exit          F11=Remove a message      F12=Cancel
```

4.4.3.2 Verifying the server status

In order to verify the Tivoli Storage Manager server status, you can use option 4, Verify Server Status, from the Tivoli Storage Manager Main menu or use the `VFYSVRADSM` command:

Press **Enter** to accept the default. You should receive the following message at bottom of your screen:

The ADSM server for work library QUSRADSM is running.

4.4.3.3 Stopping the server

You can stop the server without warning if an unexpected problem requires you to return control to the operating system. Normally, however, you should end the server in a controlled manner in order to allow running processes to complete.

To accomplish this, select option 11, **End Server**, from the Tivoli Storage Manager Main menu or enter the `ENDSVRADSM` command at the AS/400 command line.

The following screen appears. Confirm the displayed working library by pressing **Enter**.

```

                                End Server for ADSM (ENDSVRADSM)

Type choices, press Enter.

Work library . . . . . QUSRADSM      Name, *CURLIB
How to end . . . . . *CNTRLD        *CNTRLD, *IMMED

                                           Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

The Tivoli Storage Manager server will stop.

4.4.4 Administrative interfaces

To manage the complete operation of Tivoli Storage Manager, you need to define *administrators*. Administrators are persons responsible for defining, configuring, and managing the server storage, the data management policies and controlling daily operations.

Each Tivoli Storage Manager administrator has a logon ID. Connected to this logon ID is a set of privileges, which define the responsibilities that administrators can have, and limit them to a specific span of control and/or to a limited set of Tivoli Storage Manager commands they are able to issue. This makes the Tivoli Storage Manager administration very flexible because you have the ability to delegate very specific administration tasks to different people or departments.

As discussed in 4.4.2, “Initialize the Tivoli Storage Manager server” on page 88, at initialization time of the Tivoli Storage Manager server, an administrator ID, `ADSMADMIN`, with the highest system privilege will automatically be defined.

4.4.4.1 Privilege classes

Figure 33 shows all the privilege classes supported by Tivoli Storage Manager. It also defines a hierarchy of authorities. There is a system privilege that allows you to perform all administration tasks without any restrictions including defining new administrator accesses. All the other privileges are limited in their span of control or in their subset of authorized administration functionality.

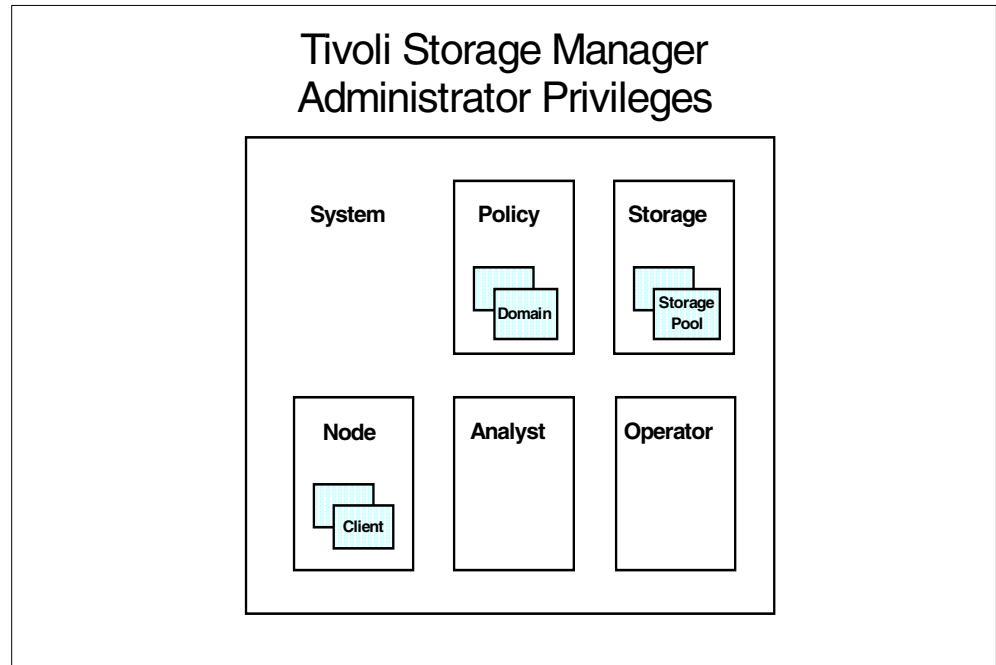


Figure 33. Administrative privileges

The *policy* privilege can be assigned for all policy domains (unrestricted privilege) or on an individual domain basis (restricted privilege). The *storage* privilege can be assigned for all storage pools (unrestricted privilege) or on an individual storage pool basis (restricted privilege). The *node* privilege can be assigned on an individual client basis.

An administrator can have up to six different levels of privilege:

System: An administrator with system privilege can perform any administrative task. All other privileges are included.

Policy (restricted or nonrestricted): An administrator with unrestricted policy privilege can manage the backup and archive services 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.

Storage (restricted or nonrestricted): 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.

Node: Administrators with client node can remotely access a Web backup-archive client and perform backup and restore actions on that client.

Operator: Administrators with operator privilege control the immediate operation of the Tivoli Storage Manager server and the availability of storage media.

Analyst: An administrator with analyst privilege can issue commands that reset the counters that track server statistics.

4.4.4.2 Operations defined for administrator IDs

An administrator is created through the `REGISTER ADMIN` command. Administrators must be registered with a name and a password. Administrator name and password length is limited to 64 characters.

After administrators are registered, they can make queries and request command-line help. To perform other Tivoli Storage Manager functions, they must be granted authority by being assigned one or more administrative privilege classes.

Privileges are granted to an administrator through the `GRANT AUTHORITY` command. You require system privilege to issue this command.

There are a number of operations that you can perform with administrators. Some of these are:

- Renaming an administrator
- Changing the administrative authority
- Removing an administrator
- Locking or unlocking an administrator
- Requesting information about an administrator

Authentication of administrators in a Tivoli Storage Manager environment can be switched off. The default is that authentication is required and, generally, it is *not* recommended to turn them off. However, authentication is controlled by the `SET AUTHENTICATION` command.

When security authentication is in effect, there are a number of security options that can be specified to implement a security policy. These options are related to the use of passwords and cover:

- Maximum Logon Attempts
- Password Expiry period
- Minimum Password Length
- Web Authentication Time Out

All commands issued by all administrators are logged to the server activity log. This cannot be removed or altered in any way. The information is written to the log as a message. The message contains the name of the administrator who issued the command and the full text of the command. The command is logged regardless of whether it was valid or not.

4.4.4.3 Tivoli Storage Manager administration interfaces

Tivoli Storage Manager supports different types of administration interfaces for *administrative clients* separated from the Tivoli Storage Manager server program. This allows the Tivoli Storage Manager administrator to control the whole Tivoli Storage Manager environment centrally from the Tivoli Storage Manager server system itself or decentrally from his or her office desk or from home.

Depending on the operating system platform the administrator wants to use for managing the Tivoli Storage Manager server, two interfaces are available:

- Tivoli Storage Manager administrative command line interface
- Tivoli Storage Manager Web based administrative interface

On AS/400 systems, only a command line interface is available. This interface is similar to entering commands into a Windows command prompt screen. Once the Tivoli Storage Manager command line interface is started, commands are entered at the `adsm>` prompt. Tivoli Storage Manager usually returns some output to the screen and then redisplay the `adsm>` prompt again.

The AS/400 administrative client code is installed during Tivoli Storage Manager code installation. Before using this client, however, you need to configure the client option file.

Setup the AS/400 administrative client option file

Like the server, the administrative client also has an option file. It is named `QOPTADSM (CLIENTOPT)` and is located in library `QUSRADSM`.

By updating the AS/400 administrative option file, you can change:

- The communication method that the AS/400 administrative client will use to communicate with the server.
- The display parameters that define how the output (to screen or to file) will look.

You can start editing this file by using one of the following options:

- By selecting option 3, **Change administrative client options**, from the Tivoli Storage Manager Utilities menu
- By entering the `CHGADMADSM` command

You will get the following screen:

Change Administrative Client (CHGADMADSM)

Type choices, press Enter.

Server working library

QUSRADSM

Name, *CURLIB

Communication method >

*IP

Name, *SAME, *SNA, *IP

Communication side information

QANRCSI

Name, *SAME

TCP/IP port

1500

1024-32767, *SAME

Remote location >

'192.168.137.159'

Display parameters:

Language

ENU

*SAME, ENU, ENP, ESP

Date format

*MDY

*SAME, *MDY, *YMD, *DMY

Date separator

/

*SAME, /, -, .

Time format

':'

*SAME, :, ,, ., 12HR

Number format

1

1-6, *SAME

Bottom

F3=Exit F4=Prompt F5=Refresh F12=Cancel F13=How to use this display

F24=More keys

The *communication method* parameter lets you choose the communication protocol used to communicate with the server. The client defaults to APPC. We recommend that you change this to TCP/IP. You will get a better response time between the server and the AS/400 administrative client.

The *Communication side information* parameter specifies the name of the side information object (*CSI) that contains the information necessary to communicate with the Tivoli Storage Manager server through APPC.

The *TCP/IP port* specifies the port which will be used for TCP/IP communication. It must be the same as was defined in the server option file, and cannot be the same as the value used for the HTTP port.

The *Display parameters* specify how information will be displayed to the administrative client. Language, date format, time format, and number formats can be controlled.

Starting the AS/400 administrative client

To start the administrative client, either choose option 5, **Start administrative client**, from the Tivoli Storage Manager main menu, or enter the STRADMADSM command:

The following screen is displayed:


```

                                Start Administrative Client (STRADMADSM)

Type choices, press Enter.

Administrator name . . . . . adsmadmin

Password . . . . .

Server working library . . . . . QUSRADSM      Name, *CURLIB

Bottom
F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
F13=How to use this display   F24=More keys

```

Fill in the administrator name and password. As described in 4.4.2, “Initialize the Tivoli Storage Manager server” on page 88, a default administrator, with the ID and password, was created at the initialization process. You can use these here.

On a successful start-up, Tivoli Storage Manager displays the following screen from which you can issue Tivoli Storage Manager administration commands:

```

                                Administrative Client Session

Previous administrative commands and messages:

Tivoli Storage Manager
Command Line Administrative Interface - Version 3, Release 1, Level 0.3
(C) Copyright IBM Corporation, 1990, 1999, All Rights Reserved.

Session established with server ADSM: AS400
Server Version 3, Release 1, Level 2.41
Server date/time: 02/10/2000 00:55:47  Last access: 02/10/2000 00:06:54

adsm>

Enter Administrative Command
===>

```

If the startup is not successful, there may have been a problem with setting up your communication.

You can also start the AS/400 administrative client as a batch job to issue multiple commands as a so-called macro without any interaction through an administrator.

```

===> SBMJOB CMD(STRADMADSM ADMINNAME(adsmadmin) PASSWORD(adsmadmin)
      WRKLIB(qusradsm) MACINF(qusradsm/macro) MACINMBR(register)) job(register)

```

This example shows how to start a macro in batch mode. For more details on this topic, see 9.4.1, “Tivoli Storage Manager Macros” on page 226.

Stopping an AS/400 administrative session

To end an administrative client session, type the Tivoli Storage Manager `QUIT` command on the Tivoli Storage Manager command prompt and press **Enter** as asked on the screen.

```
Administrative Client Session

Previous administrative commands and messages:

Session established with server ADSM: AS400
Server Version 3, Release 1, Level 2.41
Server date/time: 02/10/2000 00:55:47 Last access: 02/10/2000 00:06:54

adsm>
> quit

ANS8002I Highest return code was 0.

Press ENTER to end ADSM administrative client session.
Enter Administrative Command
===>
```

4.4.4.4 Tivoli Storage Manager administrative command line modes

The Tivoli Storage Manager administrative command line client can be started in two special modes to fulfill special monitoring requirements. These modes are:

- **Console mode** allows you to monitor all server activities as they occur. For example, you can monitor migration processes and clients logging on to Tivoli Storage Manager. You can **not** enter any Tivoli Storage Manager administrator commands in this mode.
- **Mount mode** only displays sequential volume related mount messages and offers the feature to confirm if a mount was performed by an operator.

The console mode option is not supported on the AS/400 administrative client, but you can simulate console mode by specifying the `CSLMSGQ` option (console message queue) changing the server options file using the `CHGSVRADSM` command. The information can be viewed by entering the `DSPMSG ADSMMSGQ` command. You can turn off the console message queue by setting the `CSLMSGQ` parameter (option) to `*NONE` using the `CHGSVRADSM` command.

You can also change the Tivoli Storage Manager message queue delivery mode to `*BREAK` using the following command:

```
===> CHGMSGQ MSGQ(QUSRADSM/ADSMMSGQ) DLVRY(*BREAK) SEV(*SAME)
```

This will display the message queue on the screen each time a new message arrives in the message queue. Modifying the `SEV` (message severity) parameter allows you to filter messages.

For command line administrative clients other than AS/400, you can use the console mode for your administrative client session to monitor Tivoli Storage Manager server activities.

To start an administrative client in console mode on Windows 95/98/NT platforms, perform these steps:

1. Go to the directory containing the executable program and enter the command to start the administrative command line in console mode:

```
> cd \program files\tivoli\tsm\saclient  
> dsmadmc -console
```

2. You are then prompted to enter your Tivoli Storage Manager administrator ID.
3. Enter your Tivoli Storage Manager administrator password.

You can also enter your user ID and password directly in the `DSMADMC` command by using the `ID` and `PASSWORD` options, respectively, if you do not want to be prompted for that information:

```
> DSMADMC -ID=administrator -PAssword=secret -CONsolemode
```

The mount mode option is also not supported on the AS/400 administrative client, but you can simulate mount mode by specifying the `MNTMSGQ` option (mount message queue) using the change server options command, `CHGSVRADSM`. When this option is specified, mount messages are sent to the specified message queue and these messages can then be viewed immediately.

You can turn off the mount message queue by setting the `MNTMSGQ` parameter (option) to `*NONE` using the `CHGSVRADSM` command.

To start an administrative client in mount mode on Windows 95/98/NT platforms:

1. Go to the directory containing the executable program and enter the command to start the administrative command line in console mode:

```
> cd \program files\tivoli\tsm\saclient  
> dsmadmc -mountmode
```

2. You are then prompted to enter your Tivoli Storage Manager administrator ID.
3. Enter your Tivoli Storage Manager administrator password.

You can enter your user ID and password directly in the `DSMADMC` command by using the `ID` and `PASSWORD` options, respectively, if you do not want to be prompted for that information:

```
> DSMADMC -ID=administrator -PAssword=secret -MOUNTmode
```

4.4.4.5 Web administrative interface

In Tivoli Storage Manager, the Web administrative interface is the primary interface for administration. It incorporates Java applets and provides the following functions:

- Tivoli Storage Manager enterprise console

The enterprise console displays Tivoli Storage Manager as a single entity in the enterprise. It is an interface that integrates Tivoli Storage Manager server and client functions for the administrator as a single application to manage Tivoli Storage Manager in a distributed environment.

- Server function

The Web administrative interface is a Tivoli Storage Manager server function and consists of an integrated Web server and a new HTTP server communications protocol.

- Browser requirements

The Web administrative interface can be used from any workstation running an HTML 3.0 compliant Web browser with support for Java 1.1.5 or higher. Netscape 4.03, 4.04, and 4.05 requires a JDK 1.1.5 upgrade for this support. Netscape 4.06 has the required Java support. Microsoft's Internet Explorer 4.01 has the required Java support.

- Security

Security for the Web administrative interface is based on enhanced logging of Web-based sessions, password restrictions, and administrator lockout capabilities.

- Administrative functions

The Web administrative interface can be used to perform all administrative functions graphically, and it provides a command line and server event viewer.

The Web administrative interface connects to a Tivoli Storage Manager server through the Web to present an interface to a true Tivoli Storage Manager administrator session. Using a Web browser means that you actually do not have to have any Tivoli Storage Manager code on the workstation.

To access the Web administrator interface, start your Web browser. In the Location or Address field, enter the URL: `http://<servername>:1580`, where `<servername>` is the TCP/IP DNS name or dotted IP address of your Tivoli Storage Manager server machine, and 1580 is the TCP/IP port number set by the HTTPPORT option.

Figure 34 shows the Web administrative interface logon screen.

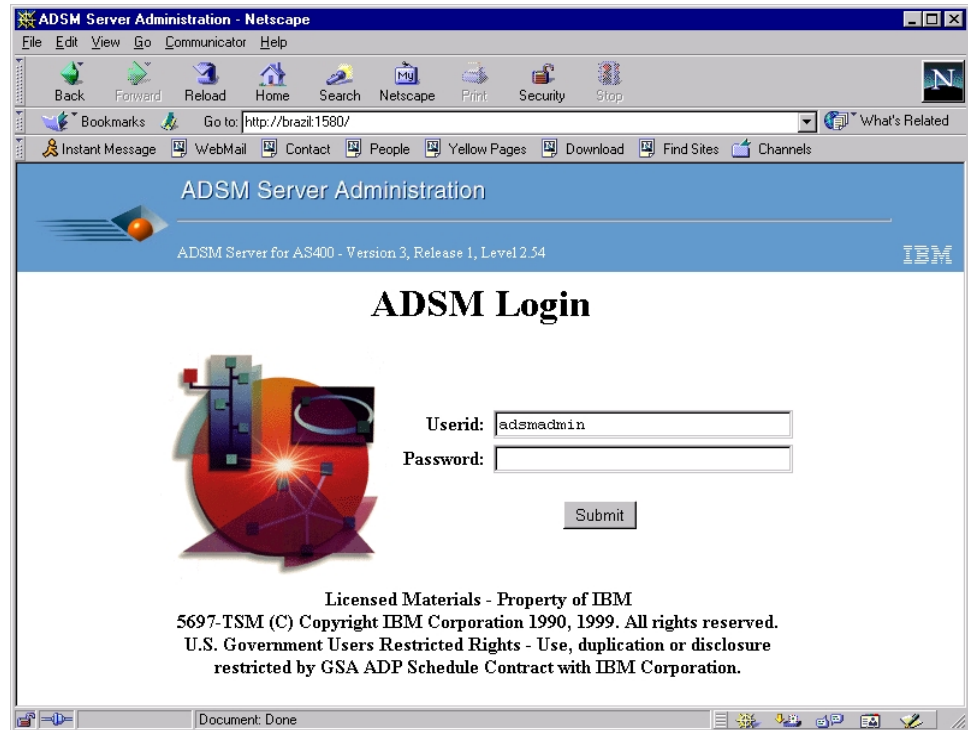


Figure 34. Web administrator logon screen

4.4.5 Setup of disk storage pool volumes

As described in 4.4.2, “Initialize the Tivoli Storage Manager server” on page 88, during Tivoli Storage Manager server initialization, a basic Tivoli Storage Manager server configuration is done. Part of this initialization is the creation of structures to use disk storage for storing backup and archive data. Storage pools with the names: BACKUPPOOL, ARCHIVEPOOL, and SPACEMGPOOL are created.

These default pools have no physical space allocated yet. In order to use them, you must allocate physical disk space to the storage pools in the form of storage pool volumes. In order to complete the setup of the Tivoli Storage Manager server, you need to do this now. See Chapter 6, “Server Storage Management” on page 139, where you will get a more comprehensive and complete overview of Tivoli Storage Manager storage management.

Storage pool volumes for disk storage on an AS/400 system are physical files. These files need to be created, formatted, and, later on, connected to the Tivoli Storage Manager storage pools. Before you can create volumes, you need to estimate their sizes.

4.4.5.1 Estimate disk storage needs

To estimate the size of the initial disk storage pool, remember that the first Tivoli Storage Manager backup for each client is a full backup, and, thereafter, Tivoli Storage Manager does incremental backups forever. That means that during start-up, the Tivoli Storage Manager disk storage pools need to be large enough to hold a complete backup of at least one backup client. On an ongoing basis, it should be enough to hold all the data from one night’s incremental backup of all

the clients. If the start-up size is larger than the ongoing size, define multiple volumes of appropriate sizes so that unneeded volumes can be removed later.

Note

You may have insufficient disk space to allocate temporary storage pool volumes to hold the initial full backup, if so, and provided that there is a tape or optical storage defined for migration from the disk storage pool, the full backup will still be able to complete but will take more time.

As a rule of thumb, you can estimate the disk storage needed using the formula presented in Figure 35.

$$\text{Estimated Data to Transmit Each Day} = \frac{\text{Number of Clients} \times \text{Avg Size of Disks} \times \text{Avg Disk \% Full} \times \text{Avg Amount of Data Changing Per Day} \times \text{Avg Data Compression}}{1}$$

Figure 35. Volume size estimation

In this formula:

Number of clients is the number of clients doing backups on the server.

Average size of disks is a sum of all disks used by clients and their sizes. For example: Client 1 disk 1 * disk 1 size + Client 2 disk A *size disk A + Client 2 disk B +...)/ number of disks

Average disk% full is the percentage of occupation of all the client disks.

Average amount of data changing per day is generally about 5 percent on a client, 20 percent on a file server, and more than 40 percent on a database server.

Average data compression has the following implications: Tivoli Storage Manager allows compression of data on the client prior to sending it to the Tivoli Storage Manager server. Before using it, take into account the speed of the network, the client CPU speed, and whether the Tivoli Storage Manager server storage devices are capable of compression

For example, older CPUs (less than a Pentium II 100 Mhz) may run slowly because the CPU cannot compress enough to keep the network connection busy.

The compression ratios are between 3:1 and 4:1 for database files, 2:1 for printer and file server data, and 1:1 for executable data.

4.4.5.2 Create disk volumes

You have the choice to create and format Tivoli Storage Manager volumes as AS/400 stream file stored in the Integrated File System (IFS)

To create a subdirectory for a storage pool volume use the CRTDIR command:

```

                                Create Directory (CRTDIR)

Type choices, press Enter.

Directory . . . . . /tsmvol/stgpool

Public authority for data . . . *EXCLUDE      Name, *INDIR, *RWX, *RW...
Public authority for object . . *NONE      *INDIR, *NONE, *ALL...
      + for more values
Auditing value for objects . . . *SYSVAL    *SYSVAL, *NONE, *USRPRF...

                                                                Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

To create disk volumes and format disk volumes, select option 5, **Create Volume for ADSM**, from the Tivoli Storage Manager Utilities menu or use the CRTVOLADSM command.

The following example shows the volume creation as a named backup01 in the /tsmvol/stgpool subdirectory:

```

                                Create Volume for ADSM (CRTVOLADSM)

Type choices, press Enter.

Volume type . . . . . > *STMF      *FILE, *STMF
Volume:
  Volume stream file . . . . . /tsmvol/stgpool/backup01

  Volume size . . . . . 500        Megabytes
  Replace volume . . . . . *NO      *NO, *YES
      + for more values

                                                                Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Create and format all volumes for all your storage pools from this screen.

- Specify a unique name for the volume file (in our example, we chose BACKUP01 for BACKUPPOOL storage pool and ARCHIVE01 for the ARCHIVEPOOL storage pool).
- The default size for a disk storage pool volume allows only 12 MB of client data to be backed up to server disk. For test purposes, you may want to format enough space to support one client You can add more space later. If you are testing Tivoli Storage Manager with a client that has a 500 MB hard drive, you may want to specify 500 MB for this file. Depending on the size of the space being allocated, this command can take some time to run.

4.4.5.3 Register volumes at server

You now need to define (associate) volumes to storage pools from an administrative client. From this one, enter the `DEFINE VOLUME` administrative command:

```
tsm: ADSM>def vol backuppool /tsmvol/stgpool/backup01
ANR2206I Volume /TSMVOL/STGPOOL/BACKUP01 defined in storage pool BACKUPPOOL
(deviceclass DISK).
```

Repeat this operation for all volumes you created.

4.4.5.4 Verification

For information on volumes you created, enter the `QUERY VOLUME` command:

```
tsm: ADSM>query volume
```

VOLUME NAME	STORAGE POOL NAME	DEVICE CLASS NAME	ESTIMATED CAPACITY (MB)	PCT UTIL	VOLUME STATUS
/TSMVOL/STGPOOL/BACKUP01	BACKUPPOOL	DISK	500.0	0.0	ON-LINE

```
tsm: ADSM>
```

The above screen shows that the volume name `BACKUP01` is already assigned to the storage pool `BACKUPPOOL`, and it belongs to the `DISK` device class. It is not yet used (0 percent utility), and it is online, which means it is accessible for use.

4.4.6 Registering client nodes

A Tivoli Storage Manager client, or a *node*, must be *registered* to the Tivoli Storage Manager server before any backup and recovery operations can be performed for that client. Tivoli Storage Manager provides two modes, open and closed registration, for registering client nodes to the server:

- **Open registration:** This lets you automatically register your workstation to the server as a node. When you connect for the first time, the Tivoli Storage Manager server prompts you for a password and contact information and registers the workstation as a client node with the server. An administrator can later change these values.
- **Closed registration:** Only an administrator can register clients as nodes. The administrator has to enter the following information: node name, password and optional contact information, and so-called policy domain. For more information about this, refer to Chapter 7, “Tivoli Storage Manager policy and automation” on page 173.

For security reasons and to have better control, it is recommended that you do not change the closed mode default.

The registration of a client node is a single-step process using the `REGISTERNODE` command. Registration requires a Tivoli Storage Manager node name and a client access password as a minimum. You should use the machine name for the Tivoli Storage Manager node name unless you specify a node name in the backup-archive client option file.

Use an administrative command line to enter the command. For example, to register a node named `ITSO02` with password `GEHEIM`:

```
tsm: ADsm>REGister Node ITSO02 GEHEIM CONtact='Hans'
```

As soon as you register a node, you are able to back up, archive, restore, and retrieve files to and from the Tivoli Storage Manager/400 server.

Note

- When using the AS/400 application client API, the registration must be closed. User IDs and passwords must be assigned by a Tivoli Storage Manager administrator prior the connection of the client to the server. This is due to the Tivoli Storage Manager APIs not supporting an automated registration facility. AS/400 users must have Tivoli Storage Manager administrators manually register the node name and password for the AS/400 system user.
- When using the AS/400 application client API, you should limit the password length to eight characters. If you have more than eight characters, several Tivoli Storage Manager functions, when in conjunction with BRMS/400, will not work without showing error messages. This problem has been fixed. You should apply the Backup Recovery Solutions Group PTF SF99075(V4R3) or SF99076(V4R4). More information is available at :

<http://as400service.ibm.com/supporthome.nsf>

Chapter 5. Setting up a BRMS API client on an AS/400 system

As briefly discussed in Chapter 3, “Tivoli Storage Manager and the AS/400 system” on page 51, by using BRMS/400 application client for Tivoli Storage Manager, it is possible to integrate an AS/400 system as a client in a Tivoli Storage Manager environment.

This chapter explains the prerequisites and tasks required in order to set up the BRMS application client on an AS/400 system. In this chapter, you will also find an example of how to perform the first backup and restore with this client and what changes need to be made to the Tivoli Storage Manager server to make the best use of the client.

5.1 BRMS application client functionality

The client contains a set of APIs, enabling the backup and restore of data to any Tivoli Storage Manager server. All backup and archive functions supported by BRMS can be saved to a Tivoli Storage Manager server instead of a local device. However, it must be noted that there are limitations imposed by the use of this client when compared to conventional Tivoli Storage Manager backup/archive clients on other platforms.

The BRMS application client was initially developed to cater to remote AS/400 sites that had little or no AS/400 knowledge. The idea was that once a system administrator had performed a complete backup of the system using BRMS or the native OS/400 save commands, the user data could then be transferred across a network to a Tivoli Storage Manager server at a remote site. This ensures that the user data is backed up on a regular basis, rather than having to rely on unskilled staff to change tapes and perform backups.

The BRMS application client is not a fully-functioning Tivoli Storage Manager backup-archive client. It is more like an interface between existing BRMS functions and a Tivoli Storage Manager server, as shown in Figure 36.

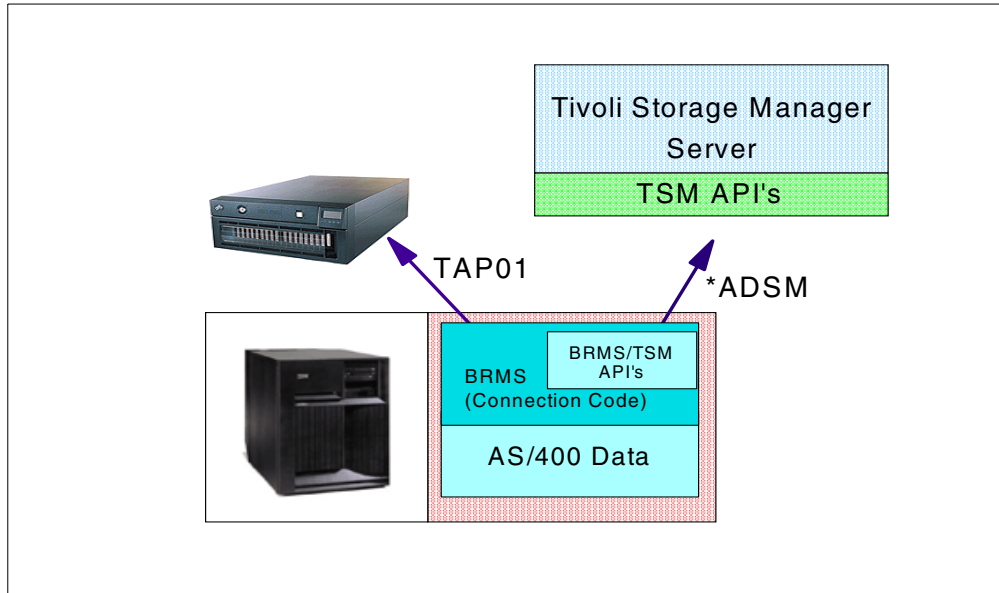


Figure 36. BRMS application client

More details on the functional differences between the BRMS API client and the native Tivoli Storage Manager backup-archive clients can be found in the following sections.

5.1.1 User interface

Unlike other TSM clients such as for Unix, there is no backup-archive command line, GUI, or HTTP client on the AS/400 system. All operations are carried out using BRMS commands and menus.

5.1.2 Operating system backup

Because of the way the AS/400 operating system works, the operating system can only be saved to a local device; so, the only way to save the operating system is through the native save commands or by using BRMS.

Because of this, you cannot fully recover an AS/400 system using only the DRM functions of Tivoli Storage Manager.

5.1.3 User data backup

Only user data can be backed up to the Tivoli Storage Manager server. System libraries, security objects, configuration objects, IBM supplied libraries and licensed programs cannot be backed up in this way. These objects need to be saved locally using BRMS or the native OS/400 save commands in order to fully protect the client.

The BRMS Application client can be used to save all types of user data, such as spool files, physical files, logical files, query definitions, and much more. Do not forget that BRMS can also save DLO files, such as those used by OfficeVision/400, and IFS files. More and more applications are using IFS files; Lotus Domino is an example — all the mail and address books are kept in the IFS. Since there is not currently a connect agent available for Lotus Domino, it is

recommended to end the Domino server before backing up the files to avoid data inconsistencies.

5.1.4 Disaster recovery manager

An AS/400 client cannot make use of the bare metal restore functions of Tivoli Storage Manager. This is because the architecture of the AS/400 and OS/400 operating systems makes it impossible to do so.

For a complete disaster recovery solution, you should use either BRMS or a mixture of BRMS and Tivoli Storage Manager. Tivoli Storage Manager could be used as a simple way of storing the user data, with BRMS used to save all the system data on a local tape device.

BRMS will then keep track of all of its local saves and the remote saves to the Tivoli Storage Manager server. BRMS will produce a recovery plan that lists activities required to recover the locally-saved system data and the remotely-saved user data from the Tivoli Storage Manager server.

For an example of how to recover from a complete system disaster, see Chapter 10, “AS/400 backup and recovery scenarios” on page 261.

5.1.5 Scheduling

Operations cannot be automated using the Tivoli Storage Manager server's central scheduling function. Schedules can be created, however, by using the AS/400 built-in job-scheduling commands. See the example in 5.5, “BRMS application client schedules” on page 133 for more details.

5.1.6 Node registration

There are two ways to register nodes (clients) on Tivoli Storage Manager servers. Either each node must be specifically defined by the Tivoli Storage Manager server administrator (closed registration), or a node can be automatically added to a policy domain by the client itself when first contacting the Tivoli Storage Manager server (open registration).

Open registration will not work with the BRMS application client; so, before an AS/400 client can perform operations to the Tivoli Storage Manager server, its node must be defined by the system administrator.

For further details on closed and open registration, see 4.4.6, “Registering client nodes” on page 108.

5.1.7 BRMS media information and object retention

BRMS media information cannot be saved to the Tivoli Storage Manager server. This data must be saved to local media. Tivoli Storage Manager policies are not used to determine object retention and expiration periods. This is handled through BRMS media policies. To understand why this is the case, you need to understand how files are saved to a Tivoli Storage Manager server using the BRMS application client.

Think of each control group in BRMS as producing a number of save files, but before the save file is saved to disk, it is intercepted by the BRMS application client and sent to the Tivoli Storage Manager server instead.

BRMS will keep track of the objects within this Tivoli Storage Manager file, and when they have all expired, BRMS will mark the file so that Tivoli Storage Manager server may delete it.

See Chapter 7, “Tivoli Storage Manager policy and automation” on page 173 for more information on object expiration.

5.1.8 Policy domains

We recommend that any AS/400 clients be added to a special Tivoli Storage Manager policy domain (a policy domain is a group of clients with similar needs) that does not have any associated schedules. Also, if archive operations are to be performed using BRMS and saved using the BRMS application client, two management classes should be created; otherwise, the archived data will be stored in the same storage pools as the backup data.

For our example later in this chapter, we set up the Tivoli Storage Manager server with a policy domain that retained data for 365 days and a copy group that kept one version of each BRMS save file. For a detailed example of this setup, see 7.2, “Setting up data storage policies” on page 174.

5.1.9 Control groups

Control groups are BRMS definitions of logical groups of libraries and objects that possess similar backup, retention, and recovery requirements. Control groups allow you to define the order in which backup and archive processing occur.

Think of a control group as the BRMS equivalent of a Tivoli Storage Manager incremental or archive command, with some of the parameters found in a conventional Tivoli Storage Manager client's option file built in.

5.1.10 Client options file

The client options file on an AS/400 system is a member called APIOPT in the file QOPTADSM. A sample of this file can be found in the member APIOPTSMP found in the file QAANSDOC in library QANSAPI.

This options file does not hold details on any include/exclude lists. The options file on an AS/400 system should not need to be modified in any way. All configuration is done through control groups.

5.1.11 Include/exclude list

There is no conventional include/exclude list on the BRMS application client.

By default, when the AS/400 client starts a backup, all items on the AS/400 system are excluded unless specifically listed in the control group.

5.1.12 Performance

Performance varies depending on configuration. See Chapter 13, “Care and feeding” on page 323 for recommendations obtained from our tests. Generally, the performance obtained through the use of the BRMS application client will be significantly lower than through a conventional Tivoli Storage Manager Backup-Archive client.

5.2 Prerequisites

Before the BRMS application client can be installed, various hardware and software requirements must be satisfied.

5.2.1 Hardware requirements

Since the BRMS application client requires BRMS, the hardware requirements for BRMS itself must first be met.

BRMS will run on any AS/400 RISC model using all types of AS/400 tape media, devices and libraries.

For more details on BRMS requirements, refer to the book *Backup, Recovery, and Media Services for AS/400*, SC41-5345.

The BRMS application client requires approximately 6 MB of disk space.

5.2.2 Software requirements

OS/400 and BRMS V4R3 or higher is the minimum requirement for using the BRMS application client. In order for BRMS to function, the Media and Storage Extensions (MSE) feature of OS/400 must be installed prior to BRMS installation.

The latest PTFs should also be applied to the system. Visit the following Web site for details on BRMS, the BRMS application client for Tivoli Storage Manager, and PTF levels:

<http://www.as400.ibm.com/service/brms/adsmclnt.htm>

Full details on how to install MSE and BRMS can be found in *Backup, Recovery, and Media Services for AS/400*, SC41-5345.

5.2.3 Communications requirements

The BRMS application client will communicate with a Tivoli Storage Manager server using either APPC or TCP/IP.

Examples on how to create TCP/IP connections can be found in Appendix A, "Setting up TCP/IP on an AS/400" on page 349.

For further details on TCP/IP and APPC, see the following publications:

- *OS/400 TCP/IP Configuration and Reference V4R3*, SC41-5420
- *OS/400 Communications Configuration V4R1*, SC41-5401

5.2.4 Installing the BRMS applications client

There are two ways of obtaining the BRMS application client: Either from the separate CD that accompanies the BRMS installation media or by downloading from the Internet at <ftp://index.storsys.ibm.com/adsm/fixes/v3r1/as400api/> via anonymous ftp.

5.2.4.1 Installing from CD-ROM

To install the product from CD-ROM, perform these steps:

1. Load the CD into the drive, and then type in the command `RSTLICEPM (5733197) DEV(OPT01)` to restore the licensed program.

Note

The `dev` parameter must be changed to fit the particular installation device used. The `LICPGM` parameter refers to the IBM supplied seven digit product identification code for the BRMS application client (5733197).

2. When restored, check the joblog with the `DSRJOBLOG` command:
3. Look for any error messages relating to the restore. If there are errors, correct them and try again.
4. Apply PTFs, if applicable.

5.2.4.2 Downloading and installing from the Internet

The code can also be downloaded from the internet into an AS/400 save file.

Perform the following steps:

1. It is generally best to create a separate library for the code to be downloaded into. Enter the command `CRTLIB ADSSAPI` to create a library called `ADSSAPI`.
2. A save file then needs to be created in this library. Enter the command `CRTSAVF ADSSAPI/APISAVF` to create a save file called `APISAVF`.
3. Enter `CLRSAVF ADSSAPI/APISAVF` to clear the contents of the save file.
4. The next step is to connect to the relevant internet site to download the file. You should type in the command `ftp index.storsys.ibm.com` to start FTP and connect to the `index.storsys.ibm.com` Web site.

The site will then ask for a login name. We used user name `anonymous` and one of our own E-mail addresses as the password.

5. Once connected to the site, change the directory of the remote system by typing in the change directory command and the path: `cd adm/fixes/v3r1/as400ap`
6. The next step is to get a directory listing by using the `DIR` command. Read any *readme* files that exist to check on requirements.
7. To download the code, the file transfer type must be changed to binary. Type `binary` at the FTP command prompt.
8. Next, enter `LCD ADSSAPI` to change the current library of the local machine to the one where the save file resides (`ADSSAPI` in our example).
9. Obtain the remote file by using the `GET api400r.cli41 APISAVF` command. The file to download is called `api400r.cli41`, and the save file to put this into is the one created earlier (in our example, we used `APISAVF`).
10. When the file transfer has completed, quit FTP by typing in the `QUIT` command on the FTP command line.
11. Now that the file exists on the AS/400 system, the code can be extracted using the restore licensed program command:

```
RSTLICPGM LICPGM(5733197) DEV(*SAVF) SAVF(ADSSAPI/APISAVF)
```


Note

If your system does NOT run with language US2924, then you may experience the problem that only *BASE will be installed. *LNG will not be restored properly. To solve this problem, issue the restore licensed program command a second time with the following options: RSTLICPGM LICPGM(5733197) DEV(*SAVF) OPTION(*LNG) LNG(2924) SAVF(ADSM API/APISAVF) .

12. Once the restore has finished, check the job log for errors with the DSPJOBLOG command.

13. Apply PTFs, if applicable.

5.2.5 Verifying installation

To verify that all the required software is in place, type in the display software resources command DSPSFWRSC.

You will see all Software Resources installed on your system. Page down the screen until you find the following resource options:

- 5769SS1 Option 18 OS/400 — Media and Storage Extensions
- 5769BR1 Option *Base — Backup Recovery and Media Services for AS/400
- 5733197 Option *Base — ADSTAR Distributed Storage Manager API
- PTF SF53289 — PTF for ADSM API to increase Performance

Display Software Resources

System: NINJA

Resource

ID	Option	Feature	Description
5769999	*BASE	5050	AS/400 Licensed Internal Code
5769SS1	*BASE	5050	Operating System/400
5769SS1	*BASE	2924	Operating System/400
5769SS1	1	5050	OS/400 - Extended Base Support
5769SS1	1	2924	OS/400 - Extended Base Support
5769SS1	2	5050	OS/400 - Online Information
5769SS1	2	2924	OS/400 - Online Information
5769SS1	3	5050	OS/400 - Extended Base Directory Support
5769SS1	3	2924	OS/400 - Extended Base Directory Support
5769SS1	12	5050	OS/400 - Host Servers
5769SS1	12	2924	OS/400 - Host Servers
5769SS1	18	5103	OS/400 - Media and Storage Extensions
5769SS1	20	5050	OS/400 - Advanced 36
5769SS1	20	2924	OS/400 - Advanced 36

More...

Press Enter to continue.

F3=Exit F11=Display libraries/releases F12=Cancel
F19=Display trademarks

Display Software Resources

System: NINJA

Resource

ID	Option	Feature	Description
5769BR1	*BASE	5050	Backup Recovery and Media Services for AS/400
5769BR1	*BASE	2924	Backup Recovery and Media Services for AS/400
5769BR1	1	5101	BRMS/400-Network Feature
5769BR1	2	5102	BRMS/400-Advanced Functions Feature
5648C54	*BASE	5050	IBM Host On-Demand
5648C54	*BASE	2929	IBM Host On-Demand
5769PW1	*BASE	5050	Application Development ToolSet/400 -SEU
5769PW1	*BASE	2924	Application Development ToolSet/400 -SEU
5733197	*BASE	5050	ADSTAR Distributed Storage Manager API
5733197	*BASE	2924	ADSTAR Distributed Storage Manager API
5769DG1	*BASE	5050	IBM HTTP Server for AS/400
5769DG1	*BASE	2924	IBM HTTP Server for AS/400
5769JV1	*BASE	5050	AS/400 Developer Kit für Java
5769JV1	1	5050	Java Developer Kit 1.1.6

More...

Press Enter to continue.

F3=Exit F11=Display libraries/releases F12=Cancel
F19=Display trademarks

If anything is missing, the BRMS Applications Client will not work. Verify that you took the correct installation steps for installing the API code, and check the book, *Backup Recovery and Media Services for AS/400*, SC41-5345, for how to install BRMS and OS/400 option 18.

5.3 Configuring the BRMS application client

There are two parts to configuring a Tivoli Storage Manager API client implementation. The first part is to create a new node on the Tivoli Storage Manager server and, optionally, to create a separate policy domain. The second part is to create the necessary configuration objects on the client.

5.3.1 Configuring the Tivoli Storage Manager server

Because the BRMS application client is an API, open registration will not work. Therefore, a node has to be created on the server first. Refer to 4.4.6, "Registering client nodes" on page 108 for details on node registration.

For this setup example, there was a node created on the server called APPN.NINJA with the password LOBSTER.

It is also recommended that a separate policy domain and management class be created for any AS/400 clients. Refer to 7.2, "Setting up data storage policies" on page 174.

We created a domain called `AS400` with a management class called `AS400` with specific parameters to make the best use of Tivoli Storage Manager server storage space.

5.3.2 Configuring the client

From the BRMS point of view, `TSM_SERVER` acts as a new storage location for BRMS. This implies that before you can use Tivoli Storage Manager to store backup data, you need to introduce this new storage location to BRMS. This includes:

- Defining a new BRMS storage location for Tivoli Storage Manager server
- Setting up a media policy for objects that are supposed to be stored in Tivoli Storage Manager server
- Adding a new device to BRMS representing Tivoli Storage Manager server as a receiver of data

The following sections provide a step-by-step guide to assist you in performing these configuration steps in order to connect an AS/400 system using the BRMS application client to a Tivoli Storage Manager server.

5.3.2.1 Add storage location

The first step is to add a location for the Tivoli Storage Manager server in BRMS. BRMS locations are areas where media is kept, such as an on-site safe or off-site vault, or when used in conjunction with the BRMS application client, a Tivoli Storage Manager server location. Type in the `WRKLOCBRM` command on the AS/400 command line.

You will arrive at the following `Work with Storage Locations` screen.

```
Work with Storage Locations                                NINJA

Position to . . . . .                                Starting characters

Type options, press Enter.
  1=Add  2=Change  3=Copy  4=Remove  5=Display  6=Work with media
  7=Work with containers

Opt  Location      Volumes  Containers  Text
  1   TSM_SERVER
      *HOME          0         0  Entry created by BRM configuration
      VAULT          0         0  Entry created by BRM configuration

Bottom

F3=Exit  F5=Refresh  F12=Cancel
```

Type `1` in the `Opt` field to add a location, and type the name of the location (`TSM_SERVER` in this instance) in the `Location` field next to it. Press **Enter** to continue to the next screen.

Add Storage Location

Type choices, press Enter.

Storage location	TSM_SERVER	Name
Address line 1	Computer Room	
Address line 2	Area 51	
Address line 3	Nowheresville	
Address line 4		
Address line 5		
Contact name		
Contact telephone number.		
Retrieval time0	Hours
Allow volumes to expire	*NO	*YES, *NO
Media slotting	*NO	*YES, *NO
Text	Tivoli Storage Manager Server ASM12	

Default values should be kept in the `Allow volumes to expire` and `Media slotting` fields. When finished, press **Enter**. A message will appear at the bottom of the screen stating that the location has been added. Press **F3** to exit from this screen and get to a command line.

5.3.2.2 Add media policy

Next, a media policy is created. Media policies are used to determine the retention periods required for saved objects. Objects can have a permanent retention period, a specific number of versions can be kept, or they can be kept for a specific number of days or until a specific date is reached.

Media policies also determine where objects are saved. This can be to a tape device, save file, or Tivoli Storage Manager server.

If different retention periods are required for different libraries or objects, create more than one media class, and specify the different media class to use in each control group.

Type in the command `GO BRMPCY` to get to the BRMS Policy Administration screen:

Then, take option 7 to go to the Work with Media Policies screen. The screen shows any existing media policies. Several media policies are automatically created when BRMS is installed; these will have the words `Entry created by BRM configuration` in the text field unless someone has changed them. From this screen, media policies can be created, deleted, copied, changed, and displayed.

Work with Media Policies		NINJA
Position to		Starting characters
Type options, press Enter		
1=Create 2=Change 3=Copy 4=Delete 5=Display		
Opt Policy	Text	
1 AD\$M		
ARCHIVAL	Entry created by BRM configuration	
FULL	Entry created by BRM configuration	
INCR	Entry created by BRM configuration	
SAVSYS	Entry created by BRM configuration, then changed by Marcus	
Bottom		
F3=Exit F5=Refresh F9=System policy F12=Cancel		

Type a 1 in the Opt field to add a new policy and type the policy name in the Policy field; in our case, we chose the policy name AD\$M. You can use any name you want for the policy, but it makes sense to choose a name indicating that the policy is for use with Tivoli Storage Manager servers. Press **Enter** to reach the parameter screen.

Create Media Policy		
Type choices, press Enter.		
Media policy	AD\$M	Name
Retention type	2	1=Date, 2=Days, 3=Versions, 4=Permanent
Retain media	35	Date, Number
Move policy	*AD\$M	Name, *NONE, *AD\$M, F4
Media class	*AD\$M	Name, *SYSPCY, *AD\$M, F4
Storage location	TSM_SERVER	Name, *ANY, F4 for list
Save to save file	*NO	*YES, *NO
ASP for save files	*SYSTEM	Name, *SYSTEM, 1-16
Save file retention type	4	1=Date, 2=Days, 3=Permanent, 4=None
Retain save files	*NONE	Date, Number, *NONE
ASP storage limit	*SYS	*SYS, 1-99
Secure media	*AD\$M	*YES, *NO, *AD\$M
Text	*NONE	
More...		
F3=Exit F4=Prompt F5=Refresh F12=Cancel		

In the Move policy, Media class and Secure media fields, enter *AD\$M. In the Storage location field, we set the parameter to match the location we created earlier (TSM_SERVER). Pressing **Enter** brings up the final fields to be filled in.

Create Media Policy

Type choices, press Enter.

Required volumes	*NONE	*NONE, 1-9999
Mark volumes for duplication . . .	*NO	*NO, *YES
ADSM management class	AS400	
ADSM security:		
ADSM node	APPN.NINJA	
ADSM password	LOBSTER	Name, *NONE

Bottom

F3=Exit F5=Refresh F12=Cancel

Fill in the `ADSM Management Class` field with the name of the AS/400-specific management class defined by the Tivoli Storage Manager server administrator. We used the management class `AS400` as specified in 5.3.1, “Configuring the Tivoli Storage Manager server” on page 118.

Next, fill in the `ADSM node` and `ADSM password` fields with the relevant details. We used Tivoli Storage Manager node `APPN.NINJA` and password `LOBSTER` as specified in 5.3.1, “Configuring the Tivoli Storage Manager server” on page 118.

5.3.2.3 Create options file

Before the ADSM device can be created, you need to create an options file for use by the API. The file does not have to contain anything, but it has to exist before you can go on to the next step. Create the file using the create source physical file command; enter `CRTSRCPF FILE(QUSRBRM/QOPTADSM) MBR(APIOPT)` on an AS/400 command line.

This command will create a source file called `QOPTADSM` in the library `QUSRBRM`. A member called `APIOPT` will be created in the file.

5.3.2.4 Add device

Perform the following steps to create a BRMS device for ADSM. A BRMS device is any AS/400 device that has been defined to BRMS.

1. Type `GO BRMMED` to go to the BRMS Media Management screen.
2. Take option 8 to work with devices.

Work with Devices	NINJA
Position to	Starting characters

Type options, press Enter.

1=Add 2=Change 4=Remove 5=Display
8=Work with status

Opt	Device	Category	Type/Model	Text
1	TSM_SERVER	*NET		
	TAP01	*TAP	6382/001	Entry created by BRM configuration

Bottom

F3=Exit F5=Refresh F12=Cancel

- Next, type 1 in the `Opt` field to add a new device, and then type in the name of the device (we chose `TSM_SERVER`) and the device category (because our system used TCP/IP, we used `*NET` to indicate the device is a Tivoli Storage Manager server using TCP/IP communication protocol). Press **Enter** to reach the next screen.

Add Net Device

Net device : `TSM_SERVER`

Type choices, press Enter.

Text Tivoli Storage Manager server in Area 51

Location `TSM_SERVER` Name, F4 for list

ADSM file space `*LCL`

Buffer size 512 `*DEVTYPE`, 1-512 KB

Internet address 9.5.62.78

Internet port 1500 1-65534

F3=Exit F4=Prompt F12=Cancel

- Add some meaningful text relating to the location of the Tivoli Storage Manager server. Change the location to the one created in 5.3.2.1, "Add storage location" on page 119 (we used `TSM_SERVER`).

Note: Do not touch the ADSM file space parameter unless you have a complete understanding of how Tivoli Storage Manager uses file space names.

- Change the buffer size parameter from `*DEVTYPE` to a value of 512 for the best performance. PTF SF53289 must be applied to the Tivoli Storage Manager APIs in order to use buffer sizes greater than 64 KB.
- Change the Internet address field to show the IP address of the Tivoli Storage Manager server, and change the Internet port field to that used for client communications on this server (the default is 1500).

Everything is now in place to enable backups to occur to a Tivoli Storage Manager server.

5.4 Verify correct setup

As mentioned earlier, the AS/400 client does not work in the same way as the other Tivoli Storage Manager backup/archive clients. All operations are performed through BRMS commands and menus. Backups and archives are performed using a BRMS control group.

The following gives you a description of how to set up a BRMS control group in order to back up data to the Tivoli Storage Manager server. It also shows you how to do a simple backup and restore operation to help verify that the setup is correct. For more practical backup and recovery scenarios, refer to Chapter 10, "AS/400 backup and recovery scenarios" on page 261.

5.4.1 Set up BRMS backup control group

Here is a simple example of how we configured a control group to verify the Tivoli Storage Manager connection. A BRMS control group is a group of objects that have a common set of backup characteristics.

Enter `GO BRMBKUPLN` to go to the Work with Backup Control Groups screen:

Take option 2 to work with control groups from the Work with Backup Control groups menu.

```
Work with Backup Control Groups                                NINJA

Position to . . . . . Starting characters

Type options, press Enter
  1=Create   2=Edit entries   3=Copy   4=Delete   5=Display
  6=Add to schedule  8=Change attributes  9=Subsystems to process ...

      Control      Full      Incr      Weekly
Opt Group  Media      Media      Activity
1  ADSM      Policy      Policy      SMTWTFS  Text
   *BKUGRP    *BKUPCY    *BKUPCY    *BKUPCY  Entry created by BRM configura
   *SYSGRP    SAVSYS      SAVSYS      *BKUPCY  Entry created by BRM configura

Bottom
F3=Exit      F5=Refresh  F7=Work with BRM scheduled jobs
```

From this screen, you can add, remove, and modify control groups. There may be other control groups already configured; some may be the default BRMS control groups that BRMS creates when it is first initialized.

Create a new group by typing a 1 in the `Opt` field and the name of the group in the `Control Group` field. Select a name for this control group (we used `ADSM`) and press **Enter**. Pressing Enter takes you to the Edit Backup Control Group Entries screen.

```
Edit Backup Control Group Entries                                NINJA

Group . . . . . : ADSM
Default activity . . . . . *BKUPCY
Text . . . . . *NONE

Type information, press Enter.

      Backup      List      Weekly      Retain      Save      SWA
Seq  Items      Type      Activity      Object      While      Message
10   adsmapi      Type      SMTWTFS      Detail      Active      Queue

      (No control group entries found)

F3=Exit      F5=Refresh      F10=Change item
F11=Display exits      F12=Cancel      F24=More keys
```

The next step is to specify the items to be backed up, bearing in mind the limitations mentioned earlier and only user data being allowed.

The above screen is used to add, remove, or change all entries that should be backed up in this control group. For each entry, you can specify the weekly

activity (on what days to do a full and incremental backup), the object detail (whether to keep track of all objects or not), and whether to save the objects while they are or are not in use. See the BRMS/400 book for more details on control group entries.

Type in the sequence number of the item to be backed up in the `Seq` field. The sequence number determines the order in which backup items are processed. Next, type in the name of the item in the `Backup Items` field and press **Enter**. In our example, we chose to back up the library `ADSMAPI`.

To add another entry, simply type a new sequence number in the `Seq` field and a new library name in the `Backup Items` field. If you wanted this new item to be processed before the first library you entered, give it a sequence number of less than 10. If you want it processed after the first library, give it a sequence number of more than 10. When **Enter** is pressed, BRMS will re-order the items in increments of 10 starting at 10.

```

Edit Backup Control Group Entries                                NINJA

Group . . . . . : ADSM
Default activity . . . . . *BKUPCY
Text . . . . . *NONE

Type information, press Enter.

Seq      Backup      List      Weekly      Retain      Save      SWA
         Items       Type      Activity    Object      While     Message
                               SMIWTFS    Detail     Active     Queue

      10    ADSMAPI                *DFTACT    *YES      *NO

Bottom
F3=Exit                F5=Refresh          F10=Change item
F11=Display exits      F12=Cancel          F24=More keys
  
```

Change the retain object detail field to `*YES`. This will allow you to easily recover individual objects from the library being saved to Tivoli Storage Manager. With object detail specified as `*YES`, individual objects can be recovered from a list of saved objects. If object detail is set to `*NO`, in order to retrieve an individual object, you must know the exact name and library that the object was stored in.

```

Exit Edit Backup Control Group Entries

Type choice, press Enter.

Option . . . . . 1      1=Save and exit session
                        2=Exit without saving session
                        3=Resume session

F12=Cancel
  
```

To save changes take option 1, and then press **Enter**. This takes you back to the Work with Backup Control Groups display.

The next task is to change the attributes of the control group so that it uses the Tivoli Storage Manager server for saves rather than local media.

```

Work with Backup Control Groups                                NINJA

Position to . . . . . Starting characters

Type options, press Enter
  1=Create   2=Edit entries   3=Copy   4=Delete   5=Display
  6=Add to schedule  8=Change attributes  9=Subsystems to process ...

      Control      Full      Incr      Weekly
Opt Group      Media      Media      Activity
      Policy      Policy      SMTWTFS      Text

      *BKUGRP      *BKUPCY      *BKUPCY      *BKUPCY      Entry created by BRM configura
      *SYSGRP      SAVSYS      SAVSYS      *BKUPCY      Entry created by BRM configura
8  ADSM      *BKUPCY      *BKUPCY      *BKUPCY      *NONE

Bottom
F3=Exit      F5=Refresh      F7=Work with BRM scheduled jobs
F9=Change backup policy      F23=More options      F24=More keys

```

Type option 8 (Change attributes) next to the ADSM control group and press **Enter** to get the Change Backup Control Group Attributes screen to appear.

```

Change Backup Control Group Attributes

Group . . . . . : ADSM

Type information, press Enter.

Media policy for:
  Full backups . . . . . ADSM      Name, F4 for list
  Incremental backups . . . . . ADSM      Name, F4 for list
  Backup devices . . . . . TSM_SERVER      Name, F4 for list

Parallel device resources:
  Minimum resources . . . . . *NONE      1-32, *NONE, *AVAIL
  Maximum resources . . . . .          1-32, *AVAIL, *MIN
  Sign off interactive users . . . . . *BKUPCY      *YES, *NO, *BKUPCY
  Sign off limit . . . . . *BKUPCY      0-999 minutes, *BKUPCY
  Default weekly activity . . . . . *BKUPCY      SMTWTFS (F/I), *BKUPCY
  Incremental type . . . . . *BKUPCY      *CUMUL, *INCR, *BKUPCY

More...

F3=Exit      F4=Prompt      F12=Cancel

```

Change the Full backups and Incremental backups media policy fields to match the name of the Tivoli Storage Manager media policy created in 5.3.2.2, “Add media policy” on page 120 (ADSM in our example). Change the backup devices field to the name of the ADSM device created in 5.3.2.4, “Add device” on page 122 (TSM_SERVER in our example).

Scroll down to the next screen to continue with the changes.

```

Change Backup Control Group Attributes

Group . . . . . : ADSM

Type information, press Enter.

Automatically backup
  media information . . . . . *NONE      *LIB, *OBJ, *NONE, *BKUPCY
  Save access paths . . . . . *BKUPCY    *YES, *NO, *BKUPCY
  Save contents of save files . . . . . *BKUPCY    *YES, *NO, *BKUPCY
  Data compression . . . . . *BKUPCY    *DEV, *YES, *NO, *BKUPCY
  Data compaction . . . . . *BKUPCY    *DEV, *NO, *BKUPCY
  Target release . . . . . *BKUPCY    *CURRENT, *PRV, *BKUPCY
  Clear . . . . . *BKUPCY    *NONE, *ALL...
  Object pre-check . . . . . *BKUPCY    *YES, *NO, *BKUPCY
  Append to media . . . . . *BKUPCY    *YES, *NO, *BKUPCY
  End of tape option . . . . . *BKUPCY    *UNLOAD, *REWIND...
  Journalled objects . . . . . *BKUPCY    *YES, *NO, *BKUPCY
  Use optimum block size . . . . . *BKUPCY    *BKUPCY, *DEV, *YES, *NO
  Text . . . . . *NONE

F3=Exit  F12=Cancel

More...

```

Change the Automatically backup media information field to *NONE. This stops BRMS from storing the media information on the Tivoli Storage Manager server since BRMS needs this information in order to be able to create a recovery report for this control group.

Press **Enter** to finish. Everything is now in place to allow the client to back up to the server!

5.4.2 Performing a test backup

To ensure that everything has been configured correctly, perform a test backup. BRMS control groups can be run either as a batch job or interactively. This means either running as a background process, or running on the screen.

For a more detailed explanation of the differences between batch and interactive jobs and the effects of these jobs on system resources, refer to *OS/400 Work Management*, SC41-5306.

5.4.2.1 Running backups interactively

To start a backup, type the command `STRBKUPBRM` to start a backup using BRMS, and then press **F4** to prompt the command. When typing in commands on an AS/400 command line, pressing the F4 key will bring up a list of parameters that can be associated with the command.

Press **F4** to prompt the command to get the following screen:

Start Backup using BRM (STRBKUBRM)

Type choices, press Enter.

Control group	ADSM	*BKUGRP, *SYSGRP, ADSM
Schedule time	*IMMED	hhmm, *IMMED
Submit to batch	*NO	*CONSOLE, *YES, *NO
Starting sequence:		
Number	*FIRST	1-9999, *FIRST
Library	*FIRST	Name, *FIRST
Append to media	*CTLGRPATR	*CTLGRPATR, *BKUPCY, *YES...

Bottom

F3=Exit F4=Prompt F5=Refresh F12=Cancel F13=How to use this display
F24=More keys

Fill in the `Control group` field with the name of the test control group created in 5.4.1, “Set up BRMS backup control group” on page 124 (`ADSM` in our example).

To run the control group job interactively, change the `Submit to batch` field to `*NO`. If you are saving a large amount of data, you should submit the job to batch so that you do not affect other users on the system by using up too many resources. Our example is only saving a small amount of data; one library containing one object (the BRMS application client save file); so, it is suitable to run interactively. Leave the other fields with default values.

Press **Enter** to run the job.

While the job is running, an X (system busy indicator) will appear at the bottom left-hand side of the display, and you will not be able to type anything on the command line. When finished, the X will disappear; you can now proceed to checking the BRMS log as shown in 5.4.3, “How to check the success of your backup” on page 129.

5.4.2.2 Running backups in batch

To start a backup, type the `STRBKUBRM` command (as shown in the previous section) to start a backup using BRMS, and then press **F4** to prompt the command:

Start Backup using BRM (STRBKUBRM)

Type choices, press Enter.

Control group	ADSM	*BKUGRP, *SYSGRP, ADSM
Schedule time	*IMMED	hhmm, *IMMED
Submit to batch	*YES	*CONSOLE, *YES, *NO
Starting sequence:		
Number	*FIRST	1-9999, *FIRST
Library	*FIRST	Name, *FIRST
Append to media	*CTLGRPATR	*CTLGRPATR, *BKUPCY, *YES...

Bottom

F3=Exit F4=Prompt F5=Refresh F12=Cancel F13=How to use this display
F24=More keys

Fill in the `Control group` field with the name of the test control group created in 5.4.1, “Set up BRMS backup control group” on page 124 (ADSM in our example).

To run the control group as a batch job, ensure that the `Submit to batch` field is set to `*YES`. Leave the other fields with default values. Press **Enter** to run the job.

If the `Schedule time` parameter is left at the default value of `*IMMED`, the job will be submitted to a job queue immediately. To check the state of your job, you can type in the work with the submitted jobs AS/400 command `WRKSBMJOB *JOB`.

The above command shows all jobs submitted from your current interactive session. You should see your job called `ADSM` with a status of `ACTIVE`.

```
Work with Submitted Jobs                                NINJA                                02/14/00  19:37:31
Submitted from . . . . . :  *JOB

Type options, press Enter.
  2=Change  3=Hold  4=End  5=Work with  6=Release  7=Display message
  8=Work with spooled files

Opt  Job      User      Type      -----Status-----  Function
   AD  ADSM    HGROSS    BATCH      ACTIVE                  CMD-STRBKUBRM

Bottom
Parameters or command
====>
F3=Exit  F4=Prompt  F5=Refresh  F9=Retrieve  F11=Display schedule data
F12=Cancel
```

If the job status is not `ACTIVE`, do not panic! There may be other jobs running on the system. Unless you know about AS/400 job queues and subsystems, you should contact your AS/400 system administrator before taking further action.

5.4.3 How to check the success of your backup

To check that the backup has completed, check the BRMS log by entering the `DSPLOGBRM` command and then pressing **F4**.

You will be presented with a screen like the following:

```

Display Log for BRM (DSPLOGBRM)

Type choices, press Enter.

Type . . . . . *ALL          *ALL, *ARC, *BKU, *MED...
Time period for log output:
  Start time and date:
    Beginning time . . . . . *AVAIL      Time, *AVAIL
    Beginning date . . . . . *CURRENT    Date, *CURRENT, *BEGIN
  End time and date:
    Ending time . . . . . *AVAIL      Time, *AVAIL
    Ending date . . . . . *CURRENT    Date, *CURRENT, *END
Severity . . . . . 00              00-99
Output . . . . . *                *, *PRINT

Bottom
F3=Exit   F4=Prompt  F5=Refresh  F10=Additional parameters  F12=Cancel
F13=How to use this display  F24=More keys

```

This screen can be used to tailor the range of BRMS log entries that you want to look at. You can specify a time and date range. You can also specify a message type and severity level.

Change the date and time parameters if required, and then press **Enter**. The screen that appears next shows you the BRMS log entries; refer to *Backup, Recovery, and Media Services for AS/400*, SC41-5345, for an explanation of these log entries.

Typical BRMS log entries will look like this:

```

Display BRM Log Information          NINJA
2/14/00 19:41:38                    Position to . . . . 2/14/00

----- 2/14/00 -----
Begin processing for control group ADSM type *BKU.
Interactive users are allowed to stay active.
Starting save of library ADSMAPI to devices TSM_SERVER.
Member QA1AS00234 added to output file QA1AS00234 in library QUSRBRM.
2 objects saved from library ADSMAPI.
Control group ADSM bypassed automatic save of media information.
Last run date for BRM maintenance was 02/12/00.
Control group ADSM type *BKU processing is complete.

Press Enter to continue.

F3=Exit      F5=Refresh      F12=Cancel      F17=Top      F18=Bottom

```

Look for a message like `Control group ADSM type *BKU processing is complete`. This indicates that the backup for control group ADSM (the one we created in our example) has finished normally. You can see from the messages higher up that two objects were saved from library ADSMAPI.

For further information on entries in the log, press the **F1** key while the cursor is positioned on the log entry that you are interested in. If the above backup were to fail, the message *Control group ADSM type *BKU ended abnormally* would be seen above. Pressing **F1** on this message would give you some clues as to what may have gone wrong.

5.4.4 Performing a test restore

The last part of the test is to try and recover an object that we have backed up earlier. Because it is just a test, we do not want to overwrite the original object. That is why we create a test library, `ADSMTEST`, where we want to store the restored object using the `CRITLIB ADSMTEST` command:

Type `GO BRMRCY` to start the BRMS recovery menu and perform the BRMS recovery.

Then, take option 2 to get to the Perform Recovery menu. Next, take option 6 to work with saved objects. You will get the following screen:

```
Work with Saved Objects (WRKOBJBRM)

Type choices, press Enter.

Object . . . . . *ALL      Name, *ALL
Library . . . . . adsmapi   Name, *ALL
Type . . . . . *ALL      Character value, *ALL
Select dates:
  From date . . . . . *BEGIN   Date, *CURRENT, *BEGIN, nnnnn
  To date . . . . . *END      Date, *CURRENT, *END, nnnnn
Save status . . . . . *ALL     *ALL, *NOERROR, *ERROR
Object information . . . . . *ALL *ALL, *OBJ, *DLO, *MBR
Sequence option . . . . . *SAVDAT *SAVDAT, *OBJ, *LIB
From system . . . . . *LCL
Output . . . . . *          *, *PRINT

Bottom
F3=Exit  F4=Prompt  F5=Refresh  F12=Cancel  F13=How to use this display
F24=More keys
```

Fill in the `Library` parameter with the name of the library saved in the control group you created earlier (in our example, this is `ADSMAPI`), and then press **Enter**.

At the next screen, type 7 in the `Opt` field next to the object to restore. In our example, this is the `APISAVF` object.

```
Work with Saved Objects                                NINJA

Position to Date . . . .

Type options, press Enter.
  4=Remove  5=Display  6=Work with media  7=Restore object
  9=Work with saved members

Opt Object      Library      Type      Save      Save      Volume      Message
 7 APISAVF      ADSMAPI      *FILE     Date      Time      ID
2/14/00  19:37:13  *ADSM

Bottom
F3=Exit  F12=Cancel
```

Then, press **Enter**. The `Select Recovery Items` screen will appear:

Select Recovery Items

NINJA

Type options, press Enter. Press F16 to select all.

1=Select 4=Remove 5=Display

Opt	Object	Library	Type	Save Date	Expiration Date	Volume	Message ID
1	APISAVF	ADSMAPI	*FILE	2/14/00	*VER 002	*ADSM	

Bottom

F3=Exit F5=Refresh F9=Recovery defaults F12=Cancel

Press **F9** to work with the recovery defaults.

Select Recovery Items

NINJA

Type options, press Enter. Press F16 to select all.

.....

:

:

Restore Command Defaults

:

:

Type information, press Enter.

:

:

Device *MEDCLS Name, *MEDCLS

:

:

End of tape option *REWIND *REWIND, *LEAVE, *UNLOAD

:

:

Option *ALL *ALL, *NEW, *OLD, *FREE

:

:

Data base member option *ALL *MATCH, *ALL, *NEW, *OLD

:

:

Allow object differences *ALL *NONE, *ALL, *AUTL...

:

:

:

Document name generation *SAME *SAME, *NEW

:

:

Restore to library **ADSMTEST** Name, *SAVLIB

:

:

Auxiliary storage pool ID *SAVASP Name, *SAVASP, 1-16...

:

:

Restore into folder

:

:

*SAME

:

:

:

F12=Cancel

Change the Allow object differences parameter to ***ALL**. This lets BRMS restore the object to a different library than the one from which it was initially saved.

Type the name of the library to restore to in the Restore to library field. Our example shows the library **ADSMTEST** (we created this earlier in this section).

Pressing **Enter** takes you back to the select recovery items menu. Pressing **Enter** again will start the restore process as displayed on the next screen:


```

Select Recovery Items                                NINJA
:
:               Display Recovery Items                NINJA  :
:               19:42:23                               :
:   Remaining items . . . . :                      1       :
:   Remaining size . . . . :          3.1703 M   100.0 %    :
:
:               Save      Expiration      Message      :
:   Object      Library   Type      Date      Date      Volume  ID      :
:   APISAVF     ADSMAPI   *FILE     2/14/00   *VER 002   *ADSM   :
:
:   Press ATTN key to cancel recovery after current item completes.
:   Restoring object APISAVF for library ADSMAPI from ADSM device TSM_SERVER.
:.....

```

Pressing the **ATTN** key (this is normally mapped to the **Esc** key on PC keyboards) will abort the operation.

When the restore has completed, a screen like the following will appear:

```

Work with Saved Objects                                NINJA
Position to Date . . . .
Type options, press Enter.
  4=Remove  5=Display  6=Work with media  7=Restore object
  9=Work with saved members

Opt Object      Library   Type      Save      Save      Volume  Message
      APISAVF     ADSMAPI   *FILE     Date      Time      ID
      2/14/00    19:37:13 *ADSM

Bottom
F3=Exit  F12=Cancel
1 objects restored from ADSMAPI to ADSMTEST.

```

Type `DSPLIB ADSMTEST` to verify that the ADSMTEST library has had the object restored into it.

This will show a list of all objects in the ADSMTEST library. The object ADSMSAVF should be in this list.

5.5 BRMS application client schedules

Because of the limited functionality of the Tivoli Storage Manager API, there is no facility to make use of the centrally-managed scheduling feature of Tivoli Storage Manager servers using the BRMS application client. Therefore, if backups need to be scheduled, this must be done using the AS/400 job scheduling functions.

This can be done either from within BRMS or by using the `ADDJOBSCDE AS/400` command. A brief explanation and example of how to do this with BRMS follows. For more specific information you should refer to the book *Backup Recovery and Media Services for AS/400*, SC41-5435.

Adding control groups to schedules using BRMS:

This is, perhaps, the easiest method. Use the work with BRMS control groups command `WRKCTLGBRM`.

Press **F4** to prompt the command as shown in the following screen:

```
Work with Control Groups (WRKCTLGBRM)

Type choices, press Enter.

Type . . . . . *BKU          *BKU, *ARC, *MGR
Output . . . . . *           *, *PRINT

Bottom
F3=Exit  F4=Prompt  F5=Refresh  F12=Cancel  F13=How to use this display
F24=More keys
```

Change the `Type` parameter to reflect what type of control group you wish to work with: either `*BKU` for backup control groups or `*ARC` for archive control groups. In our example, we chose `*BKU`. Press **Enter** to continue.

```
Work with Backup Control Groups                NINJA

Position to . . . . . Starting characters

Type options, press Enter
 1=Create  2=Edit entries  3=Copy    4=Delete  5=Display
 6=Add to schedule  8=Change attributes  9=Subsystems to process ...

      Control      Full      Incr      Weekly
Opt Group      Media      Media      Activity
      Policy      Policy      SMTWTFS  Text

      *BKUGRP      *BKUPCY      *BKUPCY      *BKUPCY  Entry created by BRM configura
      *SYSGRP      SAVSYS      SAVSYS      *BKUPCY  Entry created by BRM configura
6  ADSM      ADSM      ADSM      *BKUPCY  *NONE

Bottom
F3=Exit      F5=Refresh  F7=Work with BRM scheduled jobs
F9=Change backup policy  F23=More options  F24=More keys
```

To schedule a control group, you should type `6` in the `Opt` field next to the control group you want to add. In our case, we are scheduling the `ADSM` control group that we created earlier.

Pressing **Enter** will bring up a confirmation screen where the exact scheduling details can be determined.

```

Add Job Schedule Entry (ADDJOBSCDE)

Type choices, press Enter.

Job name . . . . . > QBRMBKUP      Name, *JOB
Command to run . . . . . > STREKUBRM CTLGRP (ADSM) SBMJOB(*YES)

Frequency . . . . . > *WEEKLY      *ONCE, *WEEKLY, *MONTHLY
Schedule date, or . . . . . > *NONE   Date, *CURRENT, *MONTHSTR...
Schedule day . . . . . > *ALL       *NONE, *ALL, *MON, *TUE...
      + for more values
Schedule time . . . . . > '23:00'    Time, *CURRENT

More...
F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
F13=How to use this display   F24=More keys

```

Figure 37. Work with control groups

The `Job name` field can be changed from the default of `QBRMBKUP` to something else if desired.

The `Frequency` field should be left at `WEEKLY`, and the `Schedule date` field should be left at `*NONE` if the control group should be run on the days listed in the `Schedule day` field every week. This is probably the most common setting. For a more complex schedule, check with the book *Backup Recovery and Media Services for AS/400*, SC41-5345. Our example will run every week.

To select which days to run the control group on, modify the `Schedule day` field accordingly. Pressing **F4** while the cursor is positioned on the `Schedule day` field provides a list of available options. Our example runs on every day of the week.

The time to run the backup is specified in the `Schedule time` field. Our example will run at 11:00pm.

Press **Enter** to confirm all parameters. A confirmation message that reads *Job schedule entry QBRMBKUP number XX added* will appear at the bottom of the screen.

5.6 Changing the node password

To change the node password for an AS/400 client, you need to update the information stored in the BRMS media policy. Type `WRKPCYBRM *MED` to bring up the Work with Media Policies screen.

```

Work with Media Policies                                NINJA

Position to . . . . . Starting characters

Type options, press Enter
1=Create 2=Change 3=Copy 4=Delete 5=Display

Opt Policy      Text

2 ADSM          *NONE
ARCHIVAL       Entry created by BRM configuration
FULL           Entry created by BRM configuration
INCR           Entry created by BRM configuration
SAVSYS         Entry created by BRM configuration
YASH           MEDIA POLICY FOR NT ADSM SERVER

Bottom

F3=Exit  F5=Refresh  F9=System policy  F12=Cancel

```

Type 2 in the `Opt` field next to the ADSM media policy (called ADSM in our example) then press **Enter** to go to the Change Media Policy screen. Scroll down until you reach the ADSM security section of the media policy as shown in the next screen:

```

Change Media Policy

Media policy . . . . . : ADSM

Type choices, press Enter.

Required volumes . . . . . *NONE      *NONE, 1-9999
Mark volumes for duplication . . . *NO      *NO, *YES
ADSM management class . . . . . AS400

ADSM security:
  ADSM node . . . . . APPN.NINJA
  ADSM password . . . . . LOBSTER      Name, *SAME, *NONE

Bottom

F3=Exit  F5=Refresh  F12=Cancel

```

To change the password, type the new password in the `ADSM password` field, and then press **Enter**. This only changes the password on the BRMS application client not on the Tivoli Storage Manager server. Make sure the Tivoli Storage Manager server administrator has changed the node definition to match your new password. See 4.4.6, “Registering client nodes” on page 108 for details on how to do this.

5.7 Restoring to a different AS/400 system

Conventional Tivoli Storage Manager backup/archive clients can easily restore objects that have been backed-up by different compatible machines, by changing the node name and password in the client options file. This works because Tivoli Storage Manager holds the database of files that have been backed up on the Tivoli Storage Manager server.

When saving objects from an AS/400 client, the details of what objects are saved are not stored in the Tivoli Storage Manager database, but as BRMS objects on the client AS/400 system.

So, if you wanted to restore AS/400 data to a different AS/400 system, you would have to transfer the BRMS media information first. Full details on how to do this are found in the book *Backup, Recovery, and Media Services for AS/400*, SC41-5345.

Chapter 6. Server Storage Management

Tivoli Storage Manager stores all managed data centrally at a storage repository connected to the Tivoli Storage Manager server system. The storage repository can consist of one or more different storage devices, such as disk, tape, and optical devices. The Tivoli Storage Manager server program completely manages these storage resources and controls the placement of the client data using different storage management functions.

This chapter describes how to configure and define storage devices within the Tivoli Storage Manager server and how to implement storage management functions. It starts with a brief explanation of Tivoli Storage Manager entities to structure the storage repository. Then, we look at some of the important functions that can be used to customize your server, such as creating disk or tape storage.

Next, we take you through the steps required to set up disk and tape storage within Tivoli Storage Manager, to store client data, and to set up some of the storage management features. It was not part of this project to set up optical storage with Tivoli Storage Manager/400; however, this book presents a short overview about this topic without further practical details.

Furthermore, we have a section on some of the situations that may occur, such as running out of storage space. Also, we offer some ideas on how to decide whether to use an external tape management system, such as BRMS, to control the AS/400 tape libraries, or whether Tivoli Storage Manager should control them directly.

6.1 Storage pools and storage pool volumes

As explained in 2.2, “Tivoli Storage Manager” on page 31, all client data is stored in a central storage repository, which is connected to the Tivoli Storage Manager server. The storage repository can consist of one or more different physical storage devices, such as disk storage, optical devices, manual tape drives, or complete automated tape libraries, including multiple drives, an automated robot system, and a number of tape cartridges.

Clients do not know where the data has been finally stored in this storage repository. The only part of the Tivoli Storage Manager implementation that knows where data has been put is the Tivoli Storage Manager server program with its internal database. Figure 38 illustrates this fact.

Unlike most backup solutions, Tivoli Storage Manager is object-based rather than tape-based. An object can be a client file, a client directory, an AS/400 save file, a database table, or simply a piece of data. With the database, Tivoli Storage Manager tracks where objects have been saved rather than just being concerned with the whereabouts of tape volumes.

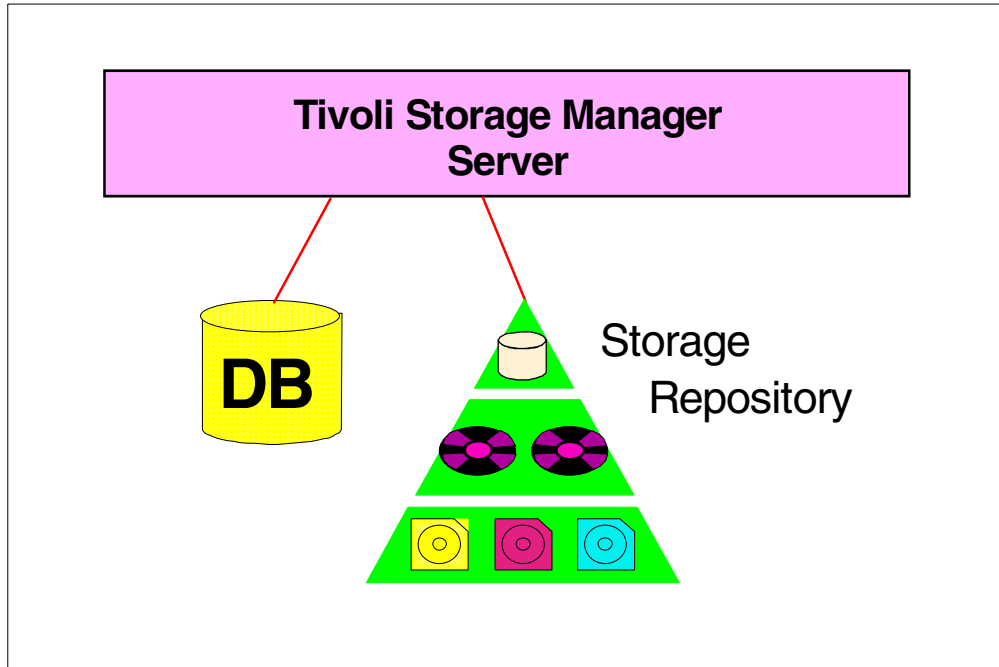


Figure 38. Tivoli Storage Manager server, database, and storage hierarchy

The storage repository is made up of any number of different *storage pools*. A pool is a type of storage media. Each pool consists of one or more *storage pool volumes* that are specific to that pool. Client data objects are stored in volumes. A volume can be either random access or sequential access. A *random access volume* is a disk volume. A *sequential access volume* can be either a tape, optical, or disk volume.

Random access volumes are accessed in a non-sequential manner. Sequential access volumes write all new data to the end of the volume. Sequential access disk volumes are disk space which will be accessed like a sequential storage space. They can be used for a variety of special purposes, such as Tivoli Storage Manager database backups on disk; however, in this book, we do not discuss them further.

A special class of sequential access volumes are known as *virtual volumes*. Virtual volumes are storage spaces physically connected to a remote Tivoli Storage Manager server system but logically part of the local storage repository. They can be employed to use other Tivoli Storage Manager server systems as overflow storage or to implement an electronic vaulting solution. See 9.8, "Virtual volumes" on page 243 for further details.

Furthermore, storage pools can be classified as *primary storage pools* and *copy storage pools* by taking into account the fact that data can be duplicated within the storage repository for availability and disaster recovery reasons. Primary storage pools are the place where the original client data will be stored; copy storage pools are the location where all the internal duplications of the client data are stored. Depending on whether or not the copy storage pools volumes are directly accessible by the Tivoli Storage Manager server software, there is also a classification into *on-site* or *off-site storage pools*. Details of how to create copy

storage pools can be found in Chapter 8, “Protecting the Tivoli Storage Manager/400 server” on page 193.

Some examples of storage pools are:

- Random access, primary storage disk pools — pre-defined areas of disk space known as disk volumes.
- Sequential access, primary tape pools — made up from a number of tape volumes, such as 3570 tape cartridges residing, for example, in a directly attached automated tape library, such as IBM 3570-C02.
- Sequential access, off-site copy tape pools — copies of one or more primary pools that are stored in a vault location for disaster recovery.

Each pool is categorized by type and format with a Tivoli Storage Manager *device class*. the device class describes how to access and use the storage pool volumes. Tape and optical pools are further described with Tivoli Storage Manager *library and drive* definitions. These definitions provide a logical description of the physical structure of the tape devices and their connection through the operating system, and represent the way volume handling will occur. Because this is very dependent on the operating system, we do not go deeper into this subject at this time. You will find more information on the relevant structures for an AS/400 system in 6.4, “Creating Tivoli Storage Manager tape storage” on page 147.

Tivoli Storage Manager storage pools are organized in a *storage pool hierarchy*, which allows data to be moved from one storage device to another. The Tivoli Storage Manager database keeps track of where the client data resides within the hierarchy. There is no limit to the size of the storage hierarchy.

A simple and common implementation will consist of just two levels: a disk-based storage pool that all clients back up to, and a tape-based storage pool. When the disk-based storage pool becomes full, data in the disk pool is *migrated* to the tape-based storage pool.

A more complex implementation will consist of any number of levels, perhaps utilizing the fastest available disks for the initial storage pool, then migrating to slower disks, then migrating to virtual volumes (virtual volumes are sequential access disk volumes that exist on another Tivoli Storage Manager server), and, finally, migrating to a tape library.

6.2 Storage management functions

The storage repository can be defined in such a way that client data is moved around transparently to the client to make the best use of all available storage or to reduce the time taken to restore a client's files. This is done by setting up different storage management functions related to the storage pools.

Important functions available to Tivoli Storage Manager administrators allow you to fine-tune the way storage management works. These functions include:

- Migration
- Reclamation
- Collocation
- Caching

This section provides an overview of how these functions work in the Tivoli Storage Manager storage management environment.

6.2.1 Migration

To move data from one primary storage pool to another, we use *migration*. Migration can be automatic or forced by a Tivoli Storage Manager administrator. In the normal operation, migration will be automatically controlled by these storage pool parameters:

- Migration thresholds
- Maxsize

The following section describes how to use these parameters to control the storage pools migration.

6.2.1.1 Migration thresholds

Thresholds are set on the primary storage pool holding the data that needs migrating. These thresholds determine when to trigger a migration process. The threshold is set as a percentage of the storage pool space that is used up. For example, if a storage pool had a high migration threshold of 70 percent, when the storage pool becomes 70 percent full of client data, the client data starts to migrate to the storage pool specified as destination in the storage pool definition. Refer to Figure 39.

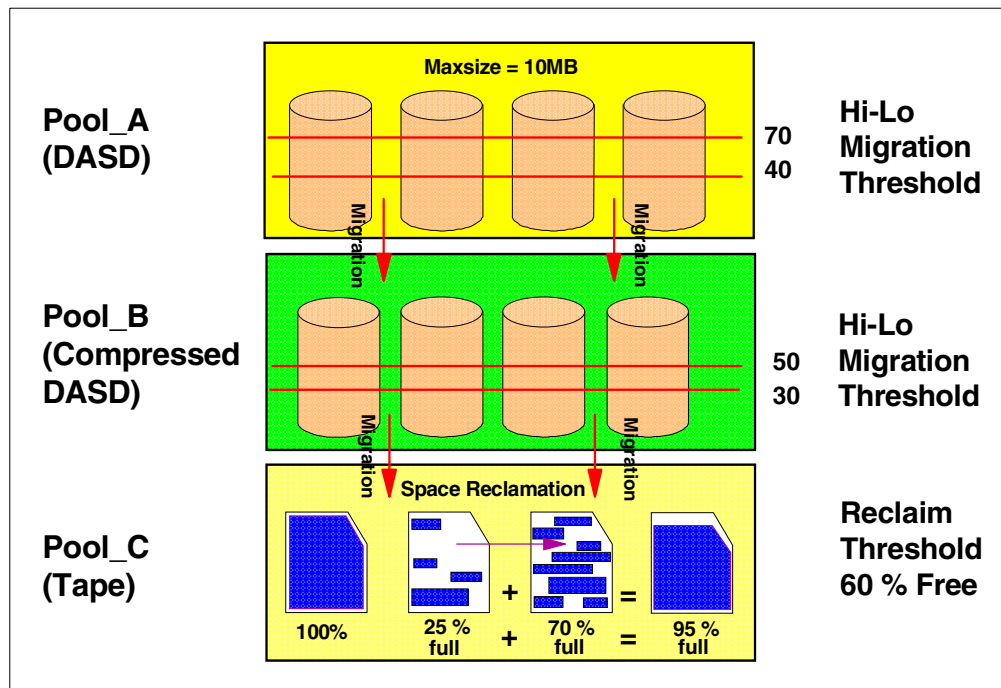


Figure 39. Migration example

In the example shown in Figure 39 on page 142, there are three storage pools:

- Pool_A - fast disk: The high migration threshold is 70 percent; the low migration threshold is 40 percent.
- Pool_B - compressed disk: The high migration threshold is 50 percent; the low migration threshold is 30 percent.
- Pool_C - tape: No migration to other pools occurs; however, reclamation is set at 60 percent. See 6.2.2, “Reclamation” on page 143 for more details.

Pool_A fills up with client data until the high migration threshold of 70 percent is reached. Once this is reached, data starts to migrate to the next level of storage, Pool_B in our example. Migration continues until Pool_A reaches the low migration threshold of 40 percent. While migration is occurring, client data can continue to fill up Pool_A until it becomes 100 percent full. When it becomes 100 percent full, client data will no longer be accepted until space becomes available. Client sessions will not end because of this; they will just be delayed until there is space available.

Pool_B will fill up with data from Pool_A until the high migration threshold of 50 percent is reached. This will trigger migration to occur to the next level of storage, Pool_C. This will continue until the low migration threshold of Pool_B is reached (30 percent). While migration is occurring from Pool_B to Pool_C, Pool_C will continue to fill up past the high migration threshold until it becomes 100 percent full. If Pool_C becomes 100 percent full, there will be no effect on client backup sessions, providing that there is still space available in Pool_A.

Tivoli Storage Manager starts migrating data by determining which client has the most data in the storage pool. It is this client's data that gets migrated first, then the next highest client, and so on. Tivoli Storage Manager tries to keep each client's data as unfragmented as possible.

6.2.1.2 Maxsize parameter

The maxsize parameter on a storage pool determines what happens to files that exceed a specified size. If this parameter is enabled, all files that are above the specified size are not stored in the target storage pool, but are instead moved to the next level of storage. We recommend making sure that the last storage pool in the hierarchy does not have this parameter set.

6.2.2 Reclamation

Reclamation is a storage management function that reduces the total number of tape volumes used by a storage pool. It is controlled by the reclamation threshold. This parameter is a percentage figure indicating the amount of free space that is available on a tape volume.

Over time, expiration processing will expire data on tapes, and when enough data has been expired to make tapes eligible for reclamation, Tivoli Storage Manager tries to combine the contents of tapes to reduce the total number of tapes used. An example is shown in Figure 40.

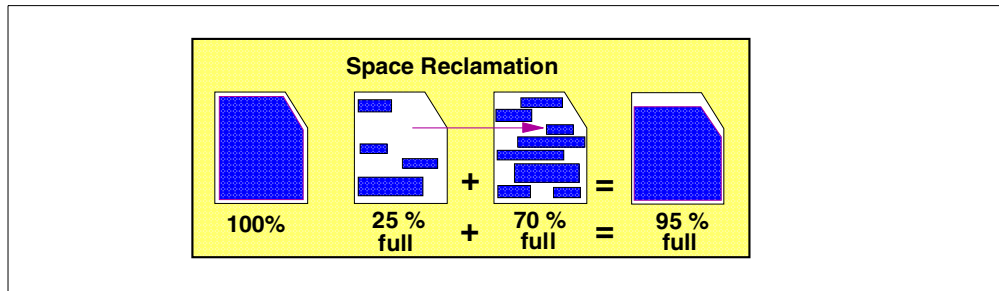


Figure 40. Reclamation example

It works like this: Pool_C contains a number of tape volumes. One is 25 percent full (this volume has more than 60 percent free space, so it is eligible for reclamation based on the reclamation threshold), and another is 70 percent full. With reclamation, Tivoli Storage Manager will move the contents of the tape that is 25 percent full onto the tape that is 70 percent full, therefore making one tape that is 95 percent full. This will leave one tape empty. This empty tape will be put back into the scratch pool for reuse.

6.2.3 Collocation

Collocation is a process used to keep the same client's data on the minimum number of tape or disk sequential volumes. The benefit of this is reduced restore times. The disadvantage is increased numbers of volumes used. Figure 41 shows an example.

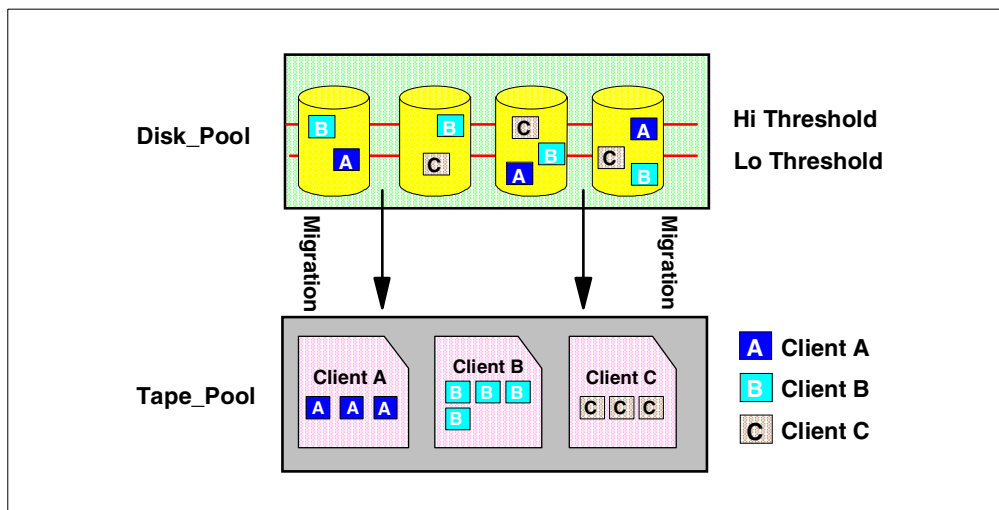


Figure 41. Collocation example

Data is stored from three clients into a storage pool called Disk_Pool. As migration occurs, client data is migrated to the Tape_Pool. With collocation, Tivoli Storage Manager attempts to keep all of the Client A data on one tape volume, all of the Client B data on another tape volume, and all of the Client C data on a third tape volume.

6.2.4 Caching

When *caching* is enabled and migration occurs, a copy of the migrated file is left in the disk storage pool until the space occupied by those files is required by incoming new files. This makes restores quicker; however, it can decrease the backup performance when files start being put into the cached storage pool. This is because, if cached files exist and the space is required for a backup, the cached files have to be removed by Tivoli Storage Manager first.

6.3 Creating Tivoli Storage Manager disk storage

Disk storage consists of either sequential or random access disk volumes that are associated with a storage pool. Random access disk volumes are used in the recovery log and Tivoli Storage Manager database. See 4.4.2, “Initialize the Tivoli Storage Manager server” on page 88 for more information on the recovery log and the database.

To use disk storage in the Tivoli Storage Manager server storage repository, you need to perform the following steps:

1. Create and format the physical disk volumes.
2. Define a disk storage pool within Tivoli Storage Manager.
3. Assign the physical disk volumes to the Tivoli Storage Manager storage pool.

The following sections give you a practical guide to performing these steps in order to use AS/400 disks as Tivoli Storage Manager storage pools within the storage repository.

6.3.1 Create and format volumes

The use of the root file system by the Tivoli Storage Manager server can significantly improve performance. Database, recovery log, and disk storage pool volumes can all be defined in the root file system.

These files will be created and formatted by an external Tivoli Storage Manager utility program. You can either start this utility program from the Tivoli Storage Manager (Go ADSM) Main Menu or with the `CRTVOLADSM` command typed into an AS/400 command line.

If you press **Enter** or prompt the above command with **F4**, the following screen appears:

```
Create Volume for ADSM (CRTVOLADSM)

Type choices, press Enter.

Volume type . . . . . > *STMF          *FILE, *STMF
Volume:
  Volume stream file . . . . . /tsmvol/stgpool/backup02

Volume size . . . . . 100              Megabytes
Replace volume . . . . . *NO           *NO, *YES
+ for more values
```

To create a volume called `backup02` in the directory library `/tsmvol/stgpool` with a size of 100 MB, fill in the screen as shown above. Pressing **Enter** will start creating and formatting the volume on your interactive job. You can also submit this as a batch job using the command:

```
SBMJOB CMD(CRTVOLADSM VOLTYPE(*STMF) VOLSTMF((' /tsmvol/stgpool/backup02'100))
```

Once a volume has been created, it needs to be defined to a storage pool.

6.3.2 Define storage pool

Choose a logical name for storage pools. For example, if you wanted to define a storage pool that is only intended for development staff to back up their data, use a name, such as `define stgpool development disk`.

The `disk` parameter is a type of device class that specifies this storage pool as being one that uses random access disk-based volumes.

To see all existing storage pools as well as the one you just created, use the `QUERY STGPOOL` command from a Tivoli Storage Manager administration command line interface. A screen similar to the following should then appear:

```
tsm: ADSM> query stgpool
```

STORAGE POOL NAME	DEVICE CLASS NAME	ESTIMATED CAPACITY (MB)	PCT UTIL	PCT MIGR	HIGH MIG PCT	LOW MIG PCT	NEXT STORAGE POOL
ARCHIVEPOOL	DISK	50.0	0.0	0.0	90	70	
BACKUPPOOL	DISK	2,200.0	30.2	30.2	90	70	3570_POOL
DEVELOPMENT	DISK	0.0	0.0	0.0	90	70	
3570_POOL	3570_CLASS	99,800.0	2.1	20.0	90	70	

```
tsm: ADSM>
```

Note that there is still no capacity assigned to that storage pool; this is because no volumes have been defined to it yet.

6.3.3 Define volumes to storage pools

Now that the volume and storage pool both exist, it is time to combine the two.

This is done with the `DEFINE VOLUME` command. This creates the link between storage pool and volume. The `DEFINE VOLUME DEVELOPMENT /tsmvol/stgpool/backup02` command defines a volume to the development storage pool. The volume `backup02` is being defined to directory `/tsmvol/stgpool` and can be found with `WRKLNK` command.

The storage pool is now available for use. Now would be a good time to set up migration and include it in the storage hierarchy. To make this storage pool the primary destination for client data, you will need to change the backup copy group. See Chapter 7, “Tivoli Storage Manager policy and automation” on page 173 for details on changing copy groups.

6.4 Creating Tivoli Storage Manager tape storage

Tivoli Storage Manager can make use of tape devices and libraries to store backed-up, archived, and space-managed client data, database backups, and copies of the device configuration and volume history information. In general, tape storage is much less expensive than all other kinds of storage media. Also, for disaster recovery reasons, it is easy to move tapes apart from the primary storage hierarchy and store them on an off-site vault location.

As already outlined in the introduction, the way Tivoli Storage Manager supports tape devices depends very much on the operating system of the server. The following section will discuss different tape device types supported by Tivoli Storage Manager in an AS/400 environment. For each type, the book shows a separate example.

6.4.1 Tape devices

Within the AS/400 environment, Tivoli Storage Manager generally classifies three types of tape devices:

- **MANUAL:** Manual libraries require operator intervention for all tape mounts.
- **AS400MLB:** Automated tape libraries have their tapes mounted automatically whenever Tivoli Storage Manager needs them.
- **USRDFN:** User-defined libraries are controlled by a tape management program, such as BRMS, through the use of specially written exit programs.

When Tivoli Storage Manager requires a tape volume, a message is sent to an AS/400 message queue or Tivoli Storage Manager mount or console administrative client requesting the tape be mounted if using a **MANUAL** library.

When using an **AS400MLB** library, all mount requests are automatically handled by Tivoli Storage Manager.

When using **USRDFN** libraries, all mount requests are passed on to the tape management system for processing.

All tape devices and libraries must first be defined to the AS/400 system before Tivoli Storage Manager can make use of them. Full details of how to attach and configure tape devices can be found in the relevant documentation, such as:

- *AS/400 Local Device Configuration*, SC41-5121
- *AS/400 Automated Tape Library Planning and Management*, SC41-5309

Usually, IBM tape devices that are attached to an AS/400 system are automatically configured to the operating system; therefore, the loading and configuration of device drivers used in Windows NT and Unix environments is not applicable.

Tape volumes that are defined to the storage pools associated with tape libraries are either scratch volumes or private volumes. A scratch volume is one that does not contain any data, and which may be claimed for use by Tivoli Storage Manager for any purpose. A private volume is one that either contains data or has been defined for a particular purpose.

6.4.2 Manual libraries

A manual library must be created if you wish to use drives with Tivoli Storage Manager that require an operator to load the tape volumes. Figure 42 explains the relationship between manual tape libraries and its associated logical objects in Tivoli Storage Manager/400.

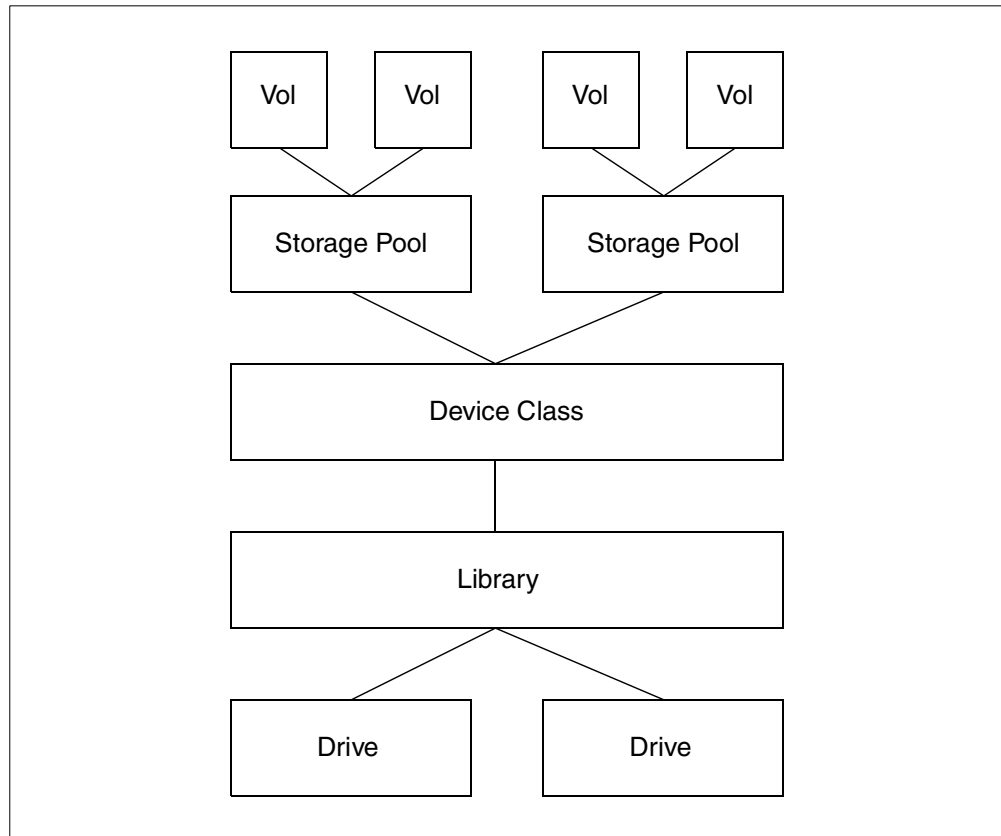


Figure 42. Tivoli Storage Manager model of manual tape library

The library is categorized by a device class; this tells Tivoli Storage Manager what type and format of tape volumes are used in it. Drives are defined to the library. A storage pool is defined using the device class created for use with this library. Each storage pool will consist of a number of volumes either specifically defined or made available by a scratch pool. The volumes will hold the client data.

When Tivoli Storage Manager requires a tape to be mounted in this type of device, a message is sent to a specific AS/400 message queue as well as to any administrative clients that were started in console or mount mode (see 4.4.4.4, “Tivoli Storage Manager administrative command line modes” on page 102). If the library has been defined with operator drive selection, the operator will have to inform Tivoli Storage Manager which tape drive a tape has been loaded into; otherwise, Tivoli Storage Manager will specify which tape drive to load tapes into.

If large amounts of client data are being migrated to tape, manual libraries are not recommended, due to the excessive amount of operator intervention required in changing tapes and replying to mount requests. An internal manual tape drive,

such as the QIC drive mentioned above, would be ideal for use in protecting the server's database, device configuration, and volume history files.

A typical example of a manual library would be the built-in QIC drive found in many AS/400 systems. The following example shows how to define an IBM 6380 (sometimes called a QIC drive).

6.4.2.1 Defining a manual library

Ensure that the device is configured to the AS/400 system. Details on how to do this can be found in the publications listed in 6.4.1, "Tape devices" on page 147.

Obtain the AS/400 name for the device by using the `WRKCFGSTS *DEV *TAP` command on an AS/400 command line.

The following screen appears:

Work with Configuration Status		ASM12	04/26/99 14:14:32
Position to		Starting characters	
Type options, press Enter.			
1=Vary on 2=Vary off 5=Work with job 8=Work with description			
9=Display mode status 13=Work with APPN status...			
Opt	Description	Status	-----Job-----
	TAP01	VARIED ON	
			Bottom
Parameters or command			
====>			
F3=Exit F4=Prompt F12=Cancel F23=More options F24=More keys			

This shows a list of all tape devices configured to the system. Find the name of the device and make a note of it. Typically, a 6380 will be built into the AS/400 system and will probably have a device name of `TAP01`. Type 8 in the `Opt` field to look at the description of the device.

From a Tivoli Storage Manager administrative client, define the library with the command `DEFINE LIBRARY MANLIB LIBTYPE=MANUAL`. The `LIBTYPE` parameter must be set to `MANUAL`, and, in our example, we set the library name to `MANLIB`.

To specify operator drive selection, add the parameter `drivesel=operator` to the above command. When replying to tape mount requests, the operator must now specify the drive the tape has been placed into, rather than Tivoli Storage Manager telling the operator which drive to put the tape into.

The above command does not specify any drive selection parameters; therefore, the default of Tivoli Storage Manager selection for drives is taken. More details on drive selection can be found in the *Tivoli Storage Manager for AS/400 Administrator's Guide*, GC35-0315.

6.4.2.2 Define the drive

The next step is to define any drives that should be associated with this library.

From a Tivoli Storage Manager administrative client, define the drive with the `DEFINE DRIVE` command. You need to specify which library the drive is being assigned to; in our example, it is the library `manlib`. You also need to specify the AS/400 device name noted in 6.4.2.1, “Defining a manual library” on page 149 (`tap01` in our example): `define drive manlib drive1 device=tap01`.

6.4.2.3 Define the device class

The drive created above must be categorized by type and format to Tivoli Storage Manager. This is done with a device class definition.

The `define devc qic_tapeclass1 devtype=qic format=2000 library=manlib` command is used for this. Our example is an IBM 6380 drive, which is a QIC type device with a cartridge capacity of 2GB.

For full details on supported tape devices and associated device class parameters, refer to the *Tivoli Storage Manager for AS/400 Administrators Guide*, GC35-0315.

- An up-to-date list of supported IBM devices can be found at the following Web site: http://www.tivoli.com/support/storage_mgr/ad40dev.htm

You now need to create a storage pool for use with the created device class.

Enter the `DEFINE STGPOOL` command `define stgpool qic_tape_pool qic_tapeclass1 maxscratch=10`.

This creates a storage pool called `qic_tape_pool` associated with the device class `qic_tapeclass1`. The `maxscratch` parameter has been set to 10. This allows to utilize up to 10 scratch volumes without those volumes having to be specifically defined within Tivoli Storage Manager.

To enable the movement of data from the `BACKUPPOOL` to this newly created pool, you must type `update stgpool backuppool nextstgpool=qic_tape_pool`.

6.4.2.4 Prepare tape volumes

Tape volumes must now be prepared prior to use. This is called initializing tapes on an AS/400 system. Tapes used by Tivoli Storage Manager must be labeled so that operators and Tivoli Storage Manager can keep track of them.

From an AS/400 command line, type `INZTAP` to initialize tapes, and then press **F4** to prompt:

The following screen will be displayed:

```

Initialize Tape (INZTAP)

Type choices, press Enter.

Device . . . . . tap01      Name
New volume identifier . . . . . tsm001    Character value, *NONE...
New owner identifier . . . . . *BLANK
Volume identifier . . . . . *MOUNTED      Character value, *MOUNTED
Check for active files . . . . . *no       *YES, *NO, *FIRST
Tape density . . . . . *ctgtype          *DEVTYPE, *CTGTYPE, *QIC120...
Code . . . . . *EBCDIC                 *EBCDIC, *ASCII
End of tape option . . . . . *REWIND      *REWIND, *UNLOAD
Clear . . . . . *NO                     *NO, *YES

Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys

```

The **Device** field should be the AS/400 name of the tape device being used. From our earlier example, this is `tap01`. You should then give the volume a new name in the **New volume identifier** field. We have changed the **Check for active files** field to `*no`, but be careful with this option, since you could wipe out important data! The **Tape density** field has been changed to `*ctgtype`. This formats the cartridge to the maximum amount the cartridge can take, which is useful if you are using cartridges of a lower capacity than the drive is capable of. This process has to be completed for each tape.

6.4.3 AS400MLB libraries

AS400MLB libraries are a Tivoli Storage Manager category for the use of automated tape libraries containing a number of tape drives (or one drive), slots for several tapes, and the ability to automatically handle tape mount and dismount operations through the use of a robotic mechanism.

All tapes in an AS400MLB belong to an AS/400 tape category. When tapes are first inserted, they are assigned a category of `*INSERT`. No tape operations can be performed on tapes in the `*INSERT` category. To perform any operations on newly inserted tapes, the tape category for that tape must first be changed to a usable category using the add tape cartridge command `ADDTAPCTG`. There are several predefined categories; however, Tivoli Storage Manager tapes should be assigned to a unique category that is only used by Tivoli Storage Manager. This helps keep track of tape media and reduces the possibility of important Tivoli Storage Manager volumes being used for other purposes.

Figure 43 explains the relationship between an AS400MLB tape library and its associated objects in Tivoli Storage Manager/400.

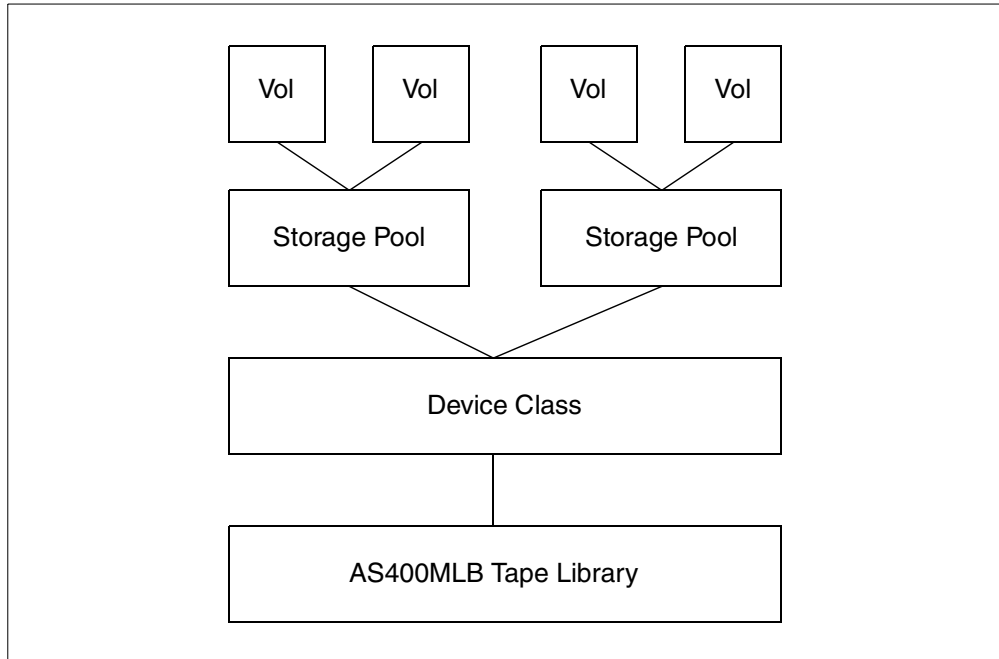


Figure 43. Tivoli Storage Manager model of AS400MLB tape library

A library is defined to Tivoli Storage Manager that indicates the AS/400 device name used for the tape library. This library definition also contains information on the tape category that Tivoli Storage Manager tape volumes are to be assigned to. The library is categorized by a device class; this tells Tivoli Storage Manager what type and format of tape volumes are used in it. Drives are not defined to AS400MLB libraries; drive selection is handled by the operating system.

A storage pool is defined using the device class created for use with this library. Each storage pool will consist of a number of volumes either specifically defined or made available by a scratch pool of volumes in a specific tape category. The volumes will hold the client data.

When Tivoli Storage Manager requires a tape to be mounted, the library knows that the tape is in a slot within the library because the tapes have been defined to Tivoli Storage Manager using the `CHECKIN LIBVOLUME` command. It then locates the tape and loads it into an available drive.

An AS400MLB-type library would be convenient if large amounts of client data need to be stored on tape, such as the next level of storage after disk, or when making copy storage pools. See Chapter 8, “Protecting the Tivoli Storage Manager/400 server” on page 193 for details on copy storage pools.

Typical libraries covered with this category are the IBM 3570 and IBM 3590. The following example shows how to define an IBM 3570 C02 tape library.

6.4.3.1 Defining an AS400MLB library

Ensure that the device is defined to the AS/400 system. This is usually just a matter of ensuring that the correct adapter card is installed and that the library device is attached when the system is powered up. Details on how to do this can be found in the previously listed publications.

Obtain the AS/400 name for the device by using the work with media library status command `WRKMLBSTS` on an AS/400 command line.

Press **Enter** and you should get a screen similar to the following:

```
Work with Media Library Status                                     System:  ASM12

Type options, press Enter.
  1=Vary on   2=Vary off   3=Reset resource   4=Allocate resource
  5=Allocate unprotected  6=Deallocate resource  8=Work with description

      Device/
      Resource      Status              Allocation      Job
Opt   Resource      Status              Allocation      name
      TAPMLB01      VARIED ON              UNPROTECTED
      TAP02          OPERATIONAL              UNPROTECTED
      TAP03          OPERATIONAL              UNPROTECTED

Bottom
Parameters or command
====>
F3=Exit  F4=Prompt  F5=Refresh  F9=Retrieve  F12=Cancel  F17=Position to
F23=More options
```

This shows a list of all tape libraries configured to the system. Find the name of the device and make a note of it. In our example, the device is called `TAPMLB01`.

From a Tivoli Storage Manager administrative client, define the library with the `define library` command:

```
define library 3570_lib libtype=as400mlb mld=tapmlb01 cat=adsmcat.
```

The `libtype` parameter must be set to `as400mlb`, and, in our example, we set the library name to `3570_lib`. You also have to specify the AS/400 device name in the `mld` parameter as well as the tape category that will be used by Tivoli Storage Manager in this library.

Before tapes can be used in an AS400MLB, they have to be assigned to a category. There can be more than one category loaded into a library at the same time, but each tape can only belong to one category. Categories are used to group tapes together. There are several AS/400 system-defined categories, but in order to distinguish Tivoli Storage Manager tapes from other tapes that may be in the library, it is suggested that Tivoli Storage Manager tapes be assigned to a unique category. In our example below, we use the example category of `ADSMCAT`.

Make sure that the category chosen for Tivoli Storage Manager tapes in this library is unique. You can get a list of currently used tape categories by using the `DSPTAPCGY` command.

You will get the following screen:

Display Tape Category Information

Category Name	Category System
*CNV	ASM12
*EJECT	
*INSERT	
*IPL	ASM12
*NL	ASM12
*NOSHARE	ASM12
*SHARE400	
*SYSGEN	ASM12

Bottom

Press Enter to continue.

F3=Exit F12=Cancel F17=Top F18=Bottom

From the screen above, you can see various categories, but not one called `ADSMCAT`. It is safe to use `ADSMCAT` for Tivoli Storage Manager tape volumes. When tapes are first added to a library, tape volumes assume the category `*INSERT`. This must be changed to another category if the tapes are to be useful in any way. Details of changing tape categories and initializing tape volumes can be found in the following sections.

6.4.3.2 Define device class

When defining an AS400MLB library, you do not need to define any drives, since this is handled by the library itself; so, the next step is to define a device class for this library. Our example is an IBM 3570 C02 library, which is a 3570 type device. The mount limit parameter has been set to 2 because the C02 model is a twin drive library. This allows Tivoli Storage Manager to have two tape processes going on at the same time. Also, we have changed the mount retention from the original 60 minutes to 5 minutes to allow other processes to use the drives without long delays. See the *Tivoli Storage Manager for AS/400 Administrators Guide*, GC35-0315 for advice on what parameters to use for different types of tape devices.

```
tsm: ADSM> define devc 3570_class devtype=3570 format=3570e
library=3570_lib mountlimit=2 mountr=5
```

6.4.3.3 Define storage pool

You now need to create a storage pool for use with the device class created. Enter the Tivoli Storage Manager command `define stgpool 3570_pool 3570_class maxscratch=20`.

This creates a storage pool called `3570_pool` associated with the device class `3570_class`. The `maxscratch` parameter has been set to 20. This allows Tivoli Storage Manager to utilize up to 20 scratch volumes without those volumes having to be specifically defined.

To enable the movement of data from the `backuppool` to this newly created pool, you must enter the command `update stgpool backuppool nextstgpool=3570_pool`. This means that when `backuppool` reaches its high migration threshold, it will automatically migrate files to `3570_pool`.

6.4.3.4 Tape volumes

Tape volumes must now be prepared prior to use by Tivoli Storage Manager. Before a tape can be used, it must be initialized. Tape initialization is the AS/400 way of preparing (or formatting) a tape.

There are several possible statuses that a tape volume can be in, before you put it under Tivoli Storage Manager control. Non-initialized tapes can be loaded into the library, moved from the *INSERT category to a usable one, initialized, and then checked into Tivoli Storage Manager.

If a tape is already initialized, there is no need to re initialize it; however, the tapes must still be assigned to the Tivoli Storage Manager category. If the tapes have just been placed in the library, then they will have a category of *INSERT. These tapes can be checked directly into Tivoli Storage Manager. If the initialized tapes are currently assigned a category, they can be checked directly into Tivoli Storage Manager and the category can be changed by using one command. However, be aware that tapes need to have an expiry date in the past. If you take *EXP tapes from BRMS, they need to be re-initialized before they are given to Tivoli Storage Manager, since BRMS writes a *PERM label on the tapes, and then manages the actual expiry date in its database.

Pre-initialized and categorized tapes

If tapes that are already assigned a category and initialized in the library are available for use, it is quite simple to add those volumes to Tivoli Storage Manager. In the following example, all tapes currently assigned the `as400share` category are going to be re-categorized as `adsmcat` and assigned to the `3570_lib` Tivoli Storage Manager library as scratch tapes.

```
tsm: ADSM> checkin libvolume 3570_lib status=scratch search=yes  
category=as400share
```

Non-initialized tapes

You can put a tape in the library and change the category from *INSERT to something usable, such as `adsmcat`, with the following command:

```
==> addtapcgy dev(tapmlb01) ctg(*volume names*) cgy(adsmcat)
```

In this command, `*volume names*` is the ID of the inserted cartridge. Next, the tape is initialized with the command to initialize tapes. Press **F4** to prompt the `INZTAP` command.

The following screen will appear:

Initialize Tape (INZTAP)

Type choices, press Enter.

Device	tapmlb01	Name
New volume identifier	*NONE	Character value, *NONE...
New owner identifier	*BLANK	
Volume identifier	*MOUNTED	Character value, *MOUNTED
Check for active files	*YES	*YES, *NO, *FIRST
Tape density	*DEVTYPE	*DEVTYPE, *CTGTYPE, *QIC120...
Code	*EBCDIC	*EBCDIC, *ASCII
End of tape option	*REWIND	*REWIND, *UNLOAD
Clear	*NO	*NO, *YES

Bottom

F3=Exit F4=Prompt F5=Refresh F12=Cancel F13=How to use this display
F24=More keys

The `Device` field should be the AS/400 name of the tape library being used. From our earlier example, this is `tapmlb01`. You should then give the volume a new name in the `New volume identifier` field.

When the tape has finished initializing, it should be checked into Tivoli Storage Manager with the command:

```
checkin libvol 3570_lib status=scratch search=yes category=adsmcat
```

Pre-initialized non-categorized tapes

If there are tapes in the library that are initialized but are still in the `*insert` category, they can be added to Tivoli Storage Manager with the command shown in the following screen:

```
tsm: ADSM> checkin libvol 3570_lib status=scratch search=yes  
category=*insert
```

This will find all tapes in the `*insert` category and add them to the category referred to in the Tivoli Storage Manager library definition, `adsmcat` in our example.

6.4.4 USRDFN libraries

A USRDFN library is a category that describes how Tivoli Storage Manager can interact with a tape management system (such as BRMS) to perform tape operations.

This is done with the use of exit programs. These can either be user-written, or, if you are using BRMS, you can use the sample exit programs provided with the Tivoli Storage Manager code, without modification. There are four exits for user define library exits:

- **MOUNT:** This exit is used by Tivoli Storage Manager to tell the media management system to mount a specific volume.
- **DISMOUNT:** This exit is used by Tivoli Storage Manager to tell the media management system that a volume that has been mounted is not needed anymore.

- **DELETION:** This exit is used by Tivoli Storage Manager to tell the media management system that a volume is now empty and no longer needed by Tivoli Storage Manager.
- **EXPIRATION:** This exit is used by Tivoli Storage Manager to tell the media management system that a volume previously registered to Tivoli Storage Manager is now empty and available for use.

Before a USRDFN library can be defined to Tivoli Storage Manager, the exit programs must first be created on the AS/400 system and registered.

Figure 44 shows the relationship between a USRDFN tape library and its associated objects in Tivoli Storage Manager/400.

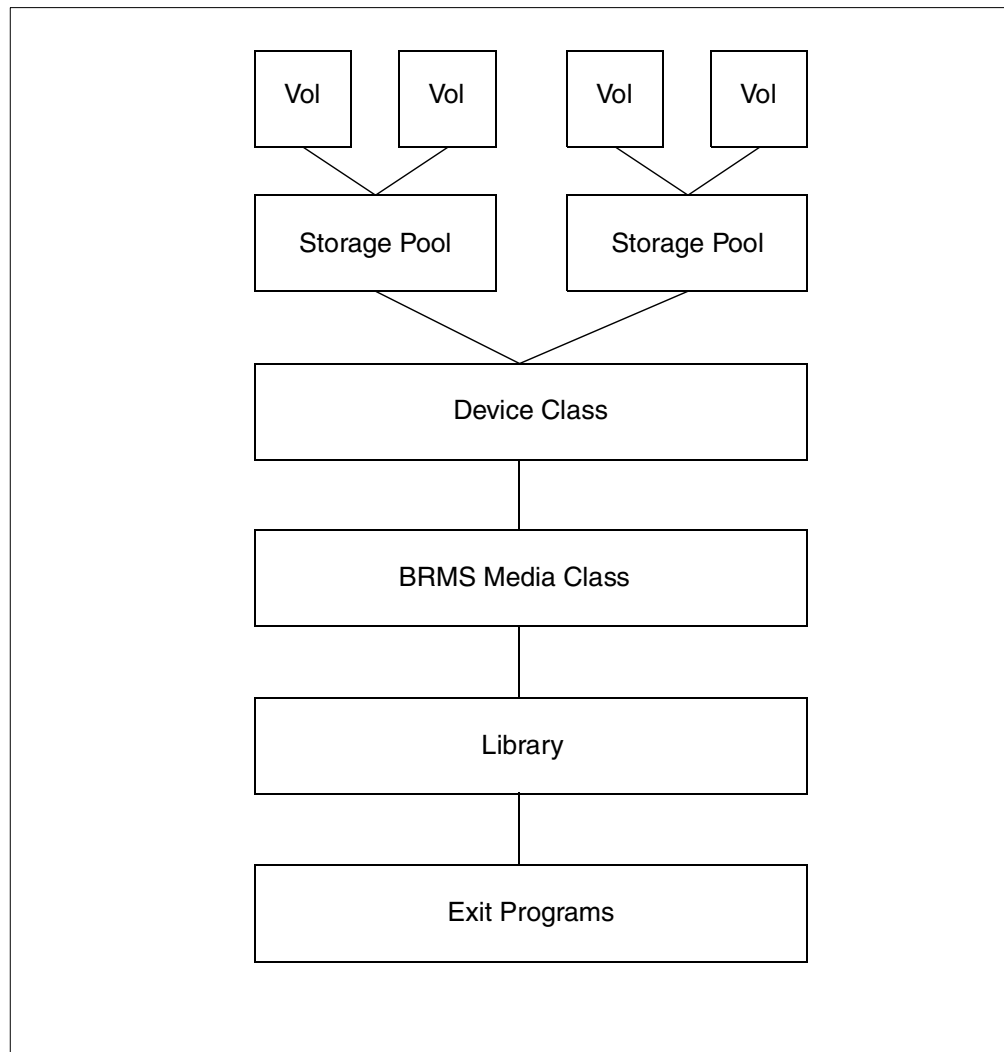


Figure 44. Tivoli Storage Manager model of USRDFN tape library

The library is defined to Tivoli Storage Manager with a device name that matches the BRMS device name. The library is categorized by a device class; this device class is used to point towards a BRMS media class. This BRMS media class specifies which BRMS tape media to use for the Tivoli Storage Manager tape operations. Drives are not defined to the library; drive selection is handled by BRMS from information passed on by the Tivoli Storage Manager exit programs.

A storage pool is defined using the device class created for use with this library. Each storage pool will consist of a number of volumes made available by the BRMS media class. The volumes will hold the client data.

A USRDFN tape library could be a manual or automatic library; the only difference between the MANUAL/AS400MLB libraries and USRDFN libraries is in the way Tivoli Storage Manager interacts with them.

6.4.4.1 Creating and defining exit programs

The source for the exit programs is in the file `qaanrsm` in the library `qadsm`. There are samples for the mount, dismount, deletion, and expiration Tivoli Storage Manager exits written in two programming languages: C and CL (CL stands for Command Language; it is a simple language used to create programs based on OS/400 commands). This example shows how to create the CL versions of the exit programs required for Tivoli Storage Manager interaction with BRMS.

First, decide which library to keep the exits in once they are created. It may be best to have them created in the work library used by the Tivoli Storage Manager server. The default for this at Tivoli Storage Manager server initialization is `qusradsm`.

Next, create the exit programs from the source file with the AS/400 command to create CL programs:

```
====> crtclpgm pgm(qusradsm/mount) srcfile(qadsm/qaanrsm)
srcmbr(mountcl)
====> crtclpgm pgm(qusradsm/delete) srcfile(qadsm/qaanrsm)
srcmbr(deletecl)
====> crtclpgm pgm(qusradsm/dismount) srcfile(qadsm/qaanrsm)
srcmbr(dismountcl)
====> crtclpgm pgm(qusradsm/expire) srcfile(qadsm/qaanrsm)
srcmbr(expirecl)
```

6.4.4.2 Registering exit programs

Now that the exit programs exist, you need to define them to the Tivoli Storage Manager server. From an administration client, execute the `define exit` commands shown in the following screen:

```
tsm: ADSM> define exit mount qusradsm/mount
tsm: ADSM> define exit dismount qusradsm/dismount
tsm: ADSM> define exit deletion qusradsm/delete
tsm: ADSM> define exit expiration qusradsm/expire
```

6.4.4.3 Defining USRDFN library

The library name used in Tivoli Storage Manager must match that of the BRMS tape library location. To verify BRMS device information, first go to the Work with Devices screen in BRMS using the `wrkdevbrm` command.

Work with Devices				ASML2
Position to		Starting characters		
Type options, press Enter.				
1=Add 2=Change =Remove 5=Display 8=Work with status				
Opt	Device	Category	Type/Model	Text
5	TAPMLB01	*TAPMLB	3570/C02	Entry created by BRM configuration
	TAP01	*TAP	6382/001	Entry created by BRM configuration
	TAP02	*TAP	7208/012	Entry created by BRM configuration
Bottom				
F3=Exit F5=Refresh F12=Cancel				

Type a 5 in the Opt field next to the BRMS 3570 device, then press Enter. In our example, it is the device TAPMLB01.

```

Display Tape Media Library Device

Media library . . . . . : TAPMLB01
Device Type/Model . . . . . : 3570/C02

Text . . . . . : Entry created by BRM configuration
Location . . . . . : TAPMLB01
Location volume count . . . . . : 5
Location volume maximum. . . . . : *NOMAX

Use optimum block size . . . . . : *YES
Next volume message . . . . . : *NO
Tape mount delay . . . . . : *IMMED

```

In this example, the AS/400 device is called `tapmlb01`, and the BRMS location of this device is also `tapmlb01`; so, the Tivoli Storage Manager library must be defined as `tapmlb01` as well.

The first step is to define the library with the command:

```
define library tapmlb01 libtype=usrdfn driveselection=exit
```

The `driveselection` parameter tells Tivoli Storage Manager that all tape operations must be carried out by the defined exit programs. These exit programs will hand over all commands to BRMS.

6.4.4.4 Define device class

The next step is to create a device class. The device class used in Tivoli Storage Manager must have the same name as that used by BRMS to categorize tapes in the BRMS media class.

It is strongly recommended that you create a new media class in BRMS for use by Tivoli Storage Manager only. If this is not done, it is possible for BRMS to place BRMS backups after Tivoli Storage Manager files on the same tapes. This would cause significant problems.

See the book *Backup, Recovery, and Media Services for AS/400*, SC41-5345, for full details on creating media classes. Here is a brief outline of what needs to be done:

```
====> go brmmed
```

Take option **1** to work with media classes, press **Enter**, and the following screen appears:

```

Work with Media Classes                                ASM12

Position to . . . . .                               Starting characters

Type options, press Enter.
  1=Add  2=Change  3=Copy  4=Remove  5=Display  6=Work with media

Opt  Class      Density  Capacity  Text
  1   TSM3570
      FMT3570    *FMT3570  *DENSITY  Entry created by BRM configuration
      FMT3570E  *FMT3570E  *DENSITY  Entry created by BRM configuration
      QIC1000    *QIC1000  *DENSITY  Entry created by BRM configuration
      QIC120     *QIC120  *DENSITY  Entry created by BRM configuration
      QIC2GB     *QIC2GB  *DENSITY  Entry created by BRM configuration
      QIC525     *QIC525  *DENSITY  Entry created by BRM configuration
      SAVSYS     *QIC2GB  *DENSITY  Entry created by BRM configuration

Bottom

F3=Exit  F5=Refresh  F12=Cancel

```

To add a new media class for use within Tivoli Storage Manager, type **1** in the *Opt* field and the new BRMS media class name in the *Class* field. We chose to call it TSM3570. Press **Enter**. The following parameter screen appears:

```

Add Media Class

Type choices, press Enter.

Media class . . . . . TSM3570  Name
Density . . . . . *FMT3570E  F4 for list
Media capacity . . . . . *DENSITY  *DENSITY, Number nnnnn.nm
  Unit of measure . . . . . 1=KB, 2=MB, 3=GB
Mark for label print . . . . . *NONE  *NONE, *MOVE, *WRITE
Label size . . . . . 1 1=6 LPI, 2=8 LPI, 3=9 LPI
Label output queue . . . . . *SYSPCY  Name, *SYSPCY, *PRTF
  Library . . . . . Name, *LIBL
Shared media . . . . . *NO  *YES, *NO
Text . . . . .

More...
F3=Exit  F4=Prompt  F12=Cancel

```

Set the density to the required type and press **Enter** again. You are now ready to create the Tivoli Storage Manager device class:

```
tsm: ADSM> define devclass tsm3570 devtype=3570 format=3570e  
library=tapmlb01
```

Remember to give the Tivoli Storage Manager device class the same name as that used by the BRMS media class.

6.4.4.5 Define storage pool

The next step is to define the storage pool:

```
tsm: ADSM> define stgpool 3570_pool tsm3570 maxscratch=20
```

This creates a storage pool called `3570_pool` using the `tsm3570` device class, which is linked to the `tapmlb01` library, which is in turn linked to BRMS library `tapmlb01` through the exit programs, that has a maximum of 20 scratch tapes available to it.

6.4.4.6 Tape volumes

Tape volumes are prepared for use with the tape management system. In our example with BRMS, the tapes would be initialized and registered to BRMS under the BRMS media class of `tsm3570`.

For information on how to manage tapes in BRMS, refer to the book *Backup, Recovery, and Media Services for AS/400*, SC41-5345. If you use a different tape management system, refer to the vendor's documentation.

6.4.4.7 Using automated libraries with a tape management program

If BRMS is installed on a system that you use as a Tivoli Storage Manager server, the inevitable question is: Should I use the library directly as an AS400MLB defined library, or should I keep it under BRMS control and define it as a USRDFN library?

There is no quick answer to this question; however, there are a few things that are worth bearing in mind:

- Integrating Tivoli Storage Manager with BRMS via the USRDFN library makes BRMS aware of your Tivoli Storage Manager tapes which can help in managing your tape environment.
- Using BRMS may cause tape operations to take marginally longer, because requests from Tivoli Storage Manager are routed through the exit programs, then BRMS, before arriving at the library. With Tivoli Storage Manager controlling the library directly, the tape operations complete marginally faster.

6.5 Creating Tivoli Storage Manager optical storage

As already mentioned, connecting optical storage to the Tivoli Storage Manager server on an AS/400 system was not part of this project; however, it is possible; so, the book will provide you with some basic information about this. For more information, refer to the *Tivoli Storage Manager AS/400 Administrators Guide*, GC35-0315, or to the *Tivoli Storage Manager server* readme.

To utilize optical media within Tivoli Storage Manager, you can use an optical library that is LAN-attached or is directly attached to your AS/400 system. Either one must be installed and configured before you can use optical media with Tivoli Storage Manager. An IBM 3995 Optical Library Dataserver is an example of such an optical library.

To prepare an optical library for use by Tivoli Storage Manager, follow the instructions in the documentation that accompanied the device and the appropriate AS/400 manuals.

6.5.1 Using optical media within Tivoli Storage Manager

To use optical media, you must first initialize both sides of each optical cartridge. The optical cartridge is then defined into a Tivoli Storage Manager storage pool that is associated with a device class of device type OPTICAL or WORM.

Initialize each side of the optical cartridge with the AS/400 command `INZOPT` (with a direct-attached optical library), or use the screen option on the display of the LAN-attached optical library console (See your optical library's software documentation for more information on initializing optical volumes and recommendations regarding initialization parameters.)

We suggest that you establish a Tivoli Storage Manager naming convention for the sides of an optical cartridge making a Tivoli Storage Manager cartridge easily distinguishable from cartridges used by different applications.

The Tivoli Storage Manager considers both sides of an optical cartridge as a single Tivoli Storage Manager volume. To accomplish this, Tivoli Storage Manager uses a special form for the names of volumes in an optical library. The volume name for an optical cartridge inside the library has the form `SIDEA/SIDEB`, where `SIDEA` is the name of one side of the cartridge and `SIDEB` is the name of the other side. Tivoli Storage Manager always sorts the names so that the name string that is alphabetically first is to the left of the slash.

When storing data on an optical volume, Tivoli Storage Manager creates a directory named `ADSM` on each side of the cartridge. Within these directories, Tivoli Storage Manager creates one or more files to contain all of the data. These files should not be erased or modified using external tools or utilities. Other files, such as user-defined data files, can be stored on volumes that Tivoli Storage Manager is using. However, this prevents Tivoli Storage Manager from using the entire capacity of a cartridge for data storage.

Note

When using a device type of `OPTICAL`, Tivoli Storage Manager treats the volumes as rewritable. If the volume is reclaimed, Tivoli Storage Manager will reinitialize the volume the next time it is mounted. If that volume contains user-defined data files, they will be lost. It is recommended that you do *not* put user-defined data files on volumes that Tivoli Storage Manager is permitted to reinitialize.

Tivoli Storage Manager is not able to generate scratch mount requests for optical volumes. To use optical volumes, they must be defined in a storage pool with the `DEFINE VOLUME` command, or they must be specified in the command that will use

them. For example, to use an optical volume on the `EXPORT` command, you would have to specify the `VOLUMENAMES` parameter.

To define an `OPTICAL` or `WORM` device class, issue the `DEFINE DEVCLASS` command with the `DEVTYPE` parameter. Other parameters specify how to manage server storage operations involving the new device class.

6.5.2 Recovering held optical files

A held optical file is an optical stream file that could not be closed normally. It contains buffered data that could not be written to the optical cartridge. When such a condition occurs, Tivoli Storage Manager considers this a volume-full situation. The server will automatically rewrite the data in the held optical file to another optical volume.

You should *not* save the held optical file to a new optical file path. Tivoli Storage Manager will *not* be able to access it and the space will be wasted. Simply release the held optical file; this clears the held status and releases the optical file system from its obligation to update the optical disk.

6.6 Changing Tivoli Storage Manager functions

In the following section, you will find examples and recommendations on how to change the storage management functions of Tivoli Storage Manager that we have introduced. All these functions are controlled by storage pool parameters and can be changed from the Tivoli Storage Manager administrator by changing their values.

6.6.1 Setting up migration

When storage pools are created in Tivoli Storage Manager, the default value for the high migration threshold is 90 percent, and the default for the low migration threshold is 70 percent. There is no setting for the `maxsize` parameter.

6.6.1.1 Setting up migration thresholds

To check the migration thresholds of storage pools, use the `QUERY STGPPOOL` command from an administrator command line interface. A screen similar to the following will appear:

```
tsm: ADSM> query stgpool
```

STORAGE POOL NAME	DEVICE CLASS NAME	ESTIMATED CAPACITY (MB)	PCT UTIL	PCT MIGR	HIGH MIG PCT	LOW MIG PCT	NEXT STORAGE POOL
ARCHIVEPOOL	DISK	50.0	0.0	0.0	90	70	
BACKUPPOOL	DISK	2,200.0	21.5	21.5	90	70	3570_POOL
COPYPOOL1	qic_tapeclass1	0.0	0.0				
ELEPHANT	DISK	0.0	0.0	0.0	90	70	
QIC_POOL	qic_tapeclass1	0.0	0.0	0.0	90	70	
SPACEMGPOOL	DISK	0.0	0.0	0.0	90	70	
TESTARCHIVE	DISK	50.0	0.0	0.0	90	70	
TESTPOOL	DISK	50.0	3.3	3.3	90	70	
3570_POOL	3570_CLASS	99,800.0	2.1	20.0	90	70	

To change the migration threshold used by the storage pool `BACKUPPOOL` to a high of 70 percent and a low of 10 percent, use the command:

```
update stgpool backuppool highmig=70 lowmig=10
```

You can have more than one migration process occurring for a storage pool at the same time. Be careful here, because if you migrate to a tape storage pool that is defined to a twin drive library and you have two migration processes running at the same time, that tape library will be unavailable for other purposes until migration is finished or cancelled.

To check the current number of migration processes allowed for a storage pool, use the `query stgpool backuppool f=d` command with the `f=d` (format=detailed) option.

You will see a screen similar to the following:

```
STORAGE POOL NAME: BACKUPPOOL
STORAGE POOL TYPE: PRIMARY
DEVICE CLASS NAME: DISK
ESTIMATED CAPACITY (MB): 2,200.0
    PCT UTIL: 21.5
    PCT MIGR: 21.5
    PCT LOGICAL: 100.0
    HIGH MIG PCT: 90
    LOW MIG PCT: 70
MIGRATION PROCESSES: 1
    NEXT STORAGE POOL: 3570_POOL
RECLAIM STORAGE POOL:
MAXIMUM SIZE THRESHOLD: NO LIMIT
```

The migration processes parameter shows the value 1. To change the storage pool to allow two migration processes to occur at once, type the command:

```
update stgpool backuppool migprocess=2
```

Other migration parameters can also be set in a management class. These settings can be used to specify how many days of inactivity are required before a file becomes eligible for migration.

Refer to Chapter 7, “Tivoli Storage Manager policy and automation” on page 173 for details on how to set up and change management-class parameters.

To force migration on a storage pool, the high migration and low migration parameters can be changed to 0 percent, then reverted once all data has been migrated to the next level of storage.

6.6.1.2 Setting up the maxsize parameter

To check current maxsize settings, do a `QUERY STGPOOL` command with the `format=detailed` option as issued in the previous section. Notice that the maximum size threshold parameter is set to no limit. This means that the storage pool will accept any file that fits in it.

If the file is too big for the storage pool, it will be sent to the next storage pool. To adjust this storage pool to have a maximum allowable file size of 10 megabytes, use the `update stgpool backuppool maxsize=10M` command.

To specify other sizes, use the K, M, G, or T suffix to indicate kilobytes, megabytes, gigabytes, or terabytes.

6.6.2 Setting up reclamation

To check the reclamation parameters of a tape pool, use the `QUERY STGPOOL` command with the `format=detailed` command. A screen similar to the following will appear:

```
tsm: ADSM> q stgpool 3570_pool f=d

      STORAGE POOL NAME: 3570_POOL
      STORAGE POOL TYPE: PRIMARY
      DEVICE CLASS NAME: 3570_CLASS
ESTIMATED CAPACITY (MB): 99,800.0
          PCT UTIL: 2.1
          PCT MIGR: 20.0
          PCT LOGICAL: 99.8
          HIGH MIG PCT: 90
          LOW MIG PCT: 70
      MIGRATION PROCESSES:
      NEXT STORAGE POOL:
      RECLAIM STORAGE POOL:
      MAXIMUM SIZE THRESHOLD: NO LIMIT
          ACCESS: READ/WRITE
      DESCRIPTION:
      OVERFLOW LOCATION:
      CACHE MIGRATED FILES?:
          COLLOCATE?: NO
      RECLAMATION THRESHOLD: 60
      MAXIMUM SCRATCH VOLUMES ALLOWED: 20
```

Notice that the reclamation threshold parameter is set to 60 percent. To change this parameter, use the `update stgpool backuppool reclaim=70` command.

This command will change the tape storage pool 3570_pool to wait until a tape has 70 percent available free space before reclamation will be attempted. It is recommended that reclamation be set to a figure equal to or greater than 50 percent to enable two tapes to be combined.

Reclamation works best when two tape drives are available; however, with Version 3.1.2 of the Tivoli Storage Manager server code, it is possible to run reclamation using only one tape drive and a storage pool specified with sequential access disk volumes as the work area. For details on how to set this up, see the *Tivoli Storage Manager for AS/400 Administrators Guide*, GC35-0315.

6.6.3 Setting up collocation

To check the status of collocation, use the `QUERY STGPOOL` command; a detailed report on the storage pool will then appear:

```

tsm: ADSM> q stgpool 3570_pool f=d

      STORAGE POOL NAME: 3570_POOL
      STORAGE POOL TYPE: PRIMARY
      DEVICE CLASS NAME: 3570_CLASS
ESTIMATED CAPACITY (MB): 99,800.0
      PCT UTIL: 2.1
      PCT MIGR: 20.0
      PCT LOGICAL: 99.8
      HIGH MIG PCT: 90
      LOW MIG PCT: 70
      MIGRATION PROCESSES:
      NEXT STORAGE POOL:
      RECLAIM STORAGE POOL:
MAXIMUM SIZE THRESHOLD: NO LIMIT
      ACCESS: READ/WRITE
      DESCRIPTION:
      OVERFLOW LOCATION:
      CACHE MIGRATED FILES?:
      COLLOCATE?: NO
      RECLAMATION THRESHOLD: 60
MAXIMUM SCRATCH VOLUMES ALLOWED: 20
      DELAY PERIOD FOR VOLUME REUSE: 0 DAY(S)

```

The collocate parameter is set to NO in the above example. To enable collocation, update the storage pool accordingly:

```

tsm: ADSM> update stgpool 3570_pool collocate=yes

```

6.6.4 Setting up caching

To find out if caching is enabled, use the QUERY STGPOOL command; a screen like the following will appear:

```

tsm: ADSM> q stgpool BACKUPPOOL f=d

      STORAGE POOL NAME: BACKUPPOOL
      STORAGE POOL TYPE: PRIMARY
      DEVICE CLASS NAME: DISK
ESTIMATED CAPACITY (MB): 2,200.0
      PCT UTIL: 21.5
      PCT MIGR: 21.5
      PCT LOGICAL: 100.0
      HIGH MIG PCT: 90
      LOW MIG PCT: 70
      MIGRATION PROCESSES: 1
      NEXT STORAGE POOL: 3570_POOL
      RECLAIM STORAGE POOL:
MAXIMUM SIZE THRESHOLD: NO LIMIT
      ACCESS: READ/WRITE
      DESCRIPTION:
      OVERFLOW LOCATION:
      CACHE MIGRATED FILES?: NO
      COLLOCATE?:

```

You can see that, for this storage pool, caching is not currently enabled. To update this storage pool to use caching, enter the command `update stgpool backuppool cache=yes`.

Caching could prove convenient on storage pools that hold space-managed files, since these files are restored to the client more regularly than archived or backed-up files are.

6.7 Mount requests for manual libraries

If you are using a manually operated tape solution in your environment, then there are specific requirements for a tape operator. In this section, we take a brief look at some of the more important aspects of tape mount requests, which form a major part of the day-to-day activities when using manual tape libraries. For full details on how to manage tape operations on a day to day basis, refer to the *Tivoli Storage Manager for AS/400 Administrator's Guide*, GC35-0315.

If Tivoli Storage Manager needs to have a tape mounted, it will send a message to all the administrative clients that have been started in the console or mount modes, and also to the AS/400 message queue specified in the server options file.

Requests targeting AS400MLB and USRDFN libraries will be automatically handled by Tivoli Storage Manager. But for requests targeting manual libraries, an operator must satisfy those requests and confirm to Tivoli Storage Manager by replying to its messages. There are two ways to do this: either from a Tivoli Storage Manager administrative client, or from the AS/400 mount message queue.

6.7.1 Tivoli Storage Manager administrative client

From a Tivoli Storage Manager administrative client, you can check whether there are any pending mount requests by using the following command from the administrator command line:

```
tsm: ADSM> query request
ANR8352I Requests outstanding:
ANR8326I 028: Mount QIC volume SCRATCH R/W in drive DRIVE1 (TAP01) of library
MANLIB within 60 minutes.
tsm: ADSM>
```

This will show a list of all pending requests. The above request (request number 28) is asking for a scratch volume to be mounted in the library `MANLIB` within the next 60 minutes. If the time period elapses with no reply, the request is cancelled, and any related processes are also cancelled.

You now need to mount the tape in the specified drive, and then confirm this to Tivoli Storage Manager. To confirm a request, you would type the command line command `reply 28`.

Sometimes, a drive will also need to be specified, such as when the library drive selection parameter is set to operator controlled. To reply that the scratch volume has been mounted in drive `tap01`, you would reply with `reply 28 tap01`.

If it has been determined that a request cannot be resolved, that request must be cancelled. For instance, Tivoli Storage Manager may request a cartridge for a QIC drive that is currently being stored off-site. To cancel a request from an administrator command line, cancel the request with the `cancel req 28` command.

This will cancel the pending request. However, if the same tape volume was later found to have been inadvertently destroyed, the next request for the volume would be dealt with by using the `can req 28 permanent` command.

This effectively changes the access parameter of the volume to unavailable. This tape will not be requested again until the status is changed.

6.7.2 AS/400 mount message queue

The other way to reply to requests is through the AS/400 mount message queue. To find out which queue is currently used by your Tivoli Storage Manager server, use the Tivoli Storage Manager (Go ADSM) menu, option 1 for the Utilities menu, then option 3 for change server options. Enter the working library for the server and scroll through the list of options until you find the parameter Mount Message Queue. Make a note of the library and message queue name.

At Tivoli Storage Manager server initialization time, the defaults for the console and mount message queue are `qusradsm` for the library and `adsmmsgq` for the message queue name; so, to see messages in this message queue, from an AS/400 command line, you would type `dspsmsg qusradsm/adsmmsgq`.

You should then see a screen similar to the following:

```

Display Messages

                                System:   ASM12
Queue . . . . . : ADSMMSGQ          Program . . . . . : *DSPMSG
Library . . . . : QUSRADSM          Library . . . . . :
Severity . . . . : 00                Delivery . . . . . : *HOLD

Type reply (if required), press Enter.
mounted.
ANR0985I Process 631 for DATABASE BACKUP running in the BACKGROUND
completed with completion state FAILURE at 10:42:09.
ANR0984I Process 632 for DATABASE BACKUP started in the BACKGROUND at
10:42:14.
ANR2281I Incremental database backup started as process 632.
ANR8326I 029: Mount QIC volume SCRATCH R/W in drive DRIVE1 (TAP01) of
library MANLIB within 60 minutes.
ADSM request 0029: Mount volume SCRATCH on device TAP01.
Reply . . .
ANR8217W Error receiving data on socket 2.
ANR0568W SESSION 254 FOR ADMIN WITTSM (Win95) TERMINATED - CONNECTION WITH
CLIENT SEVERED.

                                Bottom
F3=Exit          F11=Remove a message      F12=Cancel
F13=Remove all   F16=Remove all except unanswered  F24=More keys

```

You can then scroll through the list of messages and press **F1** with the cursor placed on the same line as the mount request message to see a list of possible responses to the message.

Pressing **F1** on a mount request will produce the following screen; scroll down until you see the following option:

```
Additional Message Information

Message ID . . . . . : ANR8100      Severity . . . . . : 99
Message type . . . . . : Inquiry

    3) Type P to cancel the request and to indicate the volume is
       unavailable for further mounts. The volume will not be
       requested by the server until an UPDATE VOLUME command is issued to
       change the access mode.

Bottom
Type reply below, then press Enter.
Reply . . . .

F3=Exit  F6=Print  F9=Display message details  F12=Cancel
F21=Select assistance level
```

To reply to the message, type the single letter response on the line, and then press **Enter**. In the example above, the possible responses are:

- R** This is the same as replying to a request using the Tivoli Storage Manager administrative client commands. It will confirm that the tape has been loaded.
- C** This cancels the request. Future requests for this volume will still be made by Tivoli Storage Manager.
- P** This cancels the request permanently; no more requests will be made for this tape volume.

6.8 What happens if I run out of storage?

Running out of server storage space is serious. Backups can fail due to having no space in the destination and overflow storage pools; they can also fail if there is no room in the database or recovery log to accommodate the transaction information. The most common causes for this are shown below.

6.8.1 Database full

After extensive backup activity has occurred, it is possible that the Tivoli Storage Manager database may become full. To check the usage of the database, use the `query db` command. This will show you some statistics on current database usage:

```
tsm: ADSM> query db
```

AVAILABLE SPACE (MB)	ASSIGNED CAPACITY (MB)	MAXIMUM EXTENSION (MB)	MAXIMUM REDUCTION (MB)	PAGE SIZE (BYTES)	TOTAL USABLE PAGES	USED PAGES	PCT UTIL	MAX. PCT UTIL
20	20	0	0	4,096	5,120	4,995	97.8	97.8

```
tsm: ADSM>
```

If the percentage used figure is high (as it is in the above example - 97.8 percent), the only answer is to add more space to the database. This is done by creating another disk volume using the Tivoli Storage Manager Main menu or with the AS/400 command

```
CRTVOLADSM VOLTYPE(*STMF) VOLSTMF((' /tsmvol/database/db02' 41)).
```

This command creates a STMF volume called db02 in the /tsmvol/database directory. The database volume will have a size of 41 MB. Due to the way the Tivoli Storage Manager database works, 1 MB of all formatted volumes will be lost as an overhead. Tivoli Storage Manager then uses the remainder of the file in 4 MB chunks; so, it is sensible to specify volume size in a way that leaves a number divisible by four after the overhead.

To define the new volume to the database, use the following command:

```
define dbvolume /tsmvol/database/db02
```

Before the database can make use of the extra volumes, it has to be extended. To extend by 40 MB using the `EXTEND DB` command, type `extend db 40`.

Do a query database to see the results:

```
tsm: ADSM> query db
```

AVAILABLE SPACE (MB)	ASSIGNED CAPACITY (MB)	MAXIMUM EXTENSION (MB)	MAXIMUM REDUCTION (MB)	PAGE SIZE (BYTES)	TOTAL USABLE PAGES	USED PAGES	PCT UTIL	MAX. PCT UTIL
60	60	0	40	4,096	15,360	5,015	32.6	32.6

```
tsm: ADSM>
```

From the previous screen, you can see that the database is now only 32.6 percent full.

Note

To avoid problems caused by a sudden filling of the database, we recommend allocating additional space in your database over what you have calculated you will need. A good policy is to keep the database at no more than 75% full.

6.8.2 Recovery log full

After extensive backup activity and the log mode is set to ROLLFORWARD, it is possible that the Tivoli Storage Manager recovery log may become full. To check the usage of the recovery log, use the `QUERY LOG` command. This will show you some statistics on current recovery log usage:

```
tsm: ADSM>query log
```

AVAILABLE SPACE (MB)	ASSIGNED CAPACITY (MB)	MAXIMUM EXTENSION (MB)	MAXIMUM REDUCTION (MB)	PAGE SIZE (BYTES)	TOTAL USABLE PAGES	USED PAGES	PCT UTIL	MAX. PCT UTIL
24	24	0	20	4,096	5,632	5288	95.0	95.7

```
tsm: ADSM>
```

If the percentage used figure is high (as it is in the above example - 95.0 percent), the only answer is to add more space to the recovery log. This is done by creating another disk volume using the Tivoli Storage Manager Main menu or with the AS/400 command:

```
CRTVOLADSM VOLTYPE(*STMF) VOLSTMF((' /tsmvol/log/rlog02' 25))
```

This command creates a STMF volume called `db02` in the `/tsmvol/database` directory. The database volume will have a size of 25 MB. Due to the way the Tivoli Storage Manager recovery log works, 1 MB of all formatted volumes will be lost as an overhead. Tivoli Storage Manager then uses the remainder of the file in 4 MB chunks; so, it is sensible to specify volume size in a way that leaves a number divisible by four after the overhead.

To define the new volume to the recovery log, use the following command:

```
define logvolume /tsmvol/log/rlog02
```

Before the recovery log can make use of the extra volumes, it has to be extended. To extend by 24 MB using the `EXTEND LOG` command, type `extend LOG 24`.

Do a `query log` to see the results:

```
tsm: ADSM>query log
```

AVAILABLE SPACE (MB)	ASSIGNED CAPACITY (MB)	MAXIMUM EXTENSION (MB)	MAXIMUM REDUCTION (MB)	PAGE SIZE (BYTES)	TOTAL USABLE PAGES	USED PAGES	PCT UTIL	MAX. PCT UTIL
48	48	0	24	4,096	11,264	5293	47.9	47.9

```
tsm: ADSM>
```

From the previous screen, you can see that the recovery log is now only 47.9 percent full.

Note

To avoid problems caused by a sudden filling of the recovery log, we recommend allocating additional space in your log volumes over what you have calculated you will need. A good policy is to keep the recovery log at no more than 60% full.

6.8.3 Storage pool full

If a storage pool fills up and there is no room in the subsequent pools in the hierarchy to migrate data to, you will need to add more volumes to the pool or remove some data.

Obviously, removing client data is not to be taken lightly; the consequences of doing so must first be fully understood. If you decide that reducing the amount of client data is a valid option, read on.

One of the easiest ways to cut down on the amount of client data is to reduce the number of versions that are kept for a file that still exists on the client. This can be achieved by updating the backup copy group and activating the policy set. Once another backup has occurred, and after expiration processing has finished, the excess files should be automatically deleted.

See Chapter 7, “Tivoli Storage Manager policy and automation” on page 173 for details on how to modify policy sets.

Another option is to use client compression. This will reduce the amount of network traffic and reduce the amount of space that client data takes up on disk volumes. However, client compression has two disadvantages — it puts a heavier workload on the client, and data that has been compressed before being migrated to a tape device that uses device level compaction will probably increase in size and actually take up more space in your tape-based storage pools.

Chapter 7. Tivoli Storage Manager policy and automation

Tivoli Storage Manager provides a wide variety of options to adapt the base function of Tivoli Storage Manager, such as backup, archive, and storage management, to your operational needs dictated by the type of data and the business policies of your organization. Using logical entities, you can configure data storage policies within Tivoli Storage Manager, which describe exactly how a storage management function should occur.

Also of great value is the capability to automate all these functions. With the Tivoli Storage Manager central scheduling feature, you are able to automate all of the Tivoli Storage Manager storage management functionality, as well as the operation of the server itself.

In this chapter we provide an overview of Tivoli Storage Manager entities, such as policy domain, policy set, management class, and copy groups, and their use in building data storage policies. We demonstrate, by using practical examples, how you can adapt Tivoli Storage Manager to the needs of your environment. Also, we provide an introduction to automation, and explain how to set up administrative and client schedules.

7.1 Data storage policy: an overview

As already explained in 2.2, “Tivoli Storage Manager” on page 31, Tivoli Storage Manager offers entities to structure the data storage management rules, and to define relationships between the client system and the data that has to be managed. We have described how this should be done, and where the rules need to be stored. The entities we are concerned with here are:

- Policy domain
- Policy set
- Management class
- Copy group

A client system, or *node* in Tivoli Storage Manager terminology, is grouped together with other nodes into a *policy domain*. In a domain, all clients are managed using the same data management rules. There are many different approaches to group nodes; however, in most cases this is based on the organizational structure of an enterprise or on the machine type of the client systems being managed.

The policy domain links the nodes to a *policy set*, which consists of management classes. There can be only one policy set active within a policy domain; however, you can have many more sets of policies inactive in your policy domain. You can activate a policy set with one command if, for example, your business practice changes for a special period of time, such as the holiday season.

A *management class* contains rules called copy groups that it links to the specific data. When the data is linked to particular rules, it is said to be bound to the management class that contains the rules. This can happen at the object (file) level, but you can also do this at the directory or filespace level. You can link data explicitly or implicitly by using the default management class.

Finally, the *copy group* is the place where the rules are described for using parameters. In general, there are two different copy groups per management class: one for archival and one for backup. Copy group parameters define where the data are stored, how many versions are kept, how long they are retained, and so on.

Another way to look at the components that make up a policy within Tivoli Storage Manager is to consider them in the hierarchical fashion in which they are defined. That is, consider the policy domain as containing the policy set, the policy set as containing the management classes, and the management classes as containing the copy groups.

7.2 Setting up data storage policies

This section takes you through the steps necessary to define a policy. The minimum steps required are:

1. Define a policy domain
2. Define a policy set
3. Define a management class
4. Define a backup copy group
5. Define an archive copy group

Tivoli Storage Manager has a default policy, called STANDARD, that is configured when the product is installed. The STANDARD policy is good for product evaluation and testing, but the recommended configuration we have developed for this redbook is a better starting point. You can develop your own policies for your own business requirements.

7.2.1 Defining a policy domain

A policy domain is a way to group Tivoli Storage Manager clients, depending on how you want to treat their data. It allows you to logically group the machines in your organization according to:

- **Default policy:** This 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.
- **Administrative control:** Access to the clients and their policies can be restricted to certain administrators.

The `define domain` command creates new policy domains. The following command shows how to create a policy domain called `production`, which is used to group the production servers for the ABC corporation.

```
tsm: adsm> define domain production backret=100 archret=365 \  
description="Production servers for ABC Corporation"  
ANR1500I Policy domain PRODUCTION defined.
```

The Tivoli Storage Manager clients that belong to this domain share the same default policy, and access to them can be restricted to administrators authorized to manage the production servers. The nodes must be assigned to this policy domain when they are registered with the Tivoli Storage Manager server as described in 4.4.6, “Registering client nodes” on page 108.

The `define domain` command also defines two parameters that are used in special cases to determine how data is handled:

- **BACKRET:** This is how long backup data is retained if it is not governed by any of the existing backup policies.
- **ARCHRET:** This is how long archive data is retained if it is not governed by any of the existing archive policies.

These two retention grace period parameters are used as a safety net for data that is *orphaned* from a valid set of policies for some reason. This can happen if a set of policies is accidentally deleted while still containing data; the `BACKRET` and `ARCHRET` parameters are used to manage this data.

7.2.2 Defining a policy set

The policy set is a grouping of management classes. There can be multiple policy sets within a policy domain, but only one policy set at a time can be active. This restriction has resulted in most installations using only one policy set per policy domain.

The `ACTIVE` policy set is a special entity in the policy domain. It exists in every domain and cannot be changed directly. To change the `ACTIVE` policy set, you must define your rules in a policy set that is subsequently validated and activated. The activation process takes a snapshot of the policy set and places it in the `ACTIVE` policy set. It is important to note that the `ACTIVE` policy set is a point-in-time snapshot of the originating policy set. Therefore, further changes to the originating policy set have no effect on the `ACTIVE` policy set until the changed policy set is validated and activated.

The `define policyset` command creates a new policy set within a policy domain. Although the policy set can be named anything except the reserved name `ACTIVE`, it is common practice to give the same name to the policy domain and policy set for simplicity. The following command shows how to define a `production` policy set for the `production` policy domain.

```
define policyset production production \  
description="Production servers for ABC Corporation"  
ANR1510I Policy set PRODUCTION defined in policy domain PRODUCTION.
```

7.2.3 Defining management classes

A management class contains specific rules and is the link between the rules and data. The rules are contained in constructs called copy groups: one for rules governing backup data and one for rules governing archive data. A management class can have a backup copy group or an archive copy group or both.

A policy set may contain many management classes, but only one is designated as the default. The default management class in the policy set is linked to any data in the domain that is not explicitly linked to another management class.

The `define mgmtclass` command creates a new management class in the policy set and domain. The `define mgmtclass` command defines a management class as the default for the domain. The following commands show how to create the CUSTDATA management class in the PRODUCTION policy set within the PRODUCTION policy domain and how to assign it as the default management class.

```
tsm: adsm> define mgmtclass production production custdata \  
description="Custdata management class for ABC Corporation"  
ANR1520I Management class CUSTDATA defined in policy domain PRODUCTION, set  
PRODUCTION.  
  
tsm: adsm> assign defmgmtclass production production custdata  
ANR1538I Default management class set to CUSTDATA for policy domain  
PRODUCTION, set PRODUCTION.
```

7.2.4 Defining backup copy groups

The backup copy group within the management class defines parameters which control how backed up files will be managed. The backup copy group is concerned with two logical objects: the file and the file copy. A file is the actual data on a node while a file copy is a point-in-time copy of the file. Another way to think of it is that Tivoli Storage Manager contains file copies, and nodes contain files.

A file can be in one of two possible states: existing or deleted. When we talk about an existing file on a node, we mean a file that has been previously backed up and still exists on the node. A deleted file is a file that has been previously backed up and has been 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, inactive, or expired. An active file copy is the most current copy of the file, an inactive file copy is a previous copy of the file, and an expired file copy is 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 set forth in the backup copy group.

Whether the file exists or is deleted, the file copy always passes through the same states in the same order. A file copy starts out as active since it is the first copy of the file and is, therefore, the most current. Once the file changes and we take another file copy, the first file copy changes to be inactive because we have a more recent one. Eventually, the first file copy expires based on one of two limits placed on it by our rules: number of copies or retention period.

The number of copies that we set in our rules specifies the total number of file copies to maintain in the Tivoli Storage Manager database. It is important to note that the specified number includes the active file copy, therefore, when we set the number of file copies to three, we are keeping one active copy and two inactive copies. When the number of copies is exceeded, the oldest copies are removed from the database.

The retention period that we set in our rules specifies the length of time that we retain inactive file copies. Note that there is no retention period for active file copies; they exist as long as the file exists on the node.

Whether or not the file exists on the node affects 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 specifies the number of file copies or versions to keep. This number includes active and inactive file copies.
- **RETEXTRA:** This specifies how long to keep inactive file copies. When a file changes from active to inactive, it is kept for these extra days and then removed. It is important to note that the retention period starts when the file copy changes to inactive, not from its original backup date. This is specified as either a number of days or **UNLIMITED**, in which case inactive file copies are never deleted unless superseded.

If the file has been deleted, the active file copy is 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 specifies the number of file copies to keep after the file has been deleted.
- **RETEXTRA:** This specifies how long to keep inactive file copies.
- **RETONLY:** This 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 that are still governed by the **RETEXTRA** parameter. This is specified as either a number of days or **UNLIMITED**, in which case the last file copy is never deleted.

The backup copy group defines five other attributes that control the way that backup data is handled:

- **TYPE:** The **TYPE** parameter is used to differentiate between the two possible types of copy groups. In the case of a backup copy group, it is set to **BACKUP**.
- **DESTINATION:** The backup copy group specifies where to store the data sent to it from backup operations using the **DESTINATION** parameter. The copy group bridges the gap between data files and storage pools. Different types of data flow through the copy groups and into the storage pools. Note that there is not necessarily a one-to-one relationship between copy groups and storage pools — a single storage pool could be the destination for many copy groups.
- **MODE:** The **MODE** parameter specifies how files are to be selected for incremental backup. Setting the mode to **MODIFIED** allows a file to be backed up only if it has changed since the last backup. The **ABSOLUTE** setting allows files to be backed up regardless of whether they have changed or not. The latter value would only be used for special cases; the default value is **MODIFIED**.
- **FREQUENCY:** The **FREQUENCY** parameter specifies how often to allow a file to be incrementally backed up. A selective backup, which backs up data regardless of whether it has changed or not, is not affected by this parameter. To incrementally back up a file from a node, it has to satisfy three conditions:
 1. Include-exclude statements allow the file to be considered for backup.

2. File satisfies the MODE setting. That is, if the MODE is set to MODIFIED, the file must have changed to qualify for backup. If the MODE is set to ABSOLUTE, the file is automatically allowed to be backed up.
 3. The difference between the server time and the active file copy timestamp must be greater than the FREQUENCY setting. The frequency is converted to hours to compare to the timestamp difference.
- **SERIALIZATION:** The SERIALIZATION parameter specifies what to do with files that are modified during a backup operation. When we say that a file is modified during backup, we mean that it is modified after Tivoli Storage Manager examined it for its details, but before it was completely backed up to the server. This sort of backup is referred to as a *dirty backup* because the file is in an inconsistent state and may not restore properly. The SERIALIZATION parameter provides four options to deal with this problem:
 - The `SHRSTATIC` setting specifies that a file is not backed up if it is modified during backup but multiple attempts are made to back up the file. If the file is being modified through all of these attempts, the file is not backed up. The number of attempts can be controlled using the `CHANGINGRETRIES` option in the client options file.
 - The `STATIC` setting specifies that a file is not backed up if it is modified during backup and no additional attempts are made.
 - The `SHRDYNAMIC` setting specifies that a file is backed up if it is modified during backup but multiple attempts are made to back it up without modification first. If that cannot be done, the file is backed up anyway.
 - The `DYNAMIC` setting specifies that a file is backed up even if it is modified during backup. There are no preliminary attempts to back up the file unmodified; it is backed up as is on the first attempt.

The `define copygroup` command creates a new copy group within the management class. Note that the command does not require a name for the backup copy group, it is always called `STANDARD` and cannot be changed. There is no reason to change this parameter since it only has relevance within the Tivoli Storage Manager server itself.

The following command shows how to create a backup copy group for the management class `CUSTDATA` in the policy set `PRODUCTION` of the policy domain `PRODUCTION`. The client checks for files that have been modified since the last backup process and tries to back them up to the `DISKDATA` primary storage pool. After a few retries, the process skips files that are being modified during backup. The client data is governed by the following rules:

- If the file exists on the client, three versions of it are kept. The active version is kept forever, with extra inactive versions expiring after 100 days.
- If the file no longer exists on the client, the last copy is kept for 365 days.

```
tsm: adsm> define copygroup production production custdata type=backup \
cont> destination=DISKDATA frequency=1 verexists=3 verdeleted=1 \
retextra=100 retonly=365 mode=modified serialization=shrstatic
ANR1530I Backup copy group STANDARD defined in policy domain PRODUCTION, set
PRODUCTION, management class CUSTDATA.
```

7.2.5 Defining an archive copy group

The archive copy group within the management class defines parameters which control how archived files will be managed.

An archive copy group consists of fewer parameters than the backup copy group. The most important of these are:

- **TYPE:** The `type` parameter is used to differentiate between the two possible types of copy groups. In the case of an archive copy group, it is set to `ARCHIVE`.
- **DESTINATION:** The destination storage pool to use for data storage. Usually, this is the primary storage pool in a storage pool hierarchy including disk pools and tape pools.
- **RETVER:** Usually, this archive copy is set to 365 days.
- **SERIALIZATION:** This parameter has several options for dealing with files that are being modified during processing. These are the same as for backup copygroups.

Archive data is assigned to the archive copy group of the default management class unless you explicitly over-ride this on the command line or the GUI when performing the archive.

The `define copygroup` command is used to define the archive copy group. Note that the command does not require a name for the archive copy group; it is always called `STANDARD` and cannot be changed. There is no reason to change this parameter, since it only has relevance within the Tivoli Storage Manager server itself.

The following command shows how to define an archive copy group for the `CUSTDATA` management class in the `PRODUCTION` policy set within the `PRODUCTION` policy domain. The archive files are sent to the `DISKDATA` primary storage pool and kept for 365 days. If the operation cannot archive a file because it is in use, it tries a few times and then skips the file.

```
tsm: adsm> define copygroup production production custdata type=archive \  
cont> destination=DISKDATA retver=365 serialization=shrstatic  
ANR1535I Archive copy group STANDARD defined in policy domain PRODUCTION, set  
PRODUCTION, management class CUSTDATA.
```

7.3 Special considerations for the BRMS application client

The Tivoli Storage Manager `STANDARD` management class does not provide the most efficient use of Tivoli Storage Manager server storage when used with the BRMS application client. This is because BRMS stores each saved AS/400 object under a unique name. A second backup of the same object again uses a unique name. From a Tivoli Storage Manager server perspective, each of these AS/400 objects are considered active because of the unique names. Therefore, Tivoli Storage Manager server versioning does not play a role in BRMS application client object retention, since Tivoli Storage Manager always saves active versions of objects.

BRMS explicitly deletes Tivoli Storage Manager stored objects when these expire in the BRMS database. The retention is governed by BRMS media policies. Tivoli

Storage Manager server copygroup retentions are not used. Therefore, when BRMS expires an object and deletes it from the Tivoli Storage Manager server, the server will, in turn, delete it from Tivoli Storage Manager storage during the next expiration process.

Figure 45 is a graphical representation of our recommended policy configuration.

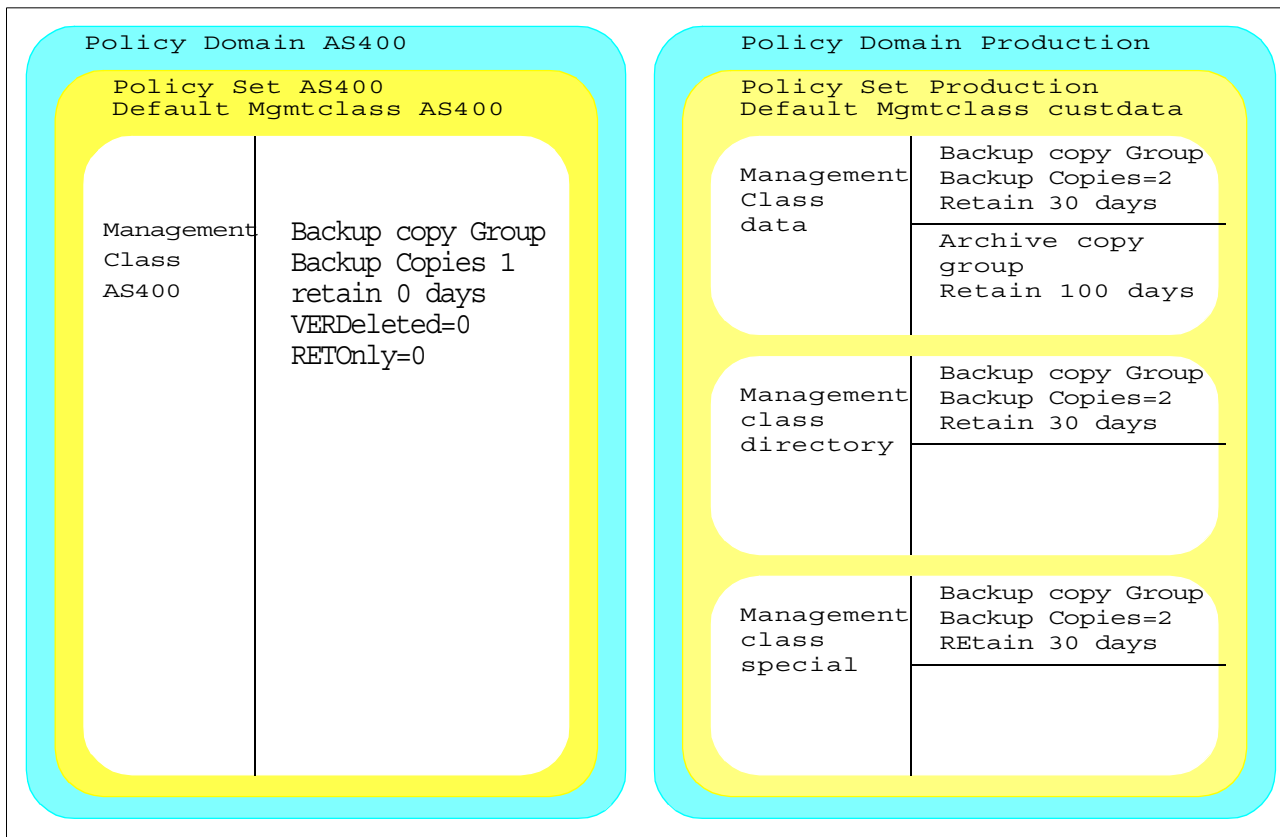


Figure 45. Recommended policy definition

You should consider using the following Tivoli Storage Manager administrative commands to create and enable a new Tivoli Storage Manager domain and management class for BRMS use as explained. This ensures that the Tivoli Storage Manager server expires objects soon after these are deleted by BRMS. AS/400 will be the management class name that is used by the BRMS application client.


```

tsm: adsm> Define Domain AS400 Description="Domain for BRMS application client" \
cont> backretention=365 Archretention=0
ANR1500I Policy domain AS400 defined.

tsm: adsm> define policyset AS400 AS400 \
cont> Description="Policy set for BRMS Application Clients"
ANR1510I Policy set AS400 defined in policy domain AS400.

tsm: adsm> define Mgmtclass AS400 AS400 AS400 \
cont> Description="Managment class for BRMS application clients"
ANR1520I Management class AS400 defined in policy domain AS400, set AS400.

tsm: adsm> define copygroup AS400 AS400 AS400 STANDARD type=backup \
cont> destination=DISKPOOL verexists=1 Verdeleted=0 retextra=0 retonly=0
ANR1530I Backup copy group STANDARD defined in policy domain AS400, set AS400,
management class AS400.

tsm: adsm> assign defmgmtclass AS400 AS400 AS400
ANR1538I Default management class set to AS400 for policy domain AS400, set AS400.

```

Archive operations by the BRMS application client store objects in the Tivoli Storage Manager server backup storage pool. If you do not want Tivoli Storage Manager server backup storage used for BRMS archive operations, you need to create a second management class and specify this management class on the BRMS Media Policies used for BRMS archive operations. The following is an example of creating Management class AS400ARC and copygroup definition with the destination=Archivepool.

```

tsm: adsm> define mgmtclass as400 as400 as400arc \
cont> description="Managment class for Archive of BRMS client"
ANR1520I Management class AS400ARC defined in policy domain AS400,
set AS400.

tsm: adsm> define copygroup as400 as400 as400arc type=backup \
cont> destination=Archivepool
ANR1530I Backup copy group STANDARD defined in policy domain AS400,
set AS400, management class AS400ARC

```

7.4 Verifying policy definitions

The best way to check the policy definitions is to examine the details of the copy groups using the `QUERY COPYGROUP` command. The output from this command displays the policy domain, policy set, management class, and copy group names as well as the copy group parameters. Note that it is really the copy group definitions that define the policy for the domain; the rest of the constructs between domain and copy group just provide flexibility in your configuration.

To check the settings for the recommended backup copy groups, use the command `q copygroup` to get the attributes displayed:

```

tsm: adsm> q copygroup production production type=backup

```

POLICY DOMAIN NAME	POLICY SET NAME	MGMT CLASS NAME	COPY GROUP NAME	VERSIONS DATA EXISTS	VERSIONS DATA DELETED	RETAIN EXTRA VERSIONS	RETAIN ONLY VERSION
PRODUCTI- ON	PRODUCTI- ON	CUSTDATA	STANDARD	3	1	100	365
PRODUCTI- ON	PRODUCTI- ON	DIRECTORY	STANDARD	3	1	100	365
PRODUCTI- ON	PRODUCTI- ON	SPECIAL	STANDARD	3	1	100	365

```

tsm: adsm> q copygroup as400 as400 type=backup

```

POLICY DOMAIN NAME	POLICY SET NAME	MGMT CLASS NAME	COPY GROUP NAME	VERSIONS DATA EXISTS	VERSIONS DATA DELETED	RETAIN EXTRA VERSIONS	RETAIN ONLY VERSION
AS400	AS400	AS400	STANDARD	1	0	0	0

To verify the defined archive copygroup, you need to issue the command with the `TYPE` parameter equals `ARCHIVE`.

7.5 Validating and activating a policy set

The last step in setting up your policy is to validate and activate your policy set. The commands are very straightforward and have few parameters. If you update copygroups and management class in any of the policy sets, your changes will be effective only when you validate and activate your policy set.

The `validate policyset` command checks for completeness in the management class and copy group definitions. It validates these policies and makes them ready for activation.

To validate the recommended policy sets:

```

tsm: adsm> validate policyset production production
ANR1515I Policy set PRODUCTION validated in domain PRODUCTION (ready for
activation).

tsm: adsm> validate policyset as400 as400
ANR1515I Policy set AS400 validated in domain AS400 (ready for activation).

```

The `activate policyset` command allows the specified policy set to be applied to the data within its policy domain.

To activate the recommended policy sets:

```
tsm: adsm> activate policyset production production

Do you wish to proceed? (Yes/No) y
ANR1514I Policy set PRODUCTION activated in policy domain PRODUCTION.

tsm: adsm> activate policyset as400 as400

Do you wish to proceed? (Yes/No) y
ANR1514I Policy set as400 activated in policy domain as400
```

7.6 Enforcing your policy

Once the policy is defined, you want to enforce it using the `expire inventory` command. This command makes sure that any extra copies of data in your copy groups are removed from the database. It also takes care of data that is older than your specified retention period. The backup copy group parameters `VEREXISTS`, `VERDELETED`, `RETEXTRA`, and `REONLY` are applied to backup data through the expiration process as well as the archive copy group parameter `RETV`. The following command shows how to expire the database references for the Tivoli Storage Manager server:

```
tsm: adsm> expire inventory wait=yes
ANR0984I Process 23 for EXPIRE INVENTORY started in the FOREGROUND at
19:11:30.
```

This command can be computationally intensive, so it should only be executed when critical processes are completed.

The `EXPINTERVAL` parameter in the server options file specifies the number of hours between automatic expiration processing and is initially configured for 24 hours. With automatic expiration processing enabled, the server runs inventory expiration at start-up and every 24 hours thereafter. We recommend setting the `EXPINTERVAL` to zero (disabling automatic expiration) and defining a daily administrative schedule to run this command at a convenient time.

7.7 Tivoli Storage Manager automation

For complete automation of all Tivoli Storage Manager functions, the server provides a central scheduling function. Scheduling is split into two different categories: administrative and client scheduling. The two categories differ in two key areas:

- **Execution location:** An administrative schedule performs some action on the Tivoli Storage Manager server while the client schedule can only execute on the Tivoli Storage Manager client.
- **Domain privilege:** An administrative schedule can only be managed by an administrator with system privilege, while the client schedule can be managed by an administrator with policy privileges in only one domain. The granularity provided by this feature can be very useful when distributing management control across a large enterprise.

For both types of schedules, there are four key pieces of information:

- A command that needs to be executed
- When the command executes
- How long the command takes to complete
- How often the command needs to be repeated

The command that you run may be an incremental backup (client schedule) or a storage pool migration (administrative schedule) that should be run every day at a particular time. You also have to estimate how long the command will run so that you can synchronize your schedules and balance the load on the server.

7.8 Client schedules

A client schedule is a directive to trigger an action on a group of Tivoli Storage Manager client machines. It differs from an administrative schedule in that it specifies that an action be performed on the Tivoli Storage Manager client. The client scheduling system consists of a server portion and a client portion. The server part is integrated into the Tivoli Storage Manager process and is responsible for defining the schedule parameters and associated nodes with the schedule. The client scheduler is a separate process on the Tivoli Storage Manager client and provides communication between the server and client.

A Tivoli Storage Manager client machine with an active scheduler component can be scheduled to perform any of the following actions:

- Backup (incremental/selective)
- Archive
- Restore
- Retrieve
- Operating system command
- Macro

The most common use of client schedules is to implement an automatic incremental backup process for a group of machines.

At this point in the configuration of the Tivoli Storage Manager system, you will have installed the Tivoli Storage Manager client code on your clients and defined them to a policy domain. You will also have activated the scheduler service on the client so that it is ready to perform the actions that we schedule for it. The remaining activities are concentrated on the server and its scheduling facility. To schedule an action on the client, you will need to:

1. Define a client schedule
2. Associate a client with a schedule
3. Check your work

Note

As already discussed in Chapter 5, “Setting up a BRMS API client on an AS/400 system” on page 111, this client scheduling functionality is not part of the Tivoli Storage Manager API. This means all the following configurations do *not* apply to the BRMS application client for Tivoli Storage Manager on AS/400. Refer to 5.5, “BRMS application client schedules” on page 133 for alternative methods.

7.8.1 Defining a client schedule

The `define schedule` command defines a schedule to the Tivoli Storage Manager server. It does not contain any reference to a client; this will be taken care of with the `define association` command. To define a client schedule, you will need the following information:

- Policy domain name: The schedule will be created within this policy domain and can only be associated with nodes within the same domain. This will allow you to manage which administrators have control of these schedules by limiting access to the domain that owns them.
- Schedule name: This can be any name you choose, up to 30 characters.
- Start time: The time of day that you want the schedule to trigger your action.
- Duration: The scheduler can only initiate the schedule within the time period specified with the duration parameters.
- Period: The length of the time between repeated executions of the schedule. The default interval is one day.

The following command illustrates the syntax for a client schedule. This command defines a schedule named `BACKUP_NIGHTLY` in the ABC CORP policy domain. This schedule will trigger an incremental backup (the default action for a client schedule) at 10 p.m. every night. If there is a problem contacting the client, the scheduler will keep trying until 1 a.m.

```
tsm: adsm> define schedule production nightly_backup starttime=22:00 \  
cont> duration=3 durunit=Hours description="Nightly backup schedule"  
ANR2500I Schedule NIGHTLY_BACKUP defined in policy domain PRODUCTION.
```

7.8.2 Associating a client with a schedule

Once the schedule is defined, we need to specify which nodes belong to it using the `define association` command. We must associate nodes to a schedule within their own domain. The nodes must be registered to the server before running this command, but they do not necessarily have to be in contact with the server. The actual commands and output look like this:

```
tsm: adsm> define association production nightly_backup itsore07  
ANR2510I Node ITSORE07 associated with schedule NIGHTLY_BACKUP in policy  
domain PRODUCTION.
```

7.8.3 Verifying the client schedules

The schedules can be checked using the `query event` command. This will show you if the nodes and schedules are all set up correctly. The actual command and its output look like this:

```
tsm: adsm> query event production nightly_backup
```

SCHEDULED	START	ACTUAL START	SCHEDULE NAME	NODE NAME	STATUS
15.02.2000	22:00:00		NIGHTLY_BACK- UP	ITSORE07	FUTURE

In order for a client to actually execute the scheduled operation it must be running its TSM scheduler clients. Refer to the appropriate client manuals for details on how to set this up.

7.9 Administrative schedules

An administrative schedule is a directive to trigger some sort of action on the Tivoli Storage Manager server. It consists of a command or sequence of commands and some details on when the actions should happen. Any actions that are used on a regular basis to manage the Tivoli Storage Manager environment should be defined as an administrative schedule.

The following command illustrates the syntax for an administrative schedule. This command defines a schedule named `BACKUP_DATABASE` that specifies a full database backup and starts at 7 a.m. every morning.

```
tsm: adsm> define schedule backup_database type=administrative \  
cont> cmd="backup db deviceclass=offsite type=full" starttime=07:00 \  
cont> active=yes description="Database backup"  
ANR2577I Schedule BACKUP_DATABASE defined.
```

We have assembled a series of administrative schedules that should help you set up a Tivoli Storage Manager environment that will minimize user intervention while providing a high level of data availability.

The first step in setting up your administrative schedules is knowing which commands to run. Figure 8 shows our recommendations for commands that should be scheduled and where to find more information on them. The table also includes our estimates on various other factors based on a typical implementation. Client schedules are not considered administrative, but they are included to emphasize that all of the other scheduling in your environment should hinge on your client schedules. This set of schedules contains all of the specifics required to execute in a typical environment. It is based on the Tivoli Storage Manager setup described in the redbook *Getting Started with Tivoli Storage Manager: Implementation Guide*, SG24-5416. It assumes the following storage pools have been configured:

- An onsite disk storage pool called DISKDATA
- An onsite disk storage pool specifically for client directories called DISKDIRS (refer to the client DIRM option for details on this)
- An onsite tape storage pool called TAPE DATA
- An offsite (or copy) storage pool called OFFDATA
- An offsite (or copy) storage pool for client directories called OFFDIRS

Table 8. Recommended schedules

#	Function	Task	Duration	Task Dependency	Refer to:
1	Back up client data to Tivoli Storage Manager Server	Schedule client backup windows	6.0	Site requirements	7.8 on page 184
2	Copy backup data to off-site storage media	Back up storage pools DISKDIRS	0.5	Task 1 complete	7.9.1 on page 187
3		Back up storage pool DISKDATA	1.0	Task 1 complete	
4		Back up storage pool TAPE DATA	1.0	Task 1 complete	
5		Back up database	0.5	Task 2, 3, 4 complete	
6	Volume history file management	Delete volume history data for database backup volumes	0.25	Task 5	7.9.2 on page 188
7	Prepare disk storage pools for next backup window	Migrate data from DISKDATA to TAPE DATA	3.0	Task 5 complete	7.9.3 on page 189
8	Defragment tape volumes in sequential storage pools	Reclaim volumes from OFFDIRS	1.0	None	7.9.4 on page 190
9		Reclaim volumes from OFFDATA	3.0	None	
10		Reclaim volumes from TAPE DATA	3.0	None	
11	Database space management	Expire inventory	3.0	None	7.9.5 on page 191
12	Enable statistics	Audit licenses	0.25	None	7.9.6 on page 192

7.9.1 Defining an off-site backup schedule

When the client backups are complete, all of the data that has changed in the primary storage pools should be copied to a copy storage pool. The copy storage pool tapes and the database backup tapes should be taken to another site called the off-site location. These tapes are referred to collectively as the off-site backups and will be used to restore your environment in the event of a catastrophic failure or disaster.

The order of execution of these tasks should be as follows:

1. Check that there are no running sessions with the clients. When you back up the primary storage pools and database, you want to make sure that you are capturing an up-to-date copy. If there is still a client backing up its data, you should wait until it is done before starting the off-site backups. Use an SQL command to check for running sessions.
2. Back up the primary storage pools to their copy storage pool. See 8.2, “Storage pool protection” on page 195 for more general information on copy storage pools .
 1. Back up the DISKDIRS storage pool to the OFFDIRS storage pool
 2. Back up the DISKDATA storage pool to the OFFDATA storage pool
 3. Back up the TAPEDATA storage pool to the OFFDATA storage pool
3. Back up the database. See 8.4, “Database backup” on page 202 for more information.

7.9.2 Defining the volume history schedule

Every volume that is used by Tivoli Storage Manager is tracked in the volume history database, including the volume identifier for the database backups. The database volume information is important because it tells you which volume holds your most recent database backup. In the event of a disaster, this information will be very important. The volume history information is periodically copied out to a volume history file that you can specify with the `VOLUMEHISTORY` option in the server options file. We recommend that you have two copies of the volume history file, in case one becomes unusable.

There are two recommended schedules that affect the volume history file:

`DELETE_VOLHIST` and `BACKUP_VOLHIST`

When you back up the database, the previous database backups become obsolete and should be returned to scratch volume status for reuse. The way to accomplish this is to delete the volume history record of this volume using the `DELETE VOLHISTORY` command. We recommend that you delete any database backups that are more than five days old, since we back up the database every day. To define a delete volume history schedule, we define a schedule called `DELETE_VOLHIST` specifying a type of `type=dbbackup`. The backslash (\) indicates to Tivoli Storage Manager to continue the command on the next line. For example:

```
tsm: adsm> define schedule delete_volhist type=administrative \  
cont> cmd="delete volhistory type=dbbackup todate=today-5" starttime=07:00\  
cont> description="Delete volume history information for database backups"  
ANR2577I Schedule DELETE_VOLHIST defined.
```

* SCHEDULE NAME	START DATE/TIME	DURATION	PERIOD	DAY
DELETE_VOLHIST	15.02.2000 07:00:00	1 H	1 D	ANY

tsm: ADsm>

Some operations, like the `DELETE VOLHISTORY` command, will update the volume history database, but will not trigger the server to update the volume history files. To ensure that the volume history data is always current, you should schedule a daily backup of the volume history database using the `BACKUP VOLHISTORY` command. To schedule a daily backup of the volume history database:

```
tsm: ADSM> define schedule backup_volhist type=administrative \
cont> cmd="backup volhistory" starttime=07:05 \
cont> description="Backup volume history file"

ANR2577I Schedule BACKUP_VOLHIST defined.
tsm: ADSM>query schedule backup_volh* type=administrative
```

* SCHEDULE NAME	START DATE/TIME	DURATION	PERIOD	DAY
-----	-----	-----	-----	---
BACKUP_VOLHIST	15.02.2000 07:05:00	1 H	1 D	ANY

```
tsm: ADSM>
```

7.9.3 Defining a migration schedule

Migration of your primary storage pools during client backup can slow down the client backup sessions and impact the scheduling of other server processes. We recommend that you avoid migration during client backup by scheduling primary storage pool migration outside of the client backup window. This will only prevent migration during client backup if the storage pools are correctly sized to hold the daily backup data from your clients.

To schedule a migration of a storage pool, change the storage pool high and low migration thresholds to zero using the `UPDATE STGPPOOL` command. This will force the storage pools to migrate immediately to their next storage pool level. The migration process will continue until the storage pool is empty or until you reset the migration thresholds to a non-zero value. It is important not to leave the migration thresholds at zero after they are finished migrating; if more data is sent to these storage pools while they are set to zero, the data will be migrated immediately, therefore defeating the purpose of having the storage pool.

Two schedules are required: one to start the migration and one to stop it. To define the migration schedules to start and stop storage pool migration:

```
tsm: adsm> define schedule migration_start type=administrative \
cont> cmd="update stgpool diskdata hi=0 lo=0" starttime=07:00 \
cont> description="Start migration on DISKDATA storage pool"
ANR2577I Schedule MIGRATION_START defined.

tsm: adsm> define schedule migration_stop type=administrative \
cont> cmd="update stgpool diskdata hi=70 lo=30" starttime=10:00 \
cont> desc="Stop migration on DISKDATA storage pool"
ANR2577I Schedule MIGRATION_STOP defined.

tsm: adsm> query schedule migration* type=administrative
```

Schedule Name	Start Date/Time	Duration	Period	Day
-----	-----	-----	-----	---
MIGRATION_START	15.02.2000 07:00:00	1 H	1 D	Any
MIGRATION_STOP	15.02.2000 10:00:00	1 H	1 D	Any

7.9.4 Defining a reclamation schedule

Tapes in the sequential access storage pools will eventually get fragmented due to file expiration and node removal. This can cause many tapes to have very little data on them. A reclamation process will take all of this data and consolidate it onto a few tapes, therefore returning many tapes to scratch status for reuse.

To start a reclamation process on a sequential storage pool, use the `UPDATE STGPPOOL` command to set the `RECLAIM` parameter for the storage pool to a value between 50 and 99. This value represents the percentage of reclaimable space on the volume, which is the opposite of volume utilization. That is, if the output from a `QUERY VOLUME` command shows a volume as 20 percent utilized, its reclaimable space is 80 percent. Reclamation stops when the process is complete or the reclaim parameter is set to 100.

Each sequential storage pool should have a schedule to start and stop reclamation. If you have three sequential storage pools: `OFFDIRS`, `OFFDATA`, and `TAPEDATA`, you need six schedules to start and stop the reclamations. The following code listing shows how to set up the reclamation schedules:

```

tsm: adsm> define schedule RECLAIM_OFFDIRS_START type=administrative \
cont> cmd="update stgpool offdirs reclaim=75" starttime=10:00 \
cont> description="Start reclaim on the OFFDIRS storage pool"
ANR2577I Schedule RECLAIM_OFFDIRS_START defined.

tsm: adsm> define schedule RECLAIM_OFFDIRS_STOP type=administrative \
cont> cmd="update stgpool offdirs reclaim=100" starttime=11:00 \
cont> description="Stop reclaim on the OFFDIRS storage pool"
ANR2577I Schedule RECLAIM_OFFDIRS_STOP defined.

tsm: adsm> define schedule RECLAIM_OFFDATA_START type=administrative \
cont> cmd="update stgpool offdata reclaim=75" starttime=11:00 \
cont> description="Start reclaim on the OFFDATA storage pool"
ANR2577I Schedule RECLAIM_OFFDATA_START defined.

tsm: adsm> define schedule RECLAIM_OFFDATA_STOP type=administrative \
cont> cmd="update stgpool offdata reclaim=100" starttime=14:00 \
cont> description="Stop reclaim on the OFFDATA storage pool"
ANR2577I Schedule RECLAIM_OFFDATA_STOP defined.

tsm: adsm> define schedule RECLAIM_TAPEDATA_START type=administrative \
cont> cmd="update stgpool tapedata reclaim=75" starttime=14:00 \
cont> description="Start reclaim on the TAPEDATA storage pool"
ANR2577I Schedule RECLAIM_TAPEDATA_START defined.

tsm: adsm> define schedule RECLAIM_TAPEDATA_STOP type=administrative \
cont> cmd="update stgpool tapedata reclaim=100" starttime=17:00 \
cont> description="Stop reclaim on the TAPEDATA storage pool"
ANR2577I Schedule RECLAIM_TAPEDATA_STOP defined.

tsm: adsm> query schedule reclaim* type=administrative

```

Schedule Name	Start Date/Time	Duration	Period	Day
RECLAIM_OFFDATA- _START	15.02.2000 11:00:00	1 H	1 D	Any
RECLAIM_OFFDATA- _STOP	15.02.2000 14:00:00	1 H	1 D	Any
RECLAIM_OFFDIRS- _START	15.02.2000 10:00:00	1 H	1 D	Any
RECLAIM_OFFDIRS- _STOP	15.02.2000 11:00:00	1 H	1 D	Any
RECLAIM_TAPEDAT- A_START	15.02.2000 14:00:00	1 H	1 D	Any
RECLAIM_TAPEDAT- A_STOP	15.02.2000 17:00:00	1 H	1 D	Any

7.9.5 Defining an expiration schedule

Managing the amount of space used by your database becomes very important as your environment grows. The client backup process handles half of the task by marking expired data references while backing up client data. The second half of the task is handled by the `EXPIRE INVENTORY` command. This command will remove the marked entries from the database.

The Tivoli Storage Manager server configuration file defaults to a 24 hour cycle for expiration. This would result in daily expiration processing beginning 24 hours from when you start the server. This command can be computationally intensive, so it is best scheduled during a quiet server time to minimize its impact on server operations. Therefore, we recommend scheduling the expire inventory command daily:

```

tsm: adsm> define schedule expire_inventory type=administrative \
cont> cmd="expire inventory" startt=17:00 \
cont> description="Inventory expiration"
ANR2577I Schedule EXPIRE_INVENTORY defined.

```

```

tsm: adsm> query schedule expire* type=administrative

```

Schedule Name	Start Date/Time	Duration	Period	Day
-----	-----	-----	-----	---
EXPIRE_INVENTORY	15.02.2000 17:00:00	1 H	1 D	Any

7.9.6 Defining a licensing audit schedule

It is useful to be able to check statistics for the Tivoli Storage Manager server usage using the command `q auditoccupancy`. This command returns some valuable information on client data usage in the Tivoli Storage Manager environment:

```

tsm: adsm> q auditoccupancy

```

License information as of last audit on 15.02.2000 at 09:52:38.

NODE NAME	BACKUP STORAGE USED (MB)	ARCHIVE STORAGE USED (MB)	SPACE-MANAGED STORAGE USED (MB)	TOTAL STORAGE USED (MB)
-----	-----	-----	-----	-----
MARCUS	49	0	0	49
RCHASM	326	0	0	326
ITSORE07	125	0	0	125
APPN.NINJA	418	0	0	418
ITSORE06	553	0	0	553
NINJA	86	0	0	86
NINJA.MJW	490	0	0	490
SANTOSH	50	0	0	50
RCHASM12	422	0	0	422
MJW1	0	0	0	0
MJW2	9	0	0	9

The data returned from this command is updated when the `AUDIT LICENSE` command is run on the Tivoli Storage Manager server. We recommend running this command daily using the administrative schedule shown in the following screen:

```

tsm: adsm> define schedule audit_license type=administrative \
cont> cmd="audit licenses" starttime=00:00 \
cont> description="Audit licenses"
ANR2577I Schedule AUDIT_LICENSE defined.

```

```

tsm: adsm> query schedule audit* type=administrative

```

Schedule Name	Start Date/Time	Duration	Period	Day
-----	-----	-----	-----	---
AUDIT_LICENSE	15.02.2000 00:00:00	1 H	1 D	Any

Chapter 8. Protecting the Tivoli Storage Manager/400 server

Tivoli Storage Manager provides various methods for protecting data managed by the Tivoli Storage Manager server against losses due to media error or major disaster. For the most comprehensive coverage, these methods should be used together. In particular, they are:

Storage pool backup:

This duplicates each data object stored at the server side in another storage pool for availability (protection against media failure) and for disaster recovery.

Database and recovery log mirroring:

This is provided for availability reasons to protect the Tivoli Storage Manager media data catalog against disk errors.

Database backup:

This is for backup of the Tivoli Storage Manager internal database for disaster recovery.

Backup of other server information:

This is for backup of important Tivoli Storage Manager server configuration data for disaster recovery and storing together with the database backup and the off-site storage pool backup.

Figure 46 shows how all these methods work together to provide complete Tivoli Storage Manager server protection.

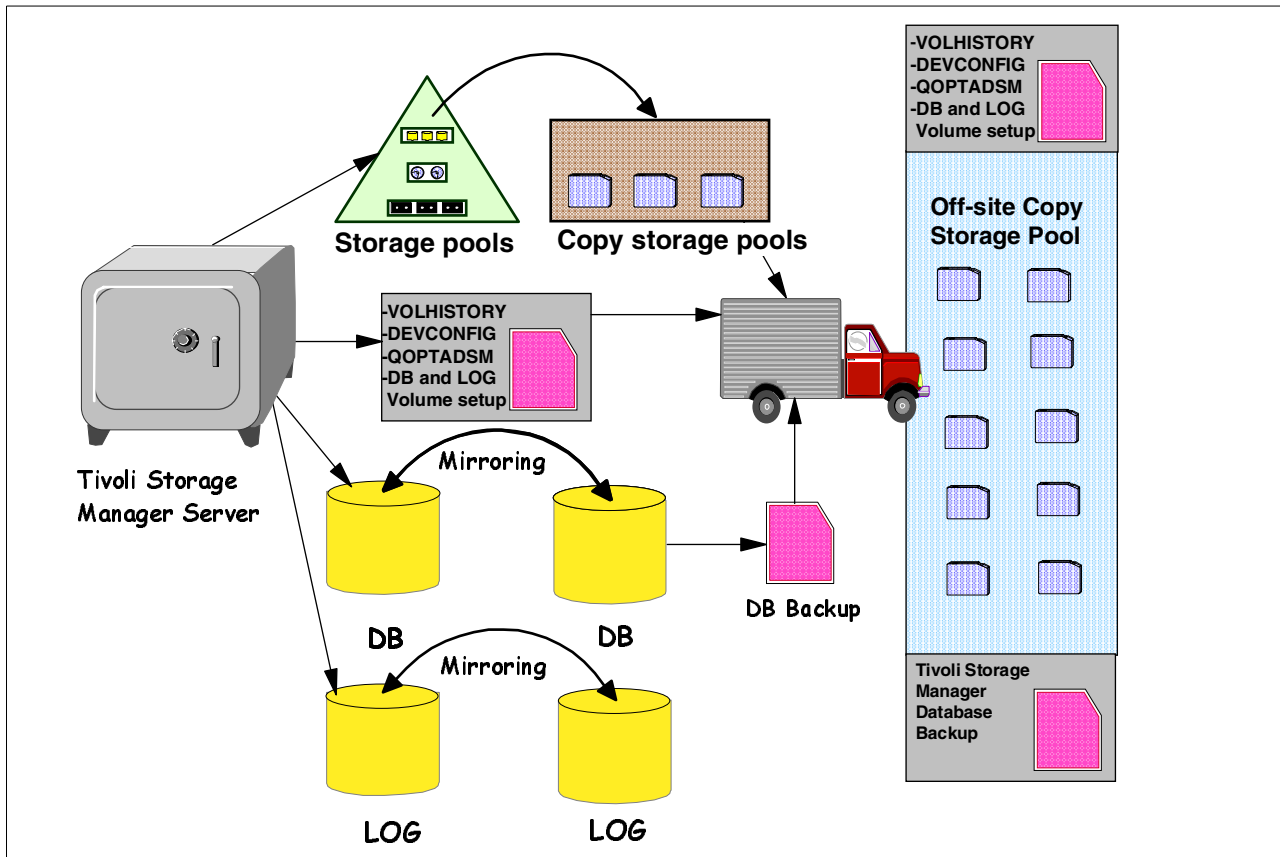


Figure 46. Tivoli Storage Manager server protection

This chapter explains the various methods for protecting the Tivoli Storage Manager server and provides a practical example of how to set up this protection.

8.1 Complete database and storage pool protection scenario

Before you learn the details of protecting your data, read the following scenarios for protecting and recovering data. This will give you a complete picture of the necessary sequence for all steps, as well as how the data secured will help you to recover from two different disaster scenarios. These scenarios will be presented in more detail in Chapter 10, “AS/400 backup and recovery scenarios” on page 261, using practical examples from AS/400 environments.

The complete protection cycle, to be prepared for a complete disaster recovery case, includes the following sequence of activities.

1. Create a copy storage pool.
2. Do a full backup of the primary storage pools to the copy storage pool.
3. Do these activities daily:
 - Do incremental backups of the primary storage pools to copy the storage pools.
 - Back up the database.

- Save the volume history file (which describes Tivoli Storage Manager volumes), the device configuration file (which describes the devices Tivoli Storage Manager uses), your server options, and the setup details for database and recovery log volumes.
- Move off-site: Copy storage pool volumes, database backup volumes, the volume history file, the device configuration file, and your server options.

Complete recovery of a complete Tivoli Storage Manager server system requires the following activities:

1. Install Tivoli Storage Manager on a replacement processor.
2. Move the database and storage pool backup volumes on-site.
3. Restore the database from the latest backup level.
4. Audit storage pool disk volumes and any tape volumes that were reused or added since the last backup. This information is recorded in external files that have been defined in the VOLUMEHISTORY option of the server options file for storing volume history information.
5. Delete from the database any volumes in the copy storage pool that were on-site at the time of the disaster.
6. Define new volumes in the primary storage pool.
7. Restore the primary storage pool volumes from those in the copy storage pools.

If only one volume was destroyed, for example, due to a media failure, the following activities would be necessary:

1. Identify the copy pool volumes containing backup copies of the files in the lost or damaged volume.
2. Mark the copy volumes as unavailable.
3. Bring the copy volumes on-site and mark them as read/write.
4. Restore the destroyed files.
5. Mark the copy volumes off-site and move them off-site.

8.2 Storage pool protection

As explained in 6.1, “Storage pools and storage pool volumes” on page 139, Tivoli Storage Manager provides two storage pool types to implement data duplication in order to protect data gains lost within the Tivoli Storage Manager server storage repository.

- Primary storage pools
- Copy 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.

Copy storage pools are used to back up primary storage pools. The copy storage pool provides a means of recovering from disasters and media failures. A copy

storage pool can use only sequential access storage (for example, tape media, optical media, sequential access disk areas, or virtual volumes on other servers).

Copy storage pool volumes can be moved off-site and still be tracked by Tivoli Storage Manager. This is done by using the access mode of off-site to ensure that Tivoli Storage Manager does not request a volume mount. Moving copy storage volumes off-site provides the ability to recover from a complete disaster.

8.2.1 Setting up storage pool backups using copy storage pools

The following is an example of how to create and set up copy storage pools:

1. Create a copy storage pool called `copypool`, with the same device class as the `tsm3570` primary storage pool, by issuing the following command:

```
tsm: ASM12> define stgpool copypool tsm3570 pooltype=copy maxscratch=50
```

Because scratch volumes are allowed in this copy storage pool, you do not need to define volumes for the pool. All of the storage volumes in the copy storage pool `copypool` are located on-site

2. Perform the initial backup of the primary storage pools to the new copy storage pool. Copy the files in the primary storage pools to the copy storage pool `copypool` by issuing the following commands:

```
tsm: ASM12> backup stgpool backuppool copypool maxprocess=4
tsm: ASM12> backup stgpool qic_tapepool1 copypool maxprocess=4
tsm: ASM12> backup stgpool archivepool copypool maxprocess=4
tsm: ASM12> backup stgpool spacemgpool copypool maxprocess=4
```

Set the `maxprocess` parameter to the number of mount points or drives that can be dedicated to this operation.

The backup stgpool operation is incremental, that is, it only copies files which have arrived in the primary storage hierarchy since the previous backup stgpool execution.

When a disk storage pool is backed up, copies of files that remain on disk after being migrated to the next storage pool (cached files) are not backed up.

3. Define schedules to automatically run the commands for backing up the primary storage pools to the copy storage pool. The commands to schedule are those that you issued in step 2.

With scheduled storage pool backups and migrations and with sufficient disk storage, most copies can be made from the disk storage pool before the files are migrated to tape, therefore, avoiding unnecessary mounts. Here is the sequence:

- a. Clients back up or archive data to disk.
- b. Back up the primary storage pools to copy storage pools.
- c. Data is migrated from disk storage pools to primary tape storage pools.

Implementing copy storage pools requires an additional 100 to 200 bytes of space in the database for each file copy. As more files are added to the copy storage pools, re-evaluate your database size requirements.

8.2.2 Setting access mode to off-site

Moving copy storage volumes off-site provides a means of recovering from site disaster. Before moving these volumes off-site, the access mode should be set to `offsite`. Change the access mode to `offsite` for volumes that have read-write or read-only access, are on-site, and are, at least partially, filled. This is done with the following command:

```
tsm: ASM12> update volume * access=offsite wherestgpool=copypool \  
cont> whereaccess=readwrite,readonly wherestatus=filling,full  
ANR2212I UPDATE VOLUME: No volumes updated.
```

8.2.3 Special considerations for reusing volumes

When you define or update a sequential access storage pool, you can use a parameter called `REUSEDelay`. 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 been expired, deleted, or moved from the volume. When you delay reuse of such volumes, they enter the pending state once they no longer contain any files. Volumes remain in the pending state for as long as specified with the `REUSEDelay` parameter for the storage pool to which the volume belongs.

Delaying reuse of volumes can be helpful under certain conditions for disaster recovery. When Tivoli Storage Manager expires, deletes, or moves files from a volume, the files are not actually erased from the volumes; the database references to these files are removed. Therefore, the file data may still exist on sequential volumes if the volumes are not immediately reused.

If a disaster forces you to restore the Tivoli Storage Manager database using a database backup that is old or is not the most recent backup, some files may not be recoverable because Tivoli Storage Manager cannot find them on current volumes. However, the files may exist on volumes that are in pending state. You may be able to use the volumes in pending state to recover data by doing the following:

1. Restore the database to a point in time prior to file expiration.
2. Use a primary or copy storage pool volume that has not been rewritten and contains the expired file at the time of database backup.

If you back up your primary storage pools, set the `reusedelay` parameter for the primary storage pools to 0 to efficiently reuse primary scratch volumes. For your copy storage pools, you should delay reuse of volumes for as long as you keep your oldest database backup.

To change the `reusedelay` for `copypool`, use following command:

```
tsm: ASM12> update stgpool copypool reusedelay=30  
ANR2202I Storage pool COPYPOOL1 updated.
```

8.3 Database and recovery log mirroring

As outlined in 4.4.2, “Initialize the Tivoli Storage Manager server” on page 88, Tivoli Storage Manager database and recovery log are the heart of the Tivoli Storage Manager server, containing information needed for server operations and information about client data that has been backed up, archived, and space-managed. The following scenarios illustrate the importance of protecting these instances against errors.

As a result of a sudden power outage, a partial page write occurs. The recovery log is now corrupted and not completely readable. Without mirroring, transaction recovery operations cannot complete when the server is restarted. However, if the recovery log is mirrored and a partial write is detected, a mirror volume can be used to construct valid images of the missing pages. If you lose the recovery log, you lose the changes that have been made since the last database backup. If you lose the database, you lose all your client data.

You can prevent the loss of the database or recovery log due to a hardware failure by mirroring them. Mirroring writes the same data to multiple disks simultaneously. However, mirroring does not protect against a disaster or a hardware failure that affects multiple drives or causes the loss of the entire system. While Tivoli Storage Manager is running, you can dynamically start or stop mirroring and change the capacity of the database.

Tivoli Storage Manager mirroring provides the following benefits:

- Protection against database and recovery log media failures
- Uninterrupted Tivoli Storage Manager operations if a database or recovery log volume fails
- Avoidance of costly database recoveries

However, there are also costs:

- Mirroring doubles the required DASD for the mirrored volumes
- Mirroring may result in decreased performance
- Your mirrored volumes must be in a separate AS/400 Auxiliary Storage Pool (ASP)

Tivoli Storage Manager mirrored volumes must have at least the same capacity as the original volumes. This means that if your database is made of two volumes of 100 MB each, you will need at least two extra 100 MB-allocated volumes for the mirrored volumes. If you create volumes larger than necessary, Tivoli Storage Manager gives you a warning message (ANR2253W for database and ANR2273W for the log), but it still allows the use of the allocated volume.

This section explains how to:

- Allocate disk volumes to mirror the database and recovery log
- Define Tivoli Storage Manager mirrored volume copies
- Monitor Tivoli Storage Manager mirrored volume copies

Note

Mirrored volumes must be in a separate AS/400 ASP to provide protection from a crash of your primary storage pool data.

8.3.1 Allocating disk volumes for database and recovery log mirroring

For database volumes, the allocated file size is always a multiple of 4 MB (plus an additional 1 MB for overhead). The steps to allocate disk volumes for mirroring the database and recovery log are as follows:

1. Create a User-Defined FS (CRTUDFS) File System ASP2.

The Create User-Defined File System `CRTUDFS` command creates a file system whose contents can be made visible to the rest of the integrated file system name space via the `ADDMFS` (Add Mounted File System) or `MOUNT` command. Users can create a UDFS in an ASP of their own choice and have the ability to specify case-sensitivity.

To get IFS files in separate ASPs, use the following procedure:

This command `crtudfs` creates a case sensitive user-defined file system (UDFS) named `tsmvolm.udfs` in the user Auxiliary Storage Pool (ASP), `qasp02`.

```
.                               Create User-Defined FS (CRTUDFS)

Type choices, press Enter.

User-defined file system . . . . > '/dev/qasp02/tsmvolm.udfs'

Public authority for data . . .   *INDIR      Name, *INDIR, *RWX, *RW...
Public authority for object . .   *INDIR      *INDIR, *NONE, *ALL...
      + for more values
Auditing value for objects . . .   *SYSVAL    *SYSVAL, *NONE, *USRPRF...

                               Additional Parameters

Case sensitivity . . . . . > *MONO          *MIXED, *MONO
```

To create a directory for database mirror volume use the `crtmdir` command:

```
.                               Create Directory (CRTDIR)

Type choices, press Enter.

Directory . . . . . > '/tsmvolm/database'

Public authority for data . . .   *INDIR      Name, *INDIR, *RWX, *RW...
Public authority for object . .   *INDIR      *INDIR, *NONE, *ALL...
      + for more values
Auditing value for objects . . .   *SYSVAL    *SYSVAL, *NONE, *USRPRF...
```

To create a directory for recovery mirror volume use the `crtdir` command:

```
.                               Create Directory (CRTDIR)

Type choices, press Enter.

Directory . . . . . > '/tsmvolm/log'

Public authority for data . . . *INDIR      Name, *INDIR, *RWX, *RW...
Public authority for object . . *INDIR      *INDIR, *NONE, *ALL...
      + for more values
Auditing value for objects . . . *SYSVAL    *SYSVAL, *NONE, *USRPRF...
```

The Add Mounted File System `mount` command makes the objects in a file system accessible to the integrated file system (*UDFS) on the local system name space:

```
.                               Add Mounted FS (MOUNT)

Type choices, press Enter.

Type of file system . . . . . > *UDFS      *NFS, *UDFS, *NETWARE
File system to mount . . . . . > '/dev/qasp02/tsmvolm.udfs'

Directory to mount over . . . . > '/tsmvolm'

Mount options . . . . . 'rw'
```

Note

The name of this IPL-time startup program is stored in a system value called `QSTRUPPGM`. The default name of the program is `QSTRUE`, which is located in the `QSYS` library. Users can edit this program to include the `MOUNT` commands that will automatically mount the file systems during startup. In our example we add the following command to the system startup program:

```
MOUNT TYPE(*UDFS) MFS('/DEV/QASP02/TSMVOLM.UDFS') MNTOVRDIR('/TSMVOLM')
```

For more information about Network File System commands, see *OS/400 Network File System*, SC41-5714.

2. From the Tivoli Storage Manager Utilities (Go ADSM) menu, Select **5 (Create and format volume)**. Specify a unique name for the stream file volume (for example, `dbm01` for the Database Mirror Volume). You will get the following screen:

```

Create Volume for ADSM (CRTVOLADSM)

Type choices, press Enter.

Volume type . . . . . > *STMF          *FILE, *STMF
Volume:
  Volume stream file . . . . . > '/tsmvolm/database/dbm01'

  Volume size . . . . . > 25            Megabytes
  Replace volume . . . . . *NO          *NO, *YES

```

3. This specified a streamed file volume `dbm01` in the User-Defined File System directory `/tsmvolm/database` should be in ASP2, a different ASP than your original DataBase).
4. The default size for a Database Volume is 24 MB. Now, to create a volume of the same size as 24 MB, specify 25 in the member size parameter.

Similarly, create volumes for the following volumes as shown in Table 9.

Table 9. Original and mirrored volume table

Original Volume (ASP1) Library/Volume Name	Mirrored Volume (ASP2) Library/Volume Name
/tsmvol/database/db01 (353MB)	/tsmvolm/database/dbm01 (353MB)
/tsmvol/database/db02 (100MB)	/tsmvolm/database/dbm02 (100MB)
/tsmvol/log/rlog01 (37MB)	/tsmvolm/log/rlogm01 (37MB)
/tsmvol/log/rlog02 (100MB)	/tsmvolm/log/rlogm02 (100MB)

8.3.2 Defining database or recovery log mirrored volumes

After allocating volumes, the next step is to define all database volumes in Tivoli Storage Manager using the `define dbcopy` command.

```

tsm: ASM12> define dbcopy /tsmvol/database/db01 /tsmvolm/database/dbm01
tsm: ASM12> define dbcopy /tsmvol/database/db02 /tsmvolm/database/dbm02

```

After a volume copy is defined, Tivoli Storage Manager synchronizes the volume copy with the original volume. This process can range from minutes to hours depending on the size of the volumes and performance of your system. After synchronization is complete (see msg ANR0234I in log), the volume copies are mirror images of each other.

Similarly, define Recovery Log mirrored volumes by using the following Tivoli Storage Manager command:

```

tsm: ASM12> define logcopy /tsmvol/log/rlog01 /tsmvolm/log/rlogm01
tsm: ASM12> define logcopy /tsmvol/log/rlog02 /tsmvolm/log/rlogm02

```

Tivoli Storage Manager provides server options that specify how mirrored volumes are written to. These options can significantly affect the level of protection afforded by database and recovery log mirroring. Write operations for the database and the recovery log can be set to `SEQUENTIAL` or `PARALLEL`:

- **PARALLEL:** This setting offers better performance but at the cost of recoverability. Pages are written to all copies at about the same time. If a system outage results in a partial page write and the outage affects both mirrored copies, both copies could be corrupted.
- **SEQUENTIAL:** This setting offers improved recoverability but at the cost of performance. Pages are written to one copy at a time. Therefore, if a system outage results in a partial page write, only one copy is affected. However, because a successful I/O must be completed after the write to the first copy but before the write to the second copy, performance can be affected.

8.3.3 Requesting information about mirrored volumes

You can request information about mirrored database or recovery log volumes by using the `QUERY DBVOLUME` and `QUERY LOGVOLUME` commands. Using these commands, you can verify that database and recovery log volumes are mirrored and synchronized. The following is an example; look at the `COPY STATUS` column: It shows `SYNC'D`, which indicates that volumes are synchronized. If you ever see a `COPY STATUS` of `STALE`, it means that the volume is not synchronized with the other mirrored copies. This usually happens when you have just added or replaced a mirrored volume and it is in the process of synchronizing.

```
tsm: ASM12> q dbvolume
```

VOLUME NAME (COPY 1)	COPY STATUS	VOLUME NAME (COPY 2)	COPY STATUS	VOLUME NAME (COPY 3)	COPY STATUS
/TSMVOL/DATABAS- E/DB01	SYNC'D	/TSMVOLM/DATABA- SE/DBM01	SYNC'D		UNDEF- INED
/TSMVOL/DATABAS- E/DB02	SYNC'D	/TSMVOLM/DATABA- SE/DBM02	SYNC'D		UNDEF- INED

```
tsm: ASM12> q logvolume
```

VOLUME NAME (COPY 1)	COPY STATUS	VOLUME NAME (COPY 2)	COPY STATUS	VOLUME NAME (COPY 3)	COPY STATUS
/TSMVOL/LOG/RLO- G01	SYNC'D	/TSMVOLM/LOG/RL- OGM01	SYNC'D		UNDEF- INED
/TSMVOL/LOG/RLO- G02	SYNC'D	/TSMVOLM/LOG/RL- OGM02	SYNC'D		UNDEF- INED

8.4 Database backup

It is important to run regular Tivoli Storage Manager database backups. If the database is damaged or lost, you can restore it by using the `STRRTADSM AS/400` command to perform Tivoli Storage Manager database recovery.

Use the `BACKUP DB` command to back up a Tivoli Storage Manager database to sequential access storage volumes. You can use this command to run one of the following types of backup:

- **Full backup (TYPE=FULL):** Copies the entire Tivoli Storage Manager database
- **Incremental backup (TYPE=INCREMENTAL):** Copies only those database pages that have been added or changed since the last time the database was backed up.

Tivoli Storage Manager can perform full and incremental backups of the database to tape while the server is running and available to clients. Consider the following when you decide what kind of backups to do and when to do them:

Full backups

- Take longer to run than incremental backups.
- Have shorter recovery times than incremental backups (you must load only one set of volumes to restore the entire database).
- Full backups are required:
 - For the first backup
 - If there have been 32 incremental backups since the last full backup
 - After changing the log mode to rollforward
 - After changing the database size (an extend or reduce operation)

Incremental backups

- Take less time to run than full backups
- Have longer recovery times than full backups, because a full backup must be loaded first

The following section will show you how to perform database backups in order to have a copy ready for disaster recovery purposes.

8.4.1 Performing a manual database backup

You can start database backups interactively by issuing the following command from any Tivoli Storage Manager administrator command line. For example, to start a full backup, you would issue these commands:

```
tsm: ASM12>backup db type=full devclass=qic_tapeclass1 wait=yes

ANR0984I Process 8 for DATABASE BACKUP started in the FOREGROUND at 17:35:37.
ANR2280I Full database backup started as process 8.
ANR4554I Backed up 512 of 774 database pages.
ANR4550I Full database backup (process 8) complete, 774 pages copied.
ANR0985I Process 8 for DATABASE BACKUP running in the FOREGROUND completed with completi
state SUCCESS at 17:36:42.

tsm: ASM12>
```

8.4.2 Performing a scheduled database backup

Database backups can tie up resources (mount points and tapes) and, depending on the type of backup and the size of your database, can take some time. You will probably want to schedule your backups to occur, when possible, after certain activities and at specific times of the day.

To ensure that you have the most recent database information, you might back up the database in the following situations:

- Significant backup or archive activities
- Migration between storage pools
- Reclamation

- MOVE DATA or DELETE VOLUME commands
- Storage pool backups

You would usually back up your storage pools daily, and immediately back up the database. Depending on the amount of client data and the frequency of the activities mentioned above, you may back up less often.

The following command will start a full database backup at 17:00:

```
tsm: ASM12> define schedule backup_db type=administrative \
cont> cmd="backup db devclass=qic_tapeclass1 type=full" starttime=17:00 active=yes \
cont> description="Database Backup"
ANR2577I Schedule BACKUP_DB defined.
```

8.4.3 Setting the recovery log mode

Use the `set logmode` command to set the mode for saving recovery log records. The log mode determines how long Tivoli Storage Manager saves records in the recovery log and the kind of database recovery you can use. The two log modes are `NORMAL` and `ROLLFORWARD`.

- **NORMAL:** Tivoli Storage Manager saves only those records needed to restore the database to the point of the last backup (point-in-time recovery). Tivoli Storage Manager deletes any unnecessary records from the recovery log. Changes made to the database since the last backup cannot be recovered. Any backup versions of the database created by issuing the `backup db` command can only be used to perform point-in-time recovery. In `NORMAL` log mode, you may need less space for the recovery log, because Tivoli Storage Manager does not keep all records already committed to the database.
- **ROLLFORWARD:** Tivoli Storage Manager saves all recovery log records that contain changes made to the database since the last time it was backed up. Tivoli Storage Manager deletes recovery log records only after a successful database backup. The recovery log records can be used to restore a database to its most current state (roll-forward recovery) after loading the most current database backup series. A database backup series created in `ROLLFORWARD` mode can be used for either point-in-time recovery or roll-forward recovery. We recommended that you enable `ROLLFORWARD` log mode if your site requires a high level of availability to the Tivoli Storage Manager server. `ROLLFORWARD` log mode may require a significant amount of space to record all activity.

To configure the log mode for `ROLLFORWARD`, issue the `set logmode` command:

```
tsm: ASM12> set logmode rollforward
ANR2294I Log mode set to ROLLFORWARD.
```

You can check whether the command was successful by using the `query status` command and checking the Log Mode field:

Note

If you are not using the Tivoli Storage Manager database in roll forward mode presently, but wish to do so, the recovery log pool size will need to be increased. To estimate the new value, reset the cumulative consumption value using the administrative command `reset logconsumption`, and then monitor the cumulative consumption over a number of days. Divide the cumulative consumption by the number of days since you reset the value to get a representative value. A safe size for the log pool should be around 30-40 percent larger than this figure.

8.4.4 Defining database backup trigger

Use the `define dbbackuptrigger` command to define settings for the database backup trigger. The database backup trigger determines when Tivoli Storage Manager automatically runs a full or incremental backup of the Tivoli Storage Manager database and deletes any unnecessary recovery log records.

Tivoli Storage Manager uses the settings you specify with this command only when the log mode is set to `ROLLFORWARD`, which you previously configured with the `set logmode` command. With the `define dbbackuptrigger` command, you specify the percentage of the assigned capacity of the recovery log that can be used before Tivoli Storage Manager begins a backup of the database. The actual percentage that you must choose is highly dependent on the planning considerations in Chapter 2, "Introduction to Tivoli Storage Manager" on page 29. We recommend that you use 75% as a starting point and use the default number of incrementals (six). You must monitor your environment activity to make sure that you do not start unnecessary triggering.

To set the limit of 75% for the recovery log to start a backup `db` and run up to six incremental database backups before a full database backup, issue the `define dbbackuptrigger` command:

```
tsm: ASM12> define dbbackuptrigger devclass=TSM3570 logfullpct=75 numincr=6
ANR2282I Database backup trigger defined and enabled.
```

You can check that the command was successful by issuing the `query dbbackuptrigger` command:

```
tsm: ASM12>query dbbackuptrigger format=detail

      FULL DEVICE CLASS: TSM3570
    INCREMENTAL DEVICE CLASS: TSM3570
        LOG FULL PERCENTAGE: 75
    INCREMENTALS BETWEEN FULLS: 6
  LAST UPDATE BY (ADMINISTRATOR): ADSMADMIN
    LAST UPDATE DATE/TIME: 01.03.2000 17:33:07
```

8.4.5 Setting the expansion trigger

Tivoli Storage Manager lets you fully automate the process of increasing the database and recovery log. For example, assume that you have a 200 MB database and a 100 MB recovery log. You want to increase the size of the

database by 25% when 85% is in use, but not to more than 1 GB. You also want to increase the recovery log by 30% when 75% is in use, but not to more than 500 MB.

Note:

Setting a space trigger does not mean that the percentage used in the database and recovery log will always be less than the value specified with the FULLPCT parameter. Tivoli Storage Manager checks utilization when database and recovery log activity results in a “commit”. Deleting database volumes and reducing the database does not cause the trigger to activate. Therefore, the utilization percentage can exceed the set value before new volumes are online.

8.4.6 Database space trigger

To define a new space trigger for the database in the /Tivoli Storage Manager/database/primary directory (Tivoli Storage Manager generates the volume names), issue the `define spacetrigger` command:

```
tsm: ASM12>define spacetrigger db fullpct=85 spaceexpansion=25 \  
cont> expansionprefix=/tsmvol/database/ maximumsize=1000  
  
ANR2274I Data Base Space trigger defined and enabled.
```

The MAXIMUMSIZE limit for the database is 999999999 MB. A value of zero, (0) or omitting this parameter disables checking for maximum size. If later on, you need to change the trigger definition, you can use the `update spacetrigger` command.

Whenever the system detects that the database needs extra space, it triggers the expansion as shown in the `query actlog` command:

```
tsm: ASM12> query actlog  
...  
03/01/2000 17:58:30 ANR4414I Data Base Space expansion Is Needed, 4 Megabytes needed.  
03/01/2000 17:58:30 ANR4412I Data Base and Recovery Log Space expansion triggered.  
03/01/2000 17:58:31 ANR2240I Database volume /tsmvol/database/D0151600.DBV defined.  
03/01/2000 17:58:31 ANR2240I Database volume /tsmvol/database/D0151600.DBV defined.  
03/01/2000 17:58:31 ANR2248I Database assigned capacity has been extended.  
03/01/2000 17:58:31 ANR4415I Data Base and Recovery Log Space Expansion Completed.
```

8.4.7 Recovery log space trigger

To define a new space trigger for the recovery log in the IFS /tsmvol/log directory (Tivoli Storage Manager generates the volume names), issue the following command:

```
tsm: ASM12> define spacetrigger log fullpct=75 spaceexpansion=30 \  
cont> expansionprefix=/tsmvol/log/ maximumsize=500  
  
ANR2279I Recovery Log Space trigger defined and enabled.
```

You can use a MAXIMUMSIZE from 9 MB through 5000 MB (5GB) for the recovery log. A value of zero, (0) or omitting this parameter disables checking for maximum size. If later on, you need to change the trigger definition, you can use the `update spacetrigger` command.

Whenever the system detects that the recovery log needs extra space, it triggers the expansion as shown in the `query actlog` command:

```
tsm: ASM12> query actlog
...
03/01/2000 18:06:48 ANR4413I Recovery Log Space expansion Is Needed, 4 Megabytes needed.
03/01/2000 18:06:48 ANR4412I Data Base and Recovery Log Space expansion triggered.
03/01/2000 18:06:50 ANR2260I Recovery log volume /tsmvol/log/L8002600.LOG defined.
03/01/2000 18:06:50 ANR2260I Recovery log volume /tsmvol/log/L8002600.LOG defined.
03/01/2000 18:06:50 ANR0984I Process 22 for EXTEND LOG started in the BACKGROUND at 18:06
03/01/2000 18:06:50 ANR2268I Recovery log assigned capacity has been extended.
03/01/2000 18:06:50 ANR4415I Data Base and Recovery Log Space Expansion Completed.
```

8.4.8 Using SPACETRIGGER with Mirrored Volumes

Although Tivoli Storage Manager can expand either the database or the recovery log space if needed, you must pay special attention when mirroring is active, because the `define spacetrigger` command has only one `expansionprefix` option. Therefore, if you are running Tivoli Storage Manager with software mirrored volumes (DB or LOG), you may get undesirable volumes in a single disk (therefore, making mirroring ineffective). To correct this, you must reallocate the mirror copies in the correct place.

Here is an example of database triggering, which leads to an allocation of both image and copy to the same location (`/tsmvol/database`). In this case, the database volume, `/tsmvol/database/C02372600.DBV`, must be reallocated to another filesystem, so that mirroring is still adequate:

```
03/01/2000 18:18:51 ANR4414I Data Base Space expansion Is Needed, 4 Megabytes needed.
03/01/2000 18:18:51 ANR4412I Data Base and Recovery Log Space expansion triggered.
03/01/2000 18:18:52 ANR2240I Database volume /tsmvol/database/D1372600.DBV defined.
03/01/2000 18:18:52 ANR2240I Database volume /tsmvol/database/D1372600.DBV defined.
03/01/2000 18:18:53 ANR2241I Database volume copy /tsmvol/database/C2372600.DBV defined.
03/01/2000 18:18:54 ANR2248I Database assigned capacity has been extended.
03/01/2000 18:18:54 ANR4415I Data Base and Recovery Log Space Expansion Completed.
```

8.5 Securing important server recovery information

In addition to database and recovery log backup, you should back up volume history, device configuration, and server options files. You are also required to keep information about your database and recovery log setup. This section explains how to back up this information.

8.5.1 Volume history file

Every volume used by Tivoli Storage Manager is tracked in the volume history database including the volume identifier for the database backups. The database volume information is important because it tells you which volume holds your most recent database backup. In the event of a disaster, this information will be very important. The volume history information is periodically copied out to a volume history file that you can specify with the `volhistory` server option. We

recommend that you have two copies of the volume history file in case one becomes unusable.

You can also back up the volume history information at any time, by entering the `backup volhistory` command.

The default in Tivoli Storage Manager for AS/400 is to create a volume history file, named `volhistory` containing the information in the QUSRADSM library. To ensure the availability of the volume history information, you can do any of the following:

- Store at least one copy of the volume history file on a disk separate from the database or off-site
- Store a printout of the file off-site
- Store a copy of the file off-site with your database backups
- Store a remote copy of the file, for example, on an NFS-mounted file system
- Include the volume history in the nightly AS/400 backup

Note

You can recover the database without a volume history file. However, because you must examine every volume that may contain database backup information, this is a time consuming and error-prone task.

8.5.2 Saving the device configuration file

The default in Tivoli Storage Manager for AS/400 is to create a device configuration file named `devconfig` containing the information in the QUSRADSM library. To ensure the availability of the device configuration information, you can do any of the following:

- Store at least one backup copy of the device configuration file on a disk separate from the database
- Store your device configuration file off-site with your volume history file and database backups
- Store a printout of the information stored off-site
- Store a remote copy, for example, on an NFS-mounted file system
- Include the device configuration in the nightly AS/400 backup

The `DEVCFGFILE` server option lets you specify a file in a different library and create additional backup device configuration files. (for details, see the `CHGSVRADSM` command in the Tivoli Storage Manager Administrator's Reference). After the server is restarted, whenever Tivoli Storage Manager updates device configuration information in the database, it also updates the same information in the backup files.

You can also back up the device configuration information at any time by entering:

```
tsm: ASM12> backup devconfig
```

```
ANR2394I BACKUP DEVCONFIG: Server device configuration information was  
written to all device configuration files.
```

If you do not specify file names, Tivoli Storage Manager backs up the device configuration file to all files specified with the DEVCFGFILE server option.

8.5.3 Saving the server option file

The server option file `QOPTADSM` in `QUSRADSM` contains all information about licensing, communication method, server processing option, and other server options. You can save this file to tape on tape drive `tap01` using the AS/400 command `SAVOBJ OBJ(QOPTADSM) LIB(QUSRADSM) DEV(TAP01)`.

8.5.4 Database and recovery log setup

It is necessary to keep information about database and recovery log volumes setup off-site. You will require this information while initializing server at the time of disaster recovery. You can get details of database and recovery log using the following commands. You should note this information and send it off-site.

The following is an example of getting details about database volumes setup:

```
tsm: ASM12> q dbvolume f=d  
  
VOLUME NAME (COPY 1): /TSMVOL/DATABASE/DB01  
COPY STATUS: SYNC'D  
VOLUME NAME (COPY 2): /TSMVOLM/DATABASE/DBM01  
COPY STATUS: SYNC'D  
VOLUME NAME (COPY 3):  
COPY STATUS: UNDEFINED  
AVAILABLE SPACE (MB): 352  
ALLOCATED SPACE (MB): 352  
FREE SPACE (MB): 0  
  
VOLUME NAME (COPY 1): /TSMVOL/DATABASE/DB02  
COPY STATUS: SYNC'D  
VOLUME NAME (COPY 2): /TSMVOLM/DATABASE/DBM02  
COPY STATUS: SYNC'D  
VOLUME NAME (COPY 3):  
COPY STATUS: UNDEFINED  
AVAILABLE SPACE (MB): 100  
ALLOCATED SPACE (MB): 100  
FREE SPACE (MB): 0
```

The following screen shows an example of getting details about recovery log volumes setup:

```

tsm: ASM12>q logvol f=d

VOLUME NAME (COPY 1): /TSMVOL/LOG/RLOG01
COPY STATUS: SYNC'D
VOLUME NAME (COPY 2): /TSMVOLM/LOG/RLOGM01
COPY STATUS: SYNC'D
VOLUME NAME (COPY 3):
COPY STATUS: UNDEFINED
AVAILABLE SPACE (MB): 36
ALLOCATED SPACE (MB): 36
FREE SPACE (MB): 0

VOLUME NAME (COPY 1): /TSMVOL/LOG/RLOG02
COPY STATUS: SYNC'D
VOLUME NAME (COPY 2): /TSMVOLM/LOG/RLOGM02
COPY STATUS: SYNC'D
VOLUME NAME (COPY 3):
COPY STATUS: UNDEFINED
AVAILABLE SPACE (MB): 100
ALLOCATED SPACE (MB): 100
FREE SPACE (MB): 0

```

8.5.5 Backing up server information using AS/400 commands

Stop the server from the Tivoli Storage Manager Main menu (Go ADSM) or enter the `endsvradsm` command at the AS/400 command line.

You can back up Tivoli Storage Manager database, recovery log and storage pools to an AS/400 local tape device by using the following AS/400 `sav` command:

```

I                                     Save Object (SAV)
Type choices, press Enter.

Device . . . . . > '/qsys.lib/tap01.devd'
Objects:

Name . . . . . > '/tsmvol/database/*'
Include or omit . . . . . *INCLUDE *INCLUDE, *OMIT

Name . . . . . > '/tsmvol/log/*'
Include or omit . . . . . *INCLUDE *INCLUDE, *OMIT

Name . . . . . > '/tsmvol/stgpool/*'
Include or omit . . . . . *INCLUDE *INCLUDE, *OMIT
+ for more values
Directory subtree . . . . . *ALL *ALL, *DIR, *NONE, *OBJ
Save active . . . . . *NO *NO, *YES, *SYNC

F3=Exit F4=Prompt F5=Refresh F10=Additional parameters F12=Cancel
F13=How to use this display F24=More keys

```

You can back up Tivoli Storage Manager volume history, device configuration, server options, exit programs to an AS/400 local tape device by using the following AS/400 `savlib` or `savobj` commands.

Save Object (SAVOBJ)

Type choices, press Enter.

Objects

> DEVCONFIG

Name, generic*, *ALL

> VOLHISTORY

+ for more values

> QOPTADSM

Library

> QUSRADSM

Name, generic*

+ for more values

Device

> TAP01

Name, *SAVF

+ for more values

Object types

*ALL

*ALL, *ALRTBL, *BNDDIR...

+ for more values

Volume identifier

*MOUNTED

+ for more values

Sequence number

*END

1-16777215, *END

More...

F3=Exit F4=Prompt F5=Refresh F10=Additional parameters F12=Cancel

F13=How to use this display F24=More keys

We recommend that you back up at least volume history, device configuration, and server options to a local tape device and send the tape off-site along with database backup tapes and copy pool tapes. Backup of database and recovery log is optional, it is only for additional safety. During this backup, the Tivoli Storage Manager server should not be running; if you save these files while they are active, you will have inconsistencies in the database backup copy.

Doing a Save Object backup of the database and recovery log volumes is not a substitute for regular database backups within Tivoli Storage Manager since they do not offer the same level of recoverability in the case of disaster. For example, using the Tivoli Storage Manager provided mechanism for backing up the database, in conjunction with ROLLFORWARD recovery allows you to recover the database back to the most recent point in time (up to the last committed transaction). This is not possible using Save Object backup of the database. Also, the Tivoli Storage Manager features for backing up the database run online, so you do not have to stop the server, unlike running Save Object on these files. Hence we mention Save Object on the database and recovery log files only as an additional optional safety measure to the standard Tivoli Storage Manager features for protection of the database.

Chapter 9. Tivoli Storage Manager advanced features

Version 3 for Tivoli Storage Manager on AS/400 introduced many advanced functions and features to provide more control of the Tivoli Storage Manager environment, to centralize data management, and to implement additional data management functionality. In this chapter, we provide an introduction to the Version 3 functions. We then cover the implementation and configuration of the following functions in more detail:

- Event logging, monitoring, and reporting functions
- Tivoli Storage Manager SQL interface and the ODBC driver
- Server scripts
- Client configuration centralization
- Tivoli Space Manager (formerly HSM client)
- Tivoli Disaster Recovery Manager (DRM)
- Server-to-server virtual volumes
- Enterprise Management

9.1 Tivoli Storage Manager Version 3 — overview of functions

This section gives a high-level overview of features, functions, and significant changes in Version 3 Tivoli Storage Manager/400 as compared to earlier versions.

A strategy has been created to build on the strength of the previous version of Tivoli Storage Manager. It addresses new challenges from the following situations: more complex environments, increased centralized storage control, the explosive growth of data, and the need to implement a single solution for storage management. Figure 47 provides an overview of this.

Tivoli Storage Manager Strategy

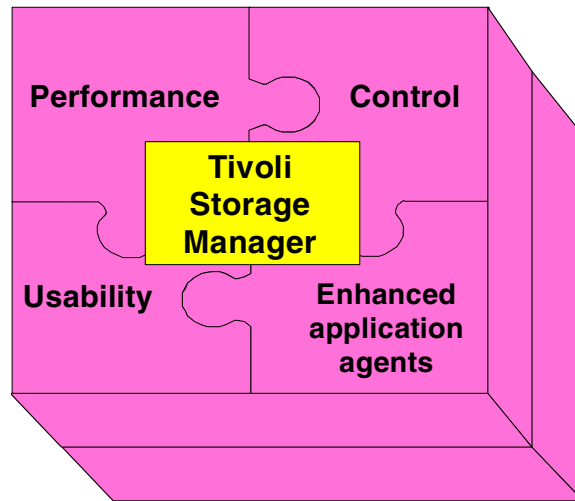


Figure 47. Tivoli Storage Manager - overview

There are four areas where Version 3 has significantly improved, as compared to earlier versions of Tivoli Storage Manager:

- Performance related enhancements and architectural changes
- Configuration, reporting, monitoring, and event logging
- Usability of Tivoli Storage Manager
- Enhanced application agents

The following high-level overview will explain the most significant changes.

Performance-related changes include:

Server file aggregation:

Tivoli Storage Manager allows small client files to be grouped into larger physical files on the server. These combined and stored files are called *aggregate files*. This function will significantly improve server operations with small files by reducing database overhead due to the smaller number of database transactions, as compared to previous versions of Tivoli Storage Manager without aggregation.

Restartable client restore sessions:

This feature allows restore to continue after an interruption without restarting at the beginning of the restore. This reduces duplicate efforts or manual determination of where a restore process was interrupted.

Point-in-time restore:

Tivoli Storage Manager clients can restore saved files or a complete system image from previous backups to a specific date and time.

An important field of improvement of the Tivoli Storage Manager server in Version 3 was configuration, monitoring, reporting, and error logging. The most significant changes include:

Central event logging and monitoring:

Tivoli Storage Manager events can be centrally logged, monitored, and reported by using industry-standard interfaces. Tivoli Storage Manager implementations can be integrated with system management applications and, therefore, centralized control is facilitated.

SQL interface and ODBC driver:

Starting with Tivoli Storage Manager Version 3, you can use SQL queries to get information from the Tivoli Storage Manager database. Also, now you can format these outputs, with assistance from an ODBC interface. This ODBC driver allows you to graphically construct SQL queries when using spreadsheets and database products, such as Lotus Approach or Microsoft Access.

Client configuration centralization:

As the number of clients and options in a Tivoli Storage Manager environment grows, it becomes increasingly important that they can be centrally configured. To assist in the central management of clients, Tivoli Storage Manager Version 3 introduces new functions, such as centralized client options, offering the possibility to define an options set and to associate this set to several nodes.

The following changes were made in Tivoli Storage Manager Version 3 to improve the usability of Tivoli Storage Manager for administrators as well as for Tivoli Storage Manager end users:

Server scripts:

You can automate Tivoli Storage Manager server management operations by storing a sequence of server commands in the Tivoli Storage Manager database as a script with an assigned name. An administrator can run the script from the command line and from the Tivoli Storage Manager Enterprise Console or schedule its execution using the administrative command scheduler in the Tivoli Storage Manager server. Server scripts can include Tivoli Storage Manager administrative commands, SQL statements, conditional logic (including return code checking) and variable substitution. Variable substitution allows scripts to become dynamic and reusable.

New Web administrative interface:

This is the standard administrative interface for Tivoli Storage Manager Version 3. The administrator can use that interface to control all Tivoli Storage Manager server platforms within the enterprise. The Web-based nature of this interface allows control of the Tivoli Storage Manager server from any workstation capable of running a Web browser that supports HTML 3.0 and Java 1.1.5 or higher.

Immediate command processing on clients:

You can use a Tivoli Storage Manager administrative interface to run operations immediately on a client workstation. This will be used to implement help desk functions for remote client backup and restores.

Enhanced media management:

Because Tivoli Storage Manager is integrated with a large number of storage devices, control of media volumes is a crucial task of administrators. To make this less labor-intensive, Tivoli Storage Manager Version 3 provides functions, such as overflow storage pool control, dynamic mount limits, and single drive reclamation.

Also, with Version 3 of Tivoli Storage Manager on AS/400, there are four important features:

Tivoli Disaster Recovery Manager:

The Tivoli Disaster Recovery Manager (DRM) feature allows you to prepare for recovery from major disasters that destroy the Tivoli Storage Manager server and the clients. The Tivoli Disaster Recovery Manager functions are: client inventory, automatically generated disaster recovery plan, electronic vaulting of copy storage pools and server database backups and off-site media tracking. Tivoli DRM is an optional separately priced product

Tivoli Space Manager:

The HSM feature maximizes usage of existing storage resources by transparently migrating data off workstation and file server hard drives to the Tivoli Storage Manager storage repository, based on size and age criteria, and leaving only a stub file. When the migrated data is accessed, Tivoli Space Manager (HSM) transparently migrates the data back onto the local disk. Tivoli Space Manager is an optional separately priced product.

Server-To-Server Virtual Volumes:

This allows data to be exchanged between multiple Tivoli Storage Manager servers reducing the storage costs by enabling the sharing of key storage resources, such as large tape libraries. Base virtual volume function allows you to define a primary storage pool on another Tivoli Storage Manager. Advanced virtual volume function, which allows *electronic vaulting* of Tivoli Storage Manager storage pool and database backup on a remote server is provided in the Tivoli DRM product.

Enterprise Administration:

allows server configuration and administration to be defined centrally by an administrator and then propagated to other servers. This simplifies the configuration and management of multiple Tivoli Storage Manager servers in an enterprise. This feature introduces notions of central server and managed servers and is now part of the Tivoli Storage Manager V3.1.2 base product.

The following sections cover selected Tivoli Storage Manager functions and features in more detail. Here you will find useful information based on practical examples, to help you to implement these functions of Tivoli Storage Manager in your AS/400 environment. All topics covered here, as well as more information on

the following topics, can be found in the book *ADSM Version 3 Technical Guide*, SG24-2236.

9.2 Event logging, monitoring, and reporting

All activities done by the server and clients generate informational, error, or statistical messages that are stored in the activity log for the server or in the client's error log for each client. These clients and server messages are called *events*.

Before Tivoli Storage Manager Version 3, client messages could only be stored in the client error log and schedule log. To view these logs, the administrator had to have access to the client system. Now, with Tivoli Storage Manager Version 3, certain client messages can be collected to one central point.

This section describes how client events are created and passed to the server and gives an overview of reporting alternatives for central client and server events in the Tivoli Storage Manager for AS/400 environment.

9.2.1 Central client event logging

The intention of central client message logging is to log problems encountered during a Tivoli Storage Manager client operation on a central point with the goal of logging error conditions; therefore, only certain messages are logged as events. These are:

- Messages reflecting an error condition
- Client statistics messages

The messages that are *not* logged as events are the following:

- Session, communication error: When encountering a session or a communication error, the client is unable to initiate a session with the server, and, therefore, cannot pass any message of this type to the server.
- Client memory error: The client cannot log memory error messages because it has insufficient memory resources.
- Informational messages: These types of messages do not contain any error condition and, therefore, are not logged.
- Server disabled messages: During the client sign-on procedure, the server provides information to the client about which messages should, but cannot, be logged to the server because of the disabled status of the server.

Tivoli Storage Manager API-related messages consist of a single-string text string. It is the responsibility of the application to place appropriate message text into the string buffer. When using the AS/400 Tivoli Storage Manager/BRMS application client, only the opening and closing session messages are logged to the Tivoli Storage Manager server. The API opens and closes a session for each library saved. For additional messages about the save operation itself, you need to look at the BRMS/400 log on the client.

9.2.1.1 Client event formatting

Client messages eligible to be sent to the server are formatted as client events to ensure that client events have a common format on all platforms.

Eligible messages are grouped in a common and shared message repository. The repository, which resides on both the client and the server, contains new messages for all client events and related event data. It is shared by the command line and the GUI clients.

Client messages in the ANS4000-ANS4999 range are eligible to be sent to the server as client events. ADSM Version 2 command line messages belonging to this range have been renumbered to ANS1000 through ANS1999 to make the ANS4000-ANS4999 available for clients events.

Eligible client messages are sent to the server as events using the prefix ANE instead of ANS. They appear as client events with message numbers in the ANE4000-ANE4999 range. These messages are also locally logged in the client schedule log or error log as appropriate.

Client event messages contain enough information to be processed outside the context where they were issued. The client assigns the correct message number and provides information about related object to file space names, and the server adds information, such time stamp, nodename, or any other relevant information.

9.2.1.2 Client event processing

Figure 48 shows how client events are processed to the server. When an eligible message is issued, the message number is looked up in the client message event repository and assigned to the appropriate ANE message number. The event message is formatted with the related object or file space name and is sent to the server in this format.

The server receives the event message and then adds information, such as the nodename that submitted it and the session number from which the original client error message originated. If the event has been enabled for the Tivoli Storage Manager server console, it is shown on the console as soon as all necessary information has been formatted.

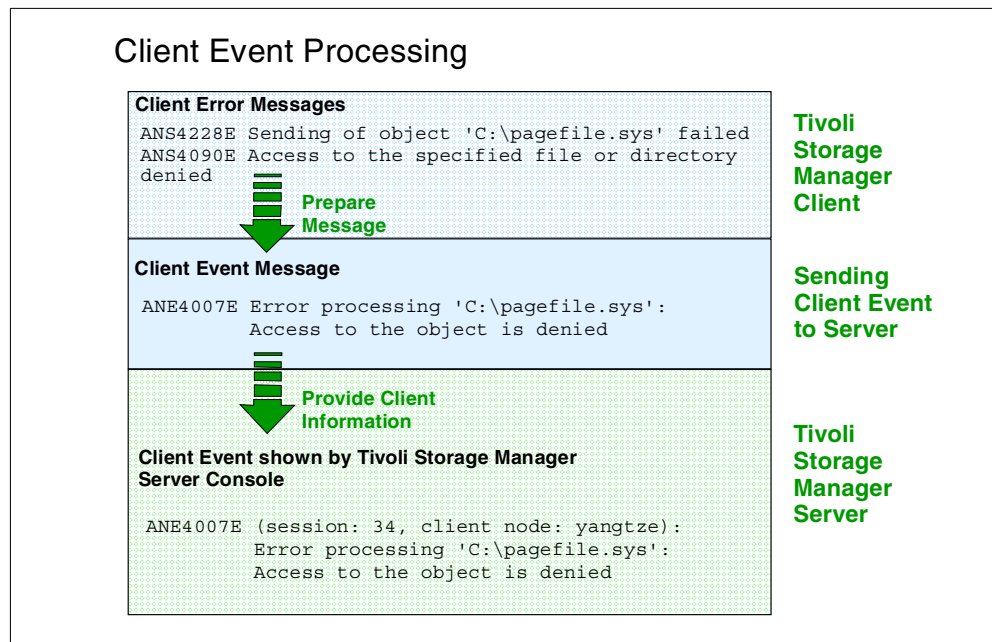


Figure 48. Client event processing

9.2.1.3 Enabling events

Before client events can be passed to the server, logging must be enabled at the server.

Event logging begins automatically at server start-up to the console and activity log, and for any receivers that are started based on entries in the server options file. A *receiver* is simply the destination for the Tivoli Storage Manager messages. See 9.2.2, “Event reporting” on page 220 for details about receivers.

You can also use the `enable events` command to manage central logging and monitoring. It enables logging of client and server events.

The following example illustrates how to enable logging client events for all nodes at the console. Only events of type SEVERE or ERROR are logged:

```
tsm: ASM12> enable events console error,severe node=*
```

Events are displayed to the console as soon as they have occurred on the client and have been passed to the server.

Note

Client messages are loggable or non-loggable. All loggable messages can be enabled as events. There is no distinction between server and client events; any server message that has an associated message number is an event. All events, whether client or server, can be enabled or disabled by the event receivers.

9.2.2 Event reporting

This section covers the reporting of eligible client and server events to external interfaces, which are called *event receivers*.

After logging is enabled, you can report these events to the events receivers, which simply specify the destination of the Tivoli Storage Manager messages. These destinations can be any combination of the following:

- Tivoli Storage Manager server console message queue
- Tivoli Storage Manager activity log
- File exit (an AS/400 physical file)
- Userexit program
- Another remote Tivoli Storage Manager server
- Tivoli/Enterprise console

9.2.2.1 Sending events to the server console output message queue

Tivoli Storage Manager server events are always stored in the server console (the ADSMMMSGQ message queue) and cannot be disabled. See “Console output and console output message queue” on page 86 for more information on the message queue.

Client events are also enabled by default for the console. They can be disabled.

9.2.2.2 Storing events in the activity log

Tivoli Storage Manager server events are always stored in the activity log and cannot be disabled, because server information in the activity log is often needed to resolve critical situations.

Client events are also enabled by default for the activity log. They can be disabled.

Following is an example of disabling event logging in the activity log, only for informational messages coming from a node named `CLIENT01`:

```
tsm: ASM12> disable events actlog info nodename=CLIENT01
```

9.2.2.3 Sending events to a file

Events can be routed to a file; these events can be client or server events. The file must already exist, and must be defined in the server options file, and the logging must be enabled. Use the `CHGSVRADSM` AS/400 command line to define it. See 4.4.1.1, “How to update the server options file” on page 81 for more information on updating the server option file. The next screen shows the event logging setup part of the `CHGSVRADSM` command:


```

Change Server Options for ADSM (CHGSVRADSM)

Type choices, press Enter.

Log events to file:
  Enable logging . . . . . *NO          *SAME, *YES, *NO
  Event file:
    File . . . . . *NONE          NAME, *SAME, *NONE
      Library . . . . .          NAME, *WRKLIB
      Member . . . . .          NAME, *FILE
  Event file mode . . . . . *APPEND      *SAME, *APPEND, *REPLACE
Log events to user exit:
  Enable logging . . . . . *NO          *SAME, *YES, *NO
  Exit program . . . . . *NONE          NAME, *SAME, *NONE
      Library . . . . .          NAME, *WRKLIB
Log events to Tivoli:
  Enable logging . . . . . *YES          *SAME, *YES, *NO

```

You also have to enable logging to the file exit before events can be passed to the specified file using the `enable events file severe,all` command:

This example enables events logging to a file exit for events of type SEVERE or ERROR.

9.2.2.4 Sending events to a user exit program

With Tivoli Storage Manager Version 3, you can process events with a user-written program. In this way, you can process events to meet your requirements. On AS/400, you can create C programs to handle events. You can find a C sample program and the header file in library QADSM.

You enable a user exit program the same way as a file exit. The program must exist before defining it in the server options file, and before enabling event logging.

9.2.2.5 Sending events to Tivoli

The Tivoli/Enterprise Console (T/EC) is the TME 10 product used for monitoring and automating system activities. Tivoli Storage Manager Version 3 provides a T/EC event adapter for sending client and server events to the T/EC. This events adapter is the Tivoli receiver.

T/EC event adapters are the interface through which the T/EC receives events. Event adapters are typically unique to a type of event. For example, the T/EC provides event adapters for SNMP system managers such as Tivoli NetView or HP OpenView, log files, and others. These event adapters can only be used to handle events from those sources. Other applications can create their own event adapters.

An event adapter has two alternate methods for sending events to the T/EC. A *secure* connection makes use of the object request broker technology within the Tivoli framework. This method requires that both the originating system and the T/EC are Tivoli-managed nodes. The second method is a direct TCP/IP socket connection. This is termed an *insecure* connection by Tivoli, because the originating system does not have to be a managed node. Tivoli Storage Manager Version 3 uses this direct TCP/IP socket connection because it provides greater flexibility, supports all Tivoli Storage Manager server platforms, and removes the requirement that the server be a Tivoli-managed node.

The Tivoli receiver is defined in the server options. To change server options, type the `CHGSVRADSM WRKLIB(QUSRADSM)` command at the OS/400 command line and press **F4**.

Scroll down to the last page and you will see the options shown in following screen:

```
Log events to Tivoli:
Enable logging . . . . . *YES          *SAME, *YES, *NO
Tivoli port . . . . . *NONE          1024-32767, *SAME, *NONE...
Tivoli remote location . . . *NONE
```

The enable logging option specifies whether event logging for the TIVOLI receiver is started automatically during server start-up or has to be started manually by the begin event logging command, Enter the Tivoli port and remote location of the Tivoli Event Server.

The `begin eventlogging` and `enable events` commands must be used to specify the desired events for the Tivoli receiver:

```
tsm: ASM12> begin eventlogging tivoli
tsm: ASM12> enable events tivoli all
```

The T/EC must be customized to receive and process Tivoli Storage Manager events. Customizing involves defining the Tivoli Storage Manager event classes to the T/EC. These event classes are provided in a T/EC baroc file provided with the Tivoli Storage Manager server. For more details about T/EC configuration, refer to the redbook *ADSM Operation and Management with TME10*, SG24-2214.

9.2.2.6 Sending Events to a Remote Server

Events can be logged to another server through a server-to-server communication. This requires definitions between the servers and the Enterprise Administration license enabled on both servers.

The *event server receiver* is the interface on the local server that receives enabled events, packages them into a verb, and send them to an Event Server.

The *Event Server* is a server that receives events from other servers. It receives the verb sent by the Event Server receiver and routes the event to all receivers enabled for the event type and the server agent that has sent it. This server can be the configuration manager or another designated server as Event Server.

A series of commands is used to define the event server and then to enable the event server receiver to send events to the Event Server:

1. The server must be first defined on the local server using the `DEFINE SERVER` command. This command allows the local server to connect to a remote Tivoli Storage Manager server. On the Event Server, use the following command:

```
tsm: ADSM define eventserver remote
```

2. Then enable the receiver to send events of type ERROR and SEVERE to the Event Server:

```
tsm: ASM12> enable events eventserver error,severe
```

3. Start now to send events to the Event Server:

```
tsm: ASM12> begin eventlogging eventserver
```

The designated Event Server must be enabled to receive events from the event server receiver on other servers before executing the next command:

```
tsm: ASM12> enable events actlog,console severe,error servername=source
```

In the above example, all ERROR and SEVERE events from the server named SOURCE (the local server) are sent are enabled to the activity log and the console server of the Event Server.

9.3 SQL interface and ODBC driver

With Version 3, Tivoli Storage Manager provides an SQL interface and an ODBC driver to get more information from the database. This interface is read only on the Tivoli Storage Manager database; it only provides SQL SELECT commands as a subset of the SQL92 and SQL93 standards.

SQL queries provide Tivoli Storage Manager information in the form of relational tables containing rows and columns. You can execute this select statement from:

- The Tivoli Storage Manager administrative command line interface
- The Tivoli Storage Manager WEB administrative interface

There are three system catalog tables implemented to assist the administrator in determining the information available:

- SYSCAT.TABLES: This table contains information about all tables that are available for querying with the select statement.
- SYSCAT.COLUMNS: This describes the columns that reside in each of the tables.
- SYSCAT.ENUMTYPES: For columns that have an enumerated data type, this defines the legal values for each enumerated data type. An enumerated data type is a value that is assigned a numerical value rather than text.

For example, to get a list of all tables available for querying in the database, enter the following `select` command:

```

tsm: ASM12> select * from syscat.tables

      TABSCHEMA: ADSM
      TABNAME: ACTLOG
      CREATE_TIME:
      COLCOUNT: 10
      INDEX_COLCOUNT: 1
      UNIQUE_INDEX: FALSE
      REMARKS: Server activity log

      TABSCHEMA: ADSM
      TABNAME: ADMIN_SCHEDULES
      CREATE TIME:
      COLCOUNT: 15
      INDEX_COLCOUNT: 1
      UNIQUE_INDEX: TRUE
      REMARKS: Administrative command schedules

      TABSCHEMA: ADSM
      TABNAME: ADMINS
      CREATE_TIME:
      COLCOUNT: 13
      INDEX_COLCOUNT: 1
      UNIQUE_INDEX: TRUE
      TABSCHEMA: ADSM
      TABNAME: AR_COPYGROUPS
      CREATE_TIME:
      COLCOUNT: 9
      INDEX_COLCOUNT: 4
      UNIQUE_INDEX: TRUE
      REMARKS: Management class archive copy groups

      TABSCHEMA: ADSM
      TABNAME: ARCHIVES
      CREATE_TIME:

```

The following is an example of querying information from the system catalog tables:

```

tsm: ASM12> select node_name, sum(logical_mb) as data_in_mb,
sum(num_files) as num_of_files from occupancy group by node_name
having min(num_files)>=1 order by data_in_mb desc

```

NODE_NAME	DATA_IN_MB	NUM_OF_FILES
ITSORE06	518.51	5183
APPN.PALANA	417.87	51
ASM12	326.25	24
ITSORE07	124.59	419

```

tsm: ASM12>

```

The above SQL statement queries the database to present a list containing the total number of megabytes used in Tivoli Storage Manager disk volumes for each node having at least one file backed up. The list first shows the nodes consuming the most disk space.

Note

Issuing the `select` command to the Tivoli Storage Manager server can use a significant amount of server resources to run the query. Complicated queries, or queries that run for a long time, can interfere with normal server operations. If the `select` command that you issue is complex or large enough to require significant time and resources from the server to generate the results, you will receive a message asking you to confirm that you wish to continue.

To allow any use of the `select` command, the Tivoli Storage Manager database must have at least 4 MB of free space. For complex queries that require significant processing, more free space is required in the database. For additional information on SQL statements, see the *ADSM Version 3 Technical Guide*, SG24-2236.

Tivoli Storage Manager provides an Open Data Base Connectivity (ODBC) driver for Windows 95, Windows NT 3.51, and Windows NT 4.0 operating systems. The driver supports the ODBC Version 2.5 application programming interface (API). Because Tivoli Storage Manager supports only the SQL SELECT statement, the driver does not conform to any ODBC API or SQL grammar conformance level. After you have installed this driver, you can use a spreadsheet or database application that complies with ODBC to access the Tivoli Storage Manager database for information.

Tivoli Storage Manager ODBC driver setup is included in the client installation package. The Tivoli Storage Manager client installation program can install the ODBC driver and set the corresponding registry values for the driver and data sources. For more information on setting up the ODBC driver, see *Tivoli Storage Manager: Installing the Clients*, SH26-4102.

When you open the Tivoli Storage Manager database through an ODBC application, you must log on to the server (the defined data source) using the name and password of a registered Tivoli Storage Manager administrator. After you log on to the server, you can perform query functions provided by the ODBC application to access database information.

The driver allows you to use relational database products, such as Lotus Approach and Microsoft Access, to query the database and display the results as shown in Figure 49.

Note

Character strings within SQL statement are case sensitive. The output will vary depending you entered a lowercase, uppercase, or mixed case characters string.

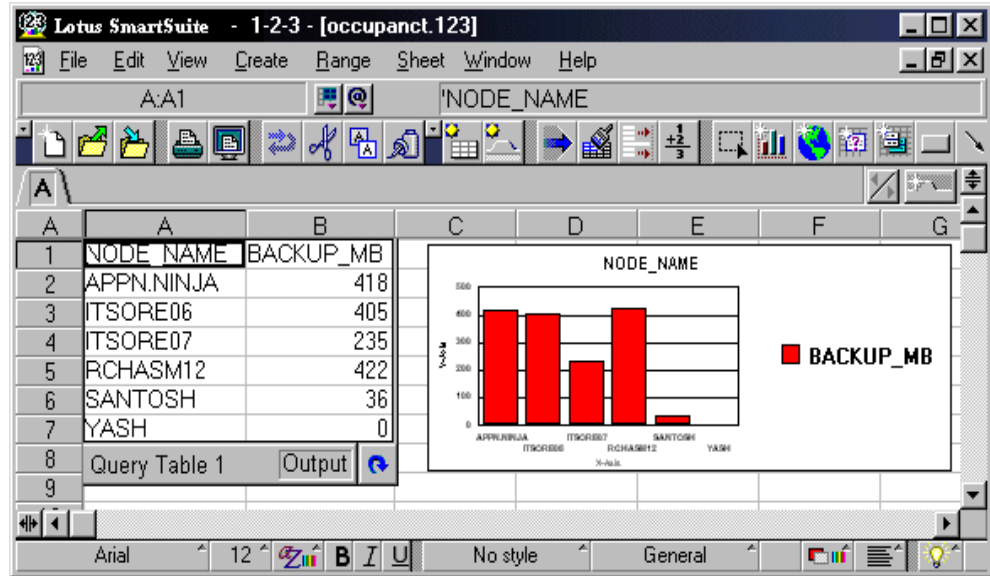


Figure 49. ODBC chart example

9.4 Server scripts

Tivoli Storage Manager version 3 introduces server scripts to automate server administration. Servers scripts are similar to Tivoli Storage Manager macros known from earlier product versions. The main difference is, that now flow control structures are available and scripts can be stored in the Tivoli Storage Manager database, what makes them accessible from every place of the Tivoli Storage Manager environment.

9.4.1 Tivoli Storage Manager Macros

A *macro* is a file stored on the client that contains one or more Tivoli Storage Manager administrative commands. You can only issue macros from the administrative client in the batch or interactive modes started on the system where the macro is stored.

The name for a macro file must follow the naming conventions of the administrative client running on your operating system.

A macro invoked from the administrative command line prompt is called a *high-level macro*. Any macros invoked within the high-level macro are called *nested macros*. You can include the `MACRO` command within a macro file to invoke other macros up to ten levels deep.

Creating a macro file to enter commands can be especially helpful when you want to issue commands that are used repeatedly. For example, you can create a macro file that contains a command to define a storage pool. By using variables

for the keyword values in the file, you can define a storage pool without having to type all the keyword parameters. You can also enter commands in a macro file to process related commands in a specific order. For example, you could create a macro file that contains commands to define a schedule and to associate client nodes to that schedule.

In a macro that contains several commands, you can use the `COMMIT` and `ROLLBACK` commands to control command processing within the macro.

9.4.1.1 Creating a Macro File on AS/400

On AS/400, a macro is a member file of type *TXT (text)* contained in a source physical file.

When you write administrator commands in a macro, use the general rules stated for entering administrative commands. Tivoli Storage Manager ignores any blank lines included in your macro. However, if your command continues on the next line use the "-" continuation characters.

Here is an example of a macro named `REGISTER` registering an administrator named `ROLAND` and granting him authority on domains `DOMAIN1` and `DOMAIN2` for the classes policy and storage:

```
REGister Admin Roland horn-  
    CONTACT='Roland Ponceveaux, #1234'  
GRant AUTHority alan -  
    CLasses=Policy,STorage      -  
    DOmains=domain1,domain2    -  
    STGpools=backuppool,3570_pool
```

9.4.1.2 Running a macro

Execute this macro from a AS/400 administrative command line and the output spooled file created, as shown below:

```

==> SBMJOB CMD(STRADMADSM ADMINNAME(ADSMADMIN) PASSWORD(ADSMADMIN)
WRKLIB(QUSRADSM) MACINF(QUSRADSM/MACRO) MACINMBR(REGISTER))
JOB(REGISTER)

Tivoli Storage Manager
Command Line Administrative Interface - Version 3, Release 1, Level 0.3
(C) Copyright IBM Corporation, 1990, 1999, All Rights Reserved.
Session established with server ADSM: AS400
Server Version 3, Release 1, Level 2.41
Server date/time: 02/17/2000 12:10:15 Last access: 02/17/2000 12:02:25
ANS8000I Server command: 'REGister Admin Roland horn CONTACT='Roland
Ronceveaux, #1234''
ANR2068I Administrator ROLAND registered.
ANS8000I Server command: 'GRant AUTHority Alan CLasses=Policy,Storage
Dmains=domain1,domain2
ANR2078I Restricted policy privilege granted to administrator ROLAND -
policy domain AS400.
ANR2078I Restricted policy privilege granted to administrator ROLAND -
policy domain PRODUCTION.
ANR2078I Restricted policy privilege granted to administrator ROLAND -
policy domain STANDARD.
ANR2080I Restricted storage privilege granted to administrator ROLAND -
storage pool 3570_POOL.
ANS8000I Server command: 'COMMIT'
ANS8002I Highest return code was 0. '

```

For additional information, refer to book *Tivoli Storage Manager for AS/400 Administrator's Reference Version 3*, GC35-0315.

9.4.2 Server Scripts

Server script also executes administrative commands. The major difference to macros is that scripts are stored in the Tivoli Storage Manager server database rather than on the administrative client system. This allows you to execute a server script from any administrative client in the environment.

Another enhancement is that server scripts include the use of variables, return codes, and script logic. A sample set of scripts is provided with the server.

Each script is referenced by a name up to 30 characters and may have an additional description up to 255 characters.

9.4.2.1 Creating a server script

Use the new `DEFINE SCRIPT` administrative command. The command initially creates the script and the first line within the script. The `UPDATE SCRIPT` administrative command is used to add new line or update an existing line:

```

tsm: ASM12> define script MyScript "query stgp"
ANR1454I DEFINE SCRIPT: Command script MYSCRIPT defined.

tsm: ASM12> update script MyScript "query session" line=2
ANR1456I UPDATE SCRIPT: Command script MYSCRIPT updated.

tsm: ASM12> update script myscript "Query Script MyScript f=d" line=3
ANR1456I UPDATE SCRIPT: Command script MYSCRIPT updated.

```


This example creates a server script named `MYSCRIPT`. It inserts the `QUERY SESSION` administrative command at first line. The second command adds a line at line two querying the server database. Third command add a new line at line three querying the server for a detailed content list of a server script named `MYSCRIPT`.

9.4.2.2 Running a server script

As server script is stored in the Tivoli Storage Manager database, any authorized administrators can execute it. You execute the script using the new `RUN` administrative command. The following screen shows the output generated by the script `MYSCRIPT`.

```
tsm: ASM12>run MyScript
```

STORAGE POOL NAME	DEVICE CLASS NAME	ESTIMATED CAPACITY (MB)	PCT UTIL	PCT MIGR	HIGH MIG PCT	LOW MIG PCT	NEXT STORAGE POOL
ARCHIVEPOOL	DISK	0.0	0.0	0.0	90	70	
BACKUPPOOL	DISK	500.0	91.9	91.9	90	70	
COPYPOOL	TSM3570	0.0	0.0				
3570_POOL	TSM3570	0.0	0.0	0.0	90	70	

```
ANR1487I RUN: Command return code is RC_OK (OK).

      SESS NUMBER: 13
      COMM. METHOD: Tcp/Ip
      BYTES RECVD: 112
      SESS TYPE: ADMIN
      PLATFORM: WinNT
      CLIENT NAME: ADMSADMIN
      MEDIA ACCESS STATUS:
      USER NAME:

ANR1487I RUN: Command return code is RC_OK (OK).

      NAME: MYSCRIPT
      LINE NUMBER: 1
      COMMAND: Query stg
      LAST UPDATE BY (ADMINISTRATOR): ADMSADMIN
      LAST UPDATE DATE/TIME: 17.02.2000 12:39:04

      NAME: MYSCRIPT
      LINE NUMBER: 2
      COMMAND: Query session f=d
      LAST UPDATE BY (ADMINISTRATOR): ADMSADMIN
      LAST UPDATE DATE/TIME: 17.02.2000 12:37:37

      NAME: MYSCRIPT
more... (<ENTER> to continue, 'C' to cancel) run MyScript

      LINE NUMBER: 3
      COMMAND: Query Script MyScript f=d
      LAST UPDATE BY (ADMINISTRATOR): ADMSADMIN
      LAST UPDATE DATE/TIME: 17.02.2000 12:36:59

ANR1487I RUN: Command return code is RC_OK (OK).
ANR1462I RUN: Command script MYSCRIPT completed successfully.

tsm: ASM12>
```

Server scripts can be executed by administrative schedules on the server.

Note

A server script can contain other `RUN` command to execute other server scripts, these ones are then called *nested scripts*.

A server script cannot call itself. It would cause a loop in the server script. Tivoli Storage Manager detects it and doesn't allow it.

9.4.2.3 Script SQL Tables

The administrative `SELECT` command can be used to query server scripts. There are two tables in the Tivoli Storage Manager server: `SCRIPT_NAMES` and `SCRIPTS`. The `SCRIPT_NAMES` table contains the script name, description, and information about the last update of the script. The `SCRIPTS` table contains all of the lines defined in the scripts. The following screen shows all lines of the script `MYSRIPT` as stored in the `SCRIPTS` table.

```
tsm: ASM12> select line,command from scripts where name='MYSRIPT'
```

LINE	COMMAND
1	Query session
2	Query DB
3	Query Script
	MyScript f=d

9.5 Client and server configuration

This section introduces the enhancements that have been made to Tivoli Storage Manager Version 3 in terms of client and server configuration.

As shown in Figure 50, major changes were done in centralizing the configuration of clients. However, there are also some changes on the server, such as dynamic update of server options, which make it much easier to configure the Tivoli Storage Manager server.

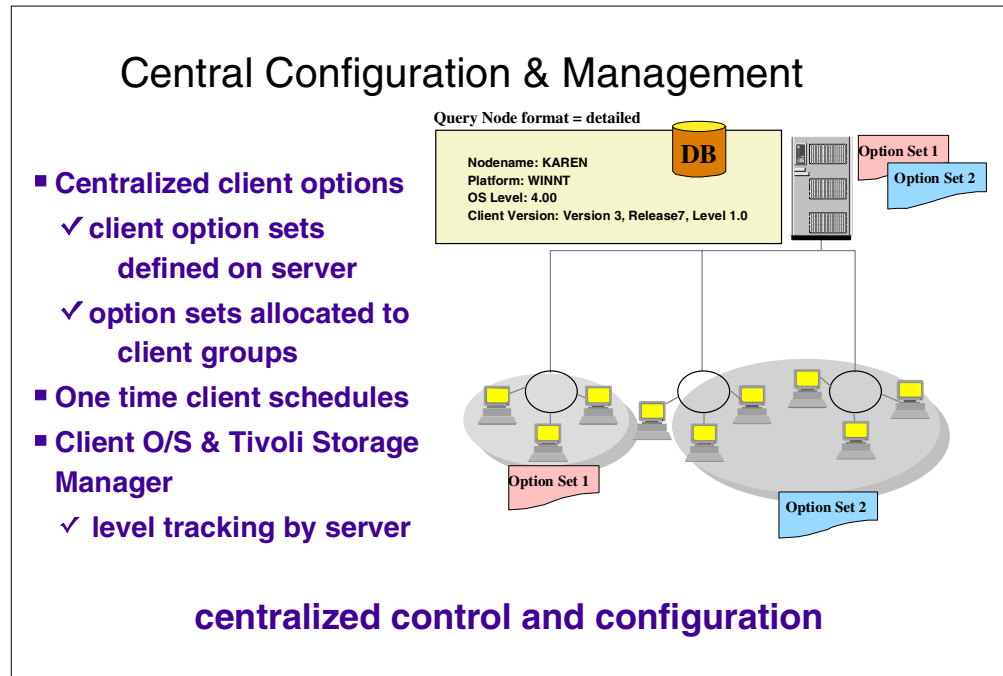


Figure 50. Central configuration and management

9.5.1 Dynamic update of Tivoli Storage Manager server option

All server options are defined in the QOPTADSM file, member OPTIONS, in library QUSRADSM. The Tivoli Storage Manager server reads this file at startup, and any changes made to the file were picked up only at that time. Before Version 3 of Tivoli Storage Manager, in order to change any server option, you had to stop and restart the Tivoli Storage Manager server.

To enable Tivoli Storage Manager to be flexible while maintaining a normal level of service, the Tivoli Storage Manager server Version 3 has been updated to enable *certain* server options to be changed while the server remains online. This forces the server to reread the options file.

You can then dynamically append or update options in the server file with a new command:

```

tsm: ASM12> setopt maxsessions 25

Do you wish to proceed? (Yes/No)

ANR2119I The MAXSESSIONS option has been changed in the options file.
  
```

This command updates the MAXSESSIONS server option to 25.

9.5.2 Query system command

Before Version 3, in order to get a complete listing of all Tivoli Storage Manager configurations, administrators had to create a macro or collect the output from a large number of single commands.

A new `QUERY SYSTEM` command has been created starting from Version 3 to help administrators obtain details of the server configuration. This command consolidates the output from a number of `QUERY` commands along with a number of SQL `SELECT` commands.

9.5.3 Client option sets

One of the challenges facing Tivoli Storage Manager administrators is the ever-increasing number of clients to manage. Such an environment requires configuration through a local options file. Management then becomes more and more complex as the number of clients and the number of configuration options increase.

Version 3 introduces the *client option set*, a set of client options defined at the server that can be allocated to one or more clients, either at registration or during normal operation. Changing an option in the option set changes this option for all clients defined to the option set.

The options defined in the client option set are a subset of available client options. These options can be locked at the server to prevent the client from overriding this client option.

9.5.4 Defining a client option set

Defining a client option set is a two-stage process: First, you define the client options set, and, second, you define the options to this options set.

1. You use the `define cloptset` command to define the option set name and, optionally, a description:

```
tsm: ASM12> define cloptset myoptionset description='My option set'
ANR2046I DEFINE CLOPTSET: Optionset MYOPTIONSET defined.
```

This example creates a client option set named `MYOPTIONSET`.

2. Once created, you have to define options and their values to the option set, as shown in the following:

```
tsm: ASM12> define clientopt myoptionset compression yes force=yes
ANR2050I DEFINE CLIENTOPT: Option COMPRESSION defined in optionset
MYOPTIONSET.

tsm: ASM12> define clientopt myoptionset inclexcl 'include *:\...\*' seq=9
ANR2050I DEFINE CLIENTOPT: Option INCLEXCL defined in optionset
MYOPTIONSET.
```

The client option set now contains the client option `COMPRESSION` and the compression is set `ON`.

3. The last step is to associate nodes with the client option set:

```
tsm: ASM12> register node client01 secret01 cloptset=myoptionset
ANR2060I Node CLIENT01 registered in policy domain STANDARD.

tsm: ASM12> update node client02 cloptset=myoptionset
ANR2063I Node CLIENT02 updated.
```

Use either the `register node` or `update node` command, depending on whether the node already exists or not. Both commands associate nodes `CLIENT01` and `CLIENT02` to a client option set named `myoptionset`.

9.5.5 Enhanced client information

When a node connects to the Tivoli Storage Manager server, a sign-on verb is sent to inform the server of certain information, such as the operating system used. In Version 2, this information is determined at the first client connection, and is never changed. Starting with Version 3, the information sent is updated at each connection to the server and contains more details:

- Client operating system level
- Tivoli Storage Manager client version, release, level, and sublevel

The next screen shows you details about a node:

```
tsm: ASMI2>query node itso02 format=detailed
```

```
      NODE NAME: ITSO02  
      PLATFORM: WinNT  
CLIENT OS LEVEL: 4.00  
CLIENT VERSION: Version 3, Release 7, Level 1.0
```

In this example, node `itso02` uses Microsoft Windows NT at level 4.00 as the operating system and the Tivoli Storage Manager client version running on this node is Version 3, Release 7, Level 1, Sublevel 0.

9.6 Tivoli Space Manager - server setup

As discussed in 2.3.1, “Tivoli Space Manager” on page 45, an important complementary product of Tivoli Storage Manager is the HSM functionality. Figure 51 shows the base functionality provided to the HSM client by the Tivoli Storage Manager server.

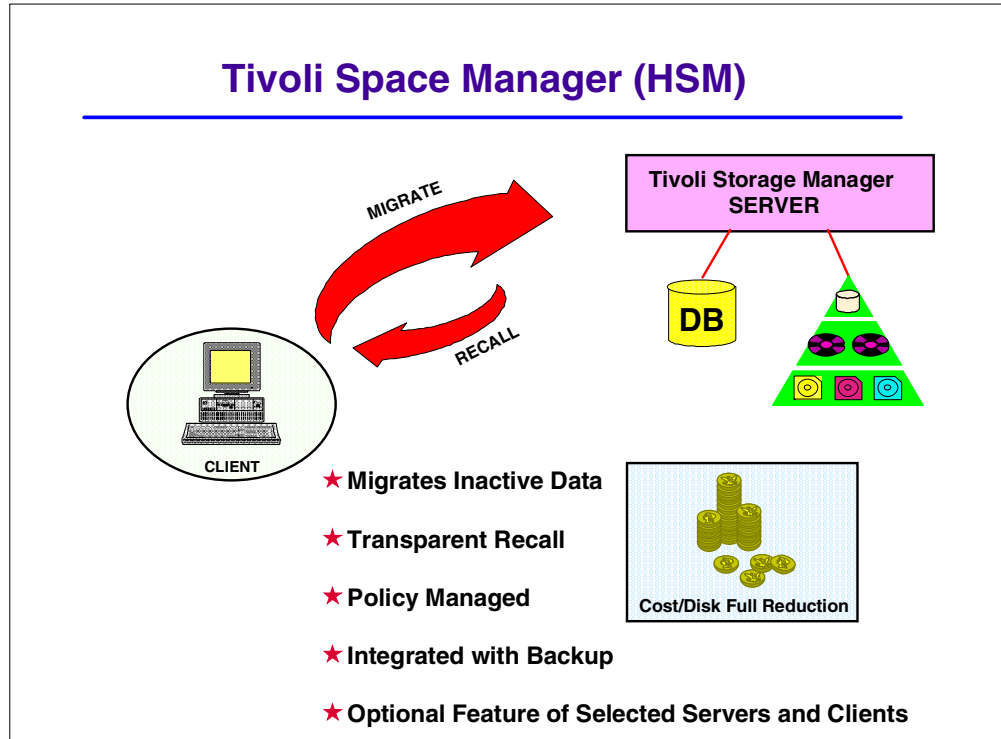


Figure 51. Tivoli Space Manager

This section gives more details on client HSM, such as migration, recall, and reconciliation processes. Also, it will help you set up client HSM on the Tivoli Storage Manager for AS/400 server. For more details on the client part, refer to *Using the UNIX HSM Clients*, SH26-4083.

9.6.1 Tivoli Space Manager concepts

The Tivoli Space Manager feature allows AIX and Solaris file servers and workstations to have data migrated automatically to a Tivoli Storage Manager server according to a predefined set of rules. This process maintains available storage on workstations and file servers at all times, and provides an easy way to share the use of larger, less-expensive storage devices at a lower cost per megabyte.

Tivoli Space Manager maximizes the usage of existing storage resources by transparently migrating data based on size and age criteria, leaving only a stub file. When the migrated data is accessed, Tivoli Space Manager transparently migrates the data back onto the local disk.

Data integrity and security of data are maintained by Tivoli Space Manager working closely with the operating system.

9.6.2 Migration

Files are *migrated* by Tivoli Space Manager from the client to Tivoli Storage Manager storage devices connected to a Tivoli Storage Manager server. The file is copied to Tivoli Storage Manager and a stub file is placed in the original file's location. Using the facilities of Tivoli Storage Manager storage management, the file is placed on various storage devices, such as disk and tape.

There are two types of migration: *automatic* and *selective*.

9.6.2.1 Automatic migration

Tivoli Space Manager monitors the amount of free space on your file systems. When Tivoli Space Manager notices a free space shortage, it migrates files off the local file system to Tivoli Storage Manager storage based on the space management options that have been chosen. Tivoli Space Manager monitors available space in two ways: by threshold or by out-of-space condition.

Threshold migration maintains your local file systems at a set level of free space. At an interval specified in the options, Tivoli Space Manager checks the file system space usage. If the space usage exceeds the high threshold, files are migrated to the Tivoli Storage Manager server by moving the least recently used recent files first. When the file system space usage reaches the set low threshold, migration stops. Threshold migration can also be started manually.

Tivoli Space Manager checks for an out-of-space condition on a file system every two seconds. If this condition is encountered, Tivoli Space Manager automatically starts migrating files until the low threshold for low space usage is reached. As space is freed up, the process causing the out-of-space condition continues to run. No out-of-space error messages are received by the running process.

9.6.2.2 Selective migration

You can use Tivoli Space Manager to selectively migrate a file immediately to Tivoli Storage Manager storage. As long as the file meets the space management options, it will be migrated. The file does not need to meet age criteria, nor does the file system need to meet space threshold criteria.

9.6.2.3 Pre-migration

Migration can take a long time to free up significant amounts of space on the local file system. Files need to be selected and copied to the TSM server, which may involve a tape mount, and a stub file must be created in place of the original file. To speed up the migration process, Tivoli Space Manager implements a *pre-migration* policy.

After threshold or demand migration completes, Tivoli Space Manager continues to copy files from the local file system until the pre-migration level is reached. These copied files are not replaced with the stub file, but are marked as pre-migrated.

The next time migration starts, the pre-migrated files are chosen as the first candidates to migrate. If the file has not changed since it was copied, the file is marked as migrated and the stub file is created in its place in the original file system. No copy of the file needs to happen, since Tivoli Storage Manager already has a copy. In this manner, migration can free up space very quickly.

9.6.2.4 Backing up files before migrating them

If you back up and migrate files to the same Tivoli Storage Manager server, an administrator can assign a management class parameter to files that specifies that a current backup version of the file (created using the Tivoli Storage Manager backup-archive client) must exist on the server before the files can be migrated. The default management class delivered with Tivoli Storage Manager includes that requirement.

Tivoli Space Manager checks for backup versions of files only on the server to which it migrates your files. If a current backup version of a file does not exist on that server, the file is not migrated.

9.6.3 Recall

Recall is the process of restoring a migrated file from Tivoli Storage Manager storage to its original place on the local file system. A recall can be either *transparent* or *selective*.

9.6.3.1 Transparent recall

From the perspective of a user or a running process, all the files in the local file system are actually available. When a migrated file is accessed by a running process, it kicks off a transparent recall for the file. The process is halted while the file is automatically copied from ASDM storage to the original file system location. Once the recall is complete, the halted process continues.

After a recall, the file contents are on both the original file system and on the Tivoli Storage Manager server. This allows Tivoli Space Manager to mark the file as pre-migrated and eligible for migration unless the file is changed.

9.6.3.2 Selective recall

Transparent recall only recalls files automatically as they are accessed. If you or a process need to access a number of files, it may be more efficient to manually recall them prior to actually using them. This is done using selective recall.

Tivoli Space Manager batches the recalled file list based on where the files are stored. It recalls the files stored on disk first, and then it recalls the files stored on sequential storage devices, such as tape.

When a Tivoli Space Manager client migrates space-managed files, the files are not grouped into an aggregate.

9.6.4 Reconciliation

Tivoli Space Manager uses *reconciliation* to maintain its integrity with the client file system. Reconciliation also builds a *migration candidates list*.

Reconciliation can be started manually, or allowed to occur automatically at intervals set in the options file, and prior to threshold migration if the migration candidate list is empty.

9.6.4.1 Synchronization

Synchronization involves maintaining the Tivoli Space Manager database in synchronization with the actual files on the original file system. It ensures that for every stub file, there is a valid file copy kept by Tivoli Space Manager; for every original file on the original file system, there are no database entries; for pre-migrated files, there is a Tivoli Space Manager database entry; and it updates status fields in the database.

For example, if you recall a file, change it and immediately migrate it, Tivoli Space Manager has two copies of the file in its storage: the most recent and valid and it is also an obsolete one. Reconciliation will remove this obsolete file after its expiration interval has passed.

9.6.4.2 Building a new migration candidates list

Tivoli Space Manager uses the reconciliation process to build a prioritized list of files on the original file system that are eligible for automatic migration. The list is created based upon management class criteria and minimum file size. It is ordered according to the number of days since the file was last used, the file size, and migration factors set in the options file. During threshold and demand migration, the list is used to select files to migrate in prioritized order. As the file is selected, it is checked again to ensure it still meets the migration criteria.

A new migration candidate list is created automatically each time reconciliation runs. The list can also be created manually at any time.

9.6.5 Setup of Tivoli Space Manager server

In order to use Tivoli Space Manager (HSM), you must define or update a space-management class.

The following command creates a management class named `production` for domain and policy set `production` that will use the automatic space management technique:

```
tsm: ASM12> define mgmtclass production production production
           spacemgmttechnique=automatic
```

Then, you have to assign this management class to a policy set as default management class. In order for the policy set to take into account the new management class, you have to validate and activate the policy set:

```
tsm: ASM12> assign defmgmtcleass production production production
tsm: ASM12> validate policyset production production
tsm: ASM12> activate policyset production production
```

9.7 Tivoli Disaster Recovery Manager setup

Tivoli Disaster Recovery Manager (DRM) is an optional feature of Tivoli Storage Manager, and has been available for Tivoli Storage Manager for AS/400 since Version 3. As shown in Figure 52, this feature will assist you with preparing a disaster recovery plan, maintaining a client inventory, and managing your off-site volumes in the event of a disaster. Tivoli Disaster Recovery Manager will assist you with automating the recovery of your Tivoli Storage Manager environment. This recovery can be performed at an alternate site or on replacement computer hardware by people not familiar with the applications. You can also use the disaster recovery plan for audits to certify the recoverability of the Tivoli Storage Manager server.

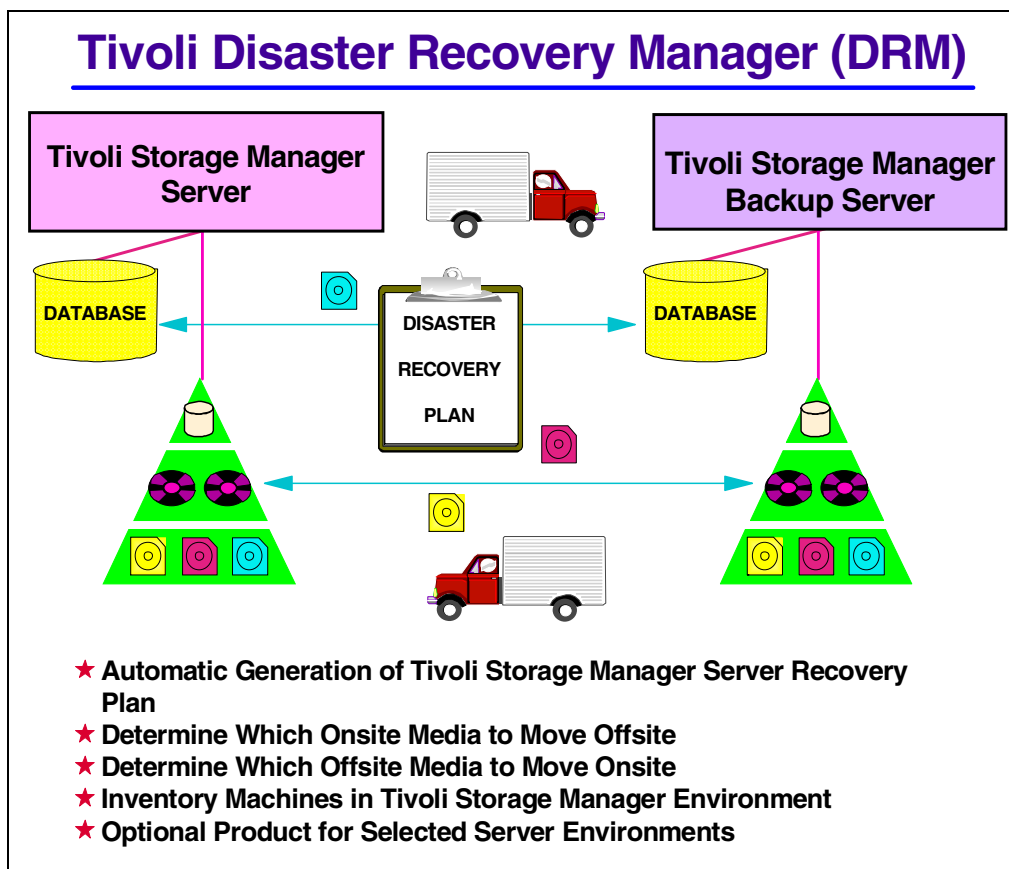


Figure 52. Tivoli Disaster Recovery Manager

9.7.1 DRM Concepts

In the following section, you will find more detailed information on the following functions provided by Tivoli Disaster Recovery Manager:

- Generation of a Disaster Recovery Plan
- Offsite recovery media management
- Client inventory

9.7.1.1 Generation of a server disaster recovery plan

The disaster recovery plan contains the information needed to recover Tivoli Storage Manager to the time of the last database backup when the disaster recovery plan was created. Tivoli Storage Manager generates the recovery plan file that is based on information from the Tivoli Storage Manager database. You can schedule the plan to be generated periodically to ensure that it is current.

If a situation occurs in which you need to recover your Tivoli Storage Manager server, the following information and procedures are available in the recovery plan:

- Instructions defined by the administrator (for example, contact names and telephone numbers)
- The necessary steps to recover the server

- A list of Tivoli Storage Manager database backup and copy storage pool volumes required to perform the recovery and the location of these volumes
- The types of devices required to read the volumes
- Tivoli Storage Manager database and recovery log space requirements
- Copies of the Tivoli Storage Manager server options file, device configuration file, and volume history information file
- Commands for performing server database recovery and primary storage pool recovery
- Machine and recovery media information defined by the administrator

9.7.1.2 Offsite recovery media management

To recover from a disaster, you must know the location of off-site recovery media. Tivoli Disaster Recovery Manager treats your backup volumes as *logical collections*. To safeguard against a disaster, these collections are selected and moved off-site. Eventually, these collections return on-site for either reuse or disposal. Tivoli Disaster Recovery Manager helps you track the location of your backup volumes and, when appropriate, expires the Tivoli Storage Manager database backup series.

If you manually move volumes off-site (not using virtual volumes), you can perform the following steps with Tivoli Disaster Recovery Manager:

- Determine which database backup volumes and copy storage pool volumes must be moved off-site or on-site.
- Track the media location in the Tivoli Storage Manager database.

9.7.1.3 Client inventory

Tivoli Disaster Recovery Manager allows you to save the following client information in the Tivoli Storage Manager database to maintain a permanent client inventory:

- The business priority of the client system
- The machine location, machine characteristics, and machine recovery instructions
- The boot media requirements

You can use `DRM QUERY` commands to determine:

- The client machines to be recovered
- The order in which to recover the client machines
- The machine and boot media requirements

9.7.2 Setup of the Tivoli Disaster Recovery Manager

The following sections will cover important aspects of the Tivoli Storage Manager DRM setup process. For a complete user scenario, refer to Appendix B., “Tivoli Disaster Recovery Manager scenario and checklist” on page 357.

9.7.2.1 Tivoli Disaster Recovery Manager license setup

Before you can start with Tivoli Disaster Recovery Manager, you need to register the license. You can register the license by entering `register license drm` or use the `CHGSVRADSM` command. See “Setting the licenses” on page 85.

9.7.3 Define machine information for the server

You have the option of defining information about the machine that contains the Tivoli Storage Manager server. This information will be retrieved later as input to your disaster recovery plan file. During disaster recovery, this information is necessary for rebuilding the replacement machine. Following is an example:

```
tsm: ASM12> define machine NINJA description='AS/400 model 170' building=107 \  
cont> floor=2 room=107 priority=3 adsmserver=yes  
ANR6609I Machine NINJA defined.
```

9.7.3.1 Define Tivoli Storage Manager server recovery instructions

The recovery instructions are flat files containing steps that you create to assist personnel involved in the recovery process of the Tivoli Storage Manager server. Recovery instructions are included in the disaster recovery plan. The files have the following names:

- Instructionsprefix/INSTR(GENERAL)
- Instructionsprefix/INSTR(OFFSITE)
- Instructionsprefix/INSTR(INSTALL)
- Instructionsprefix/INSTR(DATABASE)
- Instructionsprefix/INSTR(STGPOOL)

Instructionsprefix/INSTR(GENERAL): Include information, such as administrator names, telephone numbers, and the location of passwords. For example:

```
Recovery Instructions for ADSM Server ACMESRV on system ZEUS.  
  
Joe Smith (wk 002-000-1111 hm 002-003-0000) is the primary system  
programmer.  
Salley Doe (wk 002-000-1112 hm 002-005-0000) is primary recovery  
administrator.  
Jane Smith (wk 002-000-1113 hm 002-004-0000) is the responsible  
manager.  
Security Considerations: Joe Smith has the password for the Admin ID  
ACMEADM. If Joe is unavailable, you will need to either issue SET  
AUTHENTICATION OFF or define a new administrative user ID at the replacement  
ADSM server console.
```

Instructionsprefix/INSTR(OFFSITE): Include information, such as the off-site vault location, the courier's name, and telephone numbers.

Instructionsprefix/INSTR(INSTALL): Include information about how to restore the base server system from boot media or, if boot media is unavailable, how to install the Tivoli Storage Manager server and where the installation volumes are located.

Instructionsprefix/INSTR(DATABASE): Include information about how to recover the database along with the amount of disk space needed. However, you can use the `DRM SET` commands to override the default settings. For a customized Tivoli Disaster Recovery Manager, see *Tivoli Storage Manager for AS/400 Administrator's Guide*, GC35-0315.

9.7.3.2 Creating the disaster recovery plan

When you issue the `PREPARE` command, Tivoli Disaster Recovery Manager automatically queries the Tivoli Storage Manager database and generates a disaster recovery plan file. We first created a library on AS/400 called `DRM` to group all DRM information using the `CRTLIB DRM` command:

In the following example, the `prepare` command is issued with the `planprefix` parameter to generate the recovery plan file in library `DRM`:

```
tsm: ASM12> prepare planprefix=DRM
```

The plan file name always includes the date and time (Dyyyymmdd(Thmmss)) when the `prepare` command is issued, for example, `drm/D199904085(T120532)`.

For details about specifying the location of the disaster recovery plan, see Appendix B, “Tivoli Disaster Recovery Manager scenario and checklist” on page 357, and refer to the `prepare` command in the *Tivoli Storage Manager Administrator's Reference*, GC35-0316.

Tivoli Disaster Recovery Manager creates one copy of the disaster recovery plan file. It is recommended that you create multiple copies of your disaster recovery plan for safekeeping. For example, keep copies in print, on diskettes, or on disk space that is physically located off-site.

Issue the `prepare` command or schedule it to run after the storage pools and database have been backed up and the volumes have been marked off-site. This ensures that your disaster recovery plan is current.

When you issue the `prepare` command, any existing files are not deleted. You should periodically delete down-level recovery plan files.

9.7.3.3 Storing client recovery information

Tivoli Disaster Recovery Manager allows you to store recovery information for client machines backed up by the Tivoli Storage Manager server. Machine information is used to store details about the machine on which a client node resides. In the event of a disaster, this information can help you identify what you need in order to rebuild or restore the replacement machines.

Define the following information for each Tivoli Storage Manager-managed system in the database:

- Machine location and business priority
- The Tivoli Storage Manager client nodes associated with a machine
- Machine characteristics (hardware, communication card, and operating system)
- Machine recovery instructions

Perform the following steps:

1. Issue the `define machine` command and specify the client's location and business priority.

The following example defines machine `mach22` in building 21 on the 2nd floor in room 2929, and it has a priority value of 1:

```
tsm: ASM12> define machine mach22 building=021 floor=2 room=2929
priority=1
```

2. To associate one or more Tivoli Storage Manager client nodes with a machine, issue the command `define machnodeassociation`.

During disaster recovery, this association information is used to determine what Tivoli Storage Manager client nodes resided on machines that have been destroyed. The file spaces associated with these client nodes should be restored. The following example associates node `campbell` with machine `mach22`:

```
tsm: ASM12> define machnodeassociation mach22 campbell
```

You can query your machine definitions by issuing the `QUERY MACHINE` command. For example, see the `QUERY MACHINE` output in Appendix B., “Tivoli Disaster Recovery Manager scenario and checklist” on page 357.

3. To insert machine characteristics and recovery instructions into the Tivoli Storage Manager database, issue the `INSERT MACHINE` command. You must first query the operating system to identify the characteristics for your client machine. You can insert the characteristics and instructions manually, or you can create a C program to do it for you.

To help automate the insertion of client machine information, a sample C program named `QADSM/QANRSMP (QANRINSERT)` is shipped with Tivoli Disaster Recovery Manager on AS/400. The executable for this program is `QADSM/QANRINSERT`, and this object is type `PGM`.

9.7.4 Performing DRM operations and recovery media tracking

After you have set up Tivoli Disaster Recovery Manager, you should perform a few routine operations to stay prepared for a possible disaster. The following list is an overview of these daily tasks in the order in which they are typically done. Many of these tasks can be scheduled to occur automatically (see Chapter 7, “Tivoli Storage Manager policy and automation” on page 173 for more information on scheduling).

1. Back up client data.
2. Back up the database and storage pools.
3. Move the new backup tapes off-site and update the database with their locations.
4. Return expired or reclaimed backup tapes on-site and update the database with their locations.
5. Generate a new disaster recovery plan.

Figure 53 shows the recovery media tracking function of Tivoli Disaster Recovery Manager supporting this daily routine by assigning an exactly defined location to all the disaster recovery volumes.

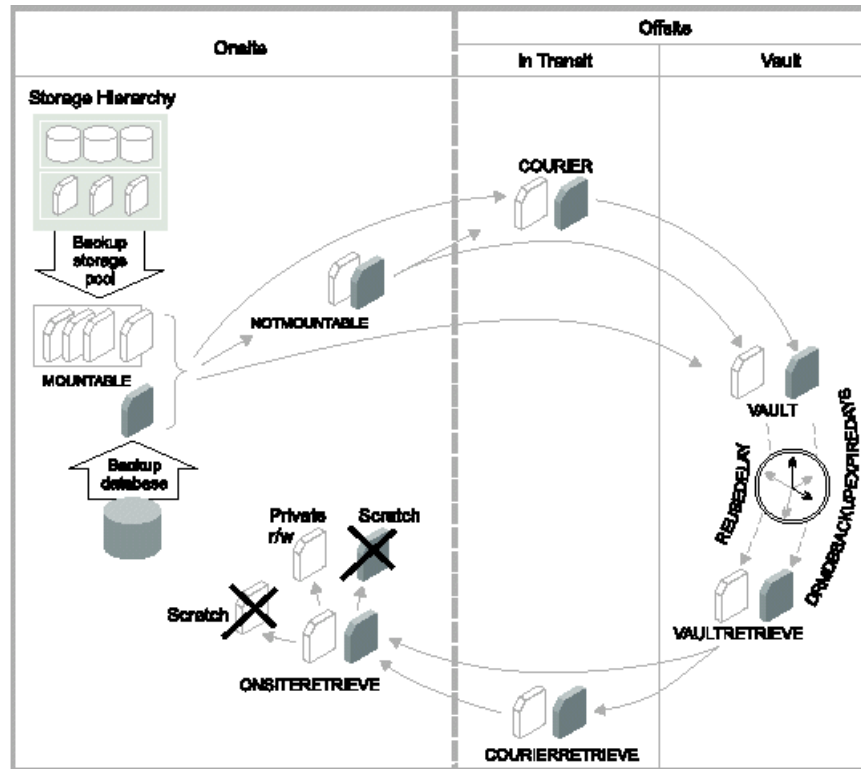


Figure 53. Off-site volume cycle

9.8 Virtual volumes

With the concept of server-to-server virtual volumes, Tivoli Storage Manager Version 3 extends the Tivoli Storage Manager storage repository to include storage resources available on remote systems. Figure 54 shows different implementation options using this Tivoli Storage Manager feature.

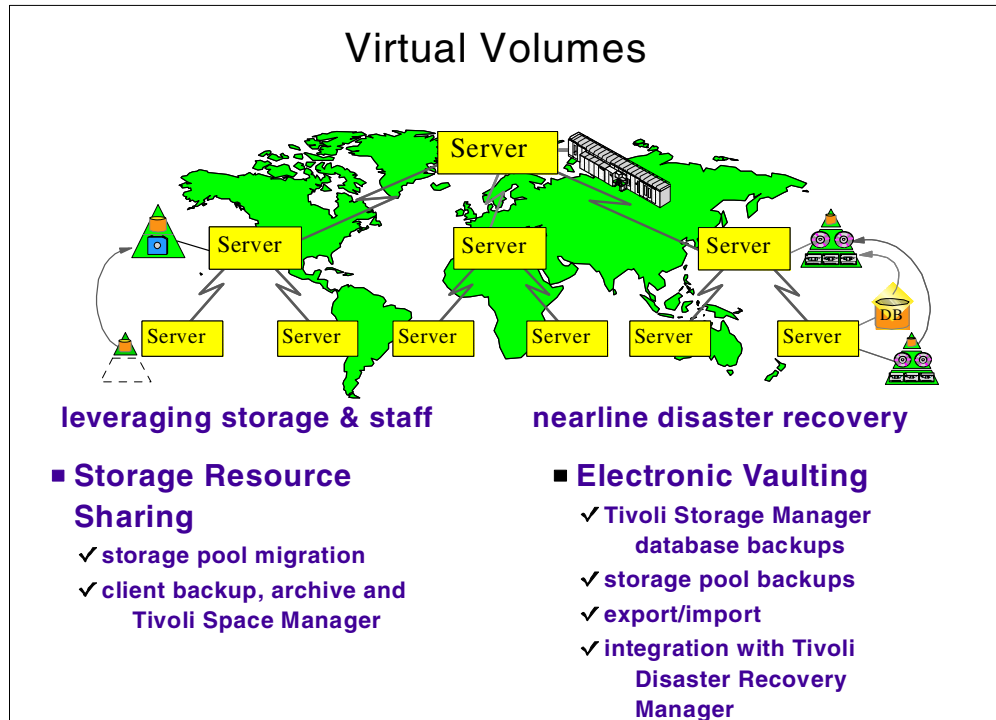


Figure 54. Server-to-server virtual volumes

This section explains the concepts of Server-to-Server virtual volumes, how to set them up, and how to reconcile virtual volumes.

9.8.1 Licensing

The ability to define remote server, and to use Virtual volumes for primary storage pools, is a part of standard TSM license. All other Virtual volume features including electronic vaulting of Storage pool and Server database backups, require a Tivoli Disaster Recovery Manager license.

9.8.2 Concepts

Tivoli Storage Manager lets a server (*source server*) store database backups, exported server data, and storage pool data on another server (*target server*). The data is stored in so-called *virtual volumes*, which appear to be sequential media volumes on the source server, but which are actually located on a target server as archive files.

Virtual volumes can be used for any of the following:

- Database and recovery log backups
- Storage pool backups
- Data backed up, archived, or migrated from client nodes
- Client data migrated from storage pools on the source server
- Any data used by `EXPORT` and `IMPORT` commands

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.

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 can benefit you in the following ways:

- 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 considerations 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 may have no backups with which to restore your databases.
- Moving large amounts of data between the servers may slow down your communications significantly depending on the network bandwidth and availability.
- In the device class definition (device type `SERVER`), you can specify how often and for how long 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 of time can affect your communication.
- 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 (see 9.8.4, “Reconciling virtual volumes and archive files” on page 248 for details).
- 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 total mount 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.

9.8.3 Setting up source and target servers

In the source target server relationship, you define the source server as a client node of the target server. To set up this relationship, a number of steps must be performed at the two servers:

At the source server (NINJA in our example):

1. Define the target server name (in our case, `asm12`) by using the `define server` command.

```
tsm: NINJA> define server asm12 commethod=tcpip password=rain  
hladdress=9.5.150.57 lladdress=1500 nodename=ninja
```

The command example does the following:

- Defines a target server named `asm12`,
- Assigns `asm12` to the TCP/IP address `9.5.150.57:1500`, the high and low level addresses, respectively
- Assigns the password `rain` to the node `ninja`.
- Assigns `ninja` as the node name by which the source server will be known at the target server. If no node name is assigned, the server name of the source server is used. To see the server name, you can issue the `QUERY STATUS` command

Note

- The target server name you have to use is the one you can see by using the `QUERY STATUS` administrative command on the target server.
- Either the Web administrative interface or the administrative command can lead to some confusion: The password you assigned is the password for the node and *not* for the server.
- The `lladdress` (low level address) parameter is the port number you defined in the server option file of the target server

2. Define a device class for the data to be sent to the target server. The device type for this device class must be `server`, and the definition must include the name of the target server, `asm12` in this case. For example, to define a device class named `targetclass`, issue the following command:

```
tsm: NINJA> define devclass targetclass devt=server servername=asm12
```

At the target server, you must register the source server as a client node. The target server can use an existing policy domain and storage pool for the data from the source server. However, you can define a separate management policy and storage pool for the source server. Doing so can provides more control over storage pool resources.

3. Use the `register node` command to define the source server as a node of `type=server`. The policy domain to which the node is assigned determines where the data from the source server is stored. Data from the source server is stored in the storage pool specified in the archive copy group of the default management class of that domain.

For example, to define the source server as a node named `ninja` with a password of `rain` (these are the values we assigned in the `DEFINE SERVER` command at the source server), issue the following command:

```
tsm: ASM12> register node ninja rain domain=standard type=server
```

4. If you choose to set up a separate policy and storage pool for the source server, ensure that the `register node` command assigns the source server to the new policy domain. Here is an example:

- a. Define a storage pool named `sourcepool`:

```
tsm: ASM12>define stgpool sourcepool targetclass maxscr=1
```

- b. Copy an existing policy domain `standard` to a new domain named `sourcedomain`:

```
tsm: ASM12> copy domain standard sourcedomain
```

- c. Assign `sourcepool` as the archive copy group destination in the default management class of `sourcedomain`:

```
tsm: ASM12> update copygroup sourcedomain standard standard type=archive\  
destination=sourcepool
```

- d. After issuing these commands, ensure you that you assign the source server to the new policy domain by running the following command:

```
tsm: ASM12> update node source domain=sourcedomain
```

Now, you can back up the database on the source server to the target server by issuing the following command:

```
tsm: ASM12> backup db type=full devclass=targetclass
```

Check the completion using the `QUERY ACTLOG` administrative command.

You can also do an automatic database backup to a target server. For example, if you have issued the following command, a database backup occurs automatically when more than 60 percent of recovery log space is used:

```
tsm: ASM12> define dbbackuptrigger devclass=targetclass logfullpct=60
```

Our example only shows how to back up the database, but you can also do the following:

- Backup storage pools
- Store client data on a target server
- Migrate source server storage pool to a server storage pool
- Export server information to a target server
- Import server information from a target server

9.8.4 Reconciling virtual volumes and archive files

If you have restored the database on the source or target server, you should perform reconciliation between the virtual volumes on the source server and the archive files on the target server. You should also perform reconciliation if you have any other reason to suspect inconsistencies. For example, frequent communication errors between target and source servers could introduce a problem.

To perform reconciliation, issue the `reconcile volumes` command specifying a device class of the device type of `SERVER`. In the following example, `targetclass` is a server device class:

```
tsm: ASM12> reconcile volumes targetclass fix=yes
```

Note

If you manually (re)created virtual volumes, set the password in clear text. After the server is operational again, you can issue a backup of the device configuration file (`DEVCONFIG` by default) to store the password in encrypted form.

The reconciliation action is determined by the `FIX` parameter as shown in Table 10.

Table 10. Reconciliation action table for inconsistencies

FIX=	At the source server	At the target server	Action
No	Volumes exist	No files exist	Report error
		Files exist but are marked for deletion	
		Active files exist but attributes do not match	
	Volumes do not exist	Active files exist	Report error
		Files exist but are marked for deletion	None
Yes	Volumes exist	No files exist	Report error For Storage pool volumes: Mark volumes as unavailable
		Files exist but are marked for deletion	Report error For storage pool volumes: If attributes match, mark files on the target server as active again, mark volumes on the source server as unavailable, and recommend that an <code>AUDIT VOLUME</code> be done to further verify the data. If attributes do not match, mark volumes as unavailable
		Active files exist but attributes do not match	Report error For storage pool volumes: Mark volumes as unavailable and recommend that an <code>AUDIT VOLUME</code> be done to further verify the data
	Volumes do not exist	Active files exist	Mark files for deletion on the target server
		Files exist but marked for deletion	None

9.9 Enterprise Administration

The Enterprise Administration is a standard feature of with Tivoli Storage Manager Version 3.1.2.

This section describes Tivoli Storage Manager Version 3 features for administering multiple Tivoli Storage Manager servers in an enterprise. We cover the following topics:

- Server-to-Server communications
- Administrative command routing
- Enterprise configuration

Some configuration steps are already known from the previous section, 9.8, “Virtual volumes” on page 243, but to have a complete picture on Enterprise Administration, the section will repeat this information for general understanding.

9.9.1 Server-to Server communications

Tivoli Storage Manager Version 3 enables multiple servers within an enterprise to be configured and administered from a central location. Tivoli Storage Manager Version 3 Server-to-Server communications provides the foundation for configuring multiple servers running Tivoli Storage Manager Version 3 within an enterprise. This section covers the following topics:

- Server-to-Server overview
- Server-to-Server configuration
- Remote server setup
- Local server setup
- Server definitions
- Server groups
- Server group configuration

9.9.1.1 Server-to-Server overview

Server-to-Server communications provides a mechanism for creating network connections between Tivoli Storage Manager version 3 servers. Server-to-Server communications are enabled by a series of definitions made on the servers. A new terminology applies now for servers:

- Local server: the server on which server definitions are created
- Remote server: server defined by the local server

Configuring Server-to-Server communication is a prerequisite for the following functions:

- Administrative command routing
- Enterprise configuration
- Server-to-Server virtual volumes
- Server-to-Server event logging

9.9.1.2 Server-to-Server Configuration

Server-to-Server communication is based on TCP/IP connections and is configured with a series of definitions on both local and remote servers. Servers are defined with a server name and a server password. These are used to authenticate sessions being initiated by the local server. There is after set command no password prompt when sessions are initiated between servers.

The server high level address, is the TCP/IP address of the local server in dotted decimal notation.

The `SET` command is used to prepare the local server:

- Server name: `set servername asm12`
- Server password: `set serverpassword secret12`
- TCP/IP address: `set serverhladdress 9.5.150.57`

- TCP/IP port: `set serverhladdress 1500`

The server low level address, is the TCP/IP port number of the server. This is the port where the local server listens for incoming TCP/IP connections from others servers or clients.

The remote server must also be set up before the local server can create server definitions. The `SET` command is used to prepare the remote server:

- An unique server name: `set servername palana`
- A server password: `set serverpassword secretpa`
- TCP/IP address: `set serverhladdress 9.5.150.113`
- TCP/IP port: `set serverhladdress 1500`
- Optionally, the `crossdefine` parameter set to on: `set crossdefine on`

Optionally you can enable a *cross define* function on the remote server. The remote server receives the server name, server password, TCP/IP address and port of the local server when performing a server-to-server function. A server definition of the local server will be dynamically created on the remote server, reducing the number of definitions to be create by the administrator.

All these parameters are passed to the remote server when the local server creates the Server-to-Server definitions.

The `DEFINE SERVER` command is used to define the network connection between the local and remote servers. If the `crossdefine` option is set on, the result of the operation is a server definition for the remote server created on the local system and a server defined of the local system created on the remote system.

The last step is to define the remote servers on the local server. For example:

```
tsm: ASM12> define server palana hladdress=9.5.150.113 lladdress=1500 \
serverpassword=secretpa crossdefine=yes
```

The above command creates, on the local server, a definition of a remote Tivoli Storage Manager server named `palana` having a server password `secretpa`, reachable at the TCP/IP address `9.5.150.113` and TCP/IP port `1500`, and the `crossdefine` option is set on.

9.9.1.3 Server Groups

Tivoli Storage Manager servers defined using Server-to-Server communication can be logically grouped together for administrative purposes. This facilitates administration where repetitive administration tasks must be performed on multiple Tivoli Storage Manager servers. Defining a server group allows an administrator to perform a single administration operation that will be executed on all the Tivoli Storage Manager servers defined within the server group.

A *server group* is a collection of defined Tivoli Storage Manager servers that have common administrative requirements. The server group can be organized by business organization, operating system, or any required combination.

With the definition of servers and identical administrators on all of the defined servers, you can route administrative commands to multiple servers (see 9.9.2, “Administrative command routing” on page 252).

The definition of server groups is very flexible. Any server or server group can be added to any server group. You can define the following:

- Multiple server groups
- Groups within server groups
- Individual server defined in more than one server group.

A server group can be defined on a server regardless of other server definitions. Servers are added to a server group after the server is defined.

Few steps are required to configure a server group:

1. First, create a server group:

```
tsm: ASML2> define servergroup MyServerGroup
```

This creates a new server group named `MYSERVERGROUP`.

2. Then you have to define Tivoli Storage Manager servers as members of the server group. You can add more than one server a time. You define them by using the following command:

```
tsm: ASML2> define grpmember myservergroup asml2,palana
```

The server group `MYSERVERGROUP` now has two members, the Tivoli Storage Manager servers `ASML2` and `PALANA`.

3. To verify the members defined within a server group, use the next command:

```
tsm: ASML2>query servergroup myservergroup
```

SERVER GROUP	MEMBERS	DESCRIPTION	MANAGING PROFILE
-----	-----	-----	-----
MYSERVERGROUP	PALANA		
	ASML2		

The `QUERY SERVERGROUP` command shows a list of all members within the server group `MYSERVERGROUP`.

Note

Before adding new members to the server group, the servers must already be defined to the local server using the `DEFINE SERVER` command.

9.9.2 Administrative command routing

Administrative command routing enables an administrator to send commands from one Tivoli Storage Manager server to one or more servers that the

administrator is authorized to access. The output of the command is displayed at the server where the command was entered.

In order to be able to use administrative command routing to multiple servers, there are several prerequisites:

- The Enterprise Administration license must be enabled on the server where the routing command is issued.
- The servers where you want to route the administrative command must be defined.
- Cross defined server definitions must exist between the server where the routing command is issued and the servers where the commands are routed.
- The administrative ID and password issuing the commands must be valid on the servers where the command is routed.
- The administrator must have the appropriate authority to execute the administrative command on the specified servers.

The password is encrypted before it is sent across the network.

There are two ways to route administrative commands to other servers, you need to use a new syntax:

```
tsm: ADSM> (server_name, server_group) administrative command  
tsm: ADSM> server_name, server_group: administrative command
```

The routing information is a prefix to the administrative command. It consists of one or more server or server group names, separated by commas. The end of the routing information is denoted by a colon. Then follows the administrative command.

An alternative syntax is to enclose server names or server group names within parentheses immediately followed by the administrative command. This syntax is required when included within server scripts. The routing information can be any combination of servers and/or server groups. Wildcards are not allowed within the routing information.

```
tsm: ASMI2> (palana, myservergroup) query db
```

The `QUERY DB` command is routed to Tivoli Storage Manager server PALANA and to the servers defined within the server group MYSERVERGROUP.

9.9.3 Enterprise configuration

The Tivoli Storage Manager Version 3 enterprise configuration allows an administrator to centrally define configuration information, or *objects*, on a *configuration manager* and then distribute those objects to *managed servers*, using Server-to-Server communication as shown in Figure 55.

The objects are first defined on the configuration manager by an administrator. He then defines a *configuration profile* and associates the objects with the configuration profile. When the managed server subscribes to this configuration profile, the objects associated with the profile are distributed to the managed server as *managed objects*.

Enterprise Configuration

- Server configuration
 - ▶ Administrator userids
 - ▶ Policy definitions
 - ▶ Administrative schedules
 - ▶ Server scripts
 - ▶ Client option sets
 - ▶ Server and server group definitions
- Components
 - ▶ Configuration manager
 - ▶ Configuration profiles
 - ▶ Managed servers
 - ▶ Management by subscription

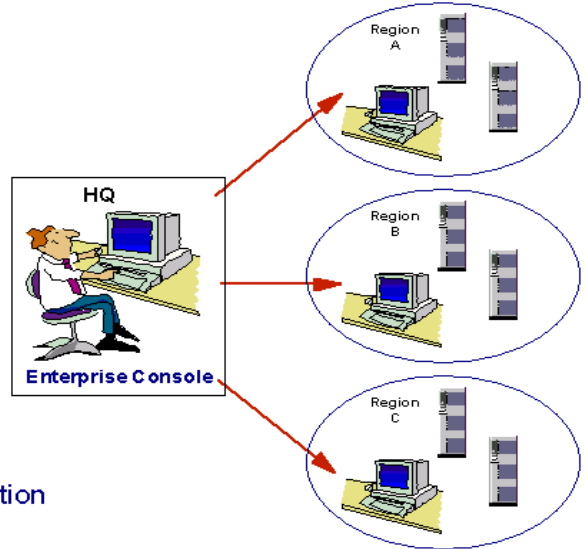


Figure 55. Enterprise Configuration Overview

The following topics are covered in this section:

- Configuration manager
- Configuration profiles
- Managed objects
- Managed servers

9.9.3.1 Configuration manager

The configuration manager is the Tivoli Storage Manager server used to define a central configuration and propagate it to one or more managed servers. There can be one or more configuration managers. However, a managed server can only be subscribed to only one configuration manager at a time.

To propagate the central configuration, the configuration manager must be able to communicate with its managed servers, using Server-to-Server communication.

As already said, Enterprise Administration must be registered as a new feature to Tivoli Storage Manager. Once it is done, you enable the configuration manager using the following command:

```
tsm: ASM12> set configmanager on
```

A server cannot be set as configuration manager if it already subscribed to a configuration profile defined on another configuration manager.

9.9.3.2 Configuration profiles

A configuration profile is a set of definitions on the configuration manager that are distributed to managed servers that subscribe to that profile. It contains

references only to the objects defined on the configuration manager, not the actual objects.

The default profile, named `DEFAULT_PROFILE`, is the first profile created on the configuration manager. It is automatically created when the `SET CONFIGMANAGER ON` command is issued and it contains associations to all server and server group definitions within the database on the configuration manager.

When a managed server subscribes to a configuration profile, it subscribes automatically to the default profile.

You can create additional configuration profiles using the following command:

```
tsm: ASM12> define profile myconfigprofile
```

This command creates a configuration profile named `MYCONFIGPROFILE`.

9.9.3.3 Managed objects

Objects associated with configuration profiles become *managed objects* on the managed servers following their distribution. They are managed objects because their attributes are determined on the configuration manager where they were originally defined, and they cannot be updated or modified on the managed server. These objects are stored on the managed server database and can be used on the managed server without any connection to the configuration manager.

The following managed objects can be received from the configuration manager:

- Administrators
- Policy domains
- Administrative command schedules
- Server scripts
- Client option sets
- Servers and server groups

Managed objects can only be updated by the configuration manager. The modifications are propagated to the managed servers, replacing previous managed objects, based on an administrator-defined refresh interval. This refresh interval is defined on the managed servers, but the configuration manager can also notify managed servers to immediately refresh their configuration.

For example, suppose you want the `MYCONFIGPROFILE` profile to distribute the administrator `HGROSS` registered to the configuration manager, enter the following command on the configuration manager:

```
tsm: ASM12>define profassociation myconfigprofile admin=hgross
```

```
ANR3041I DEFINE PROFASSOCIATION: Administrator HGROSS associated with profile MYCONFIGPROFILE.
```

Note

Individual objects can be associated with multiple configuration profiles, allowing flexibility in defining central configurations.

9.9.3.4 Managed servers

A server becomes managed by subscribing to one or more configuration profiles on the configuration manager, thereby becoming a *profile subscriber*.

This done on the remote server by the `DEFINE SUBSCRIPTION` command. You specify the profile name to subscribe to and the configuration manager name:

```
tsm: PALANA> define subscription myconfigprofile server=asm12
```

where `MYCONFIGPROFILE` is the configuration profile name and `ASM12` is the name of the configuration manager.

We illustrate the effect of this new profile by issuing two `QUERY ADMIN` commands from our AS/400 server to the subscribing server `PALANA`. You can see the administrator object `HGROSS` is now included in the list of administrators and is distinguished as a profile inherited object:

```
tsm: ASM12>palana: query admin
ANR1699I Resolved PALANA to 1 server(s) - issuing command query admin against
server(s) .
ANR1687I Output for command ' query admin' issued against server PALANA
follows:
```

Administrator Name	Days Since Last Access	Days Since Password Set	Locked?	Privilege Classes
ADSMADMIN	<1	41	Yes	System
ATAN	27	35	No	Client Access
CB	42	43	No	Client Access Client Owner
COCOS	46	46	No	Client Owner
DIOMEDE	3	36	No	Client Owner
HGROSS	<1	<1	No	System
LOCHNESS	29	29	No	Client Owner
LOCHNESS_TDP	29	29	No	Client Owner
SYSADMIN	<1	48	No	System
SYSADMIN2	48	48	No	System

```
ANR1688I Output for command ' query admin' issued against server PALANA
completed.
ANR1694I Server PALANA processed command ' query admin' and completed
successfully.
ANR1697I Command ' query admin' processed by 1 server(s): 1 successful, 0 with
```

```
tsm: ASM12>palana: query admin hgross f=d
```

```

tsm: ASM12>palana: query admin hgross f=d
ANR1699I Resolved PALANA to 1 server(s) - issuing command query admin hgross
f=d against server(s).
ANR1687I Output for command ' query admin hgross f=d' issued against server
PALANA follows:

    Administrator Name: HGROSS
    Last Access Date/Time: 29.03.2000 14:54:07
    Days Since Last Access: <1
    Password Set Date/Time: 29.03.2000 14:00:10
    Days Since Password Set: <1
    Invalid Sign-on Count: 0
    Locked?: No
    Contact: Hans
    System Privilege: Yes
    Policy Privilege: ** Included with system privilege **
    Storage Privilege: ** Included with system privilege **
    Analyst Privilege: ** Included with system privilege **
    Operator Privilege: ** Included with system privilege **
    Client Access Privilege: ** Included with system privilege **
    Client Owner Privilege: ** Included with system privilege **
    Registration Date/Time: 29.03.2000 14:00:10
Registering Administrator: $$CONFIG_MANAGER$$
Managing profile: MYCONFIGPROFILE
    Password Expiration Period:

ANR1688I Output for command ' query admin hgross f=d' issued against server
PALANA completed.
ANR1694I Server PALANA processed command ' query admin hgross f=d' and
completed successfully.
ANR1697I Command ' query admin hgross f=d' processed by 1 server(s): 1
successful, 0 with warnings, and 0 with errors.

tsm: ASM12>

```

Part 3. Practical scenarios

Chapter 10. AS/400 backup and recovery scenarios

Now that you have set up the Tivoli Storage Manager server and client on the AS/400 system, this chapter discusses different backup and recovery scenarios. It covers in detail:

- Backup and recovery of user data
- Archival and retrieval of user data
- Backup and recovery of a complete AS/400 system as a Tivoli Storage Manager client
- Backup and recovery of a complete AS/400 system as a Tivoli Storage Manager server

All these scenarios focus exclusively on AS/400 systems and their data. For information about other platforms, consult the appropriate manuals or redbooks.

10.1 Backup and recovery of user data

In this section, we will discuss examples of backing up and recovering AS/400 user data using the BRMS application client for Tivoli Storage Manager, including backup and recover user library, user objects, document library objects, integrated file system data, and spool files.

Chapter 5, “Setting up a BRMS API client on an AS/400 system” on page 111 explains how to configure the BRMS application client, and gives an example of how to create a storage location, device and media policy, and control group for the BRMS application client. The created control group was named `ADSM`, and its attributes are set up in such a way that, when you perform backup of this control group, all the items listed in this control group will be saved to a Tivoli Storage Manager server. This section uses the same storage location and device names `TSM_SERVER`, and media policy name `adsm` in the following examples.

In this section, several references are made to the `Edit Backup Control Group Entries` screen. You can get this screen by doing the following:

- Enter `GO BRMBKUPLN` at an OS/400 command line.
- Select option **2, work with control groups**.
- At the `Work with control group` screen, select option **2** for the control group, where you want to edit entries. In our example, we selected the `ADSM` control group (which was defined in Chapter 5, “Setting up a BRMS API client on an AS/400 system” on page 111), as shown in the following screen:

Edit Backup Control Group Entries						ASM12
Group : ADMS						
Default activity *BKUPCY						
Text *NONE						
Type information, press Enter.						
	Backup	List	Weekly	Retain	Save	SWA
Seq	Items	Type	Activity	Object	While	Message
			SMIWTFS	Detail	Active	Queue
						Bottom
F3=Exit		F5=Refresh		F10=Change item		
F11=Display exits		F12=Cancel		F24=More keys		

10.1.1 Backup and recovery of user libraries

You can set up a backup control group to back up AS/400 user libraries. Since the BRMS application client can back up only user data, you cannot back up libraries with names whose prefix is the letter Q.

10.1.1.1 Backup of user libraries

At the *Edit Backup Control Group Entries* screen, for the control group, ADMS, enter a sequence number and libraries you want to backup. In our example, TESTLIB1, TESTLIB2, and TESTLIB3 libraries are added to back up control group ADMS as shown in the following screen. You can set up the control group to do a full backup on Sunday and incremental backups on other days of the week by specifying **F** for full or **I** for incremental in weekly activity as shown in the screen. This helps reduce network traffic during weekdays and also reduces the needed backup window. If you want to recover individual objects by selecting from the object list, specify retain object details as *YES.

Edit Backup Control Group Entries						ASM12
Group : ADMS						
Default activity *BKUPCY						
Text *NONE						
Type information, press Enter.						
	Backup	List	Weekly	Retain	Save	SWA
Seq	Items	Type	Activity	Object	While	Message
			SMIWTFS	Detail	Active	Queue
10	<u>TESTLIB1</u>		FIIIIII	*YES	*NO	
20	TESTLIB2		FIIIIII	*YES	*NO	
30	TESTLIB3		FIIIIII	*YES	*NO	
						Bottom
F3=Exit		F5=Refresh		F10=Change item		
F11=Display exits		F12=Cancel		F24=More keys		

Press **F3** to exit from this screen and select **save and exit session**. Now, you will get screen *Work with backup control groups*. At this screen, press **F3** to go to the command line.

To start the backup, type the command `STRBKUBRM CTLGRP (ADSM)`. When the backup is complete, you will get a completion message in the BRMS log. Check the BRMS log using the `DSPLOGBRM` command for the successful completion of backup.

In addition to backing up individual libraries, you can specify `*ALLUSR` at the backup items in the *Edit backup control group entries* screen to back up all of the user libraries.

10.1.1.2 Recovery of user libraries

To recover user libraries, type the `STRRCYBRM` command at the OS/400 command line and press **F4**; you will get the following *Start Recovery using BRMS* screen. On this screen, specify `*lib` at the option parameter and `*restore` at the action parameter for restoring libraries. Type the name of library; you can use the generic star. In the example, specify `LIBTEST*` to restore all libraries starting with LIBTEST. You will have to specify for use ADSM `*yes` and the created storage location `TSM_SERVER` as the volume location to inform BRMS that you want to restore the libraries which were saved to the Tivoli Storage Manager server:

Start Recovery using BRM (STRRCYBRM)

Type choices, press Enter.

Option > *LIB

Action *restore

Time period for recovery:

Start time and date:

Beginning time *AVAIL

Beginning date *BEGIN

End time and date:

Ending time *AVAIL

Ending date *END

Use save files *NO

Library TESTLIB*

Use ADSM *yes

Volume location TSM_SERVER

+ for more values

From system *LCL

*SYSTEM, *SAVSYS, *IBM...

*REPORT, *RESTORE

Time, *AVAIL

Date, *CURRENT, *BEGIN

Time, *AVAIL

Date, *CURRENT, *END

*NO, *YES

Name, generic*

*NO, *YES

*ALL, *HOME, TAPMLB01...

Bottom

F3=Exit F4=Prompt F5=Refresh F12=Cancel F13=How to use this display

F24=More keys

After completing your selection, press **Enter** to process the command. When the command completes, you get a completion message. Review the BRMSLOG to make sure your restore completed successfully.

In addition to recovering selected individual libraries, you can use the `STRRCYBRM` command to restore all of your user libraries. To restore all of the libraries, specify `*ALLUSR` at the option parameter and leave the library field blank.

10.1.2 Backup and recovery of individual object

In some situations, you may want to back up and restore individual objects. You can back up individual objects by creating an object list and using a control group.

10.1.2.1 Backup of individual objects

To back up individual objects, create a backup items list, and specify which objects you want to back up. To get the backup items list, press **F23** at the *EDIT Backup control group entries* screen, and you will get a screen as shown below.

```
Work with Backup Lists                                     ASM12

Position to . . . . . Starting characters

Type options, press Enter.
  1=Add  2=Change  3=Copy  4=Remove  5=Display  6=Print

Opt List Name  Use  Type Text
1  OBJLIST    *BKU *OBJ

(No list entries found)

F3=Exit  F5=Refresh  F12=Cancel
```

Fill the field list name with `OBJLIST`, the field use with `*BKU`, and the type with `*OBJ`, and press **Enter**. At the next screen, enter the list of objects with object type and object member you want to backup. The screen below shows an example to backup objects `OBJ1`, `OBJ2`, and `OBJ3` from the library `TESTLIB` of type `*all` and member `*all`.

```
Change Object List                                         ASM12

Use . . . . . : *BKU
List name . . . . . : OBJLIST
Text . . . . .

Type choices, press Enter.

Seq  Library  Object  Type  Member
10   TESTLIB  OBJ1    *ALL  *ALL
20   TESTLIB  OBJ2    *ALL  *ALL
30   TESTLIB  OBJ3    *ALL  *ALL

Bottom

F3=Exit  F4=Prompt  F5=Refresh  F12=Cancel
```

Now, when you press **Enter** twice in this screen, you will come back to the screen *Edit backup control group entries*. Here, you enter the sequence number and the list name as shown in the next screen. You can instruct BRMS to save object details by specifying `*yes` in the object details screen.

Edit Backup Control Group Entries						ASM12
Group : ADSM						
Default activity *BKUPCY						
Text *NONE						
Type information, press Enter.						
Seq	Backup Items	List Type	Weekly Activity SMIWTFS	Retain Object Detail	Save While Active	SWA Message Queue
10	TESTLIB1		FIIIIII	*YES	*NO	
20	TESTLIB2		FIIIIII	*YES	*NO	
30	TESTLIB3		FIIIIII	*YES	*NO	
40	OBJLIST	*OBJ	FIIIIII	*YES	*NO	
						Bottom
F3=Exit		F5=Refresh		F10=Change item		
F11=Display exits		F12=Cancel		F24=More keys		

Press **F3** to exit from this screen and select **save and exit session**. Now, you will get the screen *Work with Backup Control Groups*. At this screen, press **F3** to go to the command line.

To start the backup, type the command `STRBKUBRM CTLGRP (ADSM)`. When the backup is complete, you will get a completion message in the joblog. Check the BRMS log for successful completion of backup using the `DSPLOGBRM` command.

10.1.2.2 Recovery of individual objects

If you have saved objects with object details, you can restore individual object using the `WRKOBJBRM` command and selecting the object from the object list. But, if you have not instructed BRMS to retain object details, you have to specify the exact object name you want to restore with the `RSTOBJBRM` command. Each of these two situations are explained below.

Recovering objects with object details

Use the `WRKOBJBRM` command and specify from which library you want to restore an object as shown in the following screen:

```

Work with Saved Objects (WRKOBJBRM)

Type choices, press Enter.

Object . . . . . > *ALL      Name, *ALL
Library . . . . . > TESTLIB  Name, *ALL
Type . . . . . *ALL        Character value, *ALL
Select dates:
  From date . . . . . *BEGIN  Date, *CURRENT, *BEGIN, nnnnn
  To date . . . . . *END     Date, *CURRENT, *END, nnnnn
Save status . . . . . *ALL    *ALL, *NOERROR, *ERROR
Object information . . . . . *ALL  *ALL, *OBJ, *DLO, *MBR
Sequence option . . . . . *SAVDAT *SAVDAT, *OBJ, *LIB
From system . . . . . *LCL
Output . . . . . *          *, *PRINT

Bottom
F3=Exit  F4=Prompt  F5=Refresh  F12=Cancel  F13=How to use this display
F24=More keys

```

Press **Enter** and you get the *Work with Saved Objects* screen, where you can select which object you want to restore:

```

Work with Saved Objects                      ASM12

Position to Date . . . .

Type options, press Enter.
  4=Remove  5=Display  6=Work with media  7=Restore object
  9=Work with saved members

Opt Object      Library      Type      Save      Save      Volume      Message
          Date      Time
7 OBJ1      TESTLIB      *FILE      2/18/00    13:14:27    *ADSM
  OBJ2      TESTLIB      *FILE      2/18/00    13:15:11    *ADSM
  OBJ3      TESTLIB      *FILE      2/18/00    13:15:20    *ADSM

Bottom

F3=Exit  F12=Cancel

```

In this example, `OBJ1` is selected to restore by typing 7 in front of the object you want to restore and pressing **Enter**. The object, `OBJ1`, will be restored, and you will get a message saying file `OBJ1` in library `TESTLIB` restored. Check the log using the `DSPLGJBRM` command for successful completion of the recovery.

Recovering objects without object details

To recover an object for which you have not instructed BRMS to retain object details, you can use the `RSTOBJBRM` command and specify the exact name of the object you want to restore. For restoring object `OBJ1`, use the command `RSTOBJBRM` and the parameters shown in the following screen:

Restore Object using BRM (RSTOBJBRM)

Type choices, press Enter.

Object	OBJ1	Name, generic*, *ALL
+ for more values		
Library	TESTLIB	Name
Device	TSM_SERVER	Name, *MEDCLS
Object type	*ALL	*ALL, *ALRTBL, *BNDDIR...
+ for more values		
Save level	*CURRENT	1-99, *CURRENT
End of tape option	*REWIND	*REWIND, *LEAVE, *UNLOAD
Option	*ALL	*ALL, *NEW, *OLD, *FREE
Database member option	*MATCH	*MATCH, *ALL, *NEW, *OLD
Allow object differences	*NONE	*NONE, *ALL
Restore to library	*SAVLIB	Name, *SAVLIB
Auxiliary storage pool	*SAVASP	Name, *SAVASP, *SYSTEM, 1...
From system	*LCL	

Bottom

F3=Exit F4=Prompt F5=Refresh F12=Cancel F13=How to use this display
F24=More keys

After completing your selection, press **Enter** to process the command. When the command completes, you get a completion message; review the job log to make sure your restore completed successfully.

You can restore multiple objects from the restore object display by specifying all objects you want to restore at the object parameter by using a plus sign (+) for more values.

10.1.3 Backup and recovery of individual folders

You can back up and restore individual folders (or document library objects) using a control group by creating your own backup list to customize how to save these folders. The following sections show, in detail, how to back up and restore these folders.

10.1.3.1 Backup of individual folders

To create a list of folders you want to save, press **F23** at the Edit backup control groups entries screen, and you will get a screen as shown below.

Work with Backup Lists

ASM12

Position to Starting characters

Type options, press Enter.

1=Add 2=Change 3=Copy 4=Remove 5=Display 6=Print

Opt	List Name	Use	Type	Text
1	DLOLIST	*BKU	*DLO	
	OBJLIST	*BKU	*OBJ	

Bottom

F3=Exit F5=Refresh F12=Cancel

Enter at the option field 1 and, at the list name field of the example, enter DLOLIST. Add type *BKU for use and *DLO for type. Then press **Enter** at the screen and you will get the screen Add folder list. Add your folder list here with sequence numbers. In our example, we have added TESTFLR.

Add Folder List		ASM12
Use	: *BKU	
List name	DLOLIST	
Text		
Type choices, press Enter.		Sel
		*INC/
Seq Folder		*EXC
10 TESTFLR		*INC
(No entries found)		
F3=Exit	F5=Refresh	F12=Cancel

When you press **Enter** twice at this screen, you will get back to the *Edit Backup Control Groups Entries* screen. On this screen, you add sequence number and DLOLIST as shown below.

Edit Backup Control Group Entries							ASM12
Group	: ADSM						
Default activity	*BKUPCY						
Text	*NONE						
Type information, press Enter.							
Seq	Backup Items	List Type	Weekly Activity SMTWFS	Retain Object Detail	Save While Active	SWA Message Queue	
10	TESTLIB1		FIIIIII	*YES	*NO		
20	TESTLIB2		FIIIIII	*YES	*NO		
30	TESTLIB3		FIIIIII	*YES	*NO		
40	OBJLIST	*OBJ	FIIIIII	*YES	*NO		
50	DLOLIST	*FLR	FIIIIII	*YES	*NO		
F3=Exit F5=Refresh F10=Change item F11=Display exits F12=Cancel F24=More keys							Bottom

Press **F3** to exit from this screen and select **save and exit session**. Now, you will get the screen *Work with backup control groups*. At this screen, press **F3** to go to the command line.

To start the backup, type the command STRBKUBRM CTLGRP (ADSM) . When the backup is completed, you will get a completion message in the BRMS log. Check the BRMS log using the DSPLOGBRM command for successful completion of backup.

10.1.3.2 Recovery of folders

For recovery of a folder, use the `WRKFLRBRM` command if you have instructed BRMS to retain object details. When you type `WRKFLRBRM` and press **Enter**, you get the following screen.

```
Work with Saved Folders                                ASM12

Position to save date . .

Type options, press Enter.
  4=Remove  5=Display  6=Work with media  7=Restore folder
  9=Work with saved objects

Opt  Folder                                Save    Save    DLO    Not    Volume
     Date    Time    Saved    Saved
-----
QWIN32/INSTALL/PRIN...  2/15/00  19:05:03    0      0    ITSO01
QWIN32/INSTALL/PRIN...  2/15/00  19:05:03    0      0    ITSO01
QWIN32/MRI2924          2/15/00  19:05:03    0      0    ITSO01
QWIN32/SERVICE          2/15/00  19:05:03    0      0    ITSO01
QWIN32/SERVICE/IMAGE    2/15/00  19:05:03    0      0    ITSO01
TESTFLR                 2/18/00  16:09:07    4      0    *ADSM

Bottom

F3=Exit  F12=Cancel
```

Now, you can restore an individual folder by pressing **7** in front of the folder or select object to restore by pressing **9** in front of folder. After completing your selection, press **Enter** to process the command. After the command completes, review the BRMS job log to make sure your restore completed successfully.

10.1.4 Backup and recovery of spool files

The BRMS application client saves spool files to Tivoli Storage Manager servers by first copying the spool files to documents and then saving these documents to Tivoli Storage Manager. These two steps are transparent to the user; BRMS does it automatically. You can back up and recover spool files using the control group as shown in the following sections.

10.1.4.1 Backup of spool files

You can create a list of spool files, which you want to save to the Tivoli Storage Manager server using the BRMS application client. You can use this list in the backup control group to save the spool files.

To create a list of spool files, press **F23** at the *Edit control group* screen. You will get the *Work with backup lists* screen. Enter a list name and fill in use with `*BKU` and the type with `*spl` as shown in the following screen:

Work with Backup Lists					ASM12
Position to			Starting characters		
Type options, press Enter.					
1=Add 2=Change 3=Copy 4=Remove 5=Display 6=Print					
Opt	List Name	Use	Type	Text	
1	SPLFLIST	*BKU	*SPL		
	DLOLIST	*BKU	*FLR		
	OBJLIST	*BKU	*OBJ		
					Bottom
F3=Exit F5=Refresh F12=Cancel					

Press **Enter** and you get the *Add Spooled File List* screen. Here, you add the list of spool files you want to save. In our example, the list name is `SPLFLIST`, and we have selected all spool files in the output queue `PRT01` as shown below.

Add Spooled File List							ASM12
Use : *BKU							
List name SPLFLIST							
Text							
Type choices, press Enter.							
Seq	Library	Outq	File	Job	User	User data	*INC/
10	QUSRSYS	PRT01	*ALL	*ALL	*ALL	*all	*EXC
							*INC
F3=Exit F5=Refresh F12=Cancel							

Now, when you press **Enter** twice, you will get back to the *Edit Backup Control Group Entries* screen. On this screen, enter a sequence number and the spool file list name as shown in the next screen and press **Enter**.

You will notice that since Retain object details and Save while active are not valid for spool files, they will not appear on the screen.

Edit Backup Control Group Entries						ASM12
Group : ADSM						
Default activity *BKUPCY						
Text *NONE						
Type information, press Enter.						
	Backup	List	Weekly	Retain	Save	SWA
Seq	Items	Type	Activity	Object	While	Message
			SMIWTFS	Detail	Active	Queue
60	SPLFLIST	*SPL	FIIIIII			
10	TESTLIB1		FIIIIII	*YES	*NO	
20	TESTLIB2		FIIIIII	*YES	*NO	
30	TESTLIB3		FIIIIII	*YES	*NO	
40	OBJLIST	*OBJ	FIIIIII	*YES	*NO	
50	DLOLIST	*FLR	FIIIIII	*YES	*NO	
						Bottom
F3=Exit		F5=Refresh		F10=Change item		
F11=Display exits		F12=Cancel		F24=More keys		

Press **F3** to exit from this screen and select **save and exit session**. Now, you will get the screen *Work with Backup Control Groups*. At this screen, press **F3** to go to the command line.

To start backup, type the command `STRBKUBRM CTLGRP(ADSM)`. When the backup is complete, you will get a completion message in the BRMS log. Check the BRMS log using the `DSPLOGBRM` command for successful completion of the backup

10.1.4.2 Recovery of spool files

You can use the `WRKSPLBRM` command to restore spool files. Type `WRKSPLFBRM` at command line and press **Enter**. You will get the following screen.

Work with Saved Spooled Files						ASM12
Position to date						
Type options, press Enter. Press F16 to select all for recovery.						
4=Remove 5=Display 6=Work with media 7=Restore spooled file						
Opt	Library	Outq	File	Job	User	Date Time
	QUSRSYS	QEZJOBLOG	QRJOBLOG	QPADEV0004	WITTSM	2/18/00 17:05:54
	QUSRSYS	PRT01	QPLAEP	QPADEV0005	WITTSM	2/18/00 18:07:44
	QUSRSYS	PRT01	QPLAVER	QPADEV0005	WITTSM	2/18/00 18:08:53
	QUSRSYS	PRT01	QPLAEP	QPADEV0005	WITTSM	2/18/00 18:08:53
	QUSRSYS	PRT01	QPLAMM	QPADEV0005	WITTSM	2/18/00 18:09:11
	QUSRSYS	PRT01	QPLAHS	QPADEV0005	WITTSM	2/18/00 18:09:18
						More...
F3=Exit		F12=Cancel		F16=Select all for recovery		

On this screen, select which file you want to restore by pressing **7** in front of the file. If the file is saved to the Tivoli Storage Manager server, the BRMS application client will restore it automatically from the Tivoli Storage Manager server.

10.1.5 Backup and recovery of the integrated file system

The integrated file system integrates existing AS/400 library objects, folders, documents, and shared folders with a new object type, *STMF*, and directories into a single hierarchical file system. The integrated file system allows you to save files from

- Integrated PC servers
- OS/2 LAN server systems

In Chapter 11, “AS/400 Integrated Netfinity Server” on page 297, this is discussed in detail. In this section, we will see how to set up a control group to back up a link list with a simple example.

10.1.5.1 Backup of the integrated file system

The integrated file system information is saved using a control group. You can create your own backup list called link list to customize how you want to save the IFS directories. You can use this list when you perform the backup using the control group.

To create a list of links you want to save, press **F23** at the *Edit backup control groups entries* screen. You will get the screen *Work with Backup Lists*. At this screen, enter a list name (*LINKLIST*) and fill Use with **BKU* and Type with **LNK* as shown in the following screen:

Work with Backup Lists

ASM12

Position toStarting characters

Type options, press Enter.

1=Add 2=Change 3=Copy 4=Remove 5=Display 6=Print

Opt	List Name	Use	Type	Text
1	LINKLIST	*BKU	*LNK	
	DLOLIST	*BKU	*FLR	
	OBJLIST	*BKU	*OBJ	
	SPLFLIST	*BKU	*SPL	

Bottom

F3=Exit F5=Refresh F12=Cancel

When you press **Enter** at this screen, you will get the *Add folder list screen*. Add your link there with sequence number. In our example, we have added *TESTLINK*, as shown, with all the details using the following *Change Link List* screen.

```

Change Link List (CHGLNKLRM)

Type choices, press Enter.

List . . . . . > LINKLIST      Character value
Objects:
  Name . . . . . /TESTLINK

  Include or omit . . . . . *INCLUDE      *INCLUDE, *OMIT
    + for more values
  Directory subtree . . . . . *ALL        *ALL, *DIR, *NONE, *OBJ
  Text . . . . .

Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys

```

When you press **Enter** twice at this screen, you go back to screen *Edit Backup Control Group Entries*. Here, you add the sequence number and the name of the link list (LINKLIST) as shown in the following screen:

```

Edit Backup Control Group Entries      ASM12

Group . . . . . : ADSTM
Default activity . . . . . *BKUPCY
Text . . . . . *NONE

Type information, press Enter.

Seq      Backup      List      Weekly      Retain      Save      SWA
         Items       Type      Activity   Object      While      Message
         .           .           SMTWTFSS  Detail      Active      Queue

10      TESTLIB1           FIIIIII   *YES      *NO
20      TESTLIB2           FIIIIII   *YES      *NO
30      TESTLIB3           FIIIIII   *YES      *NO
40      OBJLIST      *OBJ   FIIIIII   *YES      *NO
50      DLOLIST      *FLR   FIIIIII   *YES      *NO
60      SPLFLIST      *SPL   FIIIIII
70      LINKLIST      *LNK   FIIIIII   *YES      *NO

Bottom
F3=Exit      F5=Refresh      F10=Change item
F11=Display exits      F12=Cancel      F24=More keys

```

Press **F3** to exit from this screen and select **Save and exit session**. Now, you will get the screen *Work with backup control groups*. At this screen, press **F3** to go to the command line.

To start backup, type the command `STRBKUBRM CTLGRP(ADSTM)`. When the backup is completed, you will get a completion message in the BRMS log. Check the BRMS log using the `DSPLOGBRM` command for successful completion of the backup.

10.1.5.2 Recovery of integrated file system

To recover links, type `STRRCYBRM`, specify `*linklist` at the Option parameter, and `*restore` at the Action parameter as shown in the following screen. You will have to specify `ADSTM *yes` and volume location `TSM_SERVER` to inform BRMS that you want to restore the data from the Tivoli Storage Manager server.

Start Recovery using BRM (STRRCYBRM)

Type choices, press Enter.

```
Option . . . . . > *LNKLIST      *SYSTEM, *SAVSYS, *IBM...
Action . . . . . *RESTORE      *REPORT, *RESTORE
Time period for recovery:
  Start time and date:
    Beginning time . . . . . *AVAIL      Time, *AVAIL
    Beginning date . . . . . *BEGIN      Date, *CURRENT, *BEGIN
  End time and date:
    Ending time . . . . . *AVAIL      Time, *AVAIL
    Ending date . . . . . *END      Date, *CURRENT, *END
Use save files . . . . . *NO      *NO, *YES
List . . . . . *ALL      Name, *ALL
Use ADSM . . . . . *YES      *NO, *YES
Volume location . . . . . TSM_SERVER  *ALL, *HOME, TAPMLB01...
      + for more values
From system . . . . . *LCL
```

Bottom

F3=Exit F4=Prompt F5=Refresh F12=Cancel F13=How to use this display
F24=More keys

After completing your selection, press **Enter** to process the command. When the command completes, you get a completion message. Review the joblog to make sure your restore completed successfully.

You can also use the `WRKLNKBRM` command to restore a link.

10.2 Archive and retrieval — space management by BRMS

The BRMS archive function is equivalent to space management in Tivoli Storage Manager terminology. During BRMS archive, a save command is issued to the AS/400 system that performs a `STORAGE(*FREE)` function. This leaves the object descriptor on the disk and removes the data part of an object, therefore, saving it to the BRMS storage media. This data can be dynamically restored when the object is needed and the user tries to access this object.

Data archival offers the benefit of migrating less frequently used data from disk to less expensive media like tape. Depending on the structure of your database and applications, good archival practices can save you considerable disk space.

The BRMS application client provides both archival and retrieval of OS/400 objects to the Tivoli Storage Manager server. In addition, policies can be changed to delete the complete archived object from the system. Currently, only dynamic retrieval for stream files is supported by the BRMS application client.

10.2.1 Setting up control group for archival

Archiving of data is done using an archive control group. To set up an archive control group, enter `GO BRMARCPIN` at the OS/400 command line and press **Enter**. You will get the *Archive Planning* screen, where you have to select option **2, Work with archive control groups**. Then, you will get the following *Work with Archive Control Groups* screen.

Work with Archive Control Groups				ASM12
Position to		Starting characters		
Type options, press Enter				
1=Create 2=Edit entries 3=Copy 4=Delete 5=Display				
6=Add to schedule 8=Change attributes 9=Subsystems to process ...				
Weekly				
Control	Inactivity	Media	Activity	
Opt Group	Limit	Policy	SMIWTFS	Text
8	*ARCGRP	0	ARCHIVAL	*ARCPCY Entry created by BRM configura
				Bottom
F3=Exit F5=Refresh F7=Work with BRM scheduled jobs				
F9=Change archive policy F23=More options F24=More keys				

We will use the *ARCGRP control group to set up an archive. To do this, position the cursor on the option (Opt) field next to the *ARCGRP control group, enter **8** (for **Change attributes**), and press the **Enter** key.

You will get the *Change Archive Control Group Attributes* screen, which lists all of the characteristics that have been defined for this control group:

Change Archive Control Group Attributes			
Group : *ARCGRP			
Type information, press Enter.			
Media policy		ADSM	Name, F4 for list
Archive devices		TSM_SERVER	Name, F4 for list
Include:			
ASP low storage threshold		*ARCPCY	*ASP, 0-99%, *ARCPCY
Date type for archival		*ARCPCY	*BOTH, *CHANGE, *USE...
Inactivity limit		60	0-9999 days, *ARCPCY
Object size greater than		10000	0-999999 MB, *ARCPCY
Objects able to be freed		*YES	*YES, *NO, *ARCPCY
Retain object description		*YES	*YES, *NO, *ARCPCY
Objects not able to be freed		*NO	*YES, *NO, *ARCPCY
			More...
F3=Exit F4=Prompt F12=Cancel			

Media policy `ADSM` and archive device `TSM_SERVER` is selected since we want to archive the data to Tivoli Storage Manager server. Refer to Chapter 5, “Setting up a BRMS API client on an AS/400 system” on page 111 for information on how to create a media policy and device. The `Inactivity limit` field specifies the number of days of inactivity before an object becomes a candidate for archive.

The `Inactivity limit` for archive uses the most recent date, either change or use date, to determine candidates for archive. In our example, only objects that are

inactive for 60 days and whose object size is greater than 10000 can only get archived.

The *Objects able to be freed* field specifies whether you can include in the archive operation objects whose storage can be freed. Object types *FILE, *PGM, *JRNRV, *SQLPKG, *DLO, and stream files have descriptions that you can keep after an archive operation has freed the storage taken by the object. You cannot keep descriptions for other types of archived objects.

Note

The Retain object description value must be *YES, for auto-recall of archived objects to work.

Press **Enter** after changing the required parameter as shown and you will get back to the screen *Work with Archive Control Group*. Now, enter **2** at the left of the control group to edit control group entries. You will get the following screen:

```

                                Edit Archive Control Group Entries                                ASM12

Group . . . . . : *ARCGRP
Default activity . . . . . *ARPCPY
Text . . . . . Entry created by BRM configuration

Type information, press Enter.

      Archive      List      Weekly
Seq    Items      Type     SMIWIFS

      (No control group entries found)

F3=Exit          F5=Refresh          F10=Change item
F11=Display exits F12=Cancel          F24=More keys

```

Press **F23** at this screen and you will get the *Work with Archive Lists* screen. Add your list name. In the example, the list name is ARCLIST. Fill use with *ARC, and type with *OBJ as shown in the following:

```

                                Work with Archive Lists                                ASM12

Position to . . . . . Starting characters

Type options, press Enter.
  1=Add  2=Change  3=Copy  4=Remove  5=Display  6=Print

Opt List Name  Use  Type  Text
  1  ARCLIST   *ARC *OBJ

Bottom

F3=Exit  F5=Refresh  F12=Cancel

```

Now, add the objects you want to archive in this list as shown in the following screen:

Change Object List				ASM12
Use : *ARC				
List name : ARCLIST				
Text				
Type choices, press Enter.				
Seq	Library	Object	Type	Selection *INC/*EXC
10	TESTLIB	OBJARC1	*ALL	*INC
20	TESTLIB	OBJARC2	*ALL	*INC
				Bottom
F3=Exit F4=Prompt F5=Refresh F12=Cancel				

Press **Enter** twice in this screen. You will now go back to the screen *Edit Control Group Entries* screen. Here, type the sequence number and list name. In the example, it is ARCLIST to be archived on Sunday as shown in the following screen:

Edit Archive Control Group Entries				ASM12
Group : *ARCGRP				
Default activity : *ARCPY				
Text : Entry created by BRM configuration				
Type information, press Enter.				
	Archive	List	Weekly	
Seq	Items	Type	SMIWTFS	
10	ARCLIST	*OBJ	*	
				Bottom
F3=Exit		F5=Refresh		F10=Change item
F11=Display exits		F12=Cancel		F24=More keys

Press **F12** at this screen and select **Save and exit session** and press **Enter**. Now, you have completed setting up the control group and are ready to do archive.

To perform archive of the archive control group, use the OS/400 command:

```
STRARCBRM CTLGRP(*ARCGRP)
```

Check the job log to confirm successful completion of the Archive operation. We have explained one simple example of how to set up archive control group and perform archive; you can add your own lists and control group as per your own requirement.

10.2.2 Object retrieve

Currently, only objects of type *STMF are supported for dynamic retrieve by the BRMS application client. This means if you archive an object of type *STMF, this data can be dynamically restored when the object is needed and the user tries to access this object. This retrieval is transparent to the user. Other object types

that have been archived can be retrieved at any time by using option 7 (restore) from the *Work with Media Information* (WRKMEDIBRM) display.

The object retrieve is governed by the retrieve policy. To change the retrieval policy, type `GO BRMPCY` at the OS/400 command line and select option **5** retrieve policy. You will get a screen as shown below. Change your policy as per your requirements for retrieval.

Change Retrieve Policy		ASM12
Type choices, press Enter.		
Retrieve device	TSM_SERVER	Name, F4 for list
Retrieve confirmation:		
Interactive operation	*VERIFY	*VERIFY, *NOTIFY, *DELAY..
Batch operation	*NOTIFY	*NOTIFY, *DELAY, *VERIFY..
Retrieve authorization	*OBJEXIST	*OBJEXIST, *READ, *UPD...
End of tape option	*REWIND	*REWIND, *LEAVE, *UNLOAD
Option	*ALL	*ALL, *NEW, *OLD, *FREE
Allow object differences	*NONE	*NONE, *ALL
ASP high storage threshold	95	*ASP, *SYS, 1-95
Retrieved object retention	5	0-9999, *ARC, *NOMAX
Extend retention on usage	5	0-9999
F3=Exit F4=Prompt F5=Refresh F9=System policy		
F12=Cancel		

10.3 AS/400 backup and recovery as a BRMS client

The BRMS application client cannot perform save or restore operations while in restricted state because the AS/400 subsystems managing the communication with the Tivoli Storage Manager servers are no longer running in this state. Therefore, you must save all your system data using BRMS.

The AS/400 architecture and BRMS only allow you to save the system data to local media so that you are protected should you need to recover the system. In case of complete system recovery, this means either re-install all the system software and fixes, or re-boot the system using the media containing the latest system save.

Re-booting the system using the latest save is the fastest way to recover the system. If the system saves were managed by BRMS, the recovery of the system is even easier because BRMS guides you step-by-step. Only after the operating system is restored, can communication with a Tivoli Storage Manager server be established for restoration of the user data stored at Tivoli Storage Manager. BRMS automatically restores the most current data stored at Tivoli Storage Manager servers. In this section, we will consider an example to explain this further.

If your Tivoli Storage Manager server to which you have backed up your user data happens to be on the same AS/400 system as your client, you must recover Tivoli Storage Manager/400 server first before recovering your client. How to

recover Tivoli Storage Manager/400 server is explained in 10.4, “AS/400 Backup and recovery as a Tivoli Storage Manager server” on page 289. However, this scenario is not recommended because it slows down the whole recovery of the system.

10.3.1 Protecting your AS/400 system

When you are using the BRMS application client, you will typically need a minimum of three control groups to protect your entire system. The first control group is for backing up the SAVSYS and *IBM libraries to local media; the second control group is for backing up data, which will be used by BRMS while recovering the entire system; and the third control group is for backing up *ALLUSR, *ALLDLO, *LINK and spool files to the Tivoli Storage Manager server. You may have additional control groups if you want to save individual objects.

The following screen shows an example of the first control group to backup *SAVSYS and *IBM libraries.

Edit Backup Control Group Entries
ASM12

Group : SYSTEM

Default activity *BKUPCY

Text *NONE

Type information, press Enter.

Seq	Backup Items	List Type	Weekly Activity SMIWTFSS	Retain Object Detail	Save While Active	SWA Message Queue
10	*SAVSYS		*DFTACT			
20	*IBM		*DFTACT	*ERR	*NO	
30	*EXIT		*DFTACT			

F3=Exit

F11=Display exits

F5=Refresh

F12=Cancel

F10=Change item

F24=More keys

Bottom

To perform the SAVSYS, the system is required to be in the restricted state. Typically, this backup is done on a weekend. But, if you do major changes regarding system configuration or security, you are required to do this backup again. In such a case, you may want to do only a SAVSECDTA or SAVCFG by using separate control groups.

The following screen is an example of the second control group that is used to backup BRMS related information, which is required during recovery of an entire system. Since BRMS application client cannot back up libraries starting with Q, you can add all your libraries to this control group or have a separate control group.

Edit Backup Control Group Entries						ASM12
Group : GROUP2						
Default activity *BKUPCY						
Text *NONE						
Type information, press Enter.						
Seq	Backup Items	List Type	Weekly Activity SMIWTFS	Retain Object Detail	Save While Active	SWA Message Queue
10	QUSRBRM		FIIIIII	*ERR	*NO	
20	QBRM		FIIIIII	*ERR	*NO	
30	QMSE		FIIIIII	*ERR	*NO	
40	QGPL		FIIIIII	*ERR	*NO	
50	QUSRSYS		FIIIIII	*ERR	*NO	
60	QSYS2		FIIIIII	*ERR	*NO	
70	Q1ABRMSF01		FIIIIII	*ERR	*NO	
						Bottom
F3=Exit		F5=Refresh		F10=Change item		
F11=Display exits		F12=Cancel		F24=More keys		

As an example of a control group to backup user data to Tivoli Storage Manager server, the next screen shows the control group entities of USERDATA.

Edit Backup Control Group Entries						ASM12
Group : USERDATA						
Default activity *BKUPCY						
Text *NONE						
Type information, press Enter.						
Seq	Backup Items	List Type	Weekly Activity SMIWTFS	Retain Object Detail	Save While Active	SWA Message Queue
10	*ALLUSR		FIIIIII	*YES	*NO	
20	*ALLDLO		FIIIIII	*YES	*NO	
30	*LINK		FIIIIII	*YES	*NO	
40	SPLFLIST	*SPL	FIIIIII			
50	*EXIT		FIIIIII			
						Bottom
F3=Exit		F5=Refresh		F10=Change item		
F11=Display exits		F12=Cancel		F24=More keys		

After creating this control group, change its attributes as explained in Chapter 5, “Setting up a BRMS API client on an AS/400 system” on page 111 so that data will be sent to the Tivoli Storage Manager server. You may also create an additional control group to back up or archive individual objects, libraries, folders, links, and spool files as explained in 10.1, “Backup and recovery of user data” on page 261 and 10.2, “Archive and retrieval — space management by BRMS” on page 274.

After completing the backups using the described control groups, you should print recovery reports by using the `STRRCYBRM` command and using the parameter as

shown in the following screen. For the parameter *Use ADSM* enter *YES. This is required to print details about data recovery from the Tivoli Storage Manager server. The default for this parameter is *NO.

Start Recovery using BRM (STRRCYBRM)

Type choices, press Enter.

Option	*SYSTEM	*SYSTEM, *SAVSYS, *IBM...
Action	*REPORT	*REPORT, *RESTORE
Time period for recovery:		
Start time and date:		
Beginning time	*AVAIL	Time, *AVAIL
Beginning date	*BEGIN	Date, *CURRENT, *BEGIN
End time and date:		
Ending time	*AVAIL	Time, *AVAIL
Ending date	*END	Date, *CURRENT, *END
Use save files	*NO	*NO, *YES
Use ADSM	*YES	*NO, *YES
Volume location	*ALL	*ALL, *HOME, TAPMLB01...
+ for more values		
Library to omit	*DELETE	*DELETE, *NONE
From system	*LCL	

Bottom

F3=Exit F4=Prompt F5=Refresh F12=Cancel F13=How to use this display

F24=More keys

Move backup tapes and recovery printouts to off-site for protection against site disaster.

For more details about Backup and recovery using BRMS/400, refer to *Backup, Recovery, and Media Services for AS/400*, SC41-5345.

10.3.2 Recovering an AS/400 BRMS client system from disaster

Recovering the entire system is required if you need a scratch installation because of a disaster recovery or if the load source disk unit in the system ASP is damaged and needs to be replaced. All you need are tapes containing the system data which was sent off-site, the recovery report created by BRMS, and your user data backed up to the Tivoli Storage Manager server. We outline the steps to recover from this disaster.

Note

You should not base an actual recovery on the steps that are outlined in this chapter. You must always use the BRMS/400 Recovering your entire system report that is generated by your own system along with the book *OS/400 Backup and Recovery*, SC41-5304, to guide you through the correct recovery steps based on your OS/400 release.

The following are the steps for recovering an entire system. Before you start, bring all tapes and BRMS recovery reports on-site. For assistance during recovery, you must use the recovery reports that are generated by your own system. While explaining each step, a snapshot of the recovery report is shown on the screen.

Step 1: Recover the licensed internal code

STEP 1: Recover Licensed Internal Code

Use media as shown below and the procedure for "Recovering the Licensed Internal Code" using option 2 if you are recovering to a different system or using option 3 if you are recovering to the same system as detailed in the Backup and Recovery book.

Saved Item	Type	ASP	Save Date	Save Time	Objects	Omit	File Sequence	Control Group	Volume(s)
*SAVSYS	*FULL	01	2/17/00	16:07:24		0	1	SAVE21	TEST

Licensed internal code is the layer of AS/400 architecture just above the hardware. To load the licensed internal code, use the latest *SAVSYS tape to IPL from an alternate IPL device. Take the following steps:

1. Load the *SAVSYS tape in the alternate IPL device. If you are using media library as an alternate IPL device, make sure that it is in sequential or automatic mode. It should not be in random mode.
2. Put the system in D-Manual mode. To do that, take the following steps at the front operations panel of the AS/400 system:
 1. Select function **2 (Select IPL)** from the front operations panel of the AS/400 system.
 2. Press the **Enter** button.
 3. Press the **Up arrow key** until D M is shown in the panel window.
3. Start the IPL.

Step 2: Recover the operating system

STEP 2: Recover operating system

Use the media shown below and the procedure for "Restoring the Operating System using the Complete Restore Method", as detailed in the Backup and Recovery book.

Saved Item	Type	ASP	Save Date	Save Time	Objects	Omit	File Sequence	Control Group	Volume(s)
*SAVSYS	*FULL	01	2/17/00	16:07:24		0	1	SAVE21	TEST

After installing the licensed internal code, select **Install operating system** on the AS/400 installation menu. The disk units may be in non-configured status for different reasons, so they have to be configured. Refer to the book *OS/400 Backup and Recovery*, SC41-5304 if you plan to configure disk protection or user ASPs.

The first sign-on to the system uses no password. Shortly after that, you are asked to change the password for QSECOFR.

Step 3: Recover BRMS product and associated libraries

STEP 3: Recover the BRMS/400 product and associated libraries
The BRMS/400 product and associated libraries must be recovered before you can use the product to perform other recovery operations. To prevent messages that are not related to the recovery from interrupting

5769BR1 V4R3M0 980729 Recovering Your Entire System NINJA
run: CHGMSGQ MSGQ(QSYSOPR) DLVRY(*NOTIFY) SEV(99)
Use WRKCFGSTS *DEV *TAP to see which tape devices are configured.
Then run RSTLIB for each of the following libraries specifying SEQNBR and using media shown below.

Saved Item	Type	ASP	Save Date	Save Time	Objects	Omit	File Sequence	Control Group	Volume(s)
QBRM	*FULL	01	2/17/00	17:10:46	1,037		41	SAVE21	TEST
QMSE	*FULL	01	2/17/00	17:10:46	10		53	SAVE21	TEST
Q1ABRMSF01	*FULL	01	2/17/00	17:10:46	1		70	SAVE21	TEST
QUSRBRM	*FULL	01	2/17/00	17:36:05	193		73	SAVE21	TEST

When the installation of the Licensed Internal Code and operating system has completed, the BRMS/400 product and associated libraries must be recovered before you can use the product to perform other recovery operations. To restore saved items, issue the following command at the OS/400 command line for each of the items listed in the previous screen:

```
====> RSTLIB SAVLIB(QBRM) DEV(TAP01) SEQNBR(41) ENDOPT(*LEAVE)
```

Step 4: Recover BRMS/400 related media information

STEP 4: Recover BRMS/400 related media information
You must recover this information for the BRMS/400 product to accurately guide you through remaining recovery steps. To do so, run RSTOBJ OBJ(*ALL) MBROPT(*ALL) for each of the following libraries, specifying SEQNBR and using media shown below.

Saved Item	Type	ASP	Save Date	Save Time	Objects	Omit	File Sequence	Control Group	Volume(s)
QUSRBRM	*QBRM	01	2/17/00	14:58:09	11		13	YASHWANT1	TEST3

Use the sequence number for the following restore so that you are sure to restore the right objects in case there is more than one item of QUSRBRM on that tape. Using the sequence number also improves performance if you are using an IBM 3590 tape device. To restore objects, issue the following command at the OS/400 command line for each of the items listed in the previous screen.

```
====> RSTOBJ OBJ(QUSRBRM) SAVLIB(QUSRBRM) DEV(TAP01) SEQNBR(13) ENDOPT(*LEAVE)
```

Step 5: Recover user profiles

STEP 5: Recover user profiles

Before recovering user profiles, use the INZBRM *DEVICE command to clear the BRMS/400 device and media library information and initialize the files with the tape devices currently configured on the system. INZBRM *DEVICE resets some device information to the BRMS supplied defaults. Update the BRMS device information with any necessary changes using the WRKDEVBRM command. If you have a media library device, you will also need to use the WRKMLBBRM command.

You should restore a current version of your system's user profiles. To do so, run STRRCYBRM OPTION(*SYSTEM) ACTION(*RESTORE) OMITLIB(*DELETE) using media shown below.

Press F9 (Recovery defaults) on the Select Recovery Items display. Ensure the tape device name that you are using is correct. If recovering to a different system you must specify *ALL on the Allow object differences (ALWOBJDIF) parameter and *NONE on the System resource management (SRM) parameter.

Saved Item	Type	ASP	Save Date	Save Time	Objects	Omit	File Sequence	Control Group	Volume(s)
*SAVSECDTA	*FULL	01	2/17/00	16:07:24	42		34	SAVE21	TEST

Before recovering user profiles, use the INZBRM OPTION(*DEVICE) command to clear the BRMS/400 device and media library information, and initialize the files with the tape devices currently configured on the system. Verify your BRMS/400 device and media library information for the correct settings (for example, next volume message, densities, device location, shared devices, and so on). Some of the values are reset to the defaults when you use the INZBRM OPTION(*DEVICE) command.

To recover user profiles, run the following command as shown in the screen above and then select *SAVSECDTA to restore:

```
====> STRRCYBRM OPTION(*SYSTEM) ACTION(*RESTORE) OMITLIB(*DELETE)
```

You must restore specific system libraries before you can use BRMS/400 to perform other recovery operations and tape automation. These libraries are QGPL, QUSRSYS, and QSYS2. QUSRSYS contains the tape exit registration information and QSYS2 contains the LAN code for a 3494 media library.

Step 6: Recover BRMS/400 related required system libraries

STEP 6: Recover BRMS/400 required system libraries

You must restore specific system libraries before you can use BRMS/400 to perform other recovery steps. Select the following libraries on the "Select Recovery Items" display. If the "Select Recovery Items" display is not shown and you are performing a complete system restore, run STRRCYBRM OPTION(*RESUME) to continue. Otherwise, run STRRCYBRM OPTION(*SYSTEM) ACTION(*RESTORE) OMITLIB(*DELETE) using media shown below.

						Recovering Your Entire System				NINJA
Saved Item	Type	ASP	Save Date	Save Time	Objects	Omit	File Sequence	Control Group	Volume(s)	
5769BR1 V4R3M0 980729										
QGPL	*FULL	01	2/17/00	17:35:14	126		71	SAVE21	TEST	
QUSRSYS	*FULL	01	2/17/00	17:35:20	1,204		72	SAVE21	TEST	
QSYS2	*FULL	01	2/17/00	17:10:46	113		64	SAVE21	TEST	

The library QGPL must be restored prior to library QUSRSYS because there are dependencies in QGPL that QUSRSYS needs.

To recover BRMS-related required system libraries, type the following command as shown previously, and then select the items as listed.

```
====> STRRCYBRM OPTION(*SYSTEM) ACTION(*RESTORE) OMITLIB(*DELETE)
```

Step 7: Recover configuration data

STEP 7: Recover configuration data

You should restore a current version of your system configuration.

Select the *SAVCFG items on the "Select Recovery Items" display. If the "Select Recovery Items" display is not shown and you are performing a complete system restore, run STRRCYBRM OPTION(*RESUME) to continue. Otherwise, run STRRCYBRM OPTION(*SYSTEM) ACTION(*RESTORE) OMITLIB(*DELETE) using media shown below.

After restoring configuration data, use the INZBRM *DEVICE command to clear the BRMS/400 device and media library information and initialize the files with the tape devices currently configured on the system. INZBRM *DEVICE resets some device information to BRMS supplied defaults. Update the BRMS device information with any necessary changes using the WRKDEVBRM command. If you have a media library device, you will also need to use the WRKMLBBRM command.

Press F9 (Recovery defaults) on the Select Recovery Items display.

Ensure the tape device name that you are using is correct. If recovering to a different system you must specify *ALL on the Allow object differences (ALWOBJDIF) parameter and *NONE on the System resource management (SRM) parameter.

Saved Item	Type	ASP	Save Date	Save Time	Objects	Omit	File Sequence	Control Group	Volume(s)
*SAVCFG	*FULL	01	2/17/00	16:07:24	58		35	SAVE21	TEST

You are now ready to restore your configuration data. To restore configuration data, select the *SAVCFG item on the select recovery item display as shown in the screen above. When restoring the configuration data, you should use **F9** to see the restore command defaults from the Select Recovery Items display. If you are restoring configuration data on the same system that you saved from, you should leave the System resource management (SRM) parameter to *ALL. However, if you are restoring on a different system, you should change the parameter to *NONE.

Use the INZBRM OPTION(*DEVICE) command again to clear the BRMS/400 device and media library information and initialize the files with the tape devices currently configured on the system. Verify your BRMS/400 device and media library information for the correct settings (for example, next volume message, densities, device location, shared devices, and so on). Some of the information is reset to the default values by the INZBRM OPTION(*DEVICE) command after restoring the configuration.

Step 8: Recover IBM product libraries

STEP 8: Recover IBM product libraries

You should restore the current version of IBM libraries on your system. If you are performing a complete system restore, run STIRCYBRM OPTION(*RESUME) to continue. You may now select to recover all of the data on your system and continue with Step 12, or select to recover just the IBM libraries and continue with Step 9.

Otherwise, run STIRCYBRM OPTION(*IBM) ACTION(*RESTORE) OMITLIB(*DELETE) using media shown below.

Press F9 (Recovery defaults) on the Select Recovery Items display.

Ensure the tape device name that you are using is correct.

Saved Item	Type	ASP	Save Date	Save Time	Objects	Omit	File Sequence	Control Group	Volume(s)
QANSAPI	*FULL	01	2/17/00	17:10:46	12		40	SAVE21	TEST
QCA400W	*FULL	01	2/17/00	17:10:46	8		42	SAVE21	TEST
QCODE	*FULL	01	2/17/00	17:10:46	105		43	SAVE21	TEST
QGPLTEMP	*FULL	01	2/17/00	17:10:46	1		44	SAVE21	TEST
QGY	*FULL	01	2/17/00	17:10:46	109		45	SAVE21	TEST
QHLPSYS	*FULL	01	2/17/00	17:10:46	305		46	SAVE21	TEST
QIJS	*FULL	01	2/17/00	17:10:46	467		47	SAVE21	TEST
QINMEDIA	*FULL	01	2/17/00	17:10:46	25		48	SAVE21	TEST

In the preceding step, we have shown you only a few libraries to restore to give you an idea. In reality, the list is longer than shown in the preceding report. Your BRMS/400 System Recovery Report lists all of the IBM libraries that are required to be restored.

Before the recovery, the following display is shown where you can select which libraries to recover, or you can press **F16** on the Select Recovery Items display to select all of the libraries.

ASM12

Select Recovery Items

Type options, press Enter. Press F16 to select all.
 1=Select 4=Remove 5=Display 7=Specify object

Opt	Saved Item	Date	Time	Save Type	Volume Serial	File Seq	Exp Date	Objects Saved
	QANSAPI	2/17/00	14:19:55	*FULL	000BC8	40	12/29/03	12
	QCA400W	2/17/00	14:19:55	*FULL	000BC8	42	12/29/03	8
	QCODE	2/17/00	14:19:55	*FULL	000BC8	44	12/29/03	105
	QGPLTEMP	2/17/00	14:19:55	*FULL	000BC8	47	12/29/03	1
	QGY	2/17/00	14:19:55	*FULL	000BC8	48	12/29/03	109
	QHLPSYS	2/17/00	14:19:55	*FULL	000BC8	49	12/29/03	305

More...

F3=Exit F5=Refresh F9=Recovery defaults F12=Cancel
 F14=Submit to batch F16=Select all

You can use the **F9** function key to change the recovery defaults as shown in the next screen. You can set the recovery defaults to specify the following:

- The tape drive you are using on the device parameter
- *ALL for the allow object difference parameter if recovering on a different system

```

                                Select Recovery Items                                ASM12
Type options, press Enter.  Press F16 to select all.
  1=Select    4=Remove    5=Display    7=Specify object
.....
:
:
:                                Restore Command Defaults                                :
:
: Type information, press Enter.
: Device . . . . . *MEDCLS                                Name, *MEDCLS
: End of tape option . . . . . *REWIND                    *REWIND, *LEAVE, *UNLOAD
: Option . . . . . *ALL                                    *ALL, *NEW, *OLD, *FREE
: Data base member option . . . . . *ALL                  *MATCH, *ALL, *NEW, *OLD
: Allow object differences . . . . . *NONE                *NONE, *ALL, *AUTL...
:
: Document name generation . . . . . *SAME                *SAME, *NEW
: Restore to library . . . . . *SAVLIB                    Name, *SAVLIB
: Auxiliary storage pool . . . . . *SAVASP                Name, *SAVASP, 1-16...
: System resource management . . . . . *ALL                *ALL, *NONE, *HDW, *TRA
:
: F12=Cancel
:
:
:
:.....

```

ASM12

Select Recovery Items

Type options, press Enter. Press F16 to select all.
 1=Select 4=Remove 5=Display 7=Specify object

Opt	Saved Item	Date	Time	Save Type	Volume Serial	File Seq	Exp Date	Objects Saved
	TEST3	2/17/00	14:28:44	*FULL	000BC8	89	12/29/03	1
	TEST4	2/17/00	14:28:44	*FULL	000BC8	90	12/29/03	1
	TEST5	2/17/00	14:28:44	*FULL	000BC8	91	12/29/03	1
	TEST6	2/17/00	14:28:44	*FULL	000BC8	92	12/29/03	1
	USRADSM2	2/17/00	14:28:44	*FULL	000BC8	93	12/29/03	6
	WITTSM	2/17/00	14:28:44	*FULL	000BC8	95	12/29/03	8
	WITTSMARC	2/17/00	14:28:44	*FULL	000BC8	96	12/29/03	4
	YASHWANT	2/17/00	14:28:44	*FULL	000BC8	97	12/29/03	5
	TESTLIB	2/17/00	10:34:49	*FULL	*ADSM		3/22/00	18
	TESTLIB	2/17/00	10:39:39	*INCR	*ADSM		3/22/00	1
	A1	2/17/00	13:25:47	*FULL	*ADSM		3/22/00	5
	A1	2/18/00	13:57:28	*INCR	*ADSM		3/23/00	2

Bottom

F3=Exit F5=Refresh F9=Recovery defaults F12=Cancel
 F14=Submit to batch F16=Select all

If you are restoring to a different system, press **F9** at the above screen and make sure that you change the recovery default for the parameter *Allow object difference* from *none to *all. Depending on your recovery strategy, you may choose to use the following command to restore individual control groups:

```
====> STRRCYBRM OPTION(*CTLGRP) ACTION(*RESTORE) OMITLIB(*DELETE) USEADSM(*YES)
```

If you want to recover objects saved using savefiles, you also need to specify USESAVF(*YES). If you have logical files whose based-on file is in a different library, you must restore all based-on files before you can restore the logical file. If you are journaling, the libraries containing the journals must be restored before restoring the journaled files.

The following is an example screen for recovery of library TESTLIB and A1. You get the following details in the *Recovering your entire system* report of BRMS. You should restore the current version of your libraries and objects.

Saved Item	Type	ASP	Save Date	Save Time	Objects	Omit	File Sequence	Control Group	Volume
TESTLIB	*FULL	01	7/17/00	10:34:49	18		0	ADSM	*ADSM
TESTLIB	*INCR	01	7/17/00	10:39:39	1		0	ADSM	*ADSM
A1	*FULL	01	7/17/00	13:25:47	5		0	*NONE	*ADSM
A1	*INCR	01	7/18/00	13:57:28	2		0	YASH	*ADSM

Step 11: Recover document library objects saved using Tivoli Storage Manager

You should restore the current version of your documents, folders, and mail. Run this command using the media shown in the recovery report:

```
STRRCYBRM OPTION(*ALLDLO) ACTION(*RESTORE) USEADSM(*YES)
```

If you want to recover objects saved using savefiles, you also need to specify `USESAVF(*YES)`. Before you begin, use the *Backup and Recovery - Basic* book to determine whether Document Library Objects need be reclaimed. To do this, run `RCLDLO DLO(*ALL)`.

Step 12: Recover objects in directories saved using Tivoli Storage Manager

You should restore the current version of your objects in directories. Run this command using media shown in recovery report:

```
STRRCYBRM OPTION(*LNKLIST) ACTION(*RESTORE) USEADSM(*YES)
```

Note: If you want to recover objects saved using savefiles you also need to specify `USESAVF(*YES)`.

Step 13: Recover spool files

Recover Spool files using `WRKSPLFBRM` command. If the spool file is saved to Tivoli Storage Manager server, it will recover from Tivoli Storage Manager server automatically when you select the file to recover.

Step 14: Apply journaled changes

To determine whether you need to apply journaled changes, refer to the topic "Task 2 - Determining Whether You Need to Apply Journaled Changes" under the chapter "How to Restore Changed Objects and Apply Journaled Changes" as detailed in the book *OS/400 Backup and Recovery*, SC41-5304.

Step 15: Recover authorization information

You should recover private authorizations if user profiles were recovered in an earlier step. To do this, end all subsystems using `ENDSBS SBS(*ALL) OPTION(*IMMED)` and then run `RSTAUT USRPRF(*ALL)`. This operation requires a dedicated system and can be long running.

Step 16: Print joblog

After the recovery has completed, that is, when you complete step 15, you should check the job log to ensure that all objects were restored and that all authorities were correctly recovered. The job log contains information about the restore operation. Print the job log and any other remaining spooled output. To print the job log, use the `SIGNOFF *LIST` command, or the `DSPJOBLOG * *PRINT` command.

10.4 AS/400 Backup and recovery as a Tivoli Storage Manager server

It is important to protect the entire AS/400 system on which your Tivoli Storage Manager/400 server is running. You can protect your AS/400 system using either BRMS/400 or OS/400's native save commands depending on whether or not BRMS/400 is running on the Tivoli Storage Manager server system.

The recovery of the Tivoli Storage Manager server starts from the point when you complete your AS/400 system recovery. Alternately, if you already have another backup AS/400 system running as a standby, you can start the recovery of Tivoli Storage Manager server immediately. You can start your Tivoli Storage Manager/400 server recovery as soon as you meet the following conditions:

- You have an AS/400 system, which meets the hardware and software requirements to install the Tivoli Storage Manager Server.
- You have tape drives attached to this AS/400 system that can be configured to read your off-site volumes and DB backup.
- All recovery material available on-site was secured at an off-site location.

In the following section, we will give a short overview of both methods for recovering the AS/400 system, then review the necessary preparations for the Tivoli Storage Manager server recovery, and outline recovery procedures. To find more information about automated recovery using the Tivoli Storage Manager DRM feature, refer to 9.7, “Tivoli Disaster Recovery Manager setup” on page 237 and to Appendix B., “Tivoli Disaster Recovery Manager scenario and checklist” on page 357.

10.4.1 Recovery of the AS/400 Tivoli Storage Manager server system

As already outlined, there are two methods to recover the AS/400 system where the Tivoli Storage Manager server is running on. These are

- Recovery using BRMS/400
- Recovery using the native OS/400 save and restore command

If you are using BRMS/400 on the system where Tivoli Storage Manager server software is running, the BRMS/400 recovery report guides you through the recovery of the AS/400 system environment. Refer to 10.3.2, “Recovering an AS/400 BRMS client system from disaster” on page 281 where the recovery using BRMS is explained in detail.

If you have saved user data to Tivoli Storage Manager server on the same AS/400 system, recover the Tivoli Storage Manager server first and then restore the user data. But, if you are saving user data using BRMS, the BRMS recovery report will guide you through all the steps needed to recover this data as well. When you complete the system recovery, you can start the Tivoli Storage Manager server recovery as explained in 10.4.3, “Recovering to a point-in-time” on page 292.

If you do not have BRMS/400 running on your Tivoli Storage Manager server system, you can use OS/400 commands to back up and recover your entire system. The following is a simple example of how to back up and recover an AS/400 system. For more details about commands and more complex save strategies, refer to *OS/400 Backup and Recovery*, SC41-5304.

The simple save strategy is as follows:

- Save the entire system using the command `GO SAVE` and selecting option **21**. This save is usually done on a weekend, since it requires a dedicated system, which means that no users can use the system during the save operation.
- Save changed objects using the `SAVCHGOBJ` command every night.

To recover from an AS/400 disaster, perform the following steps:

1. Put the first tape of the set, which was created during the entire system save option 21, in the alternate IPL device, and restore the Licensed Internal Code (LIC) from this tape.
2. After installing the LIC, select option **2** to install the operating system.
3. Then, restore the entire system using the `GO RESRTORE` command and select option **21**.
4. Restore all recent versions of the object from the latest saved changed objects.

When you have finished the complete system recovery, you can start with the Tivoli Storage Manager server recovery as outlined in 10.4.3, “Recovering to a point-in-time” on page 292.

10.4.2 Protecting your Tivoli Storage Manager server

Before we start discussing the recovery of a Tivoli Storage Manager/400 server with base functionality, let us review the steps needed to protect the Tivoli Storage Manager server. Chapter 8, “Protecting the Tivoli Storage Manager/400 server” on page 193 explains how to protect database and storage pools in detail. Here, we only list the steps that are important for the recovery that is explained in the next section.

- Perform reclamation of its copy storage pool, once a week. Reclamation for the copy storage pools is turned off at other times.
- Back up its storage pools every night.
- Perform a full backup of the database once a week and incremental backups on the other days.
- Back up the volume history, device configuration, and server option. Send the copy of all three files off-site.
- Send Database and Recovery log setup details off-site.
- Ship the database and copy storage pool volumes to an off-site location every day.

Note

If BRMS/400 is also installed on your Tivoli Storage Manager server system, all Tivoli Storage Manager meta information—including database, recovery log and option files—is installed in `QUSRADSM` and `/tsmvol/*`, and you are able to stop the Tivoli Storage Manager server completely for the time of disaster recovery backup, then you may wish to consider the following option of disaster recovery protection.

After you have performed storage pool migration and storage pool backup, you stop the Tivoli Storage Manager server. Then you use BRMS to make a complete backup of `QADSM`, `QUSRADSM` and `/tsmvol/*` to tape. This tape then contains the Tivoli Storage Manager database, the storage pools, recovery log, and database setup, as well as the volume history, the device configuration and the server option file. Together with your storage pool backup, you can send this tape off-site as a complete recovery set. The expiration of this tape will be controlled by BRMS and not by Tivoli Storage Manager.

In the recovery case, the complete Tivoli Storage Manager environment can be recovered in one step. If you are performing this recovery on a different AS/400 system, you may need to adopt the device configuration before starting the Tivoli Storage Manager server.

10.4.3 Recovering to a point-in-time

In this scenario, the AS/400 system on which Tivoli Storage Manager Server resides, the database, and all on-site storage pool volumes are destroyed due to disaster. We assume that the AS/400 system is already recreated on a standby system, which meets the requirement defined above and is available. Figure 56 shows the necessary resources needed for a successful Tivoli Storage Manager disaster recovery.

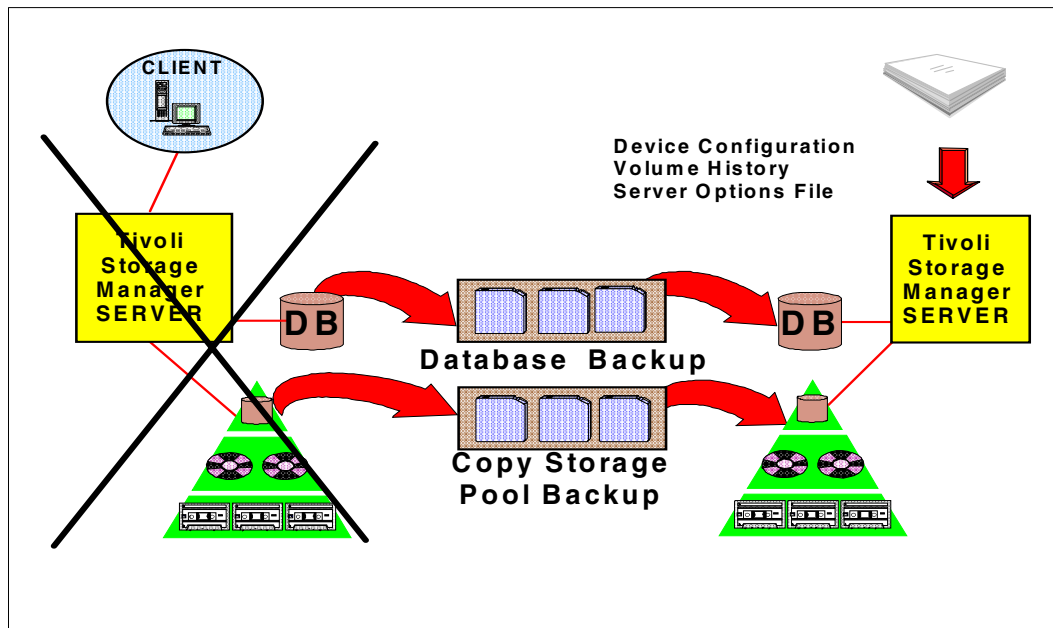


Figure 56. Tivoli Storage Manager server recovery scenario

Here are the steps to recover the server to a point in time.

1. First, recover the AS/400 system as explained in 10.4.1, "Recovery of the AS/400 Tivoli Storage Manager server system" on page 290, and then start Tivoli Storage Manager server recovery from step 2. If you have a standby AS/400 system ready and if it meets the conditions explained above, you can also start the recovery from step 2.
2. Move the latest database backup, all of the copy pool volumes, the backup copy of the volume history file, the device configuration file, server option file, and details of database and recovery log on-site from the off-site location.
3. Install the Tivoli Storage Manager server on the replacement AS/400 system. Refer to Chapter 4, "Setting up a Tivoli Storage Manager/400 server" on page 63 for more details.
4. Restore the volume history, device configuration, and server options files to the server working library `QUSRADSM`. You can use the following command if the files were stored on tape media as recommended in 8.5.5, "Backing up server information using AS/400 commands" on page 210.

```
====> RSTOBJ OBJ(QOPTADSM VOLHISTORY DEVCONFIG) SAVLIB(QUSRADSM) DEV(TAP01)
```

5. Use the details of database and recovery log setup received from an off-site location. Initialize the same size of database and recovery log as on the destroyed system. The following command can be used to create database and recovery logs as in the example considered in Chapter 8, "Protecting the Tivoli Storage Manager/400 server" on page 193.

```
====> INZSVRADSM VOLSPC(*VOLSTMF) LOGSTMF((' /tsmvol/log/rlog01' 25))
      DBSTMF((' /tsmvol/database/db01' 100)) PRPWEB(*YES)
```

6. Restore the database from the latest backup level by using `STRRSTADSM` command. For example, to restore the database to a backup series that was created on February 18, 2000, enter the following command:

```
====> STRRSTADSM TYPE(*RSTDATE) RSTDATE('02/18/00')
```

Tivoli Storage Manager does the following:

- a. It reads the volume history file to locate the last full backup that occurred on or before the specified date and time.

Note

If the volume history file is not available, you must mount tape volumes in the correct order or specify their order on the `STRRSTADSM` command by using `*VOLLIST` for parameter `TYPE`.

- b. Using the device configuration file, it requests a mount of the first volume, which contains the start of the full backup.
 - c. It restores the backup data from the first volume.
 - d. Continues to request mounts and to restore data from the backup volumes that contain the full backup and any incremental backups that occurred on or before the date specified.
7. Change the access mode of all the existing primary storage pool volumes in the damaged storage pools to `DESTROYED` by entering:

```
tsm: ADSM> update volume * access=destroyed wherestgpool=backupperpool
tsm: ADSM> update volume * access=destroyed wherestgpool=archivepool
tsm: ADSM> update volume * access=destroyed wherestgpool=spacemgpool
tsm: ADSM> update volume * access=destroyed wherestgpool=3570_pool
```

8. Issue the `QUERY VOLUME` command to identify any volumes in the copy storage pool that were on site at the time of the disaster. Any volumes that were on site would have been destroyed in the disaster and could not be used for restore processing. Delete each of these volumes from the database by using the `DELETE VOLUME` command with the `DISCARDATA` option. Any files backed up to these volumes cannot be restored.
9. Change the access mode of the remaining volumes in the copy pool to `readwrite` by entering:

```
tsm: ADSM> update volume * access=readwrite wherestgpool=copypool
```

Note

Clients can get files from Tivoli Storage Manager at this point. If a client tries to get a file that was stored on a destroyed volume, the retrieval request goes to the copy storage pool. In this way, clients can access their files without waiting for the primary storage pool to be restored. When you update volumes brought from off-site to change their access, you greatly speed recovery time.

10. Define new volumes in the primary storage pool so the files on the damaged volumes can be restored to the new volumes. The new volumes also allow clients to back up, archive, or migrate files to the server. You do not need to perform this step if you use only scratch volumes in the storage pool.
11. Restore files in the primary storage pool from the copies located in the COPYPOOL1 pool by entering:

```
tsm: ADSM> restore stgpool backuppool maxprocess=2
tsm: ADSM> restore stgpool archivepool maxprocess=2
tsm: ADSM> restore stgpool spacemgpool maxprocess=2
tsm: ADSM> restore stgpool 3570_pool maxprocess=2
```

These commands use multiple parallel processes to restore files to primary storage pools. After all the files have been restored for a destroyed volume, that volume is automatically deleted from the database.

12. To ensure against another loss of data, immediately back up all storage volumes and the database. Then, resume normal activity including weekly disaster backups and movement of data to the off-site location.

10.4.4 Restoring a database to its most current state

You can use roll forward recovery to restore a database to its most current state if the following conditions exist:

- Tivoli Storage Manager recovery log has been in roll forward mode continuously from the time of the last full backup to the time the database was damaged or lost.
- The last backup series created for the database is available. A backup series consists of a full backup, all applicable incremental backups, and all recovery log records for database changes since the last backup in the series was run.
- At least one complete set of the recovery log volumes is available and uncorrupted.

To restore the database to its most current state, enter `strrstadsm type(*rcylog)`.

If the original database or recovery log volumes are available, issue only the `STRRSTADSM` command. However, if those volumes have been lost, you must first issue the `INZSVRADSM` command to initialize the database and recovery log; then issue the `STRRSTADSM` command.

Note

Roll forward recovery does not apply if all recovery log volumes are lost. However, with the server running in rollforward mode, you can still perform point-in-time recovery in such a case.

Chapter 11. AS/400 Integrated Netfinity Server

While using the AS/400 system to run commercial and business applications and their databases, it is not unusual for companies to install PC-based servers alongside the AS/400 system for PC files and print services. Also, more and more companies are considering Windows NT servers for their network operating system, running NT for file, print, and personal productivity applications. In a standard PC-based server, you have one or more Intel processor and PC memory on a motherboard combined with a PC LAN adapter, hard disk, and CD-ROM drive.

The AS/400 Integrated Netfinity Server consists of an Intel processor and PC memory packaged on a motherboard to fit inside the AS/400e and other 64-bit RISC models. Once inside the AS/400 system, device drivers are provided to share the AS/400's hard disks, LAN adapter, and CD-ROM and tape drives between the Integrated Netfinity Server and the AS/400 system. The Integrated Netfinity Server comes in two packages that are designed to accommodate the SPD and PCI bus options on the AS/400 Advanced Series and the AS/400e series.

On an Integrated Netfinity Server, you can run a full Windows NT Server 4.0 operating system without any limitations on functionality. The AS/400 system, integrated with the NT server, offers services that improve the operation and management of the NT system:

- Extended data management by using Integrated File System backup support (OS/400 SAV and RST commands) to backup the NT user storage spaces and device sharing between the AS/400 system and the Integrated Netfinity Server.
- Faster access to the DB2/400 database using the TCP/IP internal LAN.
- Application integration between the AS/400 system and the Integrated Netfinity Server using the fast database connection, ODBC and other APIs and the ability to exchange data between the AS/400 system and the Integrated Netfinity Server using the IBM DataPropagator.
- Integration of system management in fields like disk allocation and error reporting through AS/400 message queues and preservation of NT operations through the Windows NT graphical interface where necessary.
- Combined user administration, enabling AS/400 users and groups to be defined on a Tivoli Storage Manager server or domain with user password synchronization.
- Improved DASD performance and reliability by using AS/400 disk spaces to store the Windows NT data, which are automatically protected by AS/400 RAID-5 or mirroring technology.
- Server consolidation by integrating up to 16 independent Integrated Netfinity Servers within one AS/400 system, sharing disk resources and being integrated with data management and user administration. This allows implementation of single server per application concept, which is very cost and resource efficient.

In this chapter, we discuss in more detail the hardware architecture of the Integrated Netfinity Server, including the device concept and Windows NT

operating system implementation, which has implications for possible backup and recovery. In the last section, you will learn to protect the data of an Integrated Netfinity Server, using Tivoli Storage Manager and other tools to perform a complete recovery of such systems.

Note

The Integrated Netfinity Server was formerly known as the Integrated PC Server (IPCS) and File Server Input Output Processor (FSIOP). You may encounter these names in other books.

The main differences are:

- An Integrated Netfinity Server is an Intel Pentium Pro processor running at 333 Mhz.
- An Integrated PC Server is an Intel Pentium Pro processor running at 133 or 166 Mhz.
- A File Server Input Output Processor is a 486DX/2 processor running at 66 Mhz.

11.1 The Integrated Netfinity Server

The new Integrated Netfinity Server is designed to run Windows NT Server V4.0 and Terminal Server Edition (TSE). Windows NT requires a minimum of 64 MB of memory, but 128 MB is the suggested minimum. Also needed are a monitor, keyboard, and mouse attached to the NT console. This configuration is shown in Figure 57.

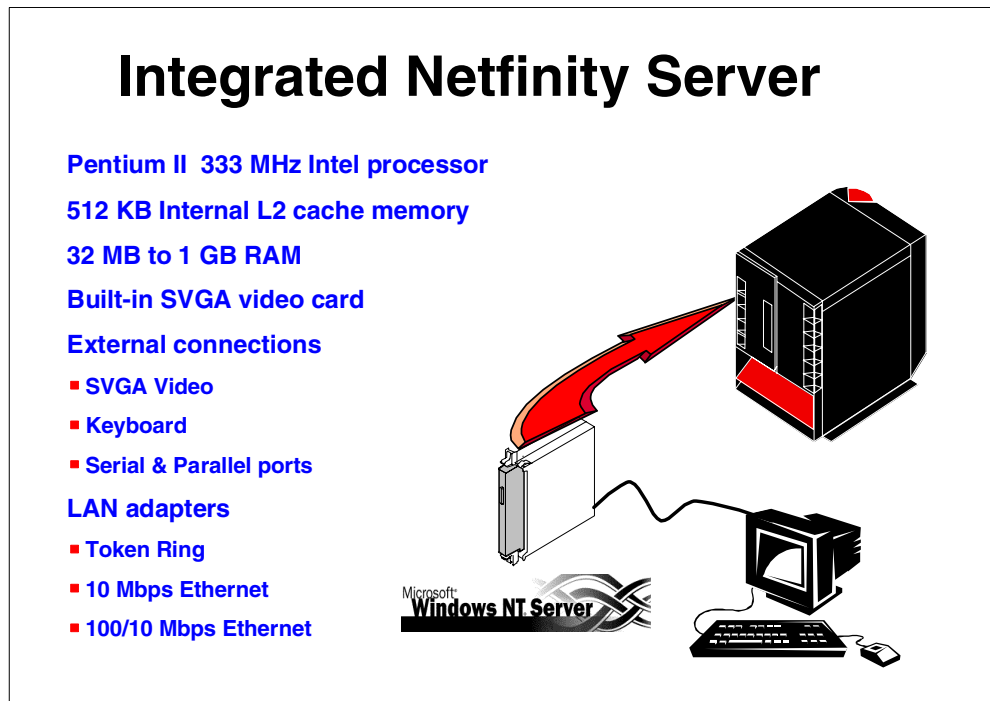


Figure 57. The Integrated Netfinity Server

It has an Intel Pentium II 333 MHz processor with 512KB of L2 cache (operating at full CPU Core Speed of 333MHz), token-ring, 10 and 100 Mbps Ethernet options, a serial and parallel port, and options for ECC/EDO memory from 32 MB up to 1 GB.

The two versions of the new Integrated Netfinity Server are:

- A PCI-based version for AS/400 RISC models with PCI slots. The PCI card needs up to four slots in the AS/400 system.
- An SPD version for AS/400 RISC models with SPD slots. The SPD card takes three slots in the AS/400 system's frame.

Both cards provide support for the following connections:

- Token Ring
- 10 Mbps Ethernet
- 100 Mbps Ethernet

11.1.1 Hardware requirements

On an AS/400 RISC system, depending on the model, you need:

- An FSIOP-4 card for AS/400 with SPD bus or an FSIOA-2 card for AS/400 with PCI bus
- At least 64 MB of memory on the Integrated Netfinity Server
- 1 GB AS/400 disk space for each network storage space
- 45 MB AS/400 disk space for the AS/400 Integration for NT (the option 29 of OS/4000)
- An SVGA display, a keyboard, and a mouse
- One or more PCI LAN adapters (Token Ring or Ethernet)

The minimum amount of RAM memory installed on a Windows NT Integrated Netfinity Server for running Windows NT Server is 64 MB, but 128 MB or more is recommended to increase operating system performance.

A machine pool is an amount of main storage reserved for SLIC operations. The following requirements for the Integrated Netfinity Server cards have to be satisfied:

- The FSIOA-2 INS card installed on a PCI AS/400 systems requires an additional 1800 KB of machine pool resources to get activated. Each LAN adapter (up to two) installed on the additional PCI slots of the AS/400 system and handled by the NT-INS requires another 1800 KB of machine pool resources.
- The FSIOP-4 version on SPD AS/400 always requires 5400 KB of Machine Pool resources regardless of the number and type of LAN cards installed inside.

11.1.2 Software requirements

OS/400 Integration with Windows NT Server (option 29 of OS/400) can be installed only on AS/400 systems running OS/400 V4R2 or later. The integration code is a chargeable feature of OS/400, and additional licenses must be

purchased for each Windows NT server installed on an AS/400 Integrated Netfinity Server.

The Windows NT code updates are supplied in Service Packs. Apply the latest Service Pack to the integration code before running the NT environment.

Another option is to download the service pack from the Internet and apply it directly to the installed Windows NT Server. Information about Service Packs can be found in APAR II10739 or at the following Web page:

<http://as400service.ibm.com/>

The only supported version of Windows NT Server is 4.0. Windows NT 3.51 and earlier versions will not work on a Windows NT-INS.

After the installation of the Windows NT 4.0 operating system, the Windows NT Service Pack 3 (or 4) *must* be applied before running the operating system. Additional AS/400 License Program Products (LPPs) should be installed to enable some functions:

- 5769TC1 (TCP/IP Connectivity Utilities) LPP is required to run TCP/IP applications as Telnet or FTP.
- 5763XD1 (Client Access for Windows 95/NT) LPP is required if you plan to use the functionalities of the new ODBC driver.

Additional information can be found at the following Web pages:

<http://www.as400.ibm.com/nt/ntins.htm>

<http://www.microsoft.com>

Related books are also available:

- *OS/400 - AS/400 Integration with Windows NT Server*, SC41-5439
- *OS/400 TCP/IP Configuration and Reference*, SC41-5420
- *AS/400 - Implementing Windows NT on the Integrated PC Server*, SG24-2164
- *Microsoft Windows NT server Resource Kit*, Microsoft Corp., 1997
- *Mastering Windows NT Server 4*, Mark Minasi, Sybex Inc., 1996

Note

The Integrated Netfinity Server for AS/400 has passed tests to meet Microsoft standards for compatibility with Windows. You can find it at:

<http://www.microsoft.com>

11.2 Running Windows NT server on the Integrated Netfinity Server

Figure 58 shows AS/400 objects created when installing a Windows NT Server on the AS/400 Integrated Netfinity Server. These objects are used for the combined management and integration of the Netfinity Server into the AS/400 environment.

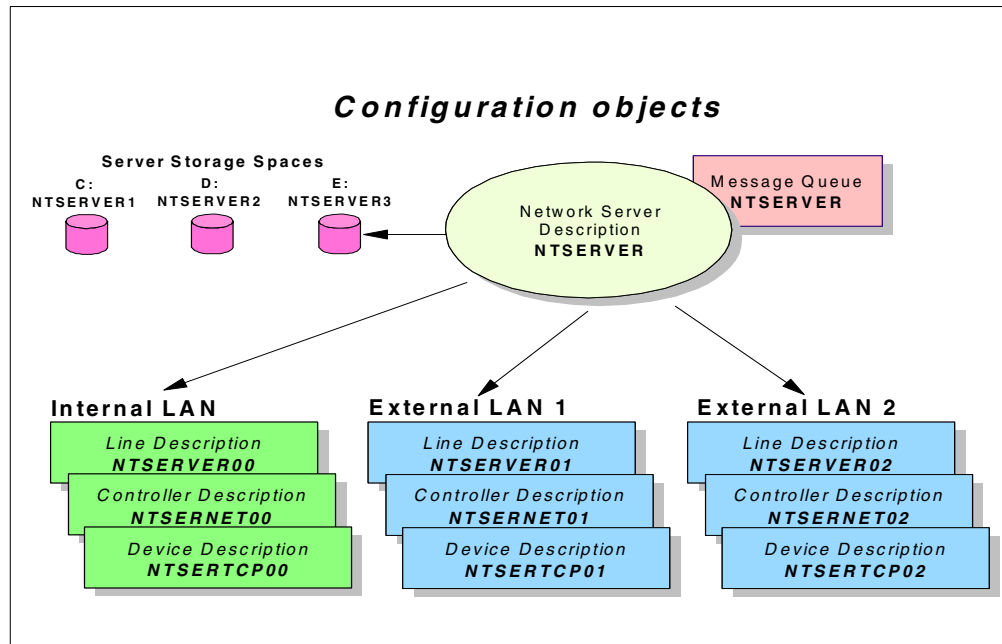


Figure 58. Windows NT server configuration objects

From the backup and recovery point of view, to back up an entire Windows NT Server, all the following OS/400 objects must be saved to ensure a complete recovery strategy:

- Each Windows NT server configured on the AS/400 Integrated Netfinity Server has its own network server, line, controller, and device descriptions for the internal and external LANs. All these objects, stored in *QSYS* library, are created during the installation of each Windows NT server and are needed to communicate with the AS/400 system and external PCs that will be part of the NT server domain.
- The (optional) server message queue, which resides in a library selected by the user during the installation should also be saved. It can be helpful for problem determination if an error is encountered.
- The *QNTAP* library and in the *NTAP* directory: The *QNTAP* library is created at installation of option 29 of the OS/400 and contains the objects required to install Windows NT server. The *NTAP* directory, located in */QIBM/Prodata*, is part of the Integrated File System, and contains files and programs, such as device drivers, required to run Windows NT server on an Integrated Netfinity Server.
- The Windows NT Server code, the Windows registry, the DOS boot image, and the NT installation files are contained in the C:, D:, and E: drives and stored in *server storage spaces* while the user data and the applications installed apart from the Windows NT code are stored in objects called *user storage spaces*.

11.2.1 Server and user storage spaces

Figure 59 shows the data structures of the Windows NT server within the AS/400 Integrated Netfinity Server environment. In our example, the Windows NT server is named NTSERVER.

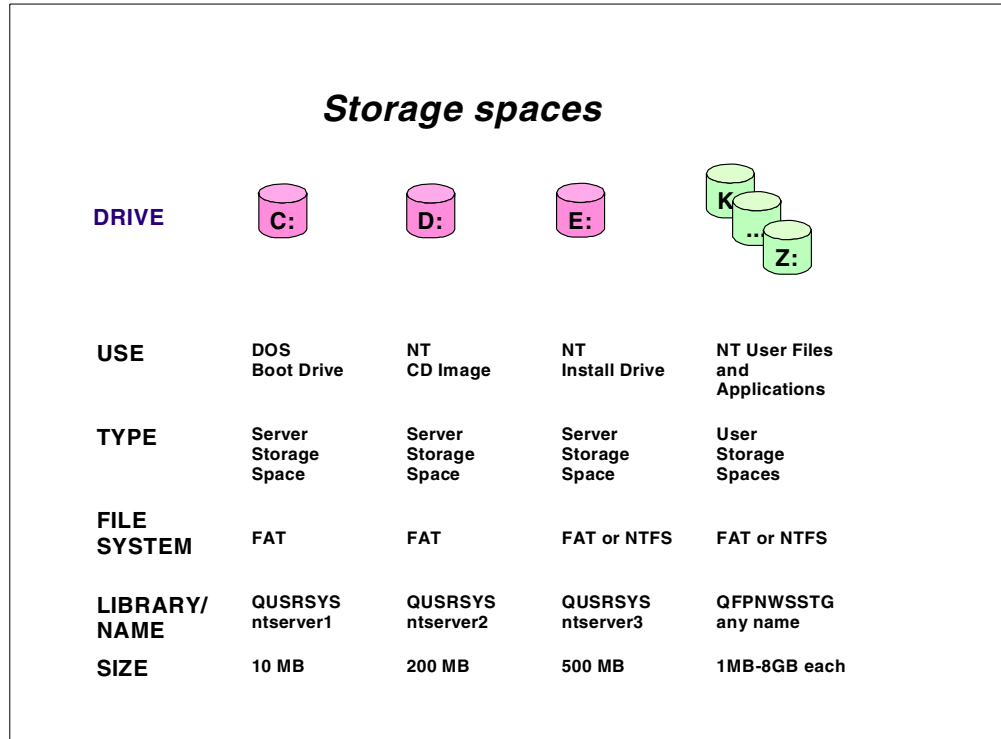


Figure 59. Server storage spaces and user storage spaces

The server storage spaces contain all the Windows NT server code, which is composed of:

- C: drive for the DOS Boot drive
- D: drive, which contains the Windows NT image as on the CD-ROM. The NT setup program may need drivers when adding new software.
- E: drive, which is the Windows NT install drive and contains the *working* code.

The drives are implemented on AS/400 storage space as three file objects of type *SVRSTG and are located in the QUSRSYS library named NTSERVER1 for the C drive, NTSERVER2 for the D drive and NTSERVER3 for E drive.

The user storage spaces are created manually after the installation of the NT server using the AS/400 command `CRINWSSTG` and linked to the network server description using the `ADDNWSSTGL` command.

The maximum size of one user storage space depends on the selected file system:

- 1 megabyte to 8GB if NTFS
- 1 megabyte to 2GB if FAT

Note

Using the NTFS file system offers better performance than the FAT file system and is not limited to 2047 megabytes, but, if the NTFS user space becomes damaged, there is no way to recover it.

11.2.2 Creation of user storage spaces

The creation of user storage spaces requires three steps:

1. First, allocate space from the AS/400 side using the CRTNWSSTG (Create Network Storage Space) command. The following example creates a user storage space named DSIK01 having a size of 2047 MB in the FAT format:

```
Create NWS Storage Space (CRTNWSSTG)

Type choices, press Enter.

Network server storage space . . > DISK01      Name
Size . . . . . > 2047                        1-8000
Format . . . . . > *FAT                      *HPFS, *FAT, *NETWARE...
Text 'description' . . . . . > 'first user space'

F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

2. To be able to use this storage space, you must link it to the Windows NT server using ADDNWSSTGL (Add network storage space link) command.

```
Add Server Storage Link (ADDNWSSTGL)

Type choices, press Enter.

Network server storage space . . > DISK01      Name
Network server description . . . > NTSERVER    Name
Drive sequence number . . . . . *CALC         1-18, *CALC, *PRV

F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

By default, the drive sequence number is set *CALC. It is an assignment number that the AS/400 system uses to link the drive. We allow the default value.

Note

This operation can only be done when the Network Server is in VARIED OFF status.

3. Then, you need to format this space. This operation must be executed using Windows NT Disk Administrator. To do this, select **Start** → **Programs** → **Administrative Tools** → **Disk Administrator**. Choose the new drive to format and select **Tools** → **Format** to format the drive in such a way that Windows NT server can use it. See Figure 60.

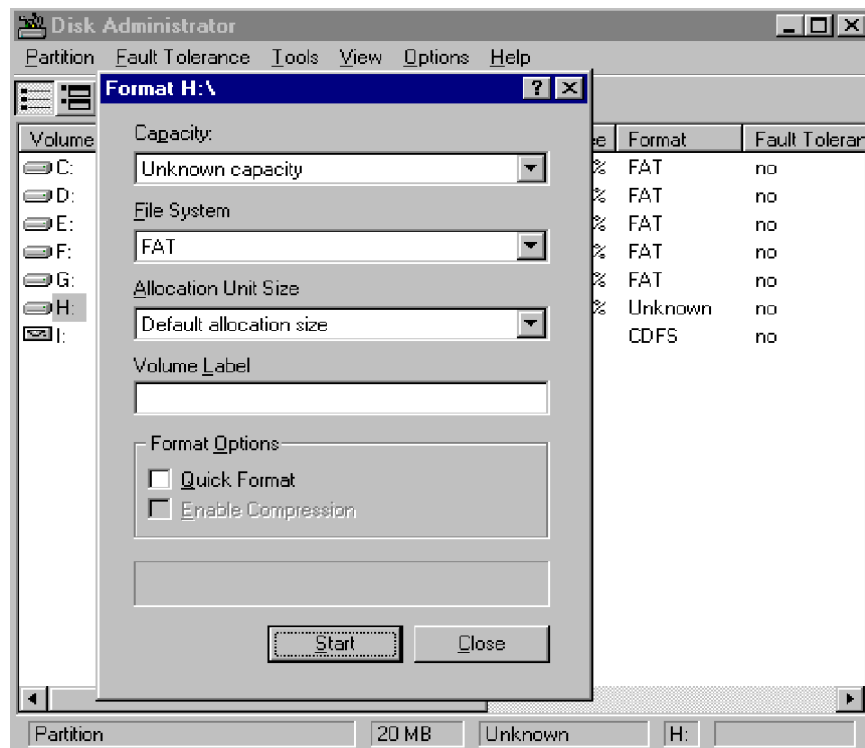


Figure 60. Drive formatting under Windows NT

The user storage spaces cannot be resized after creation; you can only create a new storage space of different size and copy all the data to it.

User storage spaces are stored inside the `/QFPNWSSTG` directory of the Integrated File System and have a name assigned by the user who created it. In our example, it is named `DISK01`. You can verify it by running the following command:

```
====> wrklnk '/qfpnwsstg
```

This command lists all user storage spaces assigned to the Windows NT server. You should receive a screen similar to the following:

Work with Object Links

Directory : /qfjnwstg

Type options, press Enter.

3=Copy 4=Remove 5=Next level 7=Rename 8=Display attributes
11=Change current directory ...

Opt	Object link	Type	Attribute	Text
	DISK001	DIR		
	DISK01	DIR		
	FDRIVE	DIR		

Parameters or command

====>

F3=Exit F4=Prompt F5=Refresh F9=Retrieve F12=Cancel F17=Position to
F22=Display entire field F23=More options

11.3 Device support on the AS/400 Integrated Netfinity Server

Devices can be added to the external serial and parallel port of the Integrated Netfinity Server, but AS/400 CD-ROM and tape drives can easily be shared.

There are some differences between the AS/400 Integrated Netfinity Server and stand-alone Netfinity Server device support that will influence backup and recovery strategies. Furthermore, this section covers the sharing of common devices used by both the AS/400 system and the Integrated Netfinity Server.

11.3.1 Differences compared to stand-alone Netfinity server

Because of the hardware implementation of the Integrated Netfinity Server, there are differences between a stand-alone Netfinity Server and an AS/400 Integrated Netfinity Server that influence backup and restore plans.

- Floppy Disk:

There are no diskette drives on an Integrated Netfinity Server. This means that you cannot use a BOOT diskette or an emergency repair diskette with the Integrated Netfinity Server.

- Tape:

There is no PC tape drive supplied with an Integrated Netfinity Server, but you can use AS/400 tape drives, except 1/2" reel tapes, such as IBM 3480 and IBM 3490 tapes and tapes libraries. You can use tape drives in a tape library when they are set up to work as separate drives without the control of a library manager. See Informational APAR II11119 for details about supported tape drives with an Integrated Netfinity Server.

- Disk drives:

The Integrated Netfinity Server has no disk of its own. It uses disk storage allocated to it by the AS/400 system.

- Saving to disk:

Because the AS/400 system has the potential for a huge amount of disks to be installed, you can use these disks to back up the Windows NT server files. The AS/400 objects can be saved to a save file instead of to tape. Saving to a save file allows quick restore, but you have to be careful not to run out of disk space on the AS/400 system.

You can also save the Windows NT server using the AS/400 netserver function, which enables AS/400 Integrated File System directories to be accessed by netserver clients including Windows NT. A similar way is to use Client Access/400, but you need to install the Client Access/400 LPP on the Windows NT server. See *AS/400 - Implementing Windows NT on the Integrated PC Server*, SG24-2164, for complete information.

11.3.2 Using AS/400 CD-ROM drives with Windows NT server

Windows NT Server can use the AS/400 CD-ROM drive just as it does a local CD-ROM drive. The AS/400 CD-ROM drive appears as a normal local CD-ROM drive in the *My Computer* folder in Windows NT.

The CD-ROM drive must be varied on before you can use it from a Windows NT Server or from the AS/400 system. If the CD-ROM drive is not varied on, follow these steps to vary it on:

1. At the AS/400 command prompt, type `WRKCFGSTS *DEV *OPT` and press **Enter**.
2. In the Opt column next to OPT01, type `1` to vary on the CD-ROM drive.
3. Press **Enter**, and the CD-ROM drive varies on.

The CD-ROM drive is now ready for use with Windows NT.

11.3.3 Using AS/400 tape drives with Windows NT server

This section explains how to install an AS/400 device driver, how to format a tape that Windows NT can use, and, finally, how Windows NT allocates an AS/400 tape drive.

AS/400 tape drives can perform significantly faster than drives you normally attach to a PC server. You can allocate AS/400 tape drives to be used by the integrated Windows NT Server. The tape drives appear as normal local tape drives in the *My Computer* folder in Windows NT.

Because multiple integrated Windows NT Servers in the same AS/400 system can all access the same tape drive (although not at the same time), you need to allocate the tape drive for the Windows NT Servers.

Although you must dedicate tape drives to the integrated Windows NT Server and to the AS/400 system, both systems cannot simultaneously use the same tape drive. The two operating systems require different tape formats. You cannot use the same tape for both Windows NT and OS/400 without reformatting it.

11.3.3.1 Installing the AS/400 tape drive device driver on Windows NT

Before Windows NT can use the AS/400 tape drive, the IBM AS/400 Tape Drive device driver must be installed on Windows NT Server. This installation is usually automatic.

If you need to manually install the AS/400 Tape Drive device driver to a Windows NT Server, follow these steps:

1. From the Windows NT task bar, select **Start —> Settings —> Control Panel**.
2. Double-click on **Tape Devices**.
3. Windows NT may generate a list of installed tape drivers for you to choose from. If it does not, click on the **Drivers tab**, then on **Add**.
4. From the list of installed tape drivers, select **IBM**, then **IBM AS/400 Tape Drive** and click **OK**.
5. Click **OK** on the New SCSI Tape Device Found prompt.
6. When the system asks if you would like to use the existing driver files, click **Yes**.
7. Click **OK** on the Tape Devices panel to close it.

The AS/400 tape drive device driver is now installed. Because Windows NT applications assume exclusive use of the tape drive, you must lock it before a Windows NT application can use it

11.3.3.2 Formatting a tape on an AS/400 system for Windows NT server

To use AS/400 tape drives on Windows NT Server, you must format a tape that Windows NT recognizes. To produce a non-labeled tape acceptable to Windows NT, use the AS/400 Initialize tape (**INZTAP**) command. To format a tape, do the following:

1. Put the tape you want to use in the AS/400 tape drive.
2. At the AS/400 command line, type the following:

```
===> INZTAP DEV(TAP01) NEWVOL(*NONE) NEWOWNID(*BLANK) VOL(*MOUNTED) CHECK(*NO)
DENSITY(*CIGTYPE) CODE(*EBCDIC)
```

Now, the Windows NT Server can recognize the tape.

11.3.3.3 Allocating the AS/400 tape drive to the Windows NT server

To use an AS/400 tape drive from the Windows NT Server console, you must vary it off on an AS/400 system and lock it on Windows NT Server. To transfer control of the AS/400 tape drive to a Windows NT Server, follow these steps:

1. At the AS/400 command line, type the following:

```
===> WRKCFGSTS *DEV TAP*
```

Press the Enter key. The "Work with Configuration Status" display appears.

2. In the *Opt* column next to *TAP01*, type 2 to vary off the tape drive.
3. Press **Enter**. The tape drive varies off.
4. From the Start menu on Windows NT Server, choose **Programs —> AS400 Windows NT Server —> AS/400 Devices**.

5. In the AS/400 Available Devices list, click on **TAP01**, where **TAP01** is the resource name of the AS/400 tape drive.
6. Click **Lock** to make the tape drive accessible to Windows NT server. Windows NT can now use the tape devices shown in Figure 61.
7. Click **Done** to close the AS/400 devices program.



Figure 61. Allocating an AS/400 tape device to Windows NT

Note

If you shut down Windows NT server or Windows NT server fails before you unlock the tape drive, it unlocks automatically. However, it is still in a varied off state on the AS/400 system.

11.4 Backup of the Windows NT server

The disk space on an AS/400 system used by the Windows NT server is made up of two logical types: the server storage spaces where the Windows NT software is stored and the user spaces that contain user data and additional software running on Windows NT 4.0. As already discussed, they are implemented as AS/400 file objects.

Backing up these objects with the Integrated File System backup support (OS/400 SAV and RST commands) is the fastest but least flexible method of saving Windows NT data. The approach is excellent for weekly or monthly backups as part of a complete system save. However, this method does not allow you to restore a single file from the save. The performance of this backup depends on your AS/400 model and tape drive speed, but it is similar to the performance of any other AS/400 object backup on the system. It also requires you to shut down the Windows NT server, which means stopping all running applications.

Another approach to securing Windows NT data is to use the NT backup utilities and data management solutions as Tivoli Storage Manager to secure the data. These methods will allow file-level backup and restore. Depending on the utility, backups are going to local tape drives shared with the AS/400 system, or the Tivoli Storage Manager client for NT can run on the Integrated Netfinity Server to a Tivoli Storage Manager server and client running on an AS/400 system. The disadvantage of this method is that management objects created within the AS/400 environment to integrate the Integrated Netfinity Server into OS/400 are not saved.

Our recommendation is to use a combination of the Windows NT and AS/400 methods to obtain the most flexible solution that is best suited for your strategy requirements, for backup and restore and complete recovery.

In the following sections, we discuss different backup strategies available, depending on your point of view.

11.4.1 Backup with AS/400 procedures

As you already know, many objects are created during installation of the Windows NT server on the AS/400 system. Consider Figure 58 on page 301. All these objects can be saved using native AS/400 commands with the following restrictions:

- The network storage space must be varied off before starting backup.
- Storage spaces are saved as an entity. You cannot save or restore individual files or directories from these backups.

This kind of backup is useful when integrated in a weekly save of the entire system but not for a daily file-level backup.

The following are the steps to save a full Windows NT server environment onto an AS/400 local tape drive using AS/400 native commands:

1. You first need to save the AS/400 operating system. It contains, among other things, the AS/400 program objects for the NT integration (option 29):

```
====> SAVSYS DEV(TAP01)
```

2. Saving the configuration saves the communication objects (network storage, line, controllers, and device descriptions) created at NT installation.

```
====> SAVCFG DEV(TAP01)
```

3. Saving security data is important to have security information in line with the server storage spaces

```
====> SAVSECDTA DEV(TAP01)
```

Note

Steps 2 and 3 are normally included in the `SAVSYS` command, but they can eventually be excluded from the command.

4. Before starting the backup of the Windows NT server, you need to shut down the Windows NT server:

```
====> VRYCFG CFGOBJ(NTSERVER) CFGTYPE(*NWS) STATUS(*OFF)
```

5. The following command saves the three storage spaces named `NTSERVER1`, `NTSERVER2`, and `NTSERVER3` found in the `QUSRSYS` library of a Windows NT server named `NTSERVER`:

```
====> SAVOBJ OBJ(NTSERVER*) LIB(QUSRSYS) DEV(TAP01) OBJTYPE(*SVRSTG)
```

6. User storage spaces are stored in the `/QFPNWSSTG` directory. They have a user-assigned name. The command below saves a directory, including all the sub-directories and files that it contains, that is named `DISK01`:

```
====> SAV DEV('/QSYS.LIB/TAP01.DEVD') OBJ((' /QFPNWSSTG/Disk01'))
```

Both server storage and user storage spaces are saved as a whole. You cannot restore individual files from these backups.

Note

It is important to save all three files constituting the Windows NT server and the user storage spaces at the same time to ensure the stability of the server. These components operate as a unit to create the full system and should be treated as such. Failure to do this may result in discrepancies in the registry and NTFS permissions.

In a high-availability environment where servers have to be available seven days a week and 24 hours a day, this solution is not suitable, because you have to shut down the server to back it up.

11.4.2 Backup with Windows NT backup utilities

A major difference when backing up an Integrated Netfinity Server from a Windows NT point of view is that the Integrated Netfinity Server remains in the varied on status, allowing backup of individual files. Windows NT server standard backup utilities like the Windows NT backup program can be used for the backup.

This program is shipped as default with Windows NT server and provides mechanisms to back up system files and data. The tape drives used must be in the Microsoft Hardware Compatibility List (HCL). Tape drives used for backups for backup can be:

- A PC tape drive connected to other PCs or a PC file server belonging to the Windows NT server domain you can use for backing up the NT Server.
- An AS/400 tape drive, which first needs to be varied on to the Windows NT server. Refer to 11.3.3, “Using AS/400 tape drives with Windows NT server” on page 306 for information on how to allocate an AS/400 tape drive to Windows NT.

When you use standard backups programs on the Windows NT server, you always backup the files, regardless of whether they have changed.

11.4.3 Backup with Tivoli Storage Manager client

Tivoli Storage Manager backups run when the Integrated Netfinity Server is in the varied on state; thereby allowing individual file backups and continuing service for applications. Another major advantage of running backups using the Tivoli Storage Manager backup-archive client on the Windows NT server is that Tivoli Storage Manager allows you to do incremental backups and file versioning; only files that have changed since the last backup will be backed up, therefore, reducing the time window needed to back up the Windows NT server.

You also do not need to pay attention to tape devices. The used tape devices are the ones that reside on the Tivoli Storage Manager server. You do not need to allocate a tape device explicitly to the Windows NT server. Also, the supported Tivoli Storage Manager tape devices list is less restrictive than tape devices supported by the Windows NT server on Integrated Netfinity Server.

The installation of the Tivoli Storage Manager client does not vary much from the installation on a stand-alone NT system. You can obtain the Tivoli Storage Manager client code by ordering a CD-ROM or by downloading it from the Web at the following addresses:

<ftp://index.storsys.ibm.com/tivoli-storage-management/maintenance/client/v3r7/>

Before installing the code from a CD-ROM, you may need to vary it on. See 11.3.2, “Using AS/400 CD-ROM drives with Windows NT server” on page 306, for how to use an AS/400 CD-ROM. For information on how to install the Server code, refer to *Tivoli Storage Manager V3.1: Installing the Clients*, SH26-4102.

The storage location where you install Tivoli Storage Manager client influences your restore procedure in case of a disaster on the Windows NT server. You may install it in the server storage space or in a user storage space.

- Installing the Tivoli Storage Manager client code on a server storage space may be impossible due to too little free disk space available on the E: drive because, in V4R3, its size is limited to 800 MB. This limitation does not exist anymore in V4R4. Although it is not recommended to install additional software to server storage, there is a way to extend the size of the E: drive. See *AS/400 - Implementing Windows NT on the Integrated PC Server*, SG24-2164.
- On a user storage space, no special recommendations apply.

Once Tivoli Storage Manager is installed, you need to setup the communication method, the Tivoli Storage Manager server destination address and the node name of the NT client.

To do this, select from the Windows task bar:

Start —> Programs —> Tivoli Storage Manager —> Backup Clients GUI

A new wizard function has been included with the backup-archive client GUI. It differs from the preference editor due to the fact that it helps with simple configurations of the option file through step-by-step instructions for *first time*, the file is saved as dsm.opt. See *Tivoli Storage Manager: Installing the Clients*, SH26-4102.

As soon the backup client options file is updated and saved, Tivoli Storage Manager is ready to backup your NT server. Figure 62 shows an example of the Tivoli Storage Manager Backup-Archive client.

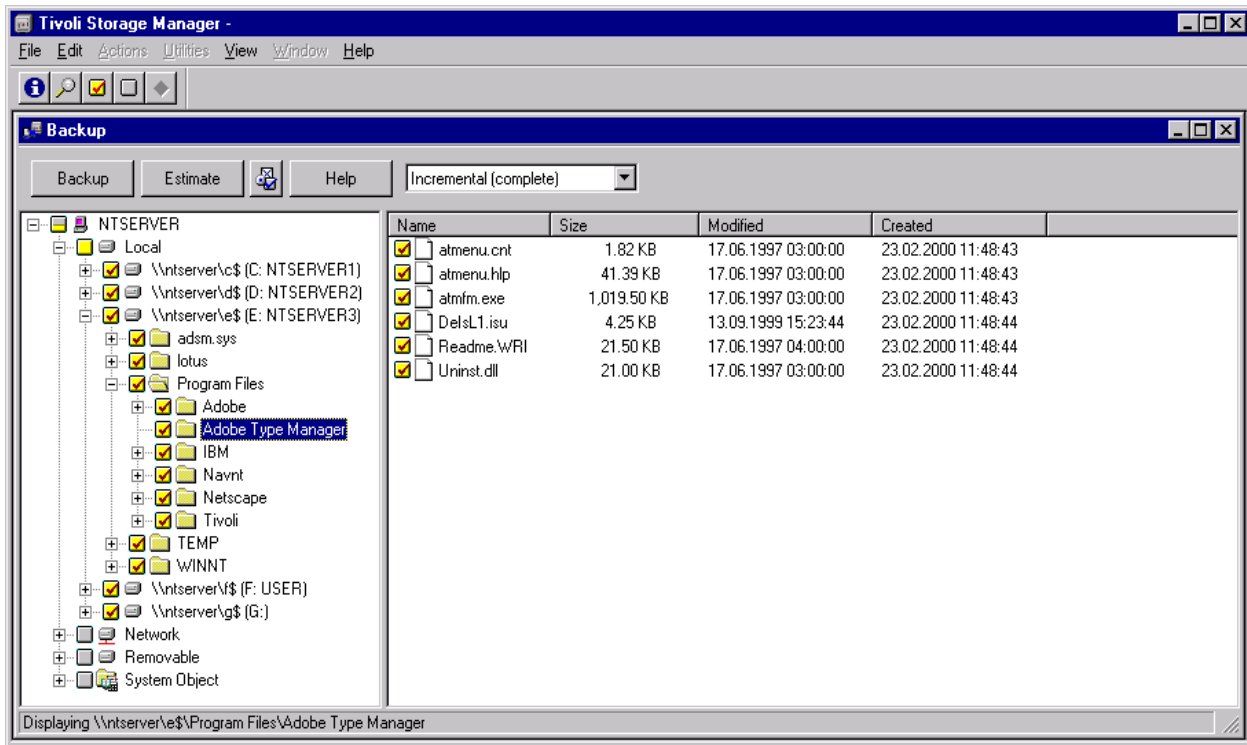


Figure 62. Tivoli Storage Manager backup-archive client

This figure shows that the C:, D: and E: drives correspond to the three network storage spaces of the Windows NT server called NTSERVER.

11.5 Restore of a Windows NT server using Tivoli Storage Manager

This section will explain three different approaches to restoring the Windows NT server data on an Integrated Netfinity Server covering:

- Restore with AS/400 utilities only
- Single file restore using NT utilities or Tivoli Storage Manager
- Complete recovery procedure of an AS/400 Integrated Netfinity Server

11.5.1 Restore with AS/400 utilities only

Restoring a complete Windows NT server on an Integrated Netfinity Server requires you to restore configuration objects using the `RSTCFG` command before restoring network storage spaces. You *must* run this command because it runs a similar process to the `INITNWSSVR` command, which initializes the storage on the AS/400 system. If the server storage space already exists when the `RSTCFG` command is run, the restore of the objects will fail as well as the restore of the network description.

You first need to delete any configuration objects as well as any storage spaces related to the Integrated Netfinity Server, if they still exist. Follow the steps below to restore all the AS/400 objects related to the Windows NT server residing on AS/400 Integrated Netfinity Server.

1. First, restore the configuration objects for the Integrated Netfinity Server named `NTSERVER`. In this case, `TAP01` is the tape device used:

```
===> RSTCFG OBJ(NTSERVER*) DEV(TAP01)
```

2. Next, restore the server storage which consists of three files:

```
===> RSTOBJ OBJ(NTSERVER*) SAVLIB(QUSRSYS) DEV(TAP01) OBJTYPE(*SVRSTG)
```

This operation requires that the network storage description is varied off or else it will fail.

3. Then, you restore all user storage you use with this Windows NT server. The example restore of user storage space is named `DISK01`. Remember that user storage spaces are stored under the `/qfpnwstg` directory:

```
===> RST DEV('qsys.lib/tap01.devd') OBJ('/qfpnwstg/disk01')
```

Repeat this operation for other user storage spaces if needed.

4. You now have to link these user storage spaces to the Windows NT server. The example shows link creation between the `DISK01` user storage space to the `NTSERVER` Windows NT server:

```
===> ADDNWSSTGL NWSSTG(DISK01) NWSD(NTSERVER)
```

Repeat this operation for other user storage spaces if needed.

5. The user and server storage space is now reloaded. You are ready to start the Windows NT server:

```
===> VRYCFG CFGOBJ(NTSERVER) CFGTYPE(*NWS) STATUS(*ON)
```

The process just shown will restore the complete data environment of the Windows NT running on the AS/400 Integrated Netfinity Server at the status from this point in time when the complete backup as outlined in 11.4.1, "Backup with AS/400 procedures" on page 309 was done. Because AS/400 objects are restored representing the complete storage space of the Windows NT server, it is *not* possible to restore only a single file from this backup, or to do the restore while the Windows NT Server is running.

11.5.2 Single file restore using NT utilities or Tivoli Storage Manager

This process is only valid to restore individual files that you accidentally deleted. For a complete restore, you also need to restore AS/400 configuration objects, which can only be done using the restore procedure outlined in 11.5.1, "Restore with AS/400 utilities only" on page 313.

You can restore your data with NT utilities from the PC tape drive or from the AS/400 tape device, depending on what devices you did your backup with. If you are using AS/400 tape devices, refer to 11.3.3, "Using AS/400 tape drives with Windows NT server" on page 306 for information on how to vary them on to Windows NT. You have to be careful that you use the right tape cartridge. The restore can be done when the Windows NT server is up and running.

Registry

After the restore operation, the Registry can contain configuration data about the domain and the directories that are out of date. A resynchronization with the other Domain controllers might be necessary.

If such a thing occurs, you may need to resynchronize it or take a daily backup of the E: drive.

It is much easier to use the Tivoli Storage Manager Windows NT backup/archive client to restore single files or whole directories within the Windows NT environment. Using the GUI shown in Figure 63, you can restore:

- Single files
- Complete directories or directory trees
- A complete Windows NT file space

All tape handling will be done by Tivoli Storage Manager server. You can restore files while the Windows NT server is up and running.

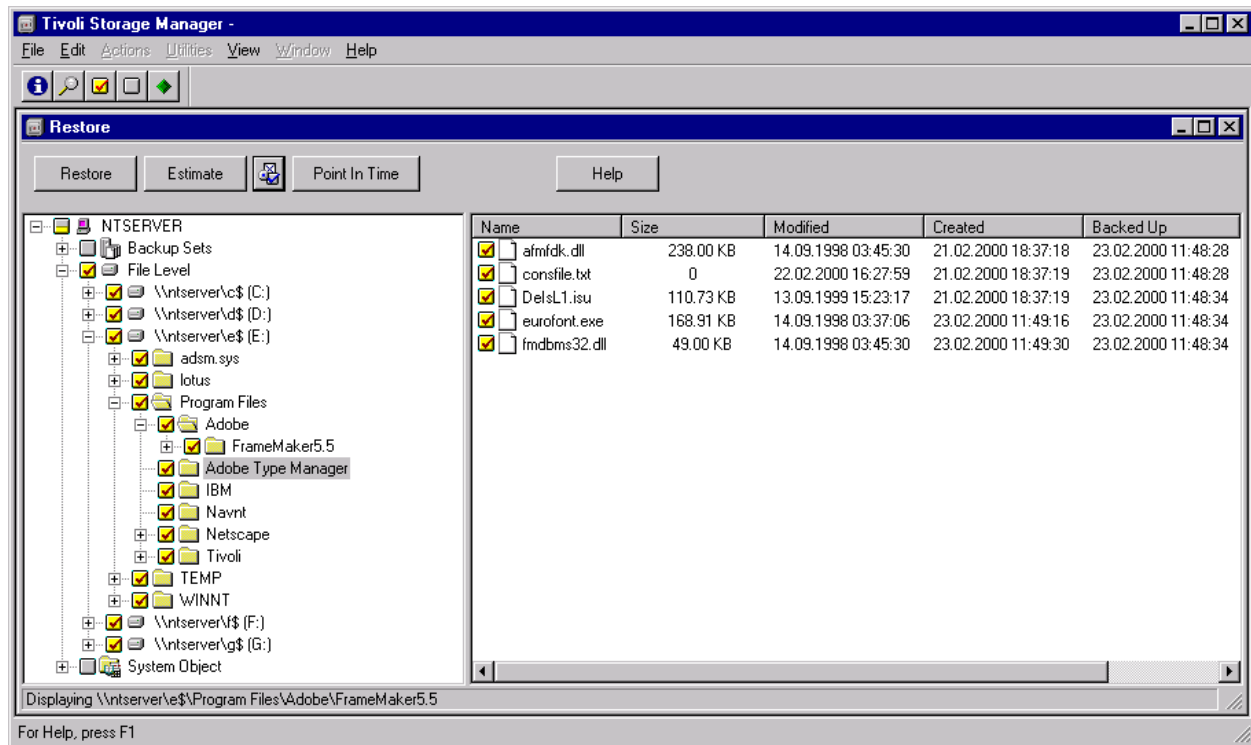


Figure 63. Tivoli Storage Manager client - restore screen

11.5.3 Complete AS/400 Integrated Netfinity Server recovery procedure

Bare-metal recovery of your Windows NT server is a combination of AS/400 restore steps that will restore the server to operational status followed by the Tivoli Storage Manager restore function.

1. The first step is to restore the configuration objects for the Windows NT server. In this case, TAP01 is the tape device used:

```
====> RSTCFG OBJ(NTSERVER*) DEV(TAP01)
```

2. The next step is to restore the networks storage space constituting the Windows NT server:

```
====> RSTOBJ OBJ(NTSERVER*) SAVLIB(QUSRSYS) DEV(TAP01) OBJTYPE(*SVRSTG)
```

This operation requires that the Network storage description be varied off; otherwise, it will fail.

Depending on whether the Tivoli Storage Manager client code is stored in server storage spaces or in a user space, the steps to follow are different:

- If the Tivoli Storage Manager code is on server storage spaces, you create user storage space(s) of at least the same size as the old storage space and link them to the Windows NT server. Go to step 3.

- If The Tivoli Storage Manager code is stored on user storage spaces, go to step 5.

3. Use the following command to create a new user space:

```
====> CRINWSSTG NWSSTG(NEWDSIK01) NWSSIZE(2047) FORMAT(*FAT)
        TEXT('New user space')
```

4. Link this new user space to the Windows NT server:

```
====> ADDNWSSTGL NWSSTG(NEWDISK01) NWS(NTSERVER)
```

Go to step 8.

5. This step restores all user storage you use with the Windows NT server. This example shows the restore of user storage space named `DISK01`. Remember that user storage spaces are stored under the `/qfprnwsstg` directory:

```
====> RST DEV('qsys.lib/tap01.devd') OBJ((' /qfprnwsstg/disk01'))
```

Repeat this operation for other user storage spaces if needed.

6. You now have to link these user storage spaces to the Windows NT server. Our example shows the link creation between the `DISK01` user storage space to the `NTSERVER` Windows NT server:

```
====> ADDNWSSTGL NWSSTG(DISK01) NWS(NTSERVER)
```

Repeat this operation for other user storage spaces if necessary.

7. The user and network storage space is now reloaded. You are ready to start the Windows NT server:

```
====> VRYCFG CFGOBJ(NTSERVER) CFGTYPE(*NWS) STATUS(*ON)
```

8. Now that the Windows NT server is started, use the Tivoli Storage Manager restore function to restore the most recent versions of files saved on the Tivoli Storage Manager server. Figure 63 shows a Tivoli Storage Manager restore screen.

Chapter 12. Tivoli Storage Manager and AS/400 logical partitions

A Tivoli Storage Manager server or BRMS application client can be installed on an AS/400 logical partition (LPAR). Using the optional OptiConnect software, it is possible to achieve very high data transfer rates between a Tivoli Storage Manager server and BRMS client if you are using logical partitions on the same AS/400 physical system.

12.1 What is a logical partition?

A logical partition is a distribution of resources within a single AS/400 system that allows it to operate as two or more distinct systems, as shown in Figure 64. Each LPAR has its own allocation of processor, memory, disk, and I/O devices.

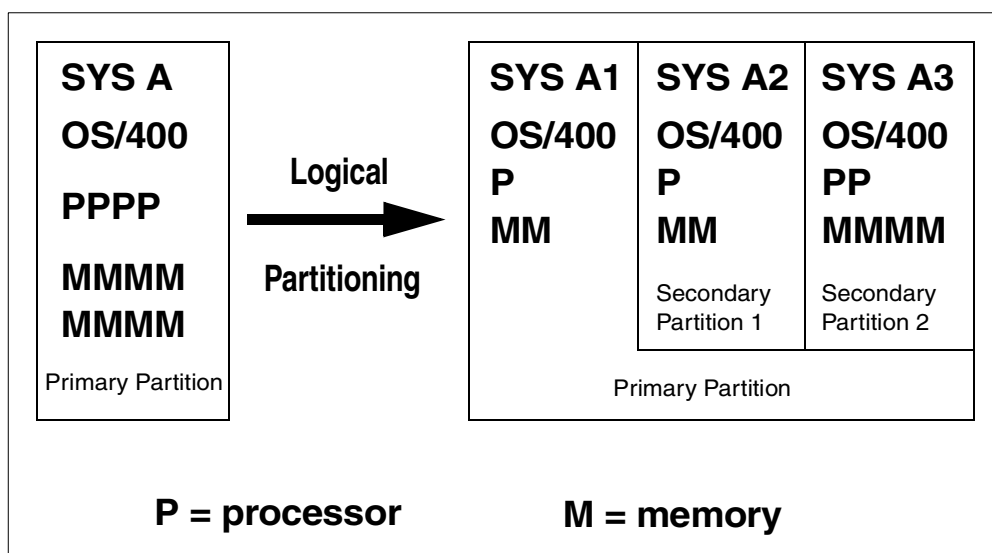


Figure 64. Logical partitions of a single AS/400 system

Figure 64 shows a single AS/400 system on the left (SYS A), and an example LPAR configuration on the right (SYS A1, SYS A2, SYS A3). Each LPAR contains a proportion of the total resources that are available to the single partition AS/400 system on the left (SYS A).

Each AS/400 system that runs LPARs will have a *primary partition*. This is a fully functional AS/400 LPAR with the added responsibility of providing all management functions for the other *secondary partitions*. Therefore, if the primary partition fails, all other partitions fail. If a non-primary partition fails, it will not affect any of the other partitions.

Each partition can run with different languages, different time zones, different PTF levels, and different OS/400 levels (with future releases of OS/400 only, the minimum OS/400 level required for an LPAR environment is V4R4).

Optical and tape devices can be shared between LPARs. These devices must be manually switched between IOPs from one LPAR to another using System Service Tools.

To find out more about LPARs, see the ITSO redbook *Slicing the AS/400 with Logical Partitioning: A How to Guide*, SG24-5439.

Before running any applications, including Tivoli Storage Manager, on a partitioned AS/400 system, you should consider what is run in the primary and secondary partitions. As stated earlier, the primary partition is critical to the functioning of all LPARs in the system. If the primary partition fails, all partitions will fail.

The safest approach is to run nothing in the primary partition. This allows the primary partition to manage the remainder of the partitions only. There will be no applications running that might cause potential problems.

The next option is to run a production system in the primary partition. The primary partition will be set up to run a production application(s) as well as the partition management functions for the secondary partitions. This is the second safest approach.

The other option is to use the primary partition as a test environment. This is the least-safe approach and is not recommended if machine availability is important.

12.2 What is virtual OptiConnect?

Before explaining virtual OptiConnect, it is best to understand how OptiConnect works in a conventional multi-AS/400 system environment. *OptiConnect/400* is a software and hardware solution for the high-speed transfer of data between AS/400 systems using fiber optic cables as shown in Figure 65.

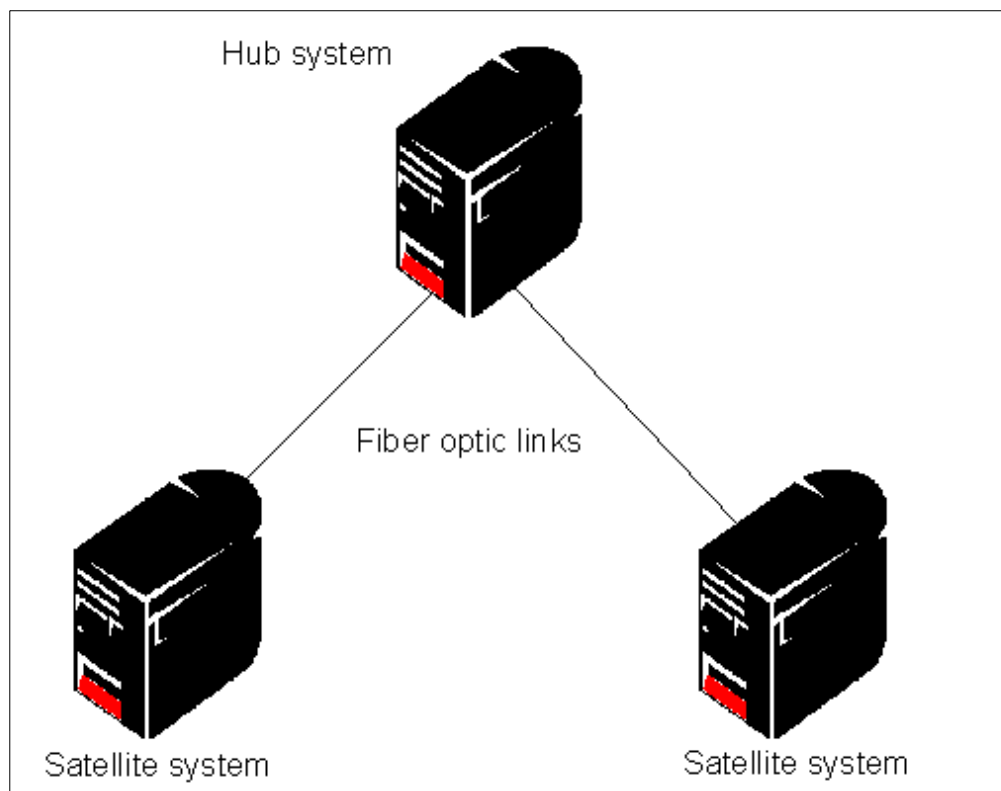


Figure 65. OptiConnect/400

The fiber optic cables connect through adapters straight into the system bus on the AS/400 system. These adapters are housed in a dedicated expansion tower on each system in the network.

Virtual OptiConnect provides a virtual bus connection between LPARs, removing the need for the hardware required by OptiConnect in a multi box situation. If an LPAR is configured with virtual OptiConnect and conventional external communications, such as ethernet or token ring, the virtual communications path will be chosen by the operating system if the ultimate destination is reachable that way.

Figure 66 shows how this virtual connection fits into the LPAR structure.

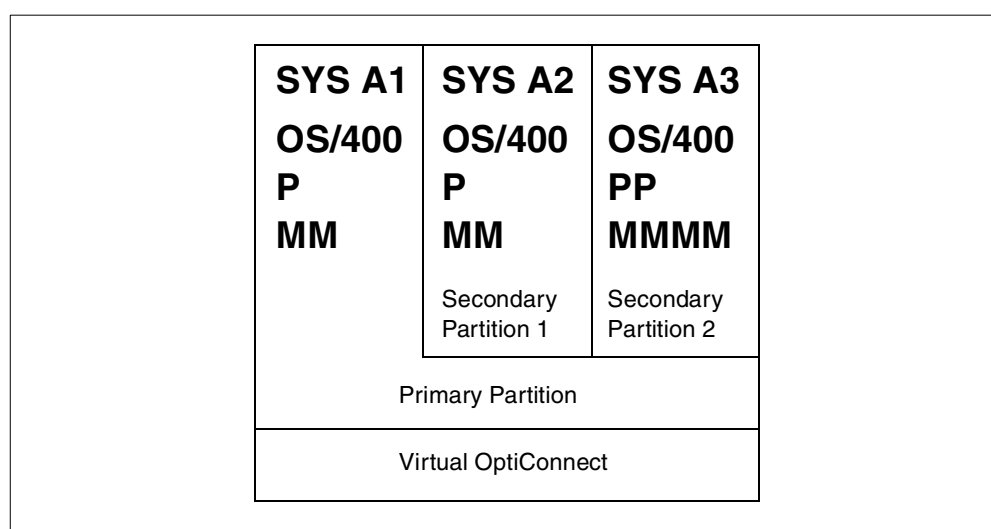


Figure 66. *Virtual OptiConnect in an LPAR environment*

To use virtual OpticConnect, you must install option 23 of the OS/400 V4R4 operating system (IBM product number 5769SS1, option 23). Inter-LPAR communications must also be set up to use virtual OptiConnect on all participating partitions. See the ITSO redbook *Slicing the AS/400 with Logical Partitioning: A How to Guide*, SG24-5439 for details on setting up virtual OptiConnect.

12.3 Backup considerations

With LPARs, it is no longer possible to back up an entire AS/400 box with a single save command. Each LPAR is a separate entity. To perform a backup on an individual LPAR requires a command to be executed on that LPAR.

12.3.1 Sharing tape drives

LPARs can be configured to share removable media devices, such as tape drives and libraries. If this is done and each LPAR does not have its own dedicated tape device, nightly backups require operator intervention to dynamically reassign the devices from one LPAR to another. Therefore, backups become a sequential rather than concurrent operation.

This saves on the expense of investing in tape drives for each partition, but consider the consequences. In a non-LPAR AS/400 environment with three AS/400 systems, if each system takes three hours to back up, and if each backup started at midnight, all systems would be finished by 3:00am.

Using an AS/400 system with three LPARs running the same applications but utilizing a shared tape device, the total backup time would be nine hours. This is because the primary partition would take three hours; then, an operator would have to reassign the tape drive to the second partition. This would then take another three hours. After the second partition has finished backing up, the operator would have to reassign the tape drive to the third LPAR. This third LPAR would then take three hours to back up; so, total backup time would be nine hours.

Using Tivoli Storage Manager to back up the user data would eliminate the need for an operator to swap over the tape device between partitions.

12.3.2 Using Tivoli Storage Manager on LPARs

Using Tivoli Storage Manager on an LPAR AS/400 system can be very useful. By running a Tivoli Storage Manager server on one LPAR and BRMS with the BRMS Application Client on other LPARs it is possible to back up each partition's user data without the need for operators to move tape devices from one partition to another. Also, if virtual OptiConnect is used, then the data transfer rates will be very high.

12.3.2.1 Tivoli Storage Manager setup considerations

Setting up a Tivoli Storage Manager/400 server or BRMS application client is no different than the procedures for conventional stand-alone AS/400 systems. Provided that OptiConnect has been set up correctly, the BRMS application client will automatically utilize the high-speed virtual link to the Tivoli Storage Manager/400 server.

The same restrictions still apply to what data can be saved to a Tivoli Storage Manager server, that is, user data only.

If the licensed program installation media needs a device that is shared between partitions, it may be easier to install BRMS and the BRMS application client on one partition, then save the licensed programs to a savefile and ftp it to the other partitions.

It is also recommended that the LPAR used as the Tivoli Storage Manager server does not share the Tivoli Storage Manager tape library with other LPARs in the system since this could disrupt or delay Tivoli Storage Manager server operations if it requires the library when it is not available. There is also an increased risk of a Tivoli Storage Manager tape volume being overwritten by data from another LPAR.

12.3.2.2 Running applications in the primary partition

If the primary concern is machine availability, the recommendation is that you should not run any applications in the primary partition, including Tivoli Storage Manager, BRMS, and the BRMS application client. This minimizes the risk of the primary partition failing due to an application fault, which would cause the failure of all the secondary partitions as well.

12.3.2.3 Performance

A two LPAR 720 machine was set up with a Tivoli Storage Manager/400 server on one LPAR and BRMS with the BRMS application client on the other. Each partition was allocated two CPUs and 4096 Mb of main storage.

It took just 28 seconds to back up 297 objects from the QSYS.LIB file system, with a total size 209 Mb. This works out to over 26 GB per hour in this particular case.

12.3.2.4 Recovery

Tivoli Storage Manager server or client recovery is similar to that detailed for non-LPAR systems. The steps required to recover the system and data should be exactly the same once the LPAR configuration is in place.

Chapter 13. Care and feeding

This chapter examines some of the daily tasks that should be carried out, and provides helpful suggestions on performance issues relating to AS/400 Tivoli Storage Manager servers and clients.

13.1 Day-to-day operations

As part of your daily operations, it is important that various aspects of the Tivoli Storage Manager implementation is checked. This helps prevent minor problems from becoming major problems.

13.1.1 Activity log

The activity log shows normal activity messages generated by the server. These messages include information about server and client operations, such as the start time of sessions or device I/O errors. Each message includes a message ID, date and time stamp, and a text description.

You should check the last twenty four hours of activity log messages. This is accomplished with the `query actlog` command:

```
tsm: ADSM>query actlog begintime=now-24
```

DATE/TIME	MESSAGE
20.02.2000 14:47:43	ANR0811I Inventory client file expiration started as process 8.
20.02.2000 14:47:43	ANR2369I Database backup volume and recovery plan file expiration starting under process 8.
20.02.2000 14:47:43	ANR0812I Inventory file expiration process 8 completed: examined 1 objects, deleting 0 backup objects, 0 archive objects, 0 DB backup volumes, and 0 recovery plan files. 0 errors were encountered.
20.02.2000 14:47:43	ANR0985I Process 8 for EXPIRATION running in the BACKGROUND completed with completion state SUCCESS at 14:47:43.
20.02.2000 17:00:23	ANR2750I Starting scheduled command BACKUP_DB (backup db devclass=qic tapeclass1 type=full).
20.02.2000 17:00:23	ANR2017I Administrator ADSMADMIN issued command: BACKUP DB devclass=qic_tapeclass1 type=full
20.02.2000 17:00:23	ANR0984I Process 9 for DATABASE BACKUP started in the BACKGROUND at 17:00:23.
20.02.2000 17:00:23	ANR2280I Full database backup started as process 9.
20.02.2000 17:00:23	ANR8326I 016: Mount QIC volume SCRATCH R/W in drive TAP01 (TAP01) of library MANLIB within 60 minutes.
20.02.2000 17:00:23	ANR2751I Scheduled command BACKUP_DB completed successfully.
21.02.2000 09:18:05	ANR0407I Session 6 started for administrator ADSMADMIN
more... (<ENTER> to continue, 'C' to cancel)	
20.02.2000 17:00:23	ANR2751I Scheduled BACKUP_DB completed successfully.

The `begintime` parameter in the preceding screen has been set to show all entries from a period starting 24 hours before the current Tivoli Storage Manager server time up until the current time.

13.1.2 Scheduled event records

Every time a scheduled event is processed or missed, an entry is made in the Tivoli Storage Manager server database.

13.1.2.1 Client schedules

You should check all event records for the past 24 hours with the `query event` (query event) command. This command must be qualified with the domain and schedule name. To check the events associated with the domain called `standard` and the schedule called `alainsch`, and to show the events of the last 24 hours and future events scheduled for today and tomorrow, do the following:

```
tsm: ADSM> q event standard alainsch begintime=now-24 enddate=today+1
```

SCHEDULED START	ACTUAL START	SCHEDULE NAME	NODE NAME	STATUS
02/20/2000 14:50:00		ALAINSCH	ITSORE06	MISSED
02/21/2000 14:50:00		ALAINSCH	ITSORE06	FUTURE
02/22/2000 14:50:00		ALAINSCH	ITSORE06	FUTURE

To show only events that did not run or events that failed, add the parameter `exceptionsonly=yes` to the query event command.

13.1.2.2 Administrative schedules

To query the event records for details of an administrative schedule called `migrate` for today and tomorrow, use the following command:

```
tsm: ADSM> q event migrate type=admin begindate=today enddate=today+1
```

SCHEDULED START	ACTUAL START	SCHEDULE NAME	STATUS
02/21/2000 16:09:00	02/21/2000 16:10:00	MIGRATE	COMPLETED
02/22/2000 16:09:00		MIGRATE	FUTURE

You can also add the `exceptionsonly=yes` parameter to get a list of failed or missed administrative schedules.

13.1.3 Nodes

It is possible to check the last time a client node accessed the server. This is done using the `query node` command as follows:


```
tsm: ADSM> query node
```

NODE NAME	PLATFORM	POLICY DOMAIN NAME	DAYS SINCE LAST ACCESS	DAYS SINCE PASSWORD SET	LOCKED?
APPN.NINJA	OS400	AS400	1	16	NO
ITSORE06	Win95	STANDARD	10	15	NO
MARCUS	Win95	STANDARD	<1	21	NO
NTSERVER	WinNT	PRODUCTION	<1	<1	NO
RCHASM12	OS400	AS400	<1	12	NO
RS6001	AIX	STANDARD	6	6	NO
SANTOSH	OS400	AS400	6	14	NO

From this screen, you can see that the nodes `ITSORE06`, `RS6001` and `SANTOSH` have not accessed the server for a few days. The `APPN.NINJA` node last accessed yesterday, and the `MARCUS`, `NTSERVER` and `ASM12` nodes have all accessed today. From the information shown, it would be prudent to carry out a check on the systems `ITSORE06`, `RS6001`, and `SANTOSH`.

13.1.4 Tivoli Storage Manager database

It is important that the database does not fill up. If this happens, clients will not be able to back up any more data to the Tivoli Storage Manager server. To check the state of the database, use the `query db` command:

```
tsm: ADSM> query db
```

AVAILABLE SPACE (MB)	ASSIGNED CAPACITY (MB)	MAXIMUM EXTENSION (MB)	MAXIMUM REDUCTION (MB)	PAGE SIZE (BYTES)	TOTAL USABLE PAGES	USED PAGES	PCT UTIL	MAX. PCT UTIL
60	60	0	44	4,096	15,360	1,221	7.9	7.9

The database above has a utilization of only 7.9 percent; so, there is lots of life left in it. To find out how to increase the size of the database, see 6.8.1, “Database full” on page 169.

13.1.5 Storage pools

If the storage pools fill up and there is no migration to another pool, backups to that pool will fail. To check storage pool utilization, use the `query stgpool` command:

```
tsm: ADSM> query stgpool
```

STORAGE POOL NAME	DEVICE CLASS NAME	ESTIMATED CAPACITY (MB)	PCT UTIL	PCT MIGR	HIGH MIG PCT	LOW MIG PCT	NEXT STORAGE POOL
ARCHIVEPOOL	DISK	50.0	0.0	0.0	90	70	
BACKUPPOOL	DISK	2,200.0	64.0	64.0	95	70	

The preceding screen shows the archivepool as empty and the backuppool as 64 percent full. See 6.8.3, “Storage pool full” on page 172 for more details on storage pool space problems.

13.1.6 Storage pool volumes

You should check the available space on disk and tape volumes. You should also ensure that there are enough scratch volumes available to tape libraries.

To check the usage of existing volumes, use the `query volume` command:

```
tsm: ADSM>query volume
```

VOLUME NAME	STORAGE POOL NAME	DEVICE CLASS NAME	ESTIMATED CAPACITY (MB)	PCT UTIL	VOLUME STATUS
/TSMVOL/STGPOOL/ARCHIV01	ARCHIVEPOOL	DISK	25.0	0.0	ON-LINE
/TSMVOL/STGPOOL/BACKUP01	BACKUPPOOL	DISK	500.0	99.9	ON-LINE
000BC8	3570_POOL	TSM_3570	4,990.0	18.4	FILLING

The screen shows that the volume `QUSRADSM/BACKUP01 (BACKUP01)` that is defined to storage pool `BACKUPPOOL` is 100 percent full. See 6.8.3, “Storage pool full” on page 172 for more details on storage pool space problems.

To check the availability of scratch volumes in an AS400MLB library, use the command `query libvol`.

```
tsm: ADSM> query libvol
```

LIBRARY NAME	VOLUME NAME	STATUS	LAST USE	ACCESS
3570_LIB	000B7E	SCRATCH		AVAILABLE
3570_LIB	000CF0	PRIVATE	DATA	AVAILABLE
3570_LIB	000D15	PRIVATE	DATA	AVAILABLE
3570_LIB	000D31	PRIVATE	DATA	AVAILABLE
3570_LIB	000D41	SCRATCH		AVAILABLE
3570_LIB	000D57	SCRATCH		AVAILABLE
3570_LIB	000D62	SCRATCH		AVAILABLE
3570_LIB	000FE8	PRIVATE	DB BACKUP	AVAILABLE
3570_LIB	000FF6	PRIVATE	DATA	AVAILABLE

To check the availability of scratch volumes if the library type is `USRDFN`, you can use the following BRMS command from an AS/400 screen:

```
====> wrkmlmbrm mlb(tapmlb01) cgy(tsm01)
```

The preceding command will display all tape volumes that have been assigned to the `tsm01` category residing in the tape library called `tapmlb01`.

13.1.7 Mount requests

If a manual library system is used, an operator must be constantly aware of pending mount requests. See 6.7, “Mount requests for manual libraries” on page 167 for further information on dealing with mount requests.

13.1.8 AS/400 system status

It is useful to be able to determine some general information about the current state of the AS/400 system. This can be achieved with the `Display System Status` command. This shows things like CPU and disk space usage as well as more advanced information regarding memory usage.

```
Work with System Status                                ASML2
                                                    02/21/00 09:44:04
% CPU used . . . . . :          5.5   Auxiliary storage:
Elapsed time . . . . . : 00:00:01   System ASP . . . . . : 22.80 G
Jobs in system . . . . . :          860 % system ASP used . . : 25.6526
% addresses used:      Total . . . . . : 22.80 G
  Permanent . . . . . :          .007   Current unprotect used : 468 M
  Temporary . . . . . :          .009   Maximum unprotect . . : 710 M

Type changes (if allowed), press Enter.

System   Pool   Reserved   Max   -----DB-----   ---Non-DB---
Pool   Size (M)   Size (M)   Active   Fault   Pages   Fault   Pages
  1      49.07      28.07   +++++   .0      .0      8.2      8.2
  2     162.91       .00      45     .0      .0      .0      .0
  3       .25       .00       1     .0      .0      .0      .0
  4      11.75       .00       8     .0      .0     11.7     22.8

Bottom
Command
====>
F3=Exit   F4=Prompt           F5=Refresh   F9=Retrieve   F10=Restart
```

Like all systems, if the amount of free space available on the AS/400 shrinks too much, the machine will slow and eventually stop working altogether. To check this, look at the `Auxiliary storage` area of the screen. The `System ASP` field shows the total available disk space in the system auxiliary storage pool. This is a collection of disks. On many systems, all available disks will be assigned to the same ASP. If this is the case, the Tivoli Storage Manager working library or directories defined will also be on this ASP.

If the Tivoli Storage Manager work library or directories are on a separate ASP, you will have to use the `Work with Disk Status` command to see the usage on the disks assigned to that ASP.

Work with Disk Status						ASM12		02/21/00 09:46:02		
Elapsed time: 00:00:06										
Unit	Type	Size (M)	% Used	I/O Rqs	Request Size (K)	Read Rqs	Write Rqs	Read (K)	Write (K)	% Busy
1	6606	1967	60.8	.1	4.0	.1	.0	4.0	.0	0
2	6602	1031	23.3	.1	4.0	.1	.0	4.0	.0	0
3	6602	1031	23.3	.0	.0	.0	.0	.0	.0	0
4	6602	1031	23.2	.0	.0	.0	.0	.0	.0	0
5	6602	1031	23.2	.0	.0	.0	.0	.0	.0	0
6	6602	1031	23.4	.1	4.0	.1	.0	4.0	.0	0
7	6602	1031	21.9	.1	4.0	.1	.0	4.0	.0	0
8	6602	1031	21.9	.1	4.0	.1	.0	4.0	.0	0
										Bottom
Command										
===>										

Pressing **F11** will cycle through the different views on this screen. The view above shows the usage of each disk. The second view will show you what ASP each disk unit belongs to.

If sequential access disk volumes are used, there is a risk that they will fill up the ASP as these volumes are defined by Tivoli Storage Manager. To ensure that this does not happen, check the maximum scratch volumes parameter on the storage pools that use sequential access disk volumes.

13.2 Server configuration information

It is useful to have a complete listing of all Tivoli Storage Manager server information. This helps with troubleshooting and server recovery. This is especially useful if, for some unfortunate reason, you cannot restore a copy of the Tivoli Storage Manager database after a disaster and need to re-create the server from scratch.

This can be performed using macros or individual commands from within a CL program. For information on macros, see Chapter 9, "Tivoli Storage Manager advanced features" on page 213.

The commands required to extract this information are numerous. However, it is easy to create a small CL program that executes each of these commands then sends the output from each command to an AS/400 file. This file can then be either copied onto another machine or printed out and stored.

The first step is to create a destination file for all this information. The following command creates an AS/400 file that has no limits on the number of members it may contain. The file also has a record length of 132 characters (to fit standard printer width). No members are initially created (they will all be created by the CL program):

```
====> CRTPF FILE(QUSRADSM/TSMOUT) RCDLEN(132) MBR(*NONE) MAXMBRS(*NOMAX)
```

The next step is to create the CL source information. Details of the actual source are shown in the following screen. For information on how to create source files, you may find the book *OS/400 CL Programming*, SC41-5721, useful.

Figure 67 and Figure 68 on page 330 show the source code of the recommended CL program:

```

***** Beginning of data *****
0001.00 PGM
0002.00          STRADMADSM ADMINNAME(WITTSM) PASSWORD(SMILEY) +
0003.00                      COMMAND('query LICENSE') +
0004.00                      OUTFILE(QUSRADSM/TSMOUT) OUTMBR(LICENSE)
0005.00          STRADMADSM ADMINNAME(WITTSM) PASSWORD(SMILEY) +
0006.00                      COMMAND('query OPTION') +
0007.00                      OUTFILE(QUSRADSM/TSMOUT) OUTMBR(OPTION)
0008.00          STRADMADSM ADMINNAME(WITTSM) PASSWORD(SMILEY) +
0009.00                      COMMAND('query STATUS') +
0010.00                      OUTFILE(QUSRADSM/TSMOUT) OUTMBR(STATUS)
0011.00          STRADMADSM ADMINNAME(WITTSM) PASSWORD(SMILEY) +
0012.00                      COMMAND('query DB F=D') +
0013.00                      OUTFILE(QUSRADSM/TSMOUT) OUTMBR(DB)
0014.00          STRADMADSM ADMINNAME(WITTSM) PASSWORD(SMILEY) +
0015.00                      COMMAND('query DBVOL F=D') +
0016.00                      OUTFILE(QUSRADSM/TSMOUT) OUTMBR(DBVOL)
0017.00          STRADMADSM ADMINNAME(WITTSM) PASSWORD(SMILEY) +
0018.00                      COMMAND('query LOG F=D') +
0019.00                      OUTFILE(QUSRADSM/TSMOUT) OUTMBR(LOG)
0020.00          STRADMADSM ADMINNAME(WITTSM) PASSWORD(SMILEY) +
0021.00                      COMMAND('query LOGVOL F=D') +
0022.00                      OUTFILE(QUSRADSM/TSMOUT) OUTMBR(LOGVOL)
0023.00          STRADMADSM ADMINNAME(WITTSM) PASSWORD(SMILEY) +
0024.00                      COMMAND('query STGPOL F=D') +
0025.00                      OUTFILE(QUSRADSM/TSMOUT) OUTMBR(STGPOL)

```

Figure 67. CL program to gather server configuration information

```

0026.00          STRADMADSM ADMINNAME(WITTSM) PASSWORD(SMILEY) +
0027.00                      COMMAND('query VOLUME F=D') +
0028.00                      OUTFILE(QUSRADSM/TSMOUT) OUTMBR(VOLUME)
0029.00          STRADMADSM ADMINNAME(WITTSM) PASSWORD(SMILEY) +
0030.00                      COMMAND('query NODE F=D') +
0031.00                      OUTFILE(QUSRADSM/TSMOUT) OUTMBR(NODE)
0032.00          STRADMADSM ADMINNAME(WITTSM) PASSWORD(SMILEY) +
0033.00                      COMMAND('query ADMIN F=D') +
0034.00                      OUTFILE(QUSRADSM/TSMOUT) OUTMBR(ADMIN)
0035.00          STRADMADSM ADMINNAME(WITTSM) PASSWORD(SMILEY) +
0036.00                      COMMAND('query DOMAIN F=D') +
0037.00                      OUTFILE(QUSRADSM/TSMOUT) OUTMBR(DOMAIN)
0038.00          STRADMADSM ADMINNAME(WITTSM) PASSWORD(SMILEY) +
0039.00                      COMMAND('query POLICY F=D') +
0040.00                      OUTFILE(QUSRADSM/TSMOUT) OUTMBR(POLICY)
0041.00          STRADMADSM ADMINNAME(WITTSM) PASSWORD(SMILEY) +
0042.00                      COMMAND('query COPY TYPE=BACKUP F=D') +
0043.00                      OUTFILE(QUSRADSM/TSMOUT) OUTMBR(COPYBACK)
0044.00          STRADMADSM ADMINNAME(WITTSM) PASSWORD(SMILEY) +
0045.00                      COMMAND('query COPY TYPE=ARCHIVE F=D') +
0046.00                      OUTFILE(QUSRADSM/TSMOUT) OUTMBR(COPYARC)
0047.00          STRADMADSM ADMINNAME(WITTSM) PASSWORD(SMILEY) +
0048.00                      COMMAND('query MGMT F=D') +
0049.00                      OUTFILE(QUSRADSM/TSMOUT) OUTMBR(MGMTCLASS)
0050.00          STRADMADSM ADMINNAME(WITTSM) PASSWORD(SMILEY) +
0051.00                      COMMAND('query DEVC F=D') +
0052.00                      OUTFILE(QUSRADSM/TSMOUT) OUTMBR(DEVC)
0053.00          STRADMADSM ADMINNAME(WITTSM) PASSWORD(SMILEY) +
0054.00                      QUIET(*YES) COMMAND('query DRIVE F=D') +
0055.00                      OUTFILE(QUSRADSM/TSMOUT) OUTMBR(DRIVE)
0056.00          MONMSG      MSGID(ANR7988)
0057.00          STRADMADSM ADMINNAME(WITTSM) PASSWORD(SMILEY) +
0058.00                      COMMAND('query LIBR F=D') +
0059.00                      OUTFILE(QUSRADSM/TSMOUT) OUTMBR(LIBRARY)
0060.00          MONMSG      MSGID(ANR7988)
0061.00          STRADMADSM ADMINNAME(WITTSM) PASSWORD(SMILEY) +
0062.00                      COMMAND('query EXIT F=D') +
0063.00                      OUTFILE(QUSRADSM/TSMOUT) OUTMBR(EXITS)
0064.00          MONMSG      MSGID(ANR7988)
0065.00          STRADMADSM ADMINNAME(WITTSM) PASSWORD(SMILEY) +
0066.00                      COMMAND('query SCHED F=D') +
0067.00                      OUTFILE(QUSRADSM/TSMOUT) OUTMBR(SCHED)
0068.00          MONMSG      MSGID(ANR7988)
0069.00          STRADMADSM ADMINNAME(WITTSM) PASSWORD(SMILEY) +
0070.00                      COMMAND('query ASSOC') +
0071.00                      OUTFILE(QUSRADSM/TSMOUT) OUTMBR(ASSOC)
0072.00          MONMSG      MSGID(ANR7988)
0073.00          CPYF          FROMFILE(QUSRADSM/TSMOUT) TOFILE(QSYSPT) +
0074.00                      FROMMBR(*ALL)
0075.00                      ENDPGM
***** End of data *****

```

Figure 68. CL program to gather server configuration information (continued)

Once created, the CL program should be run whenever needed. This should be done whenever changes are made to the Tivoli Storage Manager server, such as when new client nodes are registered or schedules are updated. It may prove useful to have this command scheduled run at a specific time each day.

Note

Alternatively you can use the `QUERY SYSTEM` command to obtain consolidated information regarding Tivoli Storage Manager configuration and capacity. This command consolidates output from a variety of existing query commands.

13.3 Server performance considerations

As an application, Tivoli Storage Manager uses nearly every part of your System environment- including CPU, memory, disk, I/O and network. Any one of these could be a potential bottleneck to performance in your configuration. Because of this, TSM tuning can sometimes be a challenge. As soon as you change one thing, something else is affected. The trick is to get the balance right, which is not easy. So much depends on your specific installation that it is difficult to give general setup information.

You will have to take your time to change things and observe the results. To give you an idea of some of the different aspects of a Tivoli Storage Manager server that can affect performance, take note of the following sections.

13.3.1 Collocation

With collocation enabled, client restores can be achieved in shorter times. This is because less tapes have to be searched through for the required data. To find out more regarding collocation, see Chapter 6, “Server Storage Management” on page 139.

13.3.2 Migration

Keep an eye on the migration thresholds. If they are set too high, when client backups are in progress, they may have to wait while migration makes room for the new client data. See Chapter 6, “Server Storage Management” on page 139 for more details on migration.

13.3.3 Caching storage pools

If restore performance is a primary consideration, you could implement caching. Caching is only applicable to disk storage pools. The drawback with caching is that it increase the size of the database because there are more copies of the same file for the database to keep an eye on.

See Chapter 6, “Server Storage Management” on page 139 for details on how to set up caching.

Note

Check the AS/400 Tivoli Storage Manager Performance Report
<http://adsmperf.tucson.ibm.com> (available for IBM internals only) for the latest recommendations on system settings.

13.3.4 Database mirroring

If the database is being mirrored, you can increase the performance of the server by using parallel read/write settings for the database instead of sequential read/write settings.

Using this method, database pages are written to all copies of the database at the same time.

Of course there is always a trade-off and in this case, it is recoverability. Using parallel settings increases the chance of both databases being corrupted during a

machine failure. So, for reduced performance but increased protection, the database should be set to sequential operation - this means database pages are written to one copy of the database at a time, and they are only written after a completed I/O operation.

Remember that if Tivoli Storage Manager database mirroring is to be effective on an AS/400 system, the different database mirrored volumes should be on different auxiliary storage pools. For details on how to setup database mirroring see Chapter 8, "Protecting the Tivoli Storage Manager/400 server" on page 193.

13.3.5 Frequently used volumes

If you have a tape volume that is frequently used for some reason, you could change the mount retention parameter on the device class.

This will increase the time that the tape volume remains loaded in the tape library after a tape operation has completed, which eliminates the need to waste time locating and mounting the volume if it is required within the mount retention period.

To change the mount retention parameter for device class TSM3570 to 60 minutes, issue the following command:

```
tsm: ADSM> update devc TSM3570 mountretention=60
```

One drawback of doing this is that, if a different tape volume is requested before the drive has been unloaded, there will be a delay while the tape is being removed.

Another drawback is that, if Tivoli Storage Manager has a volume mounted, AS/400 tape operations will not be successful on the drive until Tivoli Storage Manager has released its hold on the tape volume. To find out what volumes are currently mounted, use the command: `query mount`.

To dismount a volume so that a drive is available for use, use the command `dismount volume volname`, where `volname` is the name of the volume found with the `query mount` command above:

13.3.6 Server options

There are several parameters of the Tivoli Storage Manager server that affect its performance. These parameters are briefly discussed here. To change server options, type the `CHGSVRADSM` command at the OS/400 command line. Remember that you need to restart the Tivoli Storage Manager server for any changes to take effect.

13.3.6.1 Maximum client sessions

The `MAXSESSION` parameter specifies the maximum number of simultaneous client sessions that can connect with the Tivoli Storage Manager server. The default value is 25 client sessions. The minimum value is 2 client sessions. The maximum value is limited only by available virtual memory or communication resources. This parameter specifies the maximum number of simultaneous client sessions that can connect with 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 clients is reduced.

13.3.6.2 Expiration interval

The Tivoli Storage Manager server runs automatic inventory expiration and this option specifies the interval for this process in hours. Inventory expiration removes client backup and archive file copies from the server. The range is between zero and 336 hours, with 24 hours being the default in Version 3. Note that the default in version 2 was 1 hour.

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 very CPU intensive. If possible, it should be run when other Tivoli Storage Manager processes are not occurring. To enable this, either schedule expiration once per day, or set `EXPINTERVAL` to 0 and manually start the process with the Tivoli Storage Manager `expire inventory` command.

13.3.6.3 Restore interval

This specifies how long a restartable restore can be saved in the Tivoli Storage Manager server database. As long as the restore is saved in the database, it can be restarted from the point at which it stopped.

The default is 1440 minutes (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. In this case, you will not be able to restart restore.

The maximum value is one week; the higher the value, the greater the overhead on the Tivoli Storage Manager database.

13.3.6.4 Maximum transaction group size

This parameter controls the maximum number of files that will be transferred as a group between a client and server before a commit occurs. You can improve the performance of the backup-archive client `BACKUP`, `ARCHIVE`, `RESTORE`, and `RETRIEVE` commands by using a larger value for this option. The default is 16 files. Valid values range from 4 to 256 files.

When setting the size of transactions, consider setting a smaller size if you are suffering many resends due to files changing during backup when using static, shared static, or shared dynamic copy serialization. This would apply to static as well as to shared because, when the client realizes a file has changed during a backup and decides to not send that file, it would still have to resend the other files in that transaction as well.

13.3.6.5 Move batch size and move size threshold

Move batch size specifies the number of files that are to be moved and grouped together in a batch within the same server transaction. Valid values for move batch size range from 1 to 1000 files. Move size threshold specifies the amount of

data moved as a batch within the same server transaction. The default is 1 MB and the valid range is 1 to 500 MB.

These two options help tune the performance of the server processes that involve the movement of data between storage media. These processes include storage pool backup and restore, migration, reclamation, and move data.

Note that when the Move batch size and Move size threshold parameters are increased from their default values, the server will require more space in the recovery log. The recovery log may require an allocation space two or more times larger than a recovery log size that uses the defaults. In addition, the server requires a longer initialization time at startup. The impact of a larger recovery log size will be felt while running the server with the logmode set to NORMAL (the default value). If you choose to increase these values for performance reasons, be sure to monitor recovery log usage during the first few storage pool backup/restore, migration, reclamation, or move data processes to ensure sufficient recovery log space is available.

13.3.6.6 Maximum memory increments

This specifies the maximum number of memory increments to be used by the server. Each memory increment permits the server to use as much as an additional 80 megabytes of space. The server starts with the minimum amount of memory required to perform basic operations and increases its memory use as necessary. Specify the maximum number of memory increments for the server. Valid values range from 1 to 99. The default is one.

13.3.6.7 Use large buffers

This specifies that large buffers are used for client/server communications. This parameter increases communication and device I/O buffers. Both the client-server communication buffer and disk device I/O buffers have been increased from 32 KB to 256 KB. The communication I/O buffer is used during data transfer with a client session, such as a backup session. The disk I/O buffer is used when data is read from or written to a disk storage pool.

Significant improvement in data transfer operations and CPU usage has been observed when the USELARGEBUFFER feature is enabled. Increasing the buffer sizes allows client-server communications and disk I/O to be more efficiently performed than environments without this feature enabled. Reads and writes are quicker and server resources are better utilized. By reducing CPU utilization, more clients can concurrently be serviced, therefore, improving overall system performance. With Tivoli Storage Manager Version 3, these benefits are complemented with server aggregation. Aggregation groups smaller logical client files into fewer but larger physical files at the server level. Larger files are better able to take advantage of the larger buffers.

The USELARGEBUFFER option is enabled by default.

13.3.6.8 Storage audit

As part of a license audit operation, the server calculates, by node, the amount of backup, archive, and space management storage in use. For servers managing large amounts of data, this calculation can take a great deal of CPU time and can delay other server activity. It is recommended to schedule this activity as mentioned in Chapter 7, "Tivoli Storage Manager policy and automation" on page

173. The storage audit parameter allows users to indicate whether the storage is to be calculated as part of a license audit or not.

13.3.6.9 Buffer pool size

Cache storage is provided by the database buffer pool size, which allows the database pages to remain in memory for longer periods of time. This will allow the database pages to remain in cache. The server can make continuous updates to the pages without requiring I/O operations to external storage. While a database buffer pool can improve server performance, it will also require more virtual memory.

An optimal setting for the database buffer pool is one in which the cache hit percentage is greater than or equal to 98 percent. To check the cache hit percentage, use the query database command:

```
tsm: ADSM> query db format=detail

    Available Space (MB): 40
    Assigned Capacity (MB): 40
    Maximum Extension (MB): 0
    Maximum Reduction (MB): 32
    Page Size (bytes): 4,096
    Total Usable Pages: 10,240
    Used Pages: 1,636
    Pct Util: 16.0
    Max. Pct Util: 16.0
    Physical Volumes: 12
    Buffer Pool Pages: 512
    Total Buffer Requests: 46,315
    Cache Hit Pct.: 99.67
    Cache Wait Pct.: 0.00
    Backup in Progress?: No
    Type of Backup In Progress:
    Incrementals Since Last Full: 0
    Changed Since Last Backup (MB): 0.25
    Percentage Changed: 3.91
    Last Complete Backup Date/Time: 02/13/1999 00:23:46
```

Increasing the buffer pool size parameter can improve the performance of many Tivoli Storage Manager server functions, such as multi-client backup, storage pool migration, storage pool backup, expiration processing, and move data. If the cache hit percentage is lower than 99 percent, increase the buffer pool size parameter in the server options file. For most servers, we recommend starting with a value of 32768, which equals 8192 database pages. If you have enough memory, increase in 1 MB increments. A cache hit percentage greater than 99 percent is an indication that the proper buffer pool size has been reached. However, continuing to raise the buffer pool size beyond that level can be very helpful. While increasing buffer pool size, care must be taken not to cause paging in the virtual memory system. Monitor system memory usage to check for any increased paging after the buffer pool size change. For resetting buffer pool statistics, use the following command:

```
tsm: ADSM> reset bufpool
ANR0381I Bufferpool statistics were successfully reset.
```

13.4 AS/400 application client performance

There are a couple of methods of increasing backup performance that apply only to the BRMS application client.

13.4.1 Object detail

Backup speed can be increased if object detail is not retained in the BRMS database. BRMS takes time to update a file with information about each object that is backed up. This is less of a consideration if there are only a few large files. But, if there are numerous small files, it can have a serious impact on backup performance.

If objects are saved using the BRMS application client without any object detail information, those objects can still be recovered individually. In order to do this, the exact name of the object and library must be known rather than being able to select the object from a list as is the case when object detail is retained.

To change the object detail information on a BRMS control group is simple. Type in `go brmbkupln` to go to the Work with Backup Control Groups screen:

Take option 2 to work with control groups from the Work with Backup Control groups menu:

```
Work with Backup Control Groups                NINJA

Position to . . . . .          Starting characters

Type options, press Enter
 1=Create   2=Edit entries   3=Copy   4=Delete   5=Display
 6=Add to schedule  8=Change attributes  9=Subsystems to process ...

      Control      Full      Incr      Weekly
Opt Group      Policy      Policy      Activity
      *BKUGRP      *BKUPCY      *BKUPCY      *BKUPCY      Entry created by BRM configura
      *SYSGRP      SAVSYS      SAVSYS      *BKUPCY      Entry created by BRM configura
2  ADSM          ADSM          ADSM          *BKUPCY      *NONE

F3=Exit      F5=Refresh      F7=Work with BRM scheduled jobs
F9=Change backup policy      F23=More options      F24=More keys
```

Type option 2 (Edit entries) next to the control group and press **Enter** to get the *Edit Backup Control Group Entries* screen to appear:

```

Edit Backup Control Group Entries                                NINJA

Group . . . . . : ADSM
Default activity . . . . . *BKUPCY
Text . . . . . *NONE

Type information, press Enter.

Seq      Backup      List      Weekly      Retain      Save      SWA
         Items       Type      Activity   Object      While     Message
                               SMTWFS    Detail     Active     Queue

    10    *ALLUSR                *DFTACT    *NO        *NO

F3=Exit          F5=Refresh          F10=Change item
F11=Display exits F12=Cancel          F24=More keys

Bottom

```

There are three options for the Retain Object Detail field:

- *YES indicates that object detail information should always be recorded.
- *NO indicates that object detail should never be recorded
- *ERR indicates that object details should only be recorded when objects fail to save

13.4.2 Multiple control groups

Running multiple control groups at the same time can have a good effect on performance. Tests were carried out using six identical libraries. The time taken to complete a full backup of all the libraries was measured using only one control group (containing all six libraries), two control groups (three libraries each), and three control groups (two libraries each). Each library contained 112 objects, and total size of each library was 32.75 Mb.

Table 11. Comparison of backup-time depending on number of control groups

Number of Control Groups	Time Taken
One	11 minutes 5 seconds
Two	7 minutes 7 seconds
Three	6 minutes 30 seconds

As can be seen from Table 11 above, there is an improvement in the total time taken to back up the data when using more than one control group. Using three control groups gives an approximate data transfer rate of 1800 MB per hour in this specific situation.

13.4.3 Client options

The BRMS application client does not have many options available that can be changed. It is possible to change the Buffer Size when using TCP/IP communications between client and server. To change this, first get to the *Work with Devices* screen in BRMS using the `wrkdevbrm` command.

```

Work with Devices                                NINJA

Position to . . . . . Starting characters

Type options, press Enter.
  1=Add  2=Change  4=Remove  5=Display
  8=Work with status

Opt  Device      Category  Type/Model  Text
  2   TSM_SERVER  *NET
    TAP01        *TAP      6382/001    Entry created by BRM configuration

Bottom

```

Type a 2 in the `Opt` field next to the BRMS device that points towards the Tivoli Storage Manager server, then press **Enter**. In our preceding example, it is the device called `TSM_SERVER`.

```

Change Net Device

Net device . . . . . : TSM_SERVER

Type changes, press Enter.

Text . . . . . *NONE

Location . . . . . TSM_SERVER Name, F4 for list

ADSM file space . . . . . *LCL

Buffer size . . . . . 512          *DEVTYPE, 1-512 KB

Internet address . . . . . AS4001

Internet port . . . . . 1500       1-65534

```

The `Buffer size` parameter allows you to set the amount of storage that is allocated for server communications and data exchange. Changing this value to 512 KB reduces the TCP/IP call stack overhead and improves performance. PTF SF53289 must be applied to the Tivoli Storage Manager APIs in order to use buffer sizes greater than 64 KB.

The only other options that can be changed relate to the actual communications lines set up on the client. You could try increasing the Maximum frame size of the token ring line description to the maximum of 16393. Our test showed no significant change in performance between the maximum frame size of 16393 and the default maximum frame size of 1994. Follow the AS/400 recommendations when tuning this particular parameter.

13.5 Network-specific performance tuning

There is a document available on the Internet. This contains a performance guide for most Tivoli Storage Manager server and client platforms, with both general and specific advice relevant to the different operating systems. The guide can be obtained from the following Web page:

http://www.tivoli.com/support/storage_mgt/adsm/pfguide/tgv31mst.htm

13.6 Migration from earlier implementation to IFS usage

If you have been using an earlier Version of Tivoli Storage Manager server to work with disk storage space created within the QSYS.LIB file system, you should consider to upgrading to the faster implementation using stream files (STMF) in the Integrated File System (IFS). To upgrade disk volumes created in the QSYS.LIB file system to stream files (STMF) take the following steps.

The first step is to ensure you have a complete backup of the system in case something goes wrong, or at least make copies of the volumes that you will be replacing. If all Tivoli Storage Manager volumes have been created in the default work library called QUSRADSM, then the simplest way to backup these objects is to save the entire library. See 8.5.5, “Backing up server information using AS/400 commands” on page 210 for an example on how to save the QUSRADSM library. Note that the Tivoli Storage Manager must not be running when this is carried out.

Determine which volumes you want to replace. You should replace all QSYS.LIB volumes to maximize the performance advantage available with the IFS implementation. This includes any storage pool volumes, recovery log volumes, and database volumes.

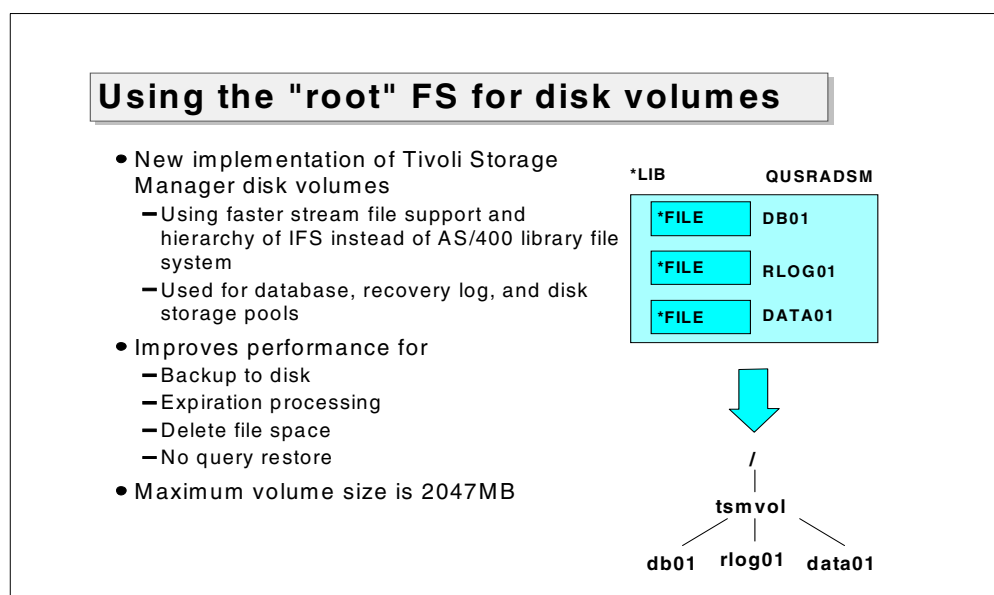


Figure 69. Using the "root" FS

Create a directory in the IFS to store your STMF volumes with the following command:

```

                                Create Directory (CRTDIR)

Type choices, press Enter.

Directory . . . . . /tsmvol

Public authority for data . . . *NONE      Name, *INDIR, *RWX, *RW...
Public authority for object . . *NONE      *INDIR, *NONE, *ALL...
      + for more values
Auditing value for objects . . . *SYSVAL    *SYSVAL, *NONE, *USRPRF...

Bottom
F3=Exit  F4=Prompt  F5=Refresh  F12=Cancel  F13=How to use this display
F24=More keys

```

This creates a directory in the IFS called "tsmvol"

To create a subdirectory for database volume use the CRTDIR command:

```

                                Create Directory (CRTDIR)

Type choices, press Enter.

Directory . . . . . /tsmvol/database

Public authority for data . . . *NONE      Name, *INDIR, *RWX, *RW...
Public authority for object . . *NONE      *INDIR, *NONE, *ALL...
      + for more values
Auditing value for objects . . . *SYSVAL    *SYSVAL, *NONE, *USRPRF...

Bottom
F3=Exit  F4=Prompt  F5=Refresh  F12=Cancel  F13=How to use this display
F24=More keys

```

To create a subdirectory for recovery log volume use the CRTDIR command:

```

T                                Create Directory (CRTDIR)

Type choices, press Enter.

Directory . . . . . /tsmvol/log

Public authority for data . . . *NONE      Name, *INDIR, *RWX, *RW...
Public authority for object . . *NONE      *INDIR, *NONE, *ALL...
      + for more values
Auditing value for objects . . . *SYSVAL    *SYSVAL, *NONE, *USRPRF...

Bottom
F3=Exit  F4=Prompt  F5=Refresh  F12=Cancel  F13=How to use this display
F24=More keys

```


To create a subdirectory for storage pool volume use the CRTDIR command:

Create Directory (CRTDIR)

Type choices, press Enter.

Directory /tsmvol/stgpool

Public authority for data . . . *NONE Name, *INDIR, *RWX, *RW...

Public authority for object . . *NONE *INDIR, *NONE, *ALL...

+ for more values

Auditing value for objects . . . *SYSVAL *SYSVAL, *NONE, *USRPRF...

Bottom

F3=Exit F4=Prompt F5=Refresh F12=Cancel F13=How to use this display

F24=More keys

When creating a directory, the owner ID (UID) is the user creating the directory. The Change Owner CHGOWN command transfers object ownership from the user creating the directory the QADSM user:

Change Owner (CHGOWN)

Type choices, press Enter.

Object > '/tsmvol/*'

New owner > QADSM Name

Revoke current authority . . . *NO *NO, *YES

Symbolic link *NO *NO, *YES

A user with *ALLOBJ has complete authority for all objects and can transfer the ownership of any object. All users have add and delete authorities for their own user profiles; that is, users can add objects to or delete objects (that they created) from their own user profiles by transferring the ownership of the object. For more information about integrated file system commands, see the AS/400 Integrated File System Introduction book, SC41-5711.

Create STMF volume using the CRTVOLADSM command. From the Tivoli Storage Manager Utilities menu (type go adsmut on a command line), take option 5.

```

Create Volume for ADSM (CRTVOLADSM)

Type choices, press Enter.

Volume type . . . . . > *STMF          *FILE, *STMF
Volume:
  Volume stream file . . . . . /tsmvol/database/db01

  Volume size . . . . . 61             Megabytes
  Replace volume . . . . . *NO         *NO, *YES
      + for more values

Bottom
F3=Exit  F4=Prompt  F5=Refresh  F12=Cancel  F13=How to use this display
F24=More keys

```

The example above is for creating a database volume. When creating database and recovery log volumes remember that Tivoli Storage Manager divides the volume up into four megabyte chunks after one megabyte of overhead has been removed, so to ensure space isn't wasted make them exactly divisible by four after subtracting one from the overall size. The example above fits this formula. You don't have to worry about any of this if you are just creating a storage pool volume.

When creating volumes ensure that it is of sufficient size to hold all the data that is on existing volume(s). Query the database, recovery log and storage pools to find out the total size. It is better to have one big volume than many small volumes as this reduces the number of processes that Tivoli Storage Manager has to run in the background.

Once the volume is created it needs to be defined. To define an STMF volume to a storage pool take the following as an example:

```
tsm: ADSM> define volume backuppool /tsmvol/stgpool/backup01
```

To define volume to database, use this command:

```
tsm: ADSM> define dbvol /tsmvol/database/db01
```

To define volume to recovery log, use this command:

```
tsm: ADSM> define logvol /tsmvol/log/rlog01
```

13.6.1 Replacing storage pool volumes

Before deleting the old volumes that reside in a storage pool the data must first be moved.

The data is moved one volume at a time to the other volumes in the storage pool. Use this command to move data from the volume `BACKUP01` in the library `QUSRADSM` to other volumes in the `BACKUPPOOL` storage pool:

```
tsm: ADSM> move data qusradsm/backup01 stgpool=backuppool
```

This will start a process that can be checked using the query process command.

Once finished you can delete the volume:

```
tsm: ADSM> delete volume qusradsm/backup01
```

This can be repeated until all `QSYS.LIB` file type volumes have had the data moved and the files deleted.

13.6.2 Replacing database volumes

The process for updating database volumes is slightly different. Once the STMF volume has been defined to the database, it is simply a matter of deleting the existing `QSYS.LIB` volume(s) using this command:

```
tsm: ADSM> delete dbvol qusradsm/db01
```

The above command will submit a process to delete the volume `db01` from Tivoli Storage Manager after automatically moving the information contained on that volume onto any other volumes defined to the database. The system checks to make sure there is enough space on the other volumes before allowing the process to start. Once the migration process is finished the database volume will be removed from the database definition.

13.6.3 Replacing recovery log volumes

The process for updating recovery log volumes is the same as that used for database volumes. Once the STMF volume has been defined to the database, it is simply a matter of deleting the existing `QSYS.LIB` volume(s) using this command:

```
tsm: ADSM> delete logvol qusradsm/log01
```

The above command will submit a process to delete the volume `log01` from Tivoli Storage Manager after automatically moving the information contained on that volume onto any other volumes defined to the recovery log. The system checks to make sure there is enough space on the other volumes before allowing the process to start. Once the migration process is finished the recovery log volume will be removed from the recovery log definition.

13.6.4 Cleaning up the storage space

When volumes are deleted from storage pools, the recovery log and the database, it is only the Tivoli Storage Manager reference to the object that is removed. In order to remove the actual files from the system to free wasted disk space it is necessary to use on AS/400 command.

To remove a volume from the QSYS.LIB file system, use this command:

```
====> dltf library/file
```

Where library is the name of the Tivoli Storage Manager work library, and file is the name of the volume to be removed. So to delete the volume backup01 in the library qusradsm do this:

```
====> dltf qusradsm/backup01
```

Because these files should already have been removed from Tivoli Storage Manager definitions this process can be done while the server is active, as there won't be any locks on the files from active Tivoli Storage Manager jobs.

13.6.5 Web administrative interface

Starting from Tivoli Storage Manager Version 3, the administrator can access the Tivoli Storage Manager server using the new Web administrative client interface. If you plan to use this new interface, start the server with the `SVRMODE` parameter set to `*PRPWEB` using the `STRSVRADSM` command:

```
====> STRSVRADSM SVRMODE(*PRPWEB)
```

In this mode the server will start, perform the database upgrade, and then stop.

13.6.6 End-of-volume support

Before V3.1.2, the AS/400 system did not provide an end-of-volume condition for applications such as TSM. Instead, the AS/400 dismounted the current volume and requested the mount of another volume. Tivoli Storage Manager fills a volume to estimated capacity based on input bytes. If the estimated capacity was set too high, warning message ANR8263W occurred. This mode of operations caused numerous problems for Tivoli Storage Manager.

OS/400 V4R3 and higher now permits a Tivoli Storage Manager server to receive an EOVS condition when writing to tape. The V3.1.2 server exploits this new function. At the point Tivoli Storage Manager receives an EOVS condition, it issues a flush of the tape and closes the tape. Tivoli Storage Manager will not attempt to write more data to that tape until it has been re-initialized. With previous levels of OS/400, Tivoli Storage Manager stops writing to tape when the predefined estimated capacity is reached.

To take advantage of the new EOVS function, you must *increase* the *estimated capacity* of your existing tape device classes to a value greater than the expected maximum capacity. If you keep your current values, Tivoli Storage Manager will continue to stop when it reaches the estimated capacity, even if that occurs before reaching the physical EOVS point.

Our example is an IBM 3570 C02 library which has two tape drives available. The format is 3570E and the default estimated capacity is 4,990 GB. You can use the `query devclass` command, that shows the following screen:

```
tsm: ASM12>query devclass tsm3570 format=detail

      DEVICE CLASS NAME: TSM3570
      DEVICE ACCESS STRATEGY: SEQUENTIAL
      STORAGE POOL COUNT: 2
      DEVICE TYPE: 3570
      FORMAT: 3570E
      EST/MAX CAPACITY (MB): 4,990.0
      MOUNT LIMIT: 2
      MOUNT WAIT (MIN): 5
      MOUNT RETENTION (MIN): 2
      LABEL PREFIX: ADMS
      LIBRARY: TAPMLB01
```

To increase the estimate capacity for device class `TSM3570` to 15 Gigabytes issue the following command:

```
tsm: ADMS> update devclass tsm3570 estcap=15g
```

You can verify the change with `query devclass` command over again:

```
tsm: ASM12>query devclass tsm3570 format=detail

      DEVICE CLASS NAME: TSM3570
      DEVICE ACCESS STRATEGY: SEQUENTIAL
      STORAGE POOL COUNT: 1
      DEVICE TYPE: 3570
      FORMAT: 3570E
      EST/MAX CAPACITY (MB): 15,360.0
      MOUNT LIMIT: 1
      MOUNT WAIT (MIN): 60
      MOUNT RETENTION (MIN): 2
      LABEL PREFIX: ADMS
      LIBRARY: TAPMLB01
```

The following shows a query of the storage pool `3570_pool` in our AS/400 Tivoli Storage Manager server.

```
tsm: ASM12>query stgp 3570_pool
```

STORAGE POOL NAME	DEVICE CLASS NAME	ESTIMATED CAPACITY (MB)	PCT UTIL	PCT MIGR	HIGH MIG PCT	LOW MIG PCT	NEXT STORAGE POOL
3570_POOL	TSM3570	19,960.1	99.8	100.0	90	70	

The following shows a query volume in our AS/400 Tivoli Storage Manager server. The example illustrates that data is being stored in storage pool 3570_pool on 3570 tape volume named 07D9A3, 080CED, 083573 and 083983:

```
tsm: ASM12>query volume stgp=3570_pool
```

VOLUME NAME	STORAGE POOL NAME	DEVICE CLASS NAME	ESTIMATED CAPACITY (MB)	PCT UTIL	VOLUME STATUS
07D9A3	3570_POOL	TSM3570	4,990.0	100.0	FULL
080CED	3570_POOL	TSM3570	4,990.0	100.0	FULL
083573	3570_POOL	TSM3570	4,990.1	100.0	FULL
083983	3570_POOL	TSM3570	4,990.0	99.1	FILLING

You can use the MOVE DATA command to move all files from selected volumes to the same storage pool provided that scratch Tapes available:

```
tsm: ASM12>move data 07D9A3 stgp=3570_pool
tsm: ASM12>move data 080CED stgp=3570_pool
tsm: ASM12>move data 083573 stgp=3570_pool
tsm: ASM12>move data 083983 stgp=3570_pool
```

The results are something like the following:

```
tsm: ASM12>query volume stgp=3570_pool
```

VOLUME NAME	STORAGE POOL NAME	DEVICE CLASS NAME	ESTIMATED CAPACITY (MB)	PCT UTIL	VOLUME STATUS
085E0A	3570_POOL	TSM3570	9,652.8	100.0	FULL
085135	3570_POOL	TSM3570	7,471.3	100.0	FULL
08527E	3570_POOL	TSM3570	15,360.0	18.2	FILLING

The compression ratios dependent on which Object Type were saved. As a rule of thumb you can expect, between 3:1-4:1 for database files, 2:1 for printer and file server data, and 1:1 for executable data.

Reclamation of a storage pool automatically move the contents of the tapes that has a estimated capacity of 4,990 GB onto the new 15,360 GB scratch tape that is new defined in the 3570_pool storage pool. That 4,990 GB empty tape will be put back into the scratch pool for reuse as 15,360 GB tape.

Appendix A. Setting up TCP/IP on an AS/400

This appendix explains how to configure the TCP/IP communication protocol on an AS/400 system. The TCP/IP code will be installed together with your OS/400 operating system; no further actions are required to load this code. The description assumes that you are running AS/400 V4R3 or higher.

For further assistance and more information on TCP/IP, consult the *TCP/IP Fast Path Setup*, SC41-5430, or *OS/400 Transmission Control Protocol/Internet Protocol Configuration and Reference Guide*, SC41-5420, for instructions and guidelines.

A.1 Collecting required information to set up TCP/IP

Some information is needed about the AS/400 system and the TCP/IP network you are attaching to before you can set up TCP/IP. Table 12 is provided to help you collect and organize this information:

Table 12. Required information to set up TCP/IP

Required information	Your system	Notes
Type of communication adapter installed in your system	A	Example: token ring. It is assumed that your communication adapter has already been installed on your system.
Resource name of this communication adapter	B	Example: CMN03
Line description for your communication line	C	Example: TRLINE
IP address of your AS/400	D	Example: 199.5.83.158 You should obtain this IP address from your network administrator.
Subnet mask for your AS/400	E	Example: 255.255.255.0 You should obtain this subnet mask from your network administrator.
Next hop address	F	Example: 199.5.83.129 The next hop address is the address of the IP router (if any) that routes network traffic from or local LAN to other networks within or outside of your organization. You should obtain this next hop address from your network administrator.
Host name and domain name for your system	G	Example: ASM12.DOMAINXY.ACME.COM You should obtain the domain name from your network administrator.
IP address for domain name server	H	Example: 199.4.191.76 The domain name server maintains the host table for an entire TCP/IP domain. You should obtain this subnet mask from your network administrator.

Write down all this information carefully. In the following sections, you will find references to this information marked by the letter used in the second column of the preceding table. In the notes column, you can see the values we used in our lab setup.

A.2 Base setup of TCP/IP

You can do all the base TCP/IP setup on your AS/400 system starting from the main TCP/IP configuration menu. To get this menu, enter the `cfgtcp` command on the AS/400 command line.

You will reach the following menu:

```
CFGTCIP                                Configure TCP/IP                                System:  ASM12

Select one of the following:

    1. Work with TCP/IP interfaces
    2. Work with TCP/IP routes
    3. Change TCP/IP attributes
    4. Work with TCP/IP port restrictions
    5. Work with TCP/IP remote system information

    10. Work with TCP/IP host table entries
    11. Merge TCP/IP host table
    12. Change TCP/IP domain information

    20. Configure TCP/IP applications
    21. Configure related tables
    22. Configure point-to-point TCP/IP

Selection or command
====>

F3=Exit  F4=Prompt  F9=Retrieve  F12=Cancel
```

Starting from this menu, follow now the configuration steps in order to perform the base setup of an TCP/IP interface on your AS/400 system.

1. From the main TCP/IP configuration menu, select option **1, Work with TCP/IP interfaces**. The *Work with the TCP/IP interfaces* screen will appear:

Work with TCP/IP Interfaces				System: ASML2
Type options, press Enter.				
1=Add 2=Change 4=Remove 5=Display 9=Start 10=End				
	Internet	Subnet	Line	Line
Opt	Address	Mask	Description	Type
1	127.0.0.1	255.0.0.0	*LOOPBACK	*NONE
Bottom				
F3=Exit	F5=Refresh	F6=Print list	F11=Display interface status	
F12=Cancel	F17=Top	F18=Bottom		

As you can see, there are already several interfaces defined. Note, the interface with a line type of `*LOOPBACK` is automatically created by TCP/IP. The `LOOPBACK` interface is provided to test TCP/IP or a TCP/IP application. Any data written to the `LOOPBACK` interface is echoed back to the same interface. `LOOPBACK` can never be used to reach a remote system.

To define your new interface, fill in the following fields.

1. Enter `1` in the `Opt` field to add a new interface and press **Enter**.
2. Fill in the `Internet` address field with **D** ('199.5.83.158' in our example. See Table 12 on page 349).
3. Fill in the `Line` description field with **C** ('TRLINE' in our example).
4. Fill in the `Subnet` mask field with **E** ('255.255.255.0' in our example).
5. You can accept the default values for the rest of the items on this display.
6. Press **Enter** and check for messages to ensure that the interface was added):

Add TCP/IP Interface (ADDTCPIFC)			
Type choices, press Enter.			
Internet address	>	'199.5.83.158'	
Line description	>	TRLINE	Name, *LOOPBACK...
Subnet mask	>	'255.255.255.0'	
Associated local interface . . .		*NONE	
Type of service		*NORMAL	*MINDELAY, *MAXTHRPUT...
Maximum transmission unit . . .		*LIND	576-16388, *LIND
Autostart		*YES	*YES, *NO
PVC logical channel identifier			001-FFF
+ for more values			
X.25 idle circuit timeout . . .	60		1-600
X.25 maximum virtual circuits .	64		0-64
X.25 DDN interface		*NO	*YES, *NO
TRLAN bit sequencing		*MSB	*MSB, *LSB
Bottom			
F3=Exit	F4=Prompt	F5=Refresh	F12=Cancel F13=How to use this display
F24=More keys			

A common mistake is to define not only the IP address for your AS/400, but also the addresses of all the other systems with which you want your AS/400 to communicate. *Do not do this!* It will not work.

An address that is defined as an interface is an IP address for this AS/400 only. An interface should never be the address of another system in your network. In most cases, only one interface needs to be defined: the IP address that identifies your AS/400 in your TCP/IP network. The steps to allow your AS/400 to communicate with the other systems in your network are covered in the next section.

A.3 Define TCP/IP routing

A *route* provides the connection between your system and the external network. It is the route that allows your system to communicate with other systems on other networks.

If you will be using an IP router to access resources beyond your local LAN, you will need to set at least one route entry for a default route. We do not need an entry pointing to our local network. But, we need a default entry pointing to the IP router. The *default route* tells the system to route any traffic for locations that are not on your local LAN to the IP router. The router handles the chore of getting the packets to their destination after that.

To define a default route, select option **2, Work with TCP/IP Routes** from the main TCP/IP configuration menu. The *Work with TCP/IP Routes* screen appears. Fill in the following fields:

1. Select option **1** to add a route
2. The Route Destination is **DFTRROUTE*.
3. The Subnet mask is **NONE*.
4. The Type of Service is **NORMAL*.
5. The *Next hop* is the address of the first IP router your traffic must go through to get to the outside world ('199.5.83.129' in our example; F in Table 12 on page 349).

Add TCP/IP Route (ADDTCPRTE)

Type choices, press Enter.

Route destination	>	*DFTRROUTE	
Subnet mask	>	*NONE	
Type of service		*NORMAL	*MINDELAY, *MAXTHRPUT...
Next hop	>	'199.5.83.129'	
Preferred binding interface . .		*NONE	
Maximum transmission unit . . .		*IFC	576-16388, *IFC
Route metric		1	1-16
Route redistribution		*NO	*NO, *YES
Duplicate route priority		5	1-10

Bottom

F3=Exit F4=Prompt F5=Refresh F12=Cancel F13=How to use this display
F24=More keys

For the vast majority of installations, this is all that is needed. If, however, you have defined multiple interfaces, you may need to add explicit entries for certain networks that you want to reach. It is possible to have multiple default routes, but it is not recommended. TCP/IP does not have selection processes to choose between these multiple defaults — results may be unpredictable.

A.4 Define a local domain name and host name

A *domain name* identifies your system within a group of systems within a TCP/IP network. This group of systems is also called the (TCP/IP) *domain*. The domain name is used by remote servers to identify the local host to other systems. Domain names consist of labels that are separated by periods (for example, HOSTXYZ.DOMAINXY.ACME.COM).

The domain name has two parts, the *local domain name* and the *local host name*. The combination of the local domain name and the local host name becomes the *fully qualified domain name* by which your host is known to the network. The fully-qualified domain name is often referred to as the host name.

You can choose any values for these names, but we suggest that you use the AS/400 system name for the local host name (ASM12 in our example).

Your local domain name should be descriptive of your organization. The last portion of the local domain name should follow Internet conventions; that is, use COM for commercial enterprises, GOV for government organizations, and EDU for educational institutions. Our primary domain name is ACME.COM.

To define the domain name, you need to select option 12 from the main TCP/IP configuration menu. The Change TCP/IP Domain (CHGTCPDMN) screen will come up. Follow the steps below to change the local domain name and the local host name. Note that changes you make take effect immediately.

1. Fill in the Host name field with the first part of G (up to the first period of the fully qualified domain name, ASM12 in our example),
2. Fill in the Domain name field with the remainder of value G (in our example, DOMAINXY.ACME.COM):

Change TCP/IP Domain (CHGTCPDMN)

Type choices, press Enter.

Host name 'ASM12'

Domain name 'DOMAINXY.ACME.COM'

Host name search priority . . . *Local *REMOTE, *LOCAL, *SAME

Domain name server:

Internet address

Bottom

F3=Exit F4=Prompt F5=Refresh F10=Additional parameters F12=Cancel

to use this display F24=More keys

3. Press **Enter**. Now, the AS/400 has a fully-qualified host name.

A.5 Define a local host table

A *local host table* is typically used to associate symbolic names of systems with IP addresses for small networks that have only a few hosts on them. The main advantage of a local host table is that, as the name implies, it is stored on your AS/400. Therefore, it is always accessible and can be quickly searched.

The main disadvantage is that whenever an entry in the table is changed, the change must be copied to all the other host tables on the systems in your network.

Each IP address in an AS/400 local host table can be associated with from one to four symbolic host names. We refer to this association of an IP address with a set of names as a host table entry.

To add an entry in the local host table, select option **10**, *Work with Host Table Entries* from the main TCP/IP configuration menu. The following screen will come up. Fill in the following fields:

1. In the *Opt* field, select **1**, **Add Host Table Entry**.
2. Fill in the *Internet address* field with value **D** (199.5.83.158 in our example),
3. Fill in the *Host name* field with value **G** (ASM12.DOMAIN.ACME.COM in our example):

```

                                Add TCP/IP Host Table Entry (ADDTCPHTE)

Type choices, press Enter.

Internet address . . . . . > '199.5.83.158'
Host names:
  Name . . . . .      ASM12.DOMAINXY.ACME.COM

                                + for more values
Text 'description' . . . . . 'This is my system'

Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

4. Press **Enter**. This associates a TCP/IP address with a host name so you do not have to remember its internet address to reach this host.
5. If the system name is `ASM12` and the domain name is `DOMAINXY.ACME.COM`, the short name would be `ASM12` and the long name would be `ASM12.DOMAINXY.ACME.COM` as shown in next screen. Each internet address entry can have multiple names assigned to it.

```
Work with TCP/IP Host Table Entries                                System:  ASM12

Type options, press Enter.
1=Add  2=Change  4=Remove  5=Display  7=Rename

Internet      Host
Opt  Address  Name

    9.5.83.158  ASM12.DOMAINXY.ACME.COM
    127.0.0.1   ASM12
                   LOOPBACK
                   LOCALHOST

Bottom
F3=Exit  F5=Refresh  F6=Print list  F12=Cancel  F17=Position to
Internet address entry 9.5.65.158 added to host table.
```

A.6 Define a remote name server

A *domain name server*, also called a remote name server, maintains the host table for an entire TCP/IP domain. The advantage of using a domain name server in your TCP/IP network is that it frees each individual host from having to maintain its own local host table. When a system is added or removed from your network, only the host table on the domain name server system needs to be updated.

The disadvantage of a name server is that it requires more effort and experience to define and administer than a local host table. It also requires that your network contain a system that can provide this function.

In general, small networks with only a few systems will use local host tables. Larger networks with many hosts will use one or more domain name servers. You can also configure your AS/400 to use both a remote name server and your local host table. They are not mutually exclusive.

You can specify whether a remote name server or your local host table is searched first. If you configure TCP/IP on your AS/400 to use a remote name server and to search it first, the AS/400 system sends a request to the remote name server each time that it wants to know the TCP/IP address associated with a host name.

To configure your AS/400 to work with a remote name server, select option **12 Work with Table Entries** from the main TCP/IP configuration menu. Follow these steps outlined in the following screen.

1. Leave the *Host name* and *Domain name* fields unchanged,
2. Change the *Host search priority* field to **REMOTE*,
3. Fill in value *H* in the *Domain name server Internet address* field (199.4.191.76 in our example).

```

Change TCP/IP Domain (CHGTCPDMN)

Type choices, press Enter.

Host name . . . . . 'ASM23'

Domain name . . . . . 'DOMAINXY.ACME.COM'


Host name search priority . . . *REMOTE      *REMOTE, *LOCAL, *SAME
Domain name server:
  Internet address . . . . . '199.4.191.76'

Bottom
F3=Exit  F4=Prompt  F5=Refresh  F10=Additional parameters  F12=Cancel
F13=How to use this display  F24=More keys

```

4. Press **Enter**. All requests for name resolution of a host are searched first on a domain name server, the ASM23 host, and if not found, are searched on the local host.

A.7 Starting TCP/IP

Before any TCP/IP services are available, TCP/IP processing must be started. To start TCP/IP, you can open the "TCP/IP Administration" menu by entering the command `go tcpadm` on the AS/400 command line.

From the TCP/IP Administration menu, select option **3, Start TCP/IP**. This will start TCP/IP, the interfaces (that have been configured to start automatically), and the TCP/IP server jobs.

Another option to start TCP/IP direct is to enter the `strtcp` command on the AS/400 command line.

Check for a completion message on the last line on the screen. TCP/IP is now running.

In order to have TCP/IP started automatically at AS/400 start-up program, you need to add an entry in your start-up program.

Appendix B. Tivoli Disaster Recovery Manager scenario and checklist

This appendix gives you an overview of all the tasks necessary to prepare your Tivoli Storage Manager environment for recovery after a major disaster using the Tivoli Disaster Recovery Manager feature. In the second part, we also provide you with a practically proven checklist, which you can use to make sure that all necessary steps are taken.

The appendix assumes that you are familiar with the Tivoli Storage Manager concept and all of its elements. For more information about these functions, refer to Chapter 9, “Tivoli Storage Manager advanced features” on page 213.

B.1 A Tivoli Disaster Recovery Manager user scenario

This section provides a real-life example of using the Tivoli Disaster Recovery Manager feature to prepare for complete disaster recovery of the Tivoli Storage Manager server and how to perform a complete recovery. The detailed steps are followed by an outline that gives you a brief day-by-day picture of the Tivoli Disaster Recovery Manager tasks.

For detailed information on the recovery of single Tivoli Storage Manager clients, see *Tivoli Storage Manager for AS/400 Administrator's Guide Version 3*, GC35-0315, or refer to Chapter 10, “AS/400 backup and recovery scenarios” on page 261 to see how to recover a complete AS/400 as a Tivoli Storage Manager client.

B.1.1 Disaster recovery preparation

The Tivoli Storage Manager server named TMSERV contains the backups for the FileRight Company accounts receivable application. ABC company uses Tivoli Storage Manager server database mirroring and copy storage pools whose volumes are kept onsite. For disaster recovery preparation, ABC company uses Tivoli Storage Manager server database backup and copy storage pool volumes, which are immediately moved offsite after creation.

The following steps describe all the necessary action the Tivoli Storage Manager administrator of ABC company has to take in order to establish complete disaster recovery protection using the Tivoli Disaster Recovery Manager feature:

1. The administrator records the following recovery information in the RECOVERY.INSTRUCTIONS stanza source files:
 - The number of Tivoli Storage Manager licenses he or she purchased
 - Sources of replacement hardware
 - The ABC corporation's specific recovery steps
 - Courier information
 - The name and locations of the off-site vault — eventually, the name and phone number of the contact person
 - The instructions to rebuild the Tivoli Storage Manager server and the location of the system backup image copy
 - The names of your software applications and the copy storage pool names containing the backup of these applications

2. The administrator schedules an automatic nightly backup to occur in the following order:
 - Primary Storage Pools
 - Database
3. At 8 a.m. each morning, the administrator creates a list of the previous night's database and storage pool backup volumes to be sent offsite. The administrator issues the following command:

```
tsm: ADSM> query drmedia * wherestate=mountable
```

4. The administrator checks the volumes out of the library by issuing the following command:

```
tsm: ADSM> move drmedia * wherestate=mountable
```

5. The administrator sends the volumes off-site and records that the volumes were given to the courier by issuing the following command:

```
tsm: ADSM> move drmedia * wherestate=notmountable
```

6. The administrator creates a new recovery plan by issuing the following command:

```
tsm: ADSM> prepare
```

The administrator copies the recovery plan file to a diskette to be given to the courier.

7. Let us assume that copy storage pool volume CSP01 had been previously reclaimed and its volume status changed to PENDING. The volume is at the offsite vault. Last night, the PENDING window passed for CSP01 and its status changed to EMPTY. The volume no longer contains valid backup data and should be brought back onsite for reuse or disposal.

The administrator creates a list of tapes that contain data that is no longer valid and should be returned to the site by issuing the following command:

```
tsm: ADSM> query drmedia * wherestate=vaultretrieve
```

Volume CSP01 is in the list.

8. The administrator gives the courier the following: database, volume history, device configuration file, server options file, storage pool backup tapes, the recovery plan file diskette, and the list of volumes to be returned from the vault. Refer to Chapter 8, "Protecting the Tivoli Storage Manager/400 server" on page 193.

9. The courier gives to the administrator any tapes that were on the previous day's return from the vault list. To update the state of these tapes and to check them into the library, the administrator issues the following command:

```
tsm: ADsm> move drmedia * wherestate=courierretrieve cmdf=drm/checkin(libvol) \
cmd="checkin libvol libauto &vol status=scratch"
```

The volume records for the tapes that were in the `courierretrieve` state are deleted from the database. The `move drmedia` command also generates the `checkin libvol` command for each tape processed in the AS/400 file `checkin(libvol)` in the `drm` library, which can run as a Tivoli Storage Manager macro.

The CMD file name parameter is optional. If you do not specify a file name, the file name specified with the `SET DRMCMDFILENAME` command is used. If you do not specify a file name with the `SET DRMCMDFILENAME` command, the `move drmedia` command will create the file `EXEC(CMDS)` in the current server work library (`WRKLIB`).

The macro looks like the following:

```
tsm: ADsm> checkin libvol libauto tape01 status=scratch
tsm: ADsm> checkin libvol libauto tape02 status=scratch
...
tsm: ADsm> checkin libvol libauto tapeXX status=scratch
```

An administrator can run a Tivoli Storage Manager macro command by specifying on the AS/400 command line.

```
====> stradmadm adminname('xxxxx') password ('yyyyy') wrklib(lib)
macinf(DRM/CHECKIN) macinmbr(LIBVOL)
```

Refer to 9.4.1, "Tivoli Storage Manager Macros" on page 226 for an explanation of macros.

10. The courier brings the database and storage pool backup tapes, the recovery plan diskette, and the list of volumes to return from the vault.
11. The Tivoli Storage Manager administrator calls the vault and verifies that the backup tapes arrived and are secure and that the tapes to be returned to the site have been given to the courier.
12. To set the location of these volumes sent to the VAULT, the administrator issues the following command:

```
tsm: ADsm> move drmedia * wherestate=courier
```

13. To set the location of these volumes given by the vault to the courier, the administrator issues the following command:

```
tsm: ADSM> move drmedia * wherestate=vaultretrieve
```

B.1.2 Recovering the Tivoli Storage Manager server

The following example shows how an administrator uses the recovery plan file to recover the Tivoli Storage Manager server. The server in this example does not use virtual volumes. A disaster has destroyed the Tivoli Storage Manager server and a complete recovery of the server is required. The administrator has the latest recovery plan file.

1. The administrator reviews the recovery steps described in the RECOVERY.INSTRUCTIONS.GENERAL stanza of the plan file.
2. The administrator requests the server backup tapes from the off-site vault.
3. The administrator views the RECOVERY.INSTRUCTIONS.OFFSITE stanza for the name and telephone number of the courier the company uses to move tapes between the data center and the offsite vault.
4. The administrator uses a locally written procedure to break out the recovery plan file stanzas into multiple files. These files can be optionally viewed, updated, printed, or executed as Tivoli Storage Manager macros or scripts.

You can use a C program or an editor to break out the stanzas in the disaster recovery plan file into individual files. An example program QAANRSMP(QANRPLNXPL) in QADSM library, is shipped with the DRM feature. You can modify this program for your installation. The executable program is called QANRPLNXPL and is found in QADSM library.

5. The administrator prints out the RECOVERY.VOLUMES.REQUIRED file. The printout is handed to the courier who goes to the off-site vault to obtain the backup volumes.
6. In the meantime, the administrator must find a suitable replacement machine. Stanza RECOVERY.DEVICES.REQUIRED specifies the required tape drive type that will be needed to read the backup tapes. The stanza SERVER.REQUIREMENTS summarizes the required amount of disk space.
7. The administrator restores the AS/400 operating system on the replacement machine as well as the Tivoli Storage Manager server software. The media and its location were specified in the RECOVERY.INSTRUCTIONS.INSTALL stanza.
Refer to 10.4, "AS/400 Backup and recovery as a Tivoli Storage Manager server" on page 289 or see *OS/400 Backup and Recovery*, SC41-5304.
8. The administrator ensures the environment is the same as when the disaster recovery plan file was created. The environment includes:
 - The library for Tivoli Storage Manager server configuration files (database log, volume history file, device configuration file, and server options file)
 - The library for database, log, and storage pool volumes
 - The library as well as the individual files created when the disaster recovery plan file was split into multiple files

Information comes from the RECOVERY.SCRIPT.DISASTER.RECOVERY.MODE stanza. It contains a script with the commands needed to restore the database and restart the

server. Use it as a guide and execute the commands as needed from a command line, or you can copy it to a file, modify it and the files it references, and execute the script. At the completion of these steps, client requests for file restores are satisfied directly from copy storage pool volumes.

The `RECOVERY.SCRIPT.DISASTER.RECOVERY.MODE` script often requires modification at the recovery site because of differences between the original and the replacement systems.

This script provides the following:

- Restores the server options, volume history, and device configuration information files.
 - Invokes the scripts contained in the following stanza
`LOGANDDB.VOLUMES.INSTALL`.
 - Invokes the Tivoli Storage Manager macros contained in the stanzas
`COPYSTGPOOL.VOLUMES.AVAILABLE`,
`COPYSTGPOOL.VOLUMES.DESTROYED`,
`PRIMARY.VOLUMES.DESTROYED`.
9. The administrator reviews the Tivoli Storage Manager macros contained in the recovery plan. At the time of the disaster, the courier had not picked up the database and storage pool incremental backup volumes created the night before. However, they were not destroyed by the water. The administrator removes the entry for the storage pool backup volume from the `MACRO(CPYVOLDEST)` file.
 10. The courier returns with the required volumes. Somehow, the vault could not find one of the copy storage pool volumes. There is not enough time to wait for the vault location to find the lost volume. The administrator removes the entry for that volume from the `MACRO(CPYVOLAVL)` file.
 11. All of the server's primary volumes were destroyed. The administrator decides there are no changes required to the `PRIMARY.VOLUMES` script and Tivoli Storage Manager macro files.
 12. To restore the server database to a point where clients can be recovered, the administrator invokes the `SCRIPT(DRMODE)` script file. Enter the script file name at the command prompt.

Alternatively, the administrator could have used the steps in the recovery script as a guide and manually executed each step. The steps executed in the recovery script are:

- a. Copy the Tivoli Storage Manager server options file from the `DATA(SERVOPT)` file to its original location.
- b. Copy the volume history file required by `STRRSTADSM` processing from the `DATA(VOLHIST)` file to its original location.
- c. Copy the device configuration file required by Tivoli Storage Manager `STRRSTADSM` processing from the `DATA(DEVCONFIG)` file to its original location.
- d. Create and initialize the Tivoli Storage Manager server recovery log and database volumes using `INZSVRADSM`.
- e. Issue the `STRRSTADSM` command.
- f. Start the server.

- g. Mark copy storage pool volumes retrieved from the vault as available
 - h. Mark copy storage pool volumes which cannot be obtained as unavailable.
 - i. Mark primary storage pool volumes as destroyed.
13. The administrator invokes the `SCRIPT(NORMALMODE)` script file to restore the server primary storage pools.

Note

This action is optional at this time because Tivoli Storage Manager can access the copy storage pool volumes directly to restore client data. Using this feature, the administrator can minimize client recovery time because server primary storage pools do not have to be restored first. However, in this scenario, the client machines were not damaged; so, the focus of the administrator is to restore full Tivoli Storage Manager server operation.

If client machines are damaged, you may want to delay this action until after all clients are recovered.

Alternatively, the administrator could have used the steps in the recovery script as a guide and manually executed each step. The steps executed in this recovery script are as follows:

- a. Create replacement primary volumes.
 - b. Define the replacement primary volumes to Tivoli Storage Manager.
 - c. Restore the primary storage pools.
14. The administrator collects the database backup and copy storage pool volumes used in the recovery so that they can be returned to the vault. For these backup volumes to be returned to the vault using the routine `MOVE DRMEDIA` process, the administrator executes the following Tivoli Storage Manager administrative commands:

```
tsm: ADSM> update volhist TPBK50 devcl=lib8mm ormstate=mountable
```

The copy storage pool volumes used in the recovery already have the correct `DRMSTATE`.

15. The administrator then runs the `BACKUP DB` command to back up the newly restored database.
16. The administrator issues the following command to check the volumes out of the library:

```
tsm: ADSM> move drmedia * wherestate=mountable
```

17. To create a list of the volumes to be given to the courier, the administrator issues the following command:

```
tsm: ADSM> query drmedia * wherestate=notmountable
```

18. After the administrator packages the volumes and gives them to the courier, the administrator issues the following command:

```
tsm: ADSM> move drmedia * wherestate=notmountable
```

19. The administrator issues `PREPARE`.

You can find a detailed description of each stanza in *Tivoli Storage Manager for AS/400 Administrator's Guide Version 3*, GC35-0315.

B.1.3 Summary of disaster recovery manager use

This section outlines a sample overview of Tivoli Space Manager used in normal operation over a couple of days processing and during disaster recovery.

B.1.3.1 Setup

Perform the following steps for the setup procedure:

1. License Tivoli Space Manager.
2. Ensure the device configuration and volume history information files exist.
3. Back up the database (full) and storage pools.
4. Define your site-specific server recovery instructions.
5. Describe priority Tivoli Storage Manager client machines.
6. Generate the disaster recovery plan.

B.1.3.2 Daily operations

Day 1

1. Back up client files
2. Back up the primary storage pools
3. Perform an incremental database backup
4. Send the backup volumes to the vault
5. Generate the disaster recovery plan

Day 2

1. Back up client files
2. Back up the primary storage pools
3. Perform an incremental database backup
4. Send the new backup volumes to the vault
5. Generate the disaster recovery plan

Day 3

1. Automatic storage pool reclamation processing occurs
2. Back up client files
3. Back up the primary storage pools
4. Perform an incremental database backup
5. Send the new backup volumes and a list of expired volumes to be reclaimed to the vault

6. The vault acknowledges receipt of the volumes sent on the previous day
7. Generate the disaster recovery plan

Day4 (Disaster and recovery)

1. The server and the client machines are destroyed
2. Restore the server using the latest recovery plan
3. Identify the top priority client node(s) at the disaster site
4. Restore client machine files from the copy storage pools
5. Restore the primary storage pools
6. Move database backup and copy storage pool volumes to the vault

Day 5 (Daily operations)

1. Back up client files
2. Back up the database (full) and storage pools
3. Send the backup volumes to the vault
4. Generate the disaster recovery plan

B.2 Disaster recovery checklist

The checklist in Table 13 can help you plan the tasks required for Tivoli Disaster Recovery Manager implementation.

Table 13. Disaster recovery checklist

Activity	Start date	End date	Status	Person responsible	Backup person
DRM planning					
Evaluate your disaster recovery requirements What are the business priorities for recovering your Tivoli Storage Manager clients? Where is the recovery site? Is the recovery site hot, warm, or cold? Do the clients have connectivity to recovery server? Who are the system and Tivoli Storage Manager administrators? Will you need to return to the original site?					
Where are the offsite backups stored? How does the vault handle the backup media? How are the backups packaged or processed? Who provides the courier service?					

Activity	Start date	End date	Status	Person responsible	Backup person
Evaluate the current storage pool backup implementation What primary storage pools are being backed up? When are the backups performed? Backup purpose: offsite or onsite? Backup media Naming conventions for replacement volumes for primary Storage pools					
Evaluate the current database backup implementation When are the backups performed? Backup purpose: offsite or onsite Backup media How many backup series do you want maintained and for how long? Review the copy storage pool REUSEDELAY value and verify that it is the same as the SET DRMDBBACKUPEXPIREDAYS value					
Determine which primary storage pools are to be managed by Tivoli Disaster Recovery Manager					
Determine which copy storage pools are to be managed by Tivoli Disaster Recovery Manager Offsite copy storage pools					
Plan for the Recovery Plan File (RPF) What is the RPF library prefix? How many RPFs should be kept? How will RPFs be made available at the recovery site? - Print and store offsite - Tape/diskette copy stored offsite - Copy sent/NFS to recovery site					
Determine where you want to create the user-specified recovery instructions What is the instructions library prefix?					

Activity	Start date	End date	Status	Person responsible	Backup person
Analyze the sequence of steps related to the PREPARE command backup movement Document the flow of activities and timings <ul style="list-style-type: none"> - Sending of volumes offsite - Return of empty volumes - PREPARE timing 					
Tivoli Disaster Recovery Manager Installation					
Receive the Tivoli Storage Manager code					
Install the Tivoli Storage Manager code					
Get licensed for Tivoli Disaster Recovery Manager REGISTERLICENSE or Update the server options					
Customize the Tivoli Disaster Recovery Manager options The administrator with system authority issues: SET DRMDBBACKUPEXPIREDAYS to define the Database backup expiration SET DRMPRIMSTGPOOL to specify the DRM-managed primary storage pools SET DRMCOPYSTGPOOL to specify the DRM-managed copy storage pools SET DRMPPLANVPOSTFIX to specify 1 character to be appended to new storage pools SET DRMPPLANPREFIX to specify the RPF prefix SET DRMINSTRPREFIX to specify the user instruction file prefix SET DRMNOTMOUNTABLENAME to specify the default location for media to be sent offsite SET DRMCOURIERNAME to specify the default courier SET DRMVAULTNAME to specify the default vault SET DRMCMDFILENAME to specify the default file name to contain the commands specified with the CMD parameter on MOVE and QUERY DRMEDIA					

Activity	Start date	End date	Status	Person responsible	Backup person
Define the site-specific recovery instructions Identify: Target disaster recovery server location Target server software requirements (OS or Tivoli Storage Manager) Target server hardware requirements (storage devices) Tivoli Storage Manager administrator contact Courier name and telephone number Vault location and contact person Create: Enter the site-specific recovery instructions data into files created in the same library as specified by SET DRMINSTRPREFIX					
Tivoli Disaster Recovery Manager test					
Test the Tivoli Disaster Recovery Manager installation and customization Q DRMSTATUS to display the Tivoli Disaster Recovery Manager setup Back up the primary storage pools Back up the Tivoli Storage Manager database Q DRMEDIA to list the backup volumes MOVE DRMEDIA to move offsite PREPARE to create the RPF					
Examine the RPF created					
Test the RPF break out C program QADSM/QANRPLNXPL, type PGM Locally written procedure					
Test Tivoli Disaster Recovery Manager production					
Set up the schedules for automated functions					
Implement the Tivoli Disaster Recovery Manager procedures					

Appendix C. Special notices

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Appendix D. Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this redbook.

D.1 IBM Redbooks

For information on ordering these ITSO publications see “How to get IBM Redbooks” on page 377.

Tivoli Storage Manager / ADSM redbooks

Book Title	Publication Number
General Topics	
Getting Started with Tivoli Storage Manager: A Practical Implementation Guide	SG24-5416
ADSM Version 3 Technical Guide	SG24-2236
Using ADSM Hierarchical Storage Management	SG24-4631
ADSM Client Disaster Recovery: Bare Metal Restore	SG24-4880
Introduction to Storage Area Network, SAN	SG24-5470
Tivoli Storage Manager Version 3.7: Technical Guide	SG24-5477
Specific Server Books	
Windows NT Backup and Recovery with ADSM	SG24-2231
ADSM Server-to-Server Implementation and Operation	SG24-5244
ADSM Server for Windows NT Configuration and Recovery Examples	SG24-4878
ADSTAR Distributed Storage Manager/6000 on 9076 SP2	GG24-4499
ADSM for OS/2: Advanced Topics	SG24-4740
ADSM/VSE Implementation Guide	SG24-4266
Enterprise Storage Solutions	SG24-5250
Tivoli Storage Manager with Other Products	
A Practical Guide to Network Storage Manager	SG24-2242
Using ADSM to Back Up Databases	SG24-4335
Using Tivoli Storage Manager to Back Up Lotus Domino R5	SG24-5247
Using Tivoli Storage Manager to Back Up Lotus Notes	SG24-4534
Using ADSM to Back Up and Recover Microsoft Exchange Server	SG24-5266
Using ADSM to Back Up OS/2 LAN Server and Warp Server	SG24-4682
Backup, Recovery, and Availability with DB2 Parallel Edition on RISC/6000	SG24-4695
ADSM Operation and Management with TME10	SG24-2214
An Introduction to Tivoli Enterprise	SG24-5494
SAP R/3 Data Management with Tivoli Storage Manager	SG24-5743
Using TSM in a Clustered Windows NT Environment	SG24-5742

AS/400 and BRMS/400 redbooks

Book Title	Publication Number
The System Administrator's Companion to AS/400 Availability and Recovery	SG24-2161
A Practical Approach to Managing Backup Recovery and Media Services for OS/400	SG24-4840
Slicing the AS/400 with Logical Partitioning: A How to Guide	SG24-5439
AS/400 - Implementing Windows NT on the Integrated PC Server	SG24-2164
Complementing AS/400 Storage Management Using HSM APIs	SG24-4450

D.2 Redbooks on CD-ROMs

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CD-ROM Title	Collection Kit Number
System/390 Redbooks Collection	SK2T-2177
Networking and Systems Management Redbooks Collection	SK2T-6022
Transaction Processing and Data Management Redbooks Collection	SK2T-8038
Lotus Redbooks Collection	SK2T-8039
Tivoli Redbooks Collection	SK2T-8044
AS/400 Redbooks Collection	SK2T-2849
Netfinity Hardware and Software Redbooks Collection	SK2T-8046
RS/6000 Redbooks Collection (BkMgr Format)	SK2T-8040
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Application Development Redbooks Collection	SK2T-8037
IBM Enterprise Storage and Systems Management Solutions	SK3T-3694

AS/400 and BRMS/400 product publications

Book Title	Publication Number
OS/400 - AS/400 Integration with Windows NT Server	SC41-5439
AS/400e Series Integrated File System Introduction	SC41-5711
OS/400 Backup and Recovery V4R4	SC41-5304
Backup, Recovery, and Media Services for AS/400	SC41-5345
AS/400 Basic System Operation, Administration, and Problem Handling	SC41-5206
AS/400 Software Installation V4R4	SC41-5120
AS/400 Road Map for Changing to PowerPC Technology	SA41-5150
OS/400 Communications Configuration V4R1	SC41-5401
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OS/400 CL Programming	SC41-5721
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AS/400 Automated Tape Library Planning and Management	SC41-5309

D.3 Tivoli Storage Manager online product library

All of the Tivoli Storage Manager publications are available in online readable format on the CD-ROM listed below.

CD-ROM Title	Publication Number
AS/400 Softcopy Library Version 4 Release 4	SK3T-0118
IBM Online Library MVS Collection	SK2T-0710

D.4 Product publications

Tivoli Storage Manager product publications

Tivoli Storage Manager Servers		Publication Number
Tivoli Storage Manager for Windows NT Version 3.7	Administrator's Guide	GC35-0380
Tivoli Storage Manager for Windows NT Version 3.7	Administrator's Reference	GC35-0381
Tivoli Storage Manager for Windows NT Version 3.7	Quick Start	GC35-0379
Tivoli Storage Manager for AIX Version 3.7	Administrator's Guide	GC35-0368
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Tivoli Storage Manager for HP-UX Version 3.7	Administrator's Guide	GC35-0371
Tivoli Storage Manager for HP-UX Version 3.7	Administrator's Reference	GC35-0372
Tivoli Storage Manager for HP-UX Version 3.7	Quick Start	GC35-0370
Tivoli Storage Manager for Sun Solaris Version 3.7	Administrator's Guide	GC35-0374
Tivoli Storage Manager for Sun Solaris Version 3.7	Administrator's Reference	GC35-0375
Tivoli Storage Manager for Sun Solaris Version 3.7	Quick Start	GC35-0373
Tivoli Storage Manager for AS/400 Version 3.1.2	Administrator's Guide	GC35-0315
Tivoli Storage Manager for AS/400 Version 3.1.2	Administrator's Reference	GC35-0316
Tivoli Storage Manager for AS/400 Version 3.1.2	Quick Start	GC35-0317
Tivoli Storage Manager for MVS and OS/390 Version 3.7	Administrator's Guide	GC35-0377
Tivoli Storage Manager for MVS and OS/390 Version 3.7	Administrator's Reference	GC35-0378
Tivoli Storage Manager for MVS and OS/390 Version 3.7	Quick Start	GC35-0376
Tivoli Storage Manager for VM Version 3.1	Administrator's Guide	GC35-0352
Tivoli Storage Manager for VM Version 3.1	Administrator's Reference	GC35-0353
Tivoli Storage Manager for VM Version 3.1	Quick Start	GC35-0351
Tivoli Storage Manager for VM Version 3.1	Messages	GC35-0271
Tivoli Storage Manager for OS/2 Version 2.1	Administrator's Guide	GC35-0232
Tivoli Storage Manager for OS/2 Version 2.1	Administrator's Reference	GC35-0233
Tivoli Storage Manager for OS/2 Version 2.1	Quick Start	GC35-0231
Tivoli Storage Manager for OS/2 Version 2.1	Messages	SH35-0133

Tivoli Storage Manager Messages

Tivoli Storage Manager Version 3.7

Messages

**Publication
Number**

GC35-0382

Tivoli Storage Manager clients

Tivoli Storage Manager: Installing the Clients

Tivoli Storage Manager Version 3.7 Clients

Using the Backup-Archive Client for Windows

Using the Backup-Archive Client for NetWare

Using the Backup-Archive Clients for UNIX

Using the UNIX HSM Clients

Reference Cards for the Backup-Archive Clients

Using the Application Program Interface

Trace Facility Guide

**Publication
Number**

SH26-4102

SH26-4106

SH26-4101

SH26-4100

SH26-4105

SH26-4083

SX26-6021

SH26-4107

SH26-4104

Tivoli Data Protection (TDP) Applications

TDP for Informix V3R7:

TDP for Lotus Domino for UNIX V1R1:

TDP for Lotus Domino for Windows NT V1R1:

TDP for Lotus Notes on AIX

TDP for Lotus Notes on Windows NT

TDP for Microsoft Exchange Server V1R1:

TDP for Microsoft SQL Server V1R1:

TDP for Oracle Backup on AIX

TDP for Oracle Backup on Windows NT

TDP for Oracle Backup on HP-UX

TDP for Oracle Backup on Sun Solaris

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SH26-4111

SH26-4061

SH26-4086

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SH26-4063

SH26-4109

Tivoli Data Protection for Workgroup

Tivoli Data Protection for Workgroups for Windows NT

User's Guide

**Publication
Number**

GC35-0359

Additional titles

IPX/SPX Install Administrator's Guide

IBM AnyNet/2 Version 2.0.2 Guide to Sockets over IPX

OS/400 Network File System

**Publication
Number**

SC23-2547

SV40-0112

SC41-5714

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