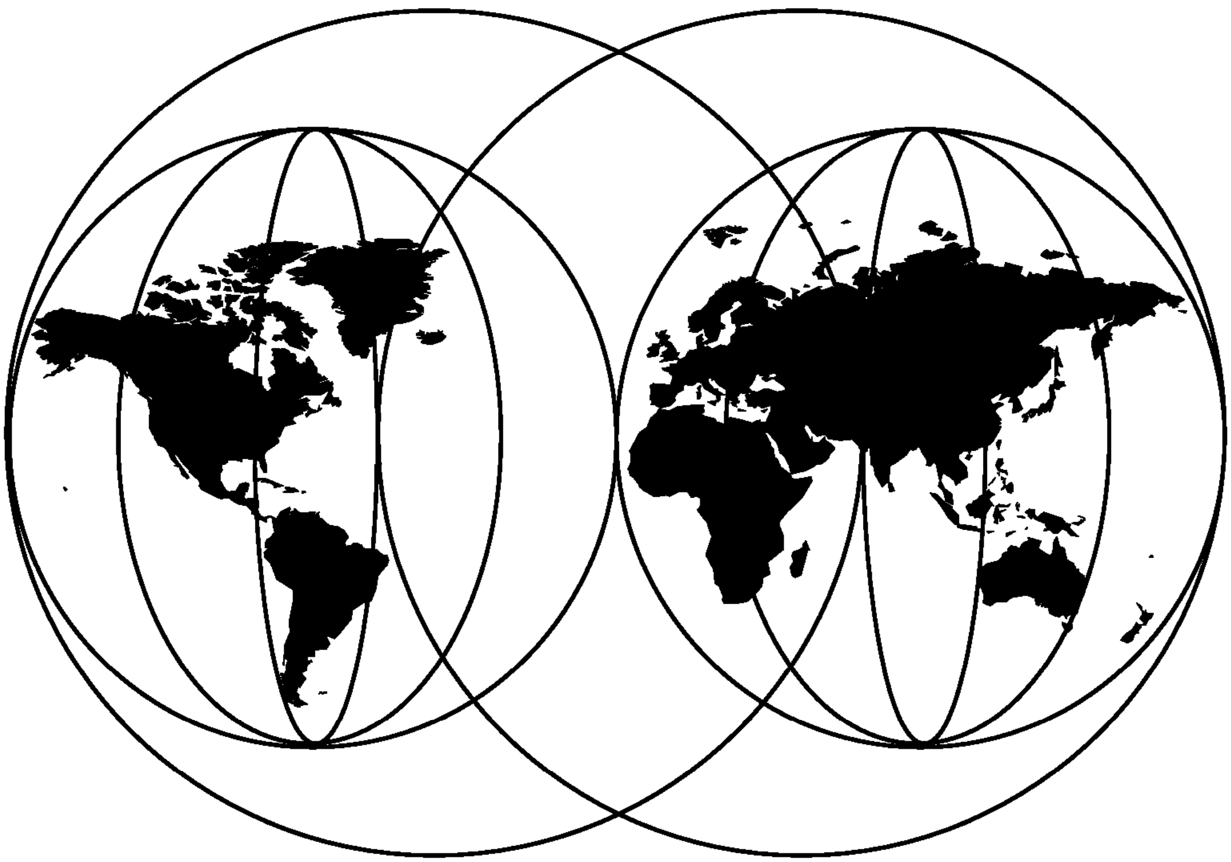
IBM Magstar 3494 Tape Libraries: A Practical Guide

Carl Bauske, Dominique Lebreton, Martin Oberholzer, Riyaan Richards, Matthias Werner



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IBM Magstar 3494 Tape Libraries: A Practical Guide

March 1999

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 371.

Third Edition (March 1999)

This edition applies to the IBM Magstar 3494 Tape Library.

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Preface

IBM engineers have done a great job enriching the IBM Magstar 3494 Tape Library in multiple areas:

- The Magstar 3494 Model HA1 High Availability unit increases library availability with a second library manager, a second accessor, and concurrent maintenance capabilities.
- The Dual Active Accessor feature provides mount and inventory performance improvements by using both accessors concurrently in a 3494 which has the HA1 installed.
- Full exploitation of Magstar 3590 tape technology is made transparent with the Magstar Virtual Tape Server.
- The Magstar 3494 open systems connectivity has been enhanced with the availability of support for HP-UX and Windows NT systems.
- The Magstar 3494 library manager has been enhanced to include SNMP support, which allows the library to be monitored from a workstation on a customer LAN.

The updated release of this top-selling redbook includes these new models and capabilities and has been thoroughly revised to reflect the latest levels of software and hardware. This redbook is the indispensable companion for a successful implementation of the IBM Magstar 3494 Tape Library in your environment because it is unique in its detailed coverage of this product.

It focuses on the practical steps of installing and implementing the IBM 3494 Tape Library on all supported platforms in a highly tape-centric computing environment and provides information about data migration and operation considerations for an IBM tape library environment. However, you will find that the OS/390 environment receives the most detailed coverage, in part because of the importance of this platform but also because of the complexity of this environment.

This document was written for storage system technical professionals. Basic knowledge of the tape library systems is assumed.

The Team That Wrote This Redbook

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

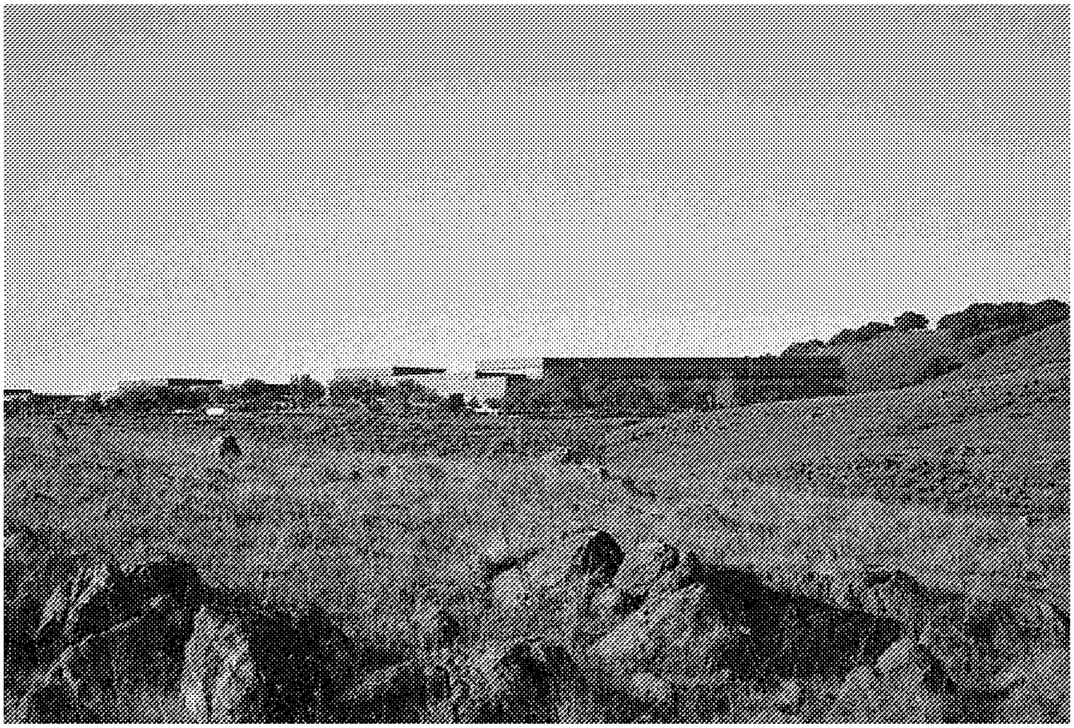

Figure 1. IBM Almaden Research Center, San Jose, California

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Chapter 1. Overview of IBM Magstar Tape Libraries

Tape storage media can provide low-cost data storage for sequential files, inactive data, and vital records. Because of the continued growth in tape use, tape automation has been seen as way of addressing an increasing number of challenges, which include:

- Increased hardware, operational, and management costs
- Growing batch workload in a shrinking batch window
- Lights-out operation
- Data mining and offsite vaulting
- Security and asset management

Now, with the increased use of different operating system platforms, tape automation solutions must also provide the ability to connect multiple platforms, enabling the sharing of both tape technology and automation.

Various solutions that provide tape automation are available, including:

- The Automated Cartridge Facility on the Magstar 3590 tape subsystem, which, working with application software, can provide a 10-cartridge mini tape library
- The IBM 3494, which can host up to 66 tape drives and store up to 187 TB of compacted data
- The Magstar Virtual Tape Server, which provides ″volume stacking″ capability and seamless exploits the capacity and bandwidth of Magstar 3590 technology

In the chapters that follow, we discuss how the IBM Magstar tape libraries provide an integrated solution to the tape processing challenges in both a single and multiple platform environment.

1.1 IBM Magstar 3494 Tape Library

The IBM 3494 fulfills the tape library requirements of high-end and enterprise systems by providing:

- High availability
- Multiple platform connectivity
- Flexible configuration
- Modular growth
- Ease of operation
- Cost efficiency

Figure 2 on page 2 shows a four-frame IBM 3494.

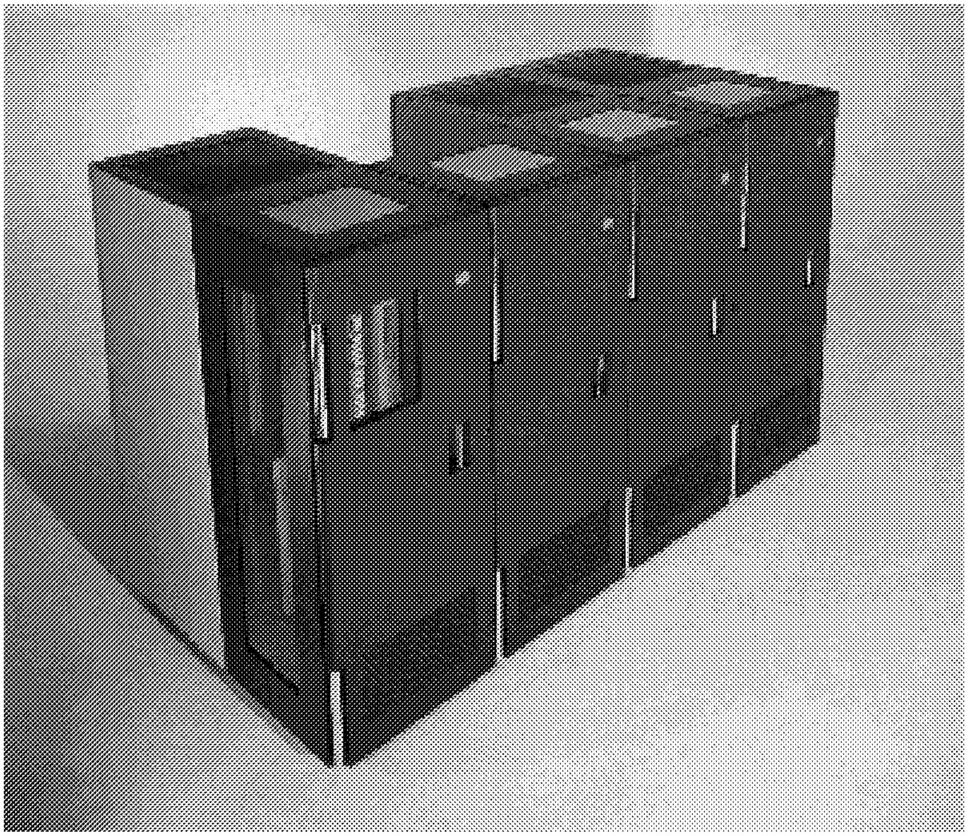


Figure 2. Four-Frame Magstar 3494 Tape Library

1.1.1 High Availability

The tape library attempts to dynamically reconfigure around failing components to maintain availability to the attached systems. The linear design of the IBM 3494 provides enhanced availability of customer data because it allows operations staff easy access to the library. These manual operations can be carried out under the control of onboard library intelligence during scheduled and unscheduled maintenance. Having dual grippers on the accessor further enhances availability. The optional High Availability feature provides redundancy for the most critical components in the tape library configuration— a second library manager and a second accessor that run in hot standby mode— thus eliminating the need for manual operation or system outages for most failure scenarios.

1.1.2 Multiple Platform Connectivity

Intelligence within the IBM 3494 hardware allows different platforms to share the library. Host processors supported include AS/400, RS/6000, S/390, RS/6000 SP, Sun, HP, and Windows NT. The licensed library manager code interfaces with software on the attached hosts to service all host requests.

1.1.3 Flexible Configuration

The IBM 3494 can be configured to meet storage capacities from 140 to 6240 cartridges and from 1 to 66 tape transports. The IBM 3494 can use either IBM's 3490E tape drive or Magstar 3590 tape drives or both in the same 3494 library. Various frame types (each a model of the 3494) are available to customize the library to have the number of tape drives and to hold the number of cartridges that meet customer needs.

1.1.4 Modular Growth

Model upgrades facilitate growth from 1 to 16 frames, allowing for increased storage capacity or additional tape drives as your business grows.

1.1.5 Ease of Operation

An easy-to-use graphical user interface (GUI) is provided for operational control and setup of the library.

1.1.6 Cost Efficiency

The IBM 3494 is a cost-effective automated tape solution, due to its multichannel support, high availability, reliability, and performance. With a wide range of configurations available, partial or full automation can be achieved and shared among multiple systems. Modular upgrades enable the addition of drive and storage capacity and ensure investment protection. A higher degree of automation is possible when the IBM 3494 is used in conjunction with other IBM storage management products such as DFSMS/MVS system-managed tape, DFSMSrmm, DFSMShsm, and ADSM.

1.2 IBM Magstar 3494 Tape Library Features

The IBM 3494 offers a wide range of models and features:

- Data storage capacity of up to 62 TB of uncompacted data and 187 TB of compacted data
- Support of the High Availability feature that provides a high level of availability for tape automation
- Support of the Magstar Virtual Tape Server
- Support for the IBM 3490E Model F1A tape drive, IBM 3490E Model CxA tape subsystems, IBM Magstar 3590 Model B1A tape drive, and IBM Magstar 3590 Model A00 or A50 tape controller
- Data paths through Ultra-SCSI, SCSI-2, ESCON, and parallel channels depending on the tape subsystem installed
- Library management commands through RS-232, a local area network (LAN), and parallel and ESCON channels

1.3 Library Components

The five building blocks of the IBM 3494 are:

- Control unit frame
- Drive unit frame
- Storage unit frame
- Optional High Availability feature
- Optional Virtual Tape Server

1.3.1 Control Unit Frame

The control unit frame is the most important component of the IBM 3494. Each frame contains:

- Optional tape subsystem
- Library manager
- Cartridge accessor with single or optional high performance dual gripper
- Cartridge storage cells
- Optional convenience I/O station

Figure 3 shows the components of the IBM 3494 control unit frame.

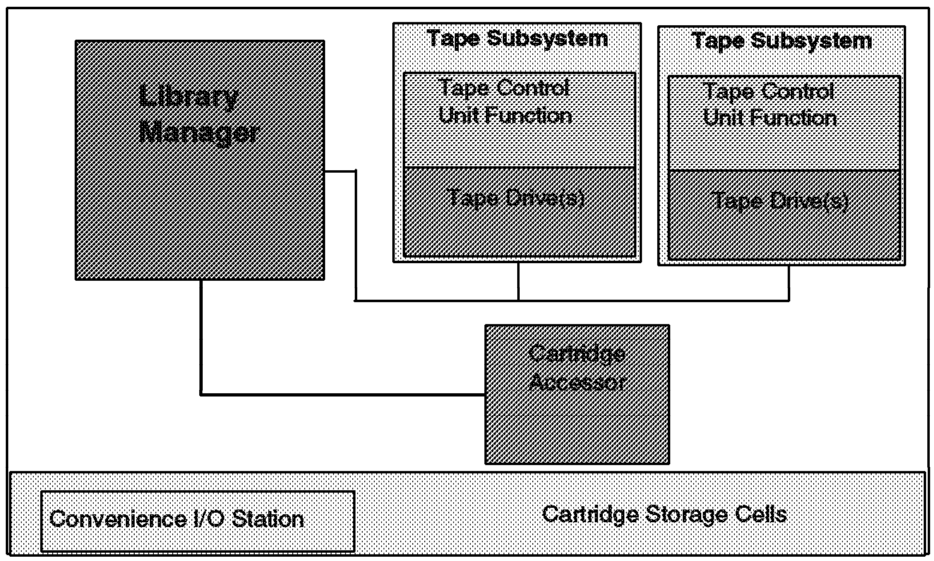


Figure 3. Control Unit Frame Components

1.3.1.1 Tape Subsystem

The tape subsystem consists of a tape control unit function and tape drives. It can be either an IBM 3490E or a Magstar 3590 tape subsystem. If drive unit frames are attached, the control unit frame does not need tape drives installed.

1.3.1.2 Library Manager

The library manager is the onboard library intelligence that enables the attachment of multiple host platforms, maintains a database of the cartridges held in the library, holds status information about library components, and provides an easy-to-use GUI for operations staff. The library manager controls all of the operations in the 3494.

1.3.1.3 Cartridge Accessor

The cartridge accessor identifies and moves cartridges between cartridge storage cells, tape drives, and library input/output facilities. The optional dual gripper feature can be installed on the cartridge accessor to provide increased performance. See 2.2.8, "Cartridge Accessor" on page 28 for more detail. Figure 19 on page 29 shows the cartridge gripper assembly.

1.3.1.4 Cartridge Storage Cells

Cartridge storage cells store cartridges within the library. Each cell has a unique location ID. The cartridges stored in these cells are held in the library manager database. The IBM 3494 contains cartridge storage cells in all of the attached frames. Cartridges of any supported media can be placed in any frame, but it is recommended that a particular media type be placed close to the drives on which it will be used.

1.3.1.5 Convenience I/O Station

If the convenience I/O station feature is installed, you can add or remove 10 to 30 cartridges from the library without interrupting the normal operations of the library.

1.3.2 Drive Unit Frame

Drive unit frames are designed for adding additional tape drives and additional tape cartridge storage to the library. The three models, D10, D12, and D14, differ in cartridge capacity and in the tape drive technology used within the drive frame, offering you flexibility in choosing your tape drive technology and channel attachment technology.

1.3.2.1 D10 Drive Unit Frame

The D10 drive unit frame can contain either:

- No tape drives and 400 cartridge cells
- One or two 3490E-F1A drives and 300 cartridge cells
- One or two 3490E-C2A drives and 300 cartridge cells

1.3.2.2 D12 Drive Unit Frame

The D12 drive unit frame can contain either:

- No tape drives and 400 cartridge cells
- One to two Magstar 3590-B1A drives and 335 cartridge cells
- Three to four Magstar 3590-B1A drives and 290 cartridge cells
- Five to six Magstar 3590-B1A drives and 250 cartridge cells

1.3.2.3 D14 Drive Unit Frame

The D14 drive unit frame can contain either:

- No tape drives and 400 cartridge cells
- One to two Magstar 3590-B1A drives and 345 cartridge cells
- Three to four Magstar 3590-B1A drives and 305 cartridge cells

Table 1 shows the drive characteristics of the drive technologies that can be used in a 3494 library.

Characteristic	3480/3490 (CST)	3490E (CST)	3490E (ECCST)	3590 (3590 Cartridge)
Number of tracks	18	36	36	128
Tape length (meters)	160 m	160 m	320 m	300 m
Tape data rate• (megabytes/second)	2.8 MB/s	2.8 MB/s	2.8 MB/s	9.0 MB/s
Tape access velocity (meters/second)	2 m/s	2 m/s	2 m/s	2 m/s
Load-to-ready time• (seconds)	7 s	8 s	10 s	19 s
Unload time•(seconds)	10 s	10 s	12 s	18 s
Nominal rewind speed (meters/second)	4 m/s	5 m/s	5 m/s	5 m/s
Time to rewind half the tape (seconds)	20 s	16 s	32 s	30 s
Full-reel rewind time (seconds)	40 s	0	0	0
Maximum rewind time (seconds)	40 s	32 s	64 s	60 s
Tape scan (locate) speed (meters/second)	4 m/s	4 m/s	4 m/s	5 m/s
Time to scan half the tape (seconds)	20 s	20 s	40 s	30 s
Maximum scan time (seconds)	40 s	40 s	80 s	60 s
Forward space file (FSF) (meters/second)•	2 m/s	2 m/s	2 m/s	5 m/s
Maximum FSF time (seconds)•	80 s	160 s	320 s	60 s
Cartridge capacity, uncompacted	200 MB	400 MB	800 MB	10,000 MB

Table 1. Tape Drive Characteristics

1. Depending on the extent of compaction, the effective data rate seen at the channel can be higher.
2. These measured times have been rounded up to the nearest second.

1.3.3 Storage Unit Frame

Storage unit frames are designed for adding only additional tape cartridge storage capacity to the library. With a storage unit frame, up to 400 additional tape cartridges can be stored in the library.

We recommend that empty drive unit frames be used instead of storage unit frames. Drive unit frames allow for flexibility and enable you to achieve a balance with the placement of additional tape drives.

1.3.4 Optional High Availability Feature

The High Availability feature provides a second library manager and a second accessor that runs in hot standby mode. With the HA1 two service frames are added, one to each end of the library. The left service frame is for servicing or storing the primary accessor, which is controlled by the primary library manager in the control unit frame. The right service frame houses the standby library manager and the standby accessor. In the unlikely event of a failure of the library manager or accessor, the hot standby takes control. The High

Availability feature is designed to ensure that you can always access your data. Also available with the High Availability feature is the dual active accessor (DAA) option, a performance feature that allows both accessors to be active at the same time.

1.3.5 Optional Virtual Tape Server

The optional Magstar Virtual Tape Server, integrated with the IBM 3494, provides for a higher utilization of 3590 tape technology than enabled by current tape controller concepts. It provides improvement in utilization without affecting current operating system or third-party software. The subsystem combines the random access and high performance characteristics of disk storage with outboard hierarchical storage management and virtual tape drives to provide significant reductions in the number of physical cartridges, tape drives, and automated libraries needed to store the customer tape data.

The key functions of the Virtual Tape Server subsystem architecture are:

- Emulation of 3490-type tape drives (32 or 64 virtual drives)
- Tape volume cache up to 864 GB (assuming 3:1 compression)
- Outboard storage management of the tape volume cache
- Fast response for nonspecific mount requests
- 150,000 logical volumes in a 3494 library (total of all Model B16s and/or B18s used)
- Compression at the channel interface with the ESCON high performance option (EHPO).

Figure 4 shows a two-frame IBM 3494 with a VTS Model B18.

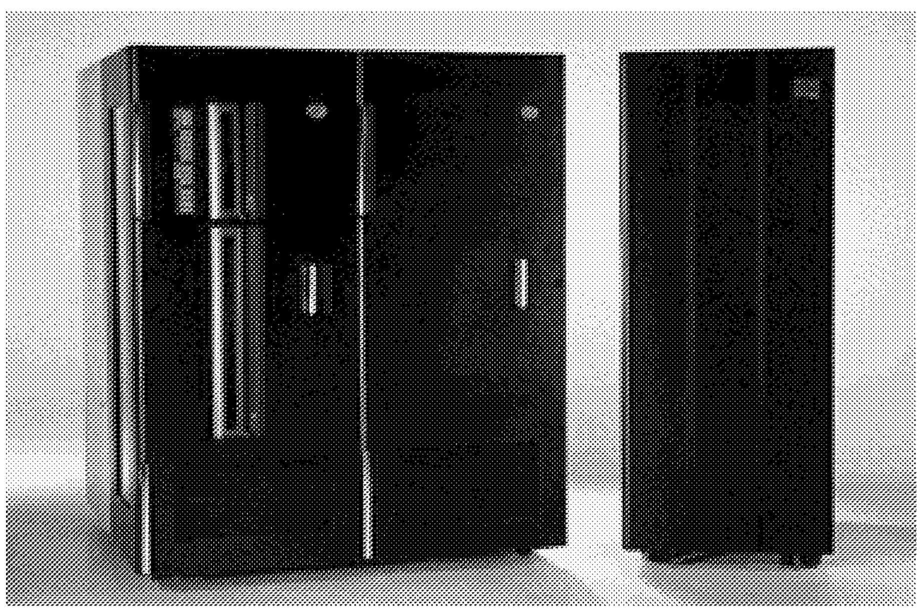


Figure 4. Two-Frame Magstar 3494 Tape Library with B18 VTS

To the host software, the Virtual Tape Server subsystem looks like an IBM 3490E Tape Subsystem with associated standard cartridge system tape (CST) or enhanced capacity cartridge system tape (ECCST).

This virtualization of both the tape devices and the storage media to the host allows for transparent full utilization of the capacity and performance characteristics of Magstar 3590 tape technology. See *Enhanced IBM Magstar Virtual Tape Server: Implementation Guide* for more detail.

1.4 Host Attachment

Physical host connections can be ESCON, parallel, Ultra-SCSI or SCSI-2 channels.

Two logically different types of connection paths are required between a host and the tape library: the data path to the tape transport (for data and tape drive commands), and the library control path to the library manager (for library-specific commands such as mount and demount).

Depending on the host environment, the logical paths can be implemented on two distinct physical connections: one for data (for example, SCSI-2), and the other for library control (through RS-232 or LAN). See *Method 1* in Figure 5.

Both logical paths can be implemented on the same physical connection from the host to the tape subsystem (for instance, ESCON or parallel-OEMI channels). See *Method 2* in Figure 5.

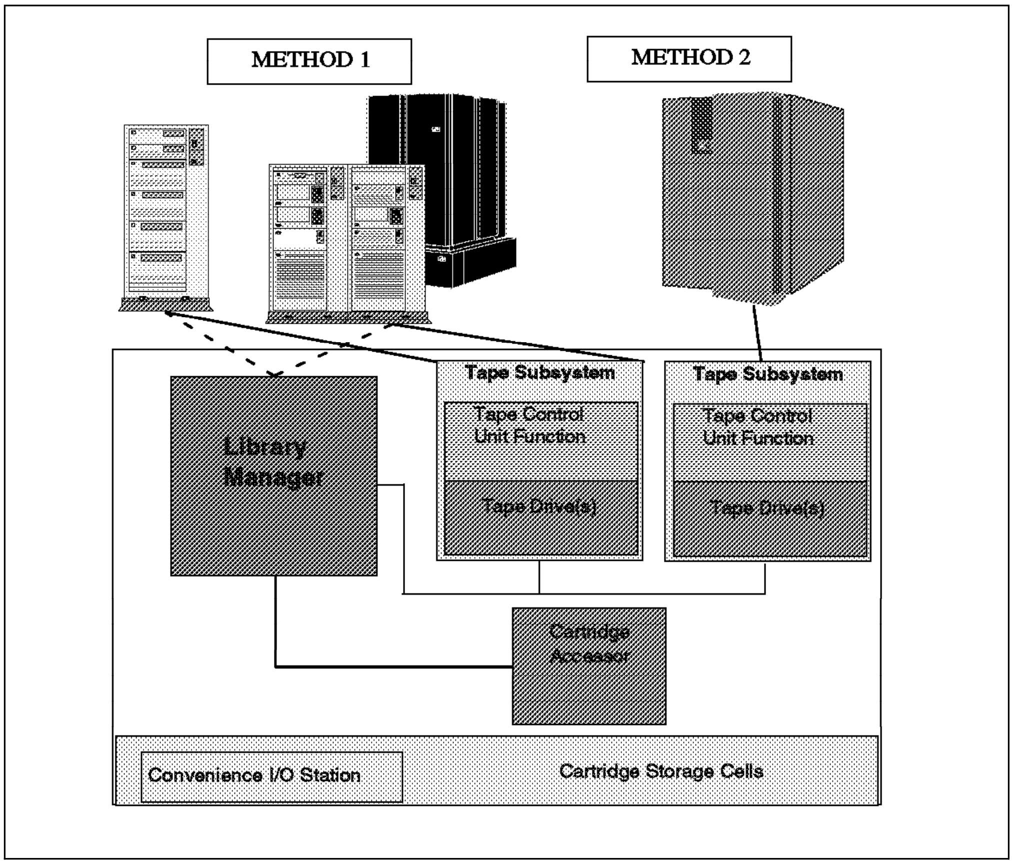


Figure 5. Host Connections

Method 1 uses the channel attachment of the tape subsystem to send requests to the 3494 library manager. The 3494 also sends status and other information back to the host through the tape subsystem attachment. Multiple hosts can simultaneously request operations and status information from the 3494.

Method 2 uses the RS-232 or LAN attachment between the host and the 3494 library manager to control the tape library. All normal tape commands, data, and responses are transmitted through the tape subsystem attachments while the library commands and responses are transmitted through the RS-232 or LAN attachment.

Figure 6 summarizes the IBM 3494 host interfaces.

Host System	3490E			3590		
	ESCON	SCSI	Parallel	ESCON	SCSI	Parallel
ES/9000	✓	—	✓	✓	—	—
AS/400	—	✓	✓	—	✓	—
RS/6000	✓	✓	✓	—	✓	—
SP	✓	✓	✓	—	✓	—
HP	—	✓	—	—	✓	—
SUN	—	✓	—	—	✓	—

Figure 6. 3494 Host Connection Summary

Note: For more information about non-IBM attachment support, see

`http://w3.rmss.storage.ibm.com/rmssprods/Tape/3494_vts/Contable.htm`
`http://www.storage.ibm.com/hardsoft/tapud/3494/mag3494.htm`

Chapter 2. IBM Magstar 3494 Tape Library

In this chapter we provide you with detailed information about the IBM Magstar 3494 tape library. We cover the frames, models, functional components, and feature codes that make up the IBM 3494.

2.1 Overview of Frames and Models

The IBM 3494 supports a variety of platforms including the S/390, RS/6000, AS/400, HP, Sun, and Intel (running Windows NT) processors and allows multiple hosts to simultaneously share the library.

Refer to:

```
http://w3.rmss.tucson.ibm.com/isvmat/default.htm
http://www.storage.ibm.com/hardsoft/tapud/3494/mag3494.htm
```

for a complete list of supported platforms and a connectivity matrix.

The IBM 3494 is self-contained and fully enclosed. It is linear in design and can be installed on either a raised or solid floor. Figure 7 on page 12 shows some possible configurations of the IBM 3494. The IBM 3494 is available in multiple configurations using one control unit frame and multiple optional frames. The available frames types are:

- The IBM Magstar 3494 Model L1x control unit frame, **1** or **3**
- The optional IBM Magstar 3494 Model D1x drive unit frame **6**, which contains tape drive subsystems and cartridge storage
- The optional IBM 3494 Magstar Virtual Tape Server control unit frame **5** with its associated drive unit frame **4**
- The optional High Availability unit with its two service bays, A **2** and B **7**, that contain the hot standby library controller and a service area for each accessor
- The optional IBM Magstar 3494 Model S10, which contains additional cartridge storage

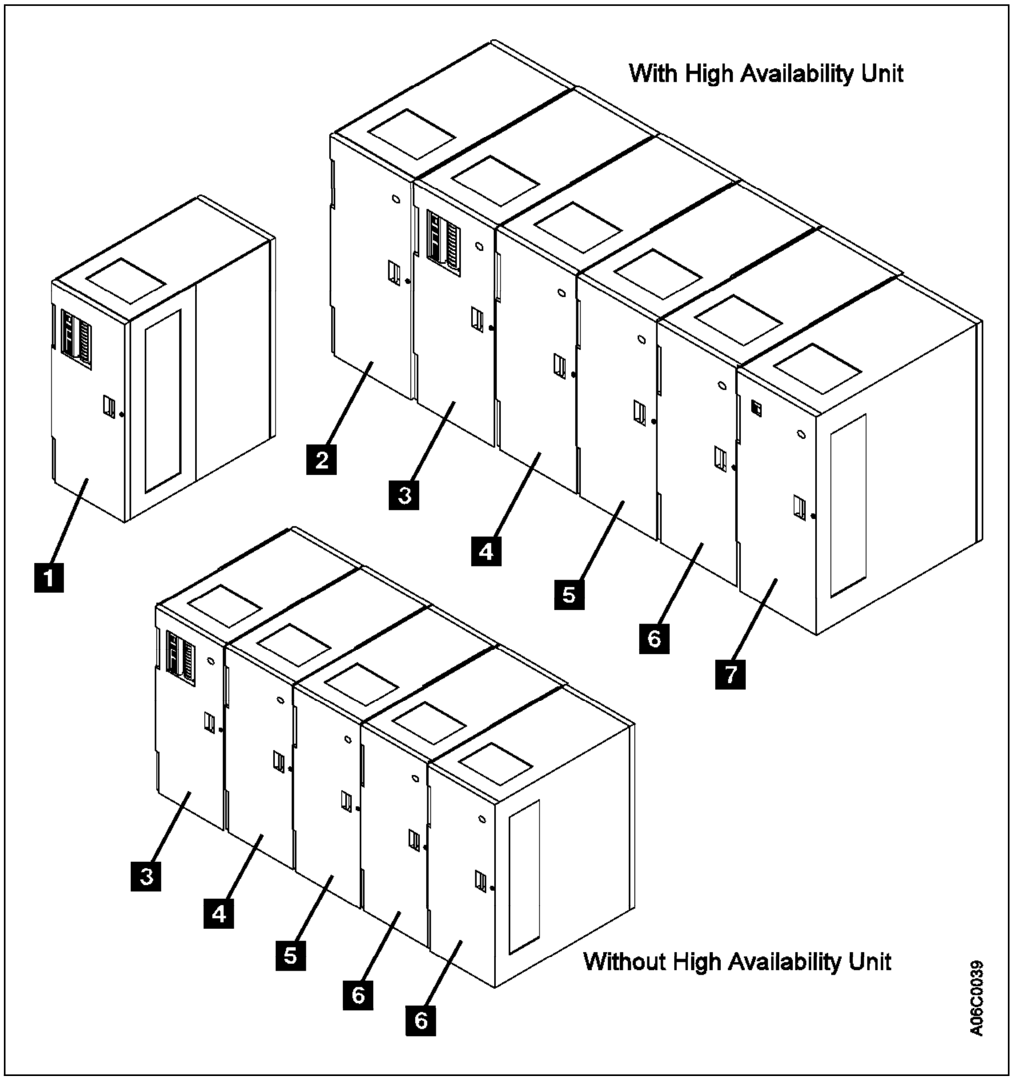


Figure 7. IBM 3494 Tape Libraries

The IBM 3494 offers configuration flexibility, ranging from a single 3494 Model L1x control unit frame, up to a maximum of 16 frames, plus two service bays. These 16 frames can include one 3494 Model L1x control unit and up to 15 optional 3494 Model D1x drive units or 3494 Model S10 storage units.

When the optional IBM Magstar 3494 Model HA1 High Availability unit is installed, it adds two service bays, one at each end, to the IBM 3494.

Configurations can be tailored to provide performance, capacity, or a combination of both. See 3.1.10, “Frame Configuration” on page 68 for more information about frame configurations.

The IBM 3494 options include a convenience input/output station, RS-232 or LAN host attachment, high-capacity input/output facility, dual gripper, remote console, second library manager disk drive, and a wide range of host attachment capabilities.

2.1.1 IBM Magstar 3494 Model L1x Control Unit Frames

The minimum IBM 3494 configuration is a single 3494 Model L1x. Depending on the model, it contains a tape subsystem, the library manager, cartridge accessor, convenience I/O station, accessor rail, and cartridge storage cells.

Figure 8 shows the following functional components viewed from the front:

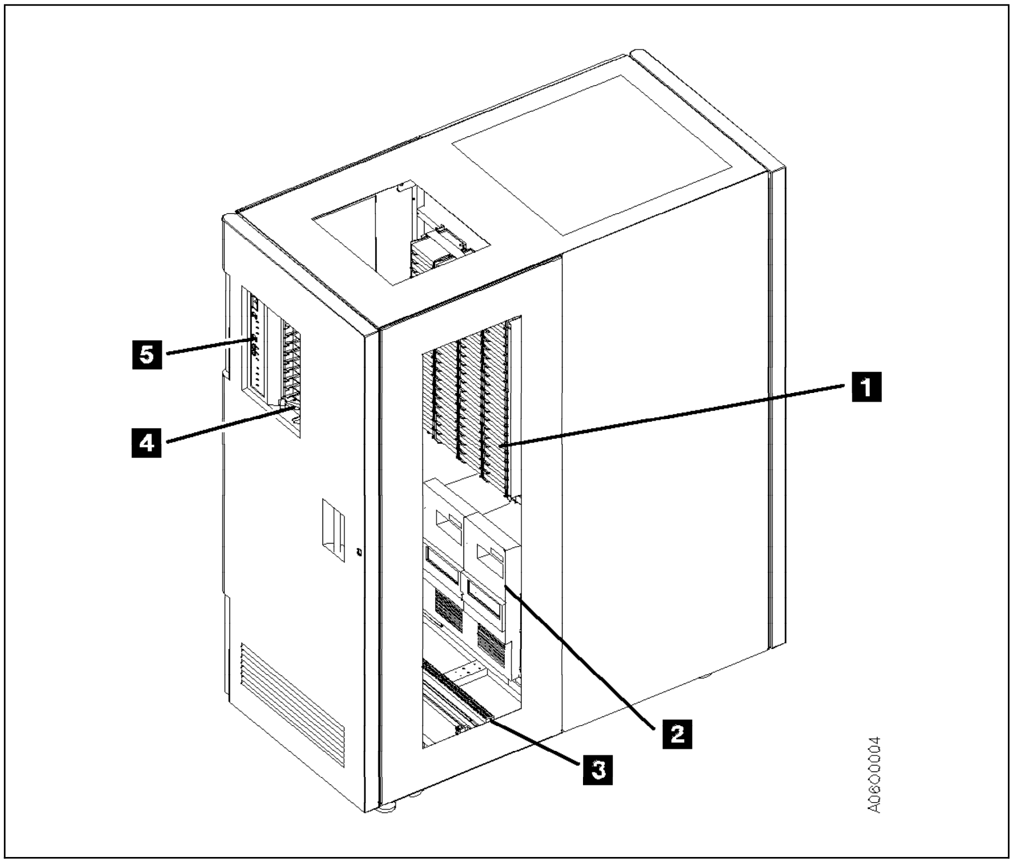


Figure 8. 3494 Model L12 Functional Components (Front View) with 3590 Subsystems

1 Cartridge storage cells are located on the interior side of the front doors and on the back walls of the IBM 3494.

2 Magnetic tape subsystem. The figure shows two IBM Magstar 3590 Model B1A tape drives, but a 3490E tape subsystem can also be installed in a 3494 Model L1x.

3 Rail system

4 Convenience I/O station

5 Operator panel

Figure 9 on page 14 shows the following functional components viewed from the rear:

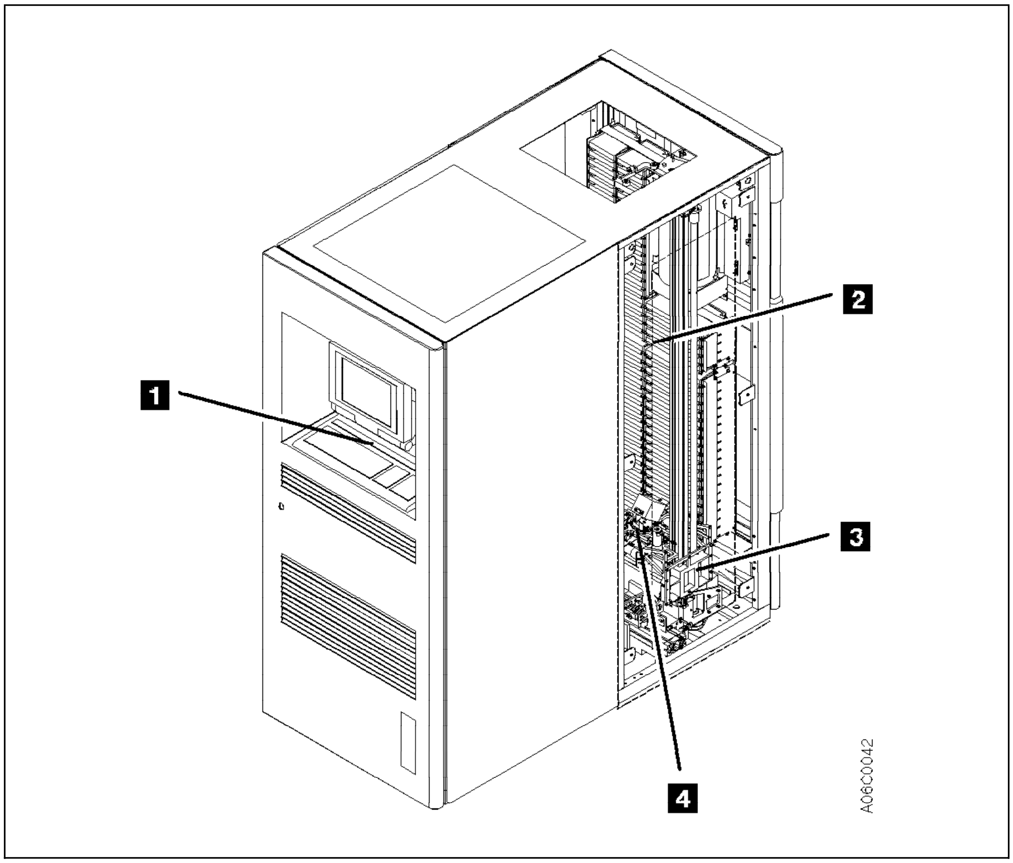


Figure 9. 3494 Model L1x Functional Components (Rear View)

1 Library manager

2 Cartridge storage cells

3 Cartridge accessor

4 Cartridge gripper (picker)

The details of each functional component are described in 2.2, “Functional Components” on page 21.

The following control unit frames are available: IBM Magstar 3494 Model L10, IBM Magstar 3494 Model L12, and IBM Magstar 3494 Model L14. The only difference among the models is the tape subsystem they are designed to house.

2.1.1.1 IBM Magstar 3494 Model L10

The IBM Magstar 3494 Model L10 contains either one or two IBM 3490E Model F1A tape drives or one IBM 3490E Model CxA tape subsystem, and cartridge storage cells. The 3490E Model F1A tape drives and the 3490E Model CxA tape subsystem cannot be intermixed in the 3494 Model L10.

The 3490E Model F1A tape drive contains one drive and an integrated control unit. If attached to an S/390 with ESCON or parallel channels, an ESCON control unit and channel adapters must be configured. With the 3490E Model F1A tape drive, the 3494 Model L10 can attach without additional drive unit frames to the following host platforms:

- S/390 Parallel Enterprise Servers
- All ESA-capable S/370 and S/390 systems

- AS/400 9402, 9404, and 9406: D models and later except D02, E02, and F02
- RS/6000 models, including SP models, that support SCSI-2 differential adapters (feature codes 2409, 2412, 2416, 2420, 6207, and 6209)

Host attachment can be achieved through either SCSI-2, ESCON, or parallel channels to the 3490E Model F1A tape drive. The type of host connection depends on the host support. Some hosts require a second connection to the library manager to pass library commands. The connection can be either an RS-232 or a LAN.

The 3490E Model CxA tape subsystem contains one or two drives and a single integrated control unit. With the 3490E Model CxA tape subsystem, the 3494 Model L10 can attach without additional drive unit frames to the following host platforms:

- S/390 Parallel Enterprise Servers
- All ESA-capable S/370 and S/390 systems
- AS/400 9402, 9404, and 9406: D models and later except D02, E02, and F02
- RS/6000 models, including SP models, that support SCSI-2 differential adapters (feature codes 2409, 2412, 2416, 2420, 6207, and 6209)
- RS/6000 models that support the System/370 Channel Emulator/A (2759)
- RS/6000 models that support the S/390 ESCON Channel Emulator (2754)

Host attachment can be achieved through either SCSI-2, ESCON, or parallel channels to the 3490E Model CxA tape subsystem. The type of host connection depends on the host support. Some hosts require a second connection to the library manager to pass library commands. The connection can be either an RS-232 or a LAN.

2.1.1.2 IBM Magstar 3494 Model L12

The IBM Magstar 3494 Model L12 contains one or two IBM Magstar 3590 Model B1A tape drives and cartridge storage cells.

The 3494 Model L12 can attach to the following host platforms without additional drive frames:

- AS/400 9402, 9404, and 9406: D models and later except D02, E02, and F02
- RS/6000 models, including SP models, that support SCSI-2 differential adapters (feature codes 2409, 2412, 2416, 2420, 6207, and 6209)
- Sun processors that support SPARC operating systems
- HP 9000 Series Business Servers using HP-UX 10.0x through 10.3x

Host attachment is achieved through a SCSI-2 connection to the 3590 Model B1A tape drive. A second connection to the library manager is required to pass library commands. The connection can be either an RS-232 or a LAN.

Note: The 3494 Model L12 can be installed without a 3590 Model B1A tape drive. In that case, host connection is achieved through the tape drives installed in the attached 3494 Model D1x frames.

2.1.1.3 IBM Magstar 3494 Model L14

The IBM Magstar 3494 Model L14 contains one IBM Magstar 3590 Model A50 tape controller, a maximum of two IBM Magstar 3590 Model B1A tape drives, and cartridge storage cells.

The 3494 Model L14 can attach to the following host platforms without additional drive frames:

- S/390 Parallel Enterprise Servers
- All ESA-capable S/370 and S/390 systems that support ESCON channels

Host attachment is achieved through one or two ESCON channels to the 3590 Model A50 tape controller.

Note: The 3494 Model L14 can be installed without a 3590 Model B1A tape drive and without the 3590 Model A50 tape controller. In that case, host connection is achieved through the tape drives installed in the attached 3494 Model D1x frames.

2.1.2 IBM Magstar 3494 Model D1x Drive Unit Frames

The IBM Magstar 3494 Model D1x contains zero to six drives (depending on the model), cartridge storage cells, and an accessor rail. The 3494 Model D1x can be attached to any model of the 3494 Model L1x. See 3.1.10, “Frame Configuration” on page 68 for more information about 3494 configurations. As with the 3494 Model L1x, there are three models, which differ according to the tape drive technology they are designed to house:

- The 3494 Model D10 has from zero to one IBM 3490E tape subsystems, or from zero to two IBM 3490E Model F1A tape drives.
- The 3494 Model D12 has from zero to six IBM Magstar 3590 Model B1A tape drives.
- The 3494 Model D14 has from zero to four 3590 Model B1A tape drives. If a 3590 Model B1A tape drive is installed, a 3590 Model A50 tape controller must also be installed.

Note: The 3494 Model D10 was formerly known as feature code 5300.

2.1.2.1 IBM Magstar 3494 Model D10

The IBM Magstar 3494 Model D10 can be attached to any model of the library control unit. It provides cartridge storage and, optionally, housing for 3490E tape technology.

The 3494 Model D10 can contain up to two 3490E Model F1A tape drives, or one 3490E Model CxA tape subsystem, or no tape drive at all. The 3490E Model F1A tape drives and the 3490E Model CxA tape subsystem cannot be intermixed in the 3494 Model D10.

With the 3490E Model F1A tape drive, the 3494 Model D10 provides tape technology that can be attached to the following hosts:

- S/390 Parallel Enterprise Servers
- All ESA-capable S/370 and S/390 systems
- AS/400 9402, 9404, and 9406: D models and later except D02, E02, and F02
- RS/6000 models, including SP models, that support SCSI-2 differential adapters (feature codes 2409, 2412, 2416, 2420, 6207, and 6209)

Additional features may be required on the library control unit to provide host attachment for library commands.

With the 3490E Model CxA tape subsystem, the 3494 Model D10 provides tape technology that can be attached to the following hosts:

- S/390 Parallel Enterprise Servers
- All ESA-capable S/370 and S/390 systems
- AS/400 9402, 9404, and 9406: D models and later except D02, E02, and F02

- RS/6000 models, including SP models, that support SCSI-2 differential adapters (feature codes 2409, 2412, 2416, 2420, 6207, and 6209)
- RS/6000 models that support the System/370 Channel Emulator/A (2759)
- RS/6000 models that support the S/390 ESCON Channel Emulator (2754)

Additional features may be required on the library control unit to provide host attachment for library commands.

When a tape subsystem is installed, the 3494 Model D10 also provides 300 storage cells. If a tape subsystem is not installed, and the drive unit has not been prepared for the field installation of a tape subsystem, the 3494 Model D10 provides 400 cartridge storage cells. The cartridge storage capacity varies according to the tape subsystem installed and the library control unit configuration. See Table 15 on page 69 for more information about the storage capacity of the 3494 Model D10.

2.1.2.2 IBM Magstar 3494 Model D12

The IBM Magstar 3494 Model D12 can be attached to any model of the library control unit. It provides cartridge storage and, optionally, housing for Magstar 3590 tape technology that can be attached to the following hosts:

- A Magstar Virtual Tape Server, logically integrated with the IBM 3494
- AS/400 9402, 9404, and 9406: D models and later except D02, E02, and F02
- RS/6000 models, including SP models, that support SCSI-2 differential adapters (feature codes 2409, 2412, 2416, 2420, 6207, and 6209)
- Sun processors that support SPARC operating systems
- HP 9000 Series Business Servers using HP-UX 10.0x through 10.3x

Additional features are required on the library control unit to provide host attachment for library commands.

The 3494 Model D12 can have from zero to six 3590 Model B1A tape drives installed. The 3494 Model D12 also provides cartridge storage cells. The cartridge storage capacity varies according to the tape subsystem installed and library control unit configuration. See Table 15 on page 69 for more information about the storage capacity of the 3494 Model D12.

Note: If the 3494 Model D12 is part of a Magstar Virtual Tape Server subsystem, three to six 3590 Model B1A tape drives can be installed.

2.1.2.3 IBM Magstar 3494 Model D14

The IBM Magstar 3494 Model D14 can be attached to any model of the library control unit. If added to a 3494 Model L10 or L12, it provides ESCON-attached Magstar 3590 tape technology, which can be attached to the following hosts:

- S/390 Parallel Enterprise Servers
- All ESA-capable S/370 and S/390 systems that support ESCON channels

The 3494 Model D14 can have from zero to four 3590 Model B1A tape drives installed. When a tape subsystem is installed in the 3494 Model D14, a 3590 Model A50 tape controller must also be installed. Depending on the tape subsystems installed and the library control unit configuration, the 3494 Model D14 provides from 305 to 400 cartridge storage cells. See Table 15 on page 69 for more information about the storage capacity of the 3494 Model D14.

2.1.3 IBM Magstar 3494 Model S10 Storage Unit Frame

The 3494 Model S10 can be attached to any model of the 3494 Model L1x. The 3494 Model S10 provides additional storage capacity for 400 tape cartridges and an accessor rail. The 3494 Model S10 cannot be upgraded to house any type of tape drive and is intended for cartridge storage only.

Note: The 3494 Model S10 was formerly known as feature code 5400.

2.1.4 IBM Magstar 3494 Model B18 Virtual Tape Server

The Magstar Virtual Tape Server (VTS) is housed in two frames of a 3494 tape library as shown in Figure 10:

- The 3494-D12 frame can be located anywhere in the 3494 tape library and contains the IBM 3590 tape drives dedicated to the VTS controller in the B18 frame. Refer to 2.1.2, "IBM Magstar 3494 Model D1x Drive Unit Frames" on page 16 for a description of the D12 frame.
- The 3494-B18 frame can be located at a distance of up to 14 m from the D12 frame. This frame contains the enhanced virtual tape server controller and the tape volume cache.

The 3494-B18 frame replaces the previous B16 VTS frame, which was installed in line with the library frames and contained cartridge storage slots, an accessor rail, and the VTS controller and the tape volume cache.

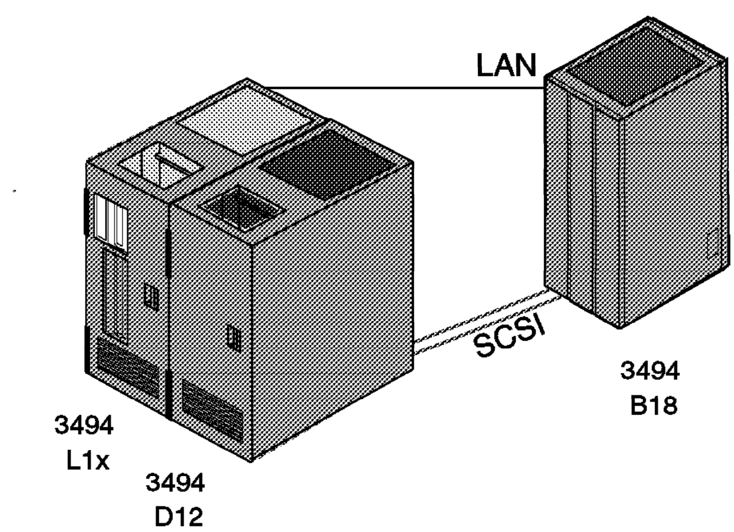


Figure 10. IBM Magstar Virtual Tape Server

From a host perspective, data is processed as if it resides on actual 3490E cartridges. All access of data is through the tape volume cache, which is managed by the VTS on fault-tolerant RAID disks (up to 864 GB assuming 3:1 compaction). The cache can hold hundreds of virtual volumes. If a requested volume is not present in the cache, the required Magstar 3590 cartridge is mounted, and the logical volume is moved back into the cache from a stacked volume. Up to 64 3490E devices and 150,000 virtual volumes can be emulated to the OS/390 software. The Magstar Virtual Tape Server provides two to four ESCON channel adapters.

For more information about the IBM Magstar 3494 Virtual Tape Server, see the *IBM Magstar Virtual Tape Server: Implementation Guide*.

2.1.5 IBM Magstar 3494 Model HA1 High Availability Unit

The IBM Magstar 3494 Model HA1 High Availability unit consists of two service bay unit frames for storage of a second accessor and a second library manager. When the High Availability unit is installed, configurations of 3, 4, 6, 8, 10, 12, and 16 frames are allowed, not counting the two service bays of the High Availability unit. With the Dual Active Accessor feature, at least four frames must be installed in the IBM 3494.

A left service bay and a right service bay are required in the configuration. The second library manager and second accessor are located in the right service bay, B, when viewing the library from the front.

Figure 11 shows the following functional components of service bay A from the right front:

1 Cartridge storage cells are located in the interior side of the front door and on the back interior wall but are for service use only.

2 Barrier door used by service personnel to separate the service bay from the main aisle of the IBM 3494. The barrier door allows for concurrent service of the accessor and the associated hardware.

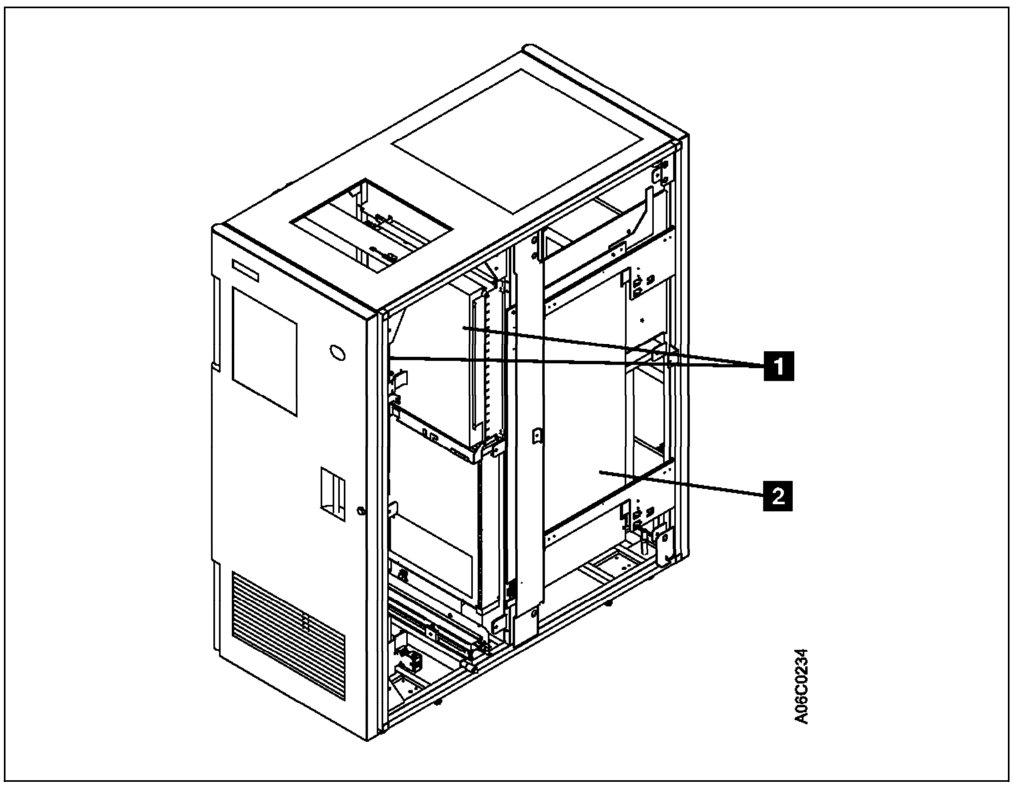


Figure 11. Service Bay A Functional Components (Right Front)

Figure 12 on page 20 shows the following functional components of service bay B from the left front:

1 Cartridge storage cells are located in the interior side of the front door and on the back interior wall but are for service use only.

2 Barrier door used by service personnel to separate the service bay from the main aisle of the IBM 3494. The barrier door allows for concurrent service and the associated hardware.

3 The hot standby library manager can take control of all operations in the IBM 3494. Its hardware consists of a controller, display, pointing device, and keyboard. An optional remote library manager console feature code is also available for remote installation in a LAN environment.

The second accessor (not visible) is similar in function to the accessor of the 3494 Model L1x. It can be controlled by either library manager.

The High Availability unit must be configured the same as in the 3494 Model L1x: with one or two grippers.

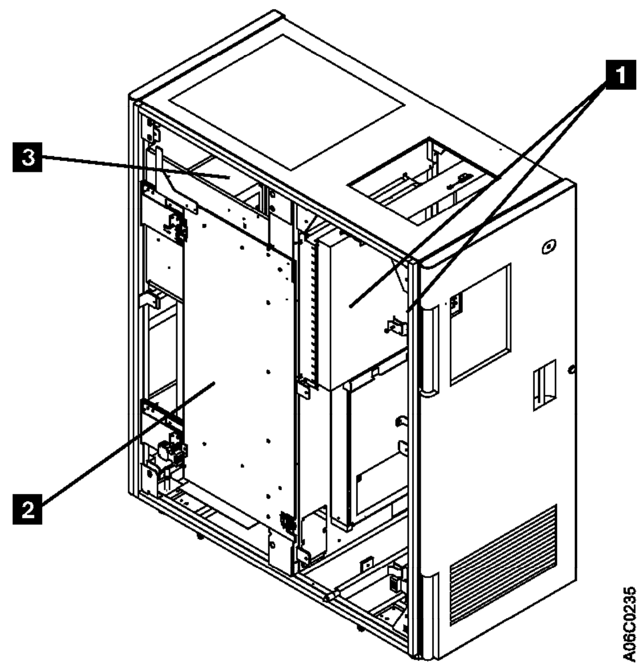


Figure 12. Service Bay B Functional Components (Left Front)

For a more detailed description of the Model HA1, see 2.2.13, “IBM Magstar 3494 Model HA1 High Availability Unit” on page 35.

2.1.6 Model Conversions

The following model conversions are supported for the IBM 3494:

- 3494 Model L10 to Model L12
- 3494 Model L10 to Model L14
- 3494 Model D10 to Model D12
- 3494 Model D10 to Model D14

Any model upgrades that are not listed must be requested through the normal RPQ process. Features cannot be upgraded to models.

For information about available feature conversions, see 2.3, “Features” on page 38.

2.2 Functional Components

In the sections that follow, we describe in detail the library manager, host command and response processing, volume categories, tape subsystems, cartridge storage, cartridge accessor, and other functional components of the IBM 3494.

2.2.1 Library Manager

The library manager, the operational focal point of the IBM 3494, provides the ability to install, maintain, configure, and operate the library. It consists of a controller (a personal computer, or PC), a display, a keyboard, and the library manager application. The library manager provides the following services:

- User interface
- Database
- Host command processing and response
- Accessor control
- Control of the convenience I/O station and high-capacity I/O facility

When the High Availability unit is installed, there are two library managers in the configuration. For more information, see 2.2.13, "IBM Magstar 3494 Model HA1 High Availability Unit" on page 35.

2.2.1.1 User Interface

The library manager graphical user interface is provided by the library manager application, which runs on the library manager PC and is delivered as Licensed Internal Code (LIC). As such, you have no responsibility for the backup, restoration, and maintenance of the application. Those activities are the sole responsibility of the IBM Service Representative.

The operator menu is displayed when the library manager is powered on. The operator menu panel consists of a title bar and an action bar (see Figure 13), and initially, the system summary window (see Figure 14).

Figure 13. Operator Menu

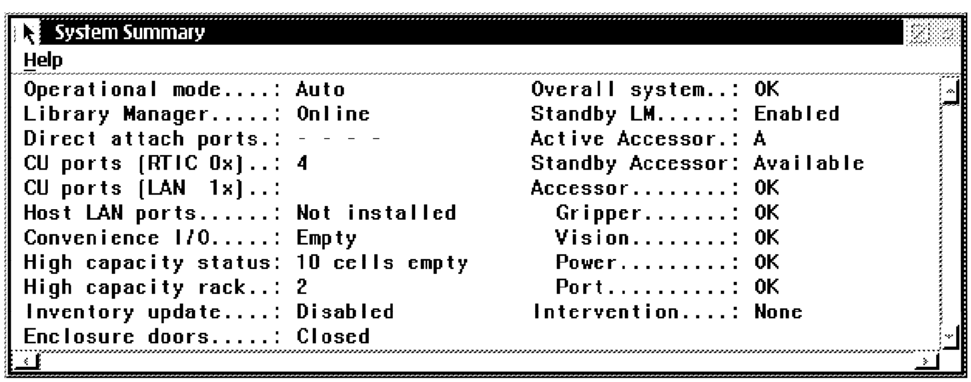


Figure 14. System Summary Window

The library manager has three levels of operational authority:

- General operator
- Systems administrator
- Service

The general operator has the authority to perform the basic day-to-day operations of the library, such as inquiring about the status of the library or inserting or removing cartridges from the library.

The systems administrator can perform all of the functions of the general operator and administrative tasks that require more detailed knowledge of and training in the use of the library manager and the 3494. An example of a systems administrator function is the initial inventory of the contents of the library or a reinventory of the library′s contents. The systems administrator has no access to the functions specific to the repair or maintenance of the library.

Service access allows all library manager functions, including changing the systems administrator password if it is forgotten, and backing up or restoring the library manager database to the diskette drive in the library manager PC.

The systems administrator and service levels can be password protected. The IBM Service Representative selects this option during the library manager installation teach process, or during a re-teach operation at any other time. See 3.5.2, “CE Initial Operations (Teach and Initial Inventory)” on page 83 for more information.

2.2.1.2 Database

The library manager database is built during installation of the IBM 3494. It consists of several tables and system files that contain information about the library and its volumes. The database tables are:

- Cell table
- Cartridge table
- Device table
- Rotating category table

These tables hold information about the logical and physical coordinates of all library components, the cartridge location, cartridge status, and cartridge category. The system files hold information about the library serial number, machine type and model, device cleaning schedule, operational statistics, and service information.

Database mirroring is available if the optional second hard disk (feature code 5214) is installed and enabled. Database mirroring facilitates recovery if the primary library manager disk fails. An asynchronous OS/2 task updates the second copy of the database each time the primary database is updated. The secondary database is fully synchronized during the termination of the library manager. During library manager initialization, the primary and secondary databases are checked, and the library manager is initialized according to their status.

If a second copy or backup copy of the database does not exist, and the primary copy is lost, a lengthy library outage occurs. See 10.3.11, “Library Manager Database Recovery and Host Resynchronization” on page 351 for more information about resynchronizing the library manager database with the host systems. We strongly recommend that you install and enable the second hard disk on all IBM 3494s.

When a second copy of the database exists, the primary hard disk only requires repair, and the secondary copy of the database has only to be copied back to the primary disk. Thus the duration of the outage is significantly reduced.

When the High Availability unit is installed, both library managers have the second hard disk feature installed, and there are four disks in the tape library. Although only two copies of the library manager database are kept at any one time, this configuration provides the maximum level of availability for the database. For more information about database mirroring, see 2.2.13, "IBM Magstar 3494 Model HA1 High Availability Unit" on page 35.

2.2.2 Host Command and Response Processing

Host command and response processing is carried out through the control path, which can be the channel connection to the tape subsystem, or an RS-232 or LAN connection. The type of physical connection used to provide the control path depends on the type of host system. Hosts can read some of the information stored in the database tables and system files and, as part of the normal library operation, cause some of the data to be updated. For additional information about the way different hosts can handle the control and data paths, see 3.1.1, "Host Attachment" on page 59.

Based on commands received from attached hosts, the library manager controls the movement of the cartridge accessor.

The library manager manages its operation by queues and task priorities within those queues. The library manager looks at the queues, takes the five highest priority tasks, performs them, and then looks at the queues and takes the next set of tasks.

Table 2 shows the priority levels and the operations in each level and indicates whether the operations can be promoted to priority 2, the highest priority to which an operator can promote a queued operation.

Table 2. Command Queue Priorities

Priority	Operation	Promotable
0	Inventory update	—
1	• Mount from category • Mount from input station operations • Mount cleaner cartridge	—
2	Reassigned by operator	—
3	• Mount specific volser • VTS Import/Export	Yes
4	• Move cartridge from input station • Unlabeled tape operation • Eject volser	Yes
5	Audit volser	Yes
6	Reserved	—
7	Demount	Yes
8	Reserved	—
9	Offline command	—

The library manager monitors and controls all operations involving the convenience I/O station and high-capacity I/O facility.

Figure 15 presents an overview of the data and control paths of the library manager. You can see that the library manager controls all IBM 3494 library components. Host access to the library manager to pass control information or receive information from the library manager database is either through the tape subsystem channel and RS-422 connection or directly to the library manager through an RS-232 or LAN connection. The RS-422 connection also provides the library manager with drive and control unit status information.

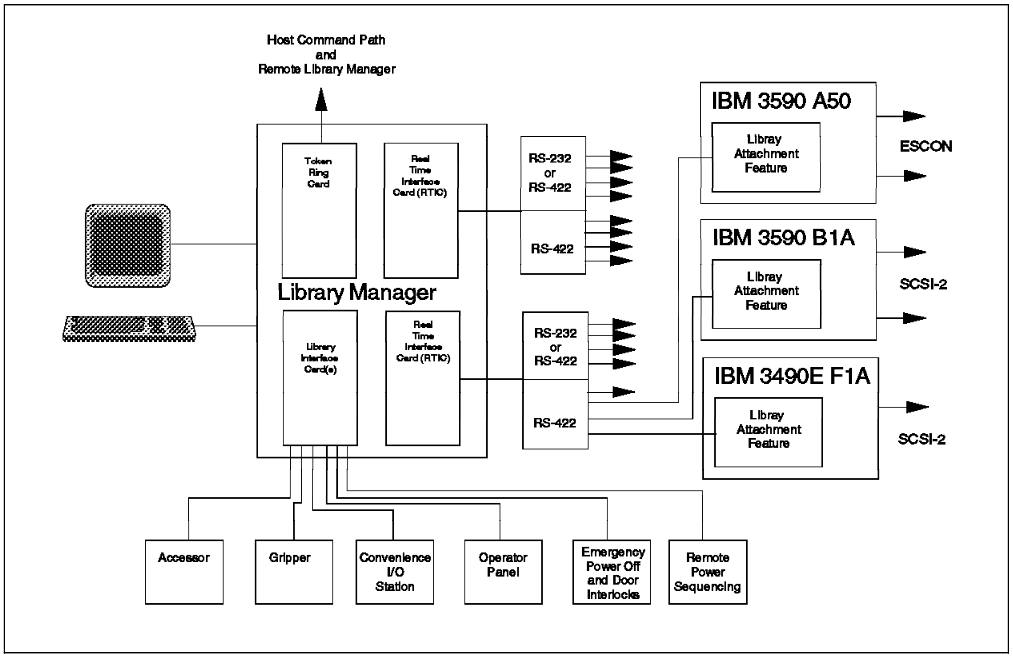


Figure 15. Library Manager Data and Control Paths

The IBM 3494 is shipped with a single real-time interface card (RTIC) in the library manager. The RTIC provides four RS-422 connections to the tape control units and four RS-232 connections to the host processors.

A second RTIC, the Expansion Adapter feature (5229), can be installed. It provides four additional RS-422 and four additional RS-232 connections. The Tape Unit Expansion feature (5228) also provides a second RTIC that transforms RS-232 connections into RS-422 connections.

When one feature 5229 and two feature 5228s are installed, 16 RS-422 connections are available (see Figure 16 on page 25). Here, hosts cannot be connected to the library manager through RS-232, and either the Token Ring (5219) or the Ethernet (5220) adapter must be installed in the IBM 3494.

See Table 11 on page 50 for a definition of the number of control units or direct-attached drive connections available with feature codes 5228 and 5229 installed in the IBM 3494.

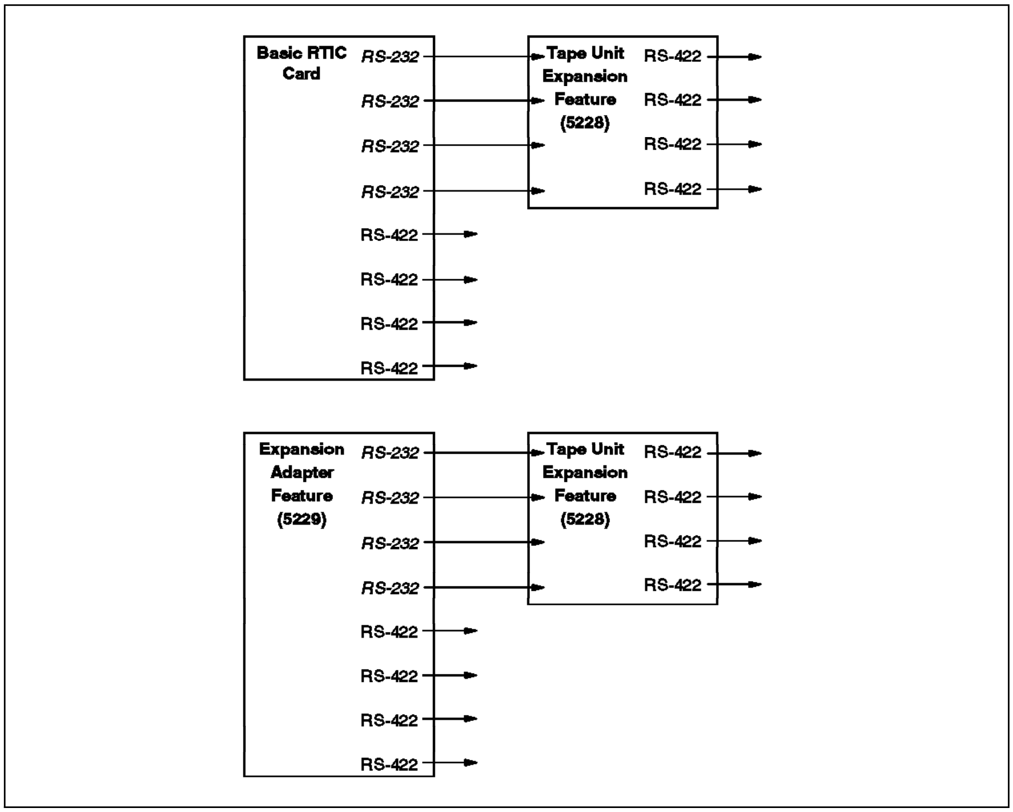


Figure 16. RTIC Connections

2.2.3 Volume Categories

The library manager uses volume categories to manage and group the volumes in the tape library. The volume category is a four-digit hexadecimal number, x“0000” to x“FFFF.”

There are two kinds of volume categories, one for hardware usage and one for software usage. The hardware usage volume categories represent CE cartridge, cleaner volume, volume to be ejected, and other hardware usages. Appendix A, “Library Manager Volume Categories” on page 353 lists the library manager hardware usage volume categories.

The software usage volume categories are used to identify the host software platform that owns the volume. Different host software platforms use different volume categories. The category is assigned to the volume during insert processing by the appropriate host system. Appendix A, “Library Manager Volume Categories” on page 353 lists all library manager volume categories.

2.2.4 IBM 3490E Tape Subsystem

The 3490E Model F1A tape drive and the 3490E Model CxA tape subsystem are fully compatible with existing 3490E models, using both CST and ECCST. They are read-compatible with earlier cartridge formats (IBM 3480 or 3490) for ease of migration. These models are specifically designed for use in the IBM 3494 and cannot be used outside the tape library.

The Cxx models contain a control unit in the same chassis as the drive(s). The F1A drives are native SCSI and can be directly attached to SCSI hosts. To attach an F1A to an ESCON or OEMI host, the feature code 3000 controller must be specified on either the D10 or L10 that will contain the drives.

Figure 17 shows the connections to the feature code 3000 controller.

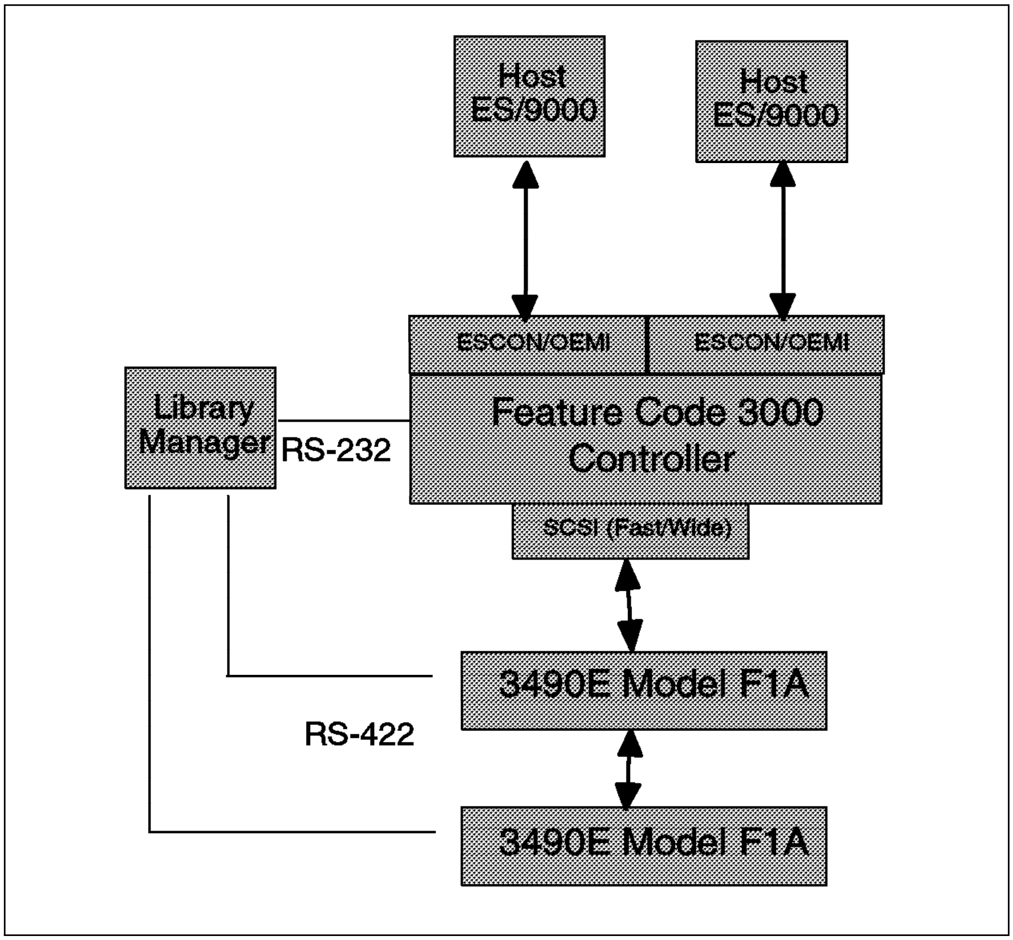


Figure 17. Feature Code 3000 Controller

2.2.5 IBM Magstar 3590 Tape Subsystem

The IBM Magstar 3590 tape subsystem is a family of tape drives designed to provide high capacity, high performance, high reliability, and connectivity for a wide range of hosts. The Magstar 3590 tape drive reads and writes in a 128-track format. While reading or writing 16 tracks at a time, the Magstar 3590 uses serpentine, interleaved, longitudinal recording technology to make a total of four round trips from physical beginning to physical end of the tape and back again. The tape read/write head indexes, or moves vertically, when it completes each round trip so that the recorded tracks are interleaved across the width of the tape.

The Magstar 3590 uses a metal particle medium in the tape cartridge that can store 10 GB of uncompacted data. The integrated control unit uses a compaction algorithm that can increase the storage capacity of these cartridges to 30 GB. The Magstar 3590 tape cartridge or MEDIA3 is the same size as today's CST or MEDIA1 and ECCST or MEDIA2 and can be placed in the IBM 3494.

For more information about the IBM Magstar 3590 tape subsystem, refer to the *IBM Magstar 3590 Tape Subsystem: Multiplatform Implementation.*

2.2.6 Tape Device and Cartridge Compatibility

The tape cartridge and media used with the 3590 Model B1A tape drive are completely new and incompatible with any other IBM tape subsystems. You cannot read from or write to this tape, using IBM 3480, 3490, or 3490E tape subsystems. Note that the 3590 Model B1A tape drive can neither read from nor write to previous IBM tape cartridge formats; that is, neither 18-track nor 36-track format. Table 3 shows tape drive and cartridge compatibility.

Table 3. Tape Drive and Cartridge Compatibility

Cartridge Type and Recording Technology	Tape Drive			
	IBM 3590	IBM 3490E	IBM 3490 or 3480 with IDRC	IBM 3480 without IDRC
IBM 3590 cartridge 128-track	Read/write	N/A	N/A	N/A
ECCST 36-track	N/A	Read/write	N/A	N/A
CST 36-track	N/A	Read/write	N/A	N/A
CST 18-track	N/A	Read only	Read/write	Read/write

2.2.7 Cartridge Storage

The IBM 3494 can provide cartridge storage for 140 to 6240 tape cartridges. The cartridge storage cells are located on the rear wall and inside the front door of each unit.

The storage cells are labeled to facilitate identifying the cartridge location. This identification consists of three characters. Figure 18 on page 28 shows the cartridge storage labeling for the 3494 Model L1x door:

1 Storage rack column

2 Storage rack row

3 Wall number

An odd wall number indicates the rear wall of a unit, and an even wall number indicates the door. For example, cartridge storage location ***1A4*** is in the rear wall of the 3494 Model L1x, in the first column from the left, the fourth cell down. The cells hold the cartridges horizontally, with the top of the cartridge facing up. Each cell has an empty cell marker. This marker is a bar code label that the vision system can see when a cartridge is not present. The empty cell marker reduces the time required for inventory processing or cell audits as the IBM 3494 does not have to physically check the cell that it is empty.

Storage cells can be either regular cells or reserved cells. As the name suggests, regular cells are used for storing cartridges. You cannot store cartridges in the convenience I/O station or the high-capacity I/O facility. The reserved cells are used to hold CE cartridges and for error recovery. The library reserves certain cells within the library for functions that the operator does not actively control. In non-high-availability models, these locations are error recovery cell ***1A1*** (***1A3*** instead of 1A1 if the optional Dual Gripper feature is installed) and CE cartridge cell ***1A20***. If both 3490E and 3590 tape subsystems are present, CE cartridge cell ***1A19*** is also reserved.

In high availability models, these locations are error recovery cells ***1A1 and 1A2***, or ***1A3 and 1A4*** if the Dual Gripper Feature is installed. CE cartridge cells are in the service bays.

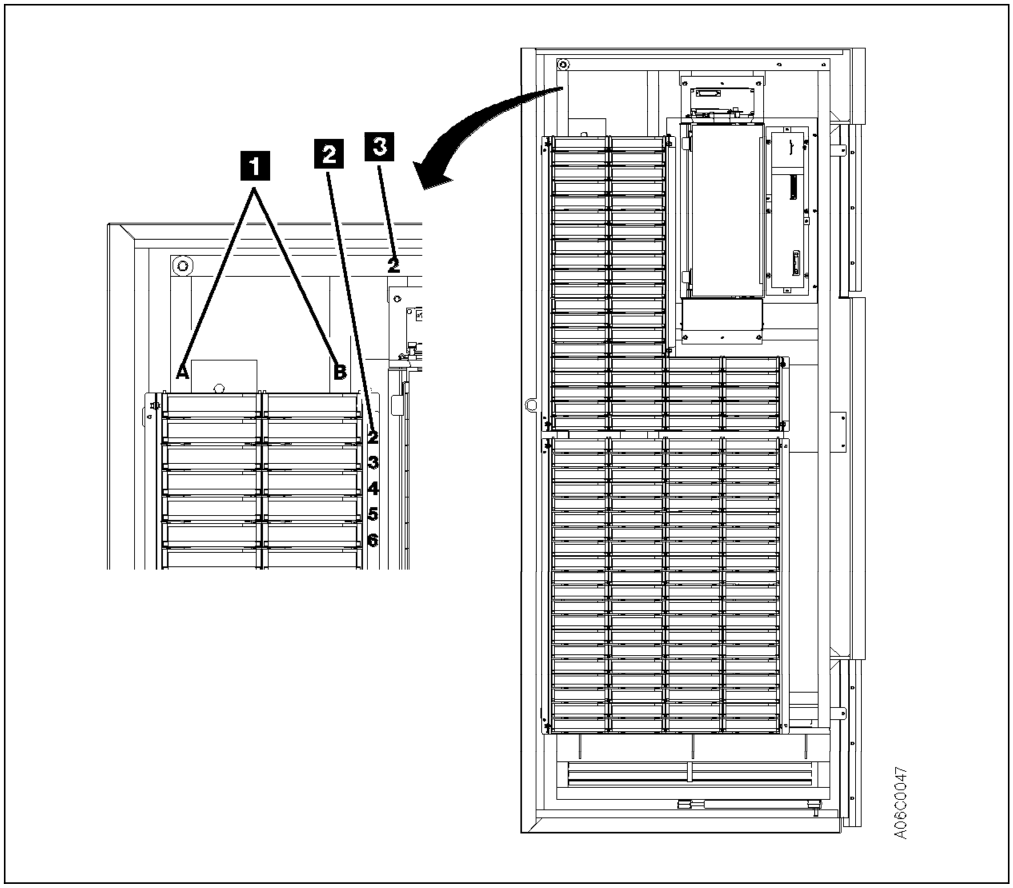


Figure 18. IBM 3494 Cartridge Storage Cell Labeling

2.2.8 Cartridge Accessor

The cartridge accessor identifies and moves cartridges among the storage cells, tape drives, convenience I/O station, and high-capacity I/O facility. The cartridge accessor consists of a carrier, which provides a mounting platform for the gripper; a picker; X and Y axis motors; and a vision system. The cartridge accessor moves through the library on a rail system.

The High Availability unit provides a second cartridge accessor in the IBM 3494. Without the Dual Active Accessor feature installed, at any time one accessor is active and the other is in standby mode in one of the two service bays of the High Availability unit. With the Dual Active Accessor feature installed and enabled, both accessors are active at the same time. This allows improved library exchange performance. In either case, if one accessor fails, the remaining accessor will take over all exchange responsibility. See 2.2.13, “IBM Magstar 3494 Model HA1 High Availability Unit” on page 35.

2.2.8.1 Cartridge Gripper

The cartridge gripper holds the cartridges when they are moved among the storage cells, tape drives, convenience I/O station, and high-capacity I/O facility. The gripper is mounted on the picker, which provides 180 degree movement, enabling cartridges at the front and rear of the library to be accessed. The optional dual gripper adds a second gripper to the accessor mechanism. Figure 19 shows the bar code reader, the picker, the first gripper, and the second gripper mounted below it.

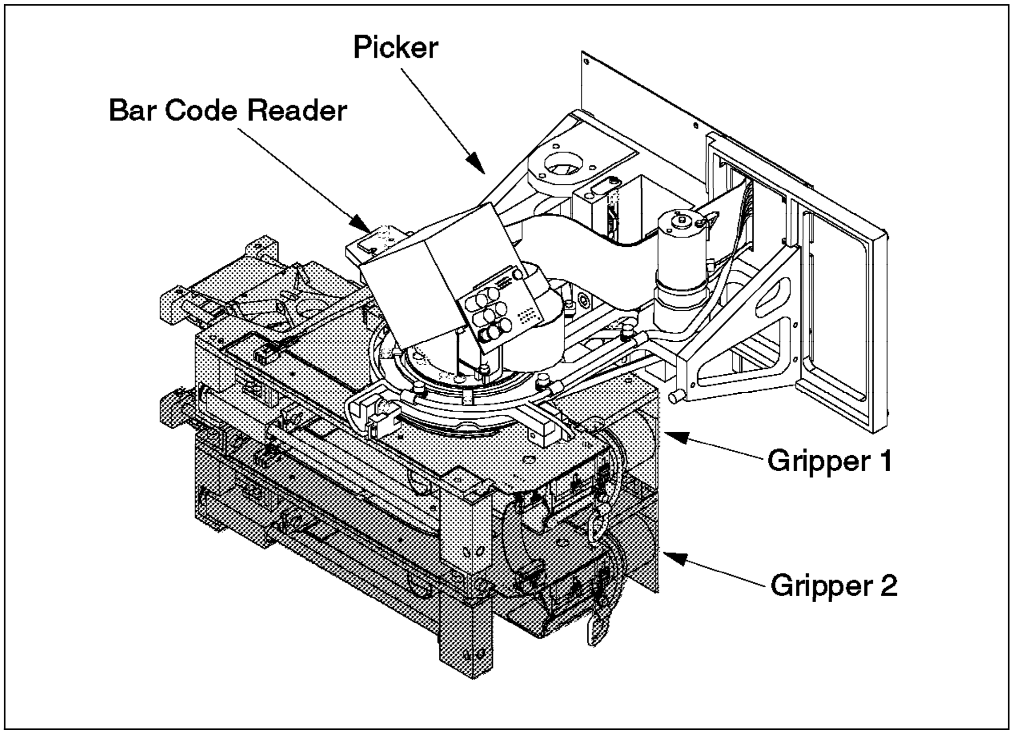


Figure 19. IBM 3494 Gripper Assembly

If a single gripper is installed, the IBM 3494 has to move to the target drive, remove the unloaded tape, and return it to its storage cell, before picking the new cartridge. When the dual gripper is installed, both grippers operate simultaneously. When a mount is requested, the IBM 3494 picks the requested cartridge and delivers it to the drive. If the drive contains an unloaded cartridge, the second gripper removes that cartridge from the drive, and the first gripper inserts the required tape. If two cartridges are requested to be picked up and delivered, the dual gripper does not pick two cartridges at a time.

The operation of the dual gripper thus improves the mount performance of the IBM 3494. Maximum performance is achieved by using a floating home cell mode, which is available only with the dual gripper. In this mode the IBM 3494 accessor returns a used cartridge to the nearest cell, rather than to the original cell (as it does in fixed home cell mode, the default). Thus floating home cell mode reduces robotic movement and improves mount performance. (For more information about performance, refer to 3.2, “Performance” on page 74.) If a gripper fails, the operation of the second gripper is not affected, so system availability is maintained. Floating home cell mode is enabled during the library manager teach and re-teach processes, which are carried out by an IBM Service Representative.

The dual gripper reduces the number of available cartridge cells by approximately 10% because the grippers cannot access the two top and bottom rows of cartridge storage cells.

The dual gripper is required on the High Availability unit when a dual gripper is installed on the 3494 Model L1x.

2.2.8.2 Vision System

The vision system on the IBM 3494 is a single bar code reader similar to those used in point-of-sale equipment (see Figure 19 on page 29). The vision system verifies the cartridge volser and media type when a cartridge is inserted into the library. It is also used to audit a specific cell and for library inventory processing. The vision system is not used to verify a cartridge′s volser before mounting. The vision system is also used in the teach process to establish the actual physical location of each component and the physical coordinates for each cartridge storage cell.

2.2.9 Rail System

The rail system consists of two separate horizontal rails, one at the top and one at the bottom of the tape library. The cartridge accessor is carried through the tape library on these rails. As frames are added, the rail system is extended to enable the cartridge accessor to operate throughout the tape library.

2.2.10 Convenience Input/Output Station

The convenience I/O station, if installed, allows you to add or remove cartridges from the IBM 3494 without interrupting automated operations. The station has a door that, when open, gives you access to 10 or 30 cartridge locations, depending on which feature is installed. Figure 20 on page 31 shows the 30-cartridge convenience I/O station.

The cell capacity of the library control unit frame (without the dual gripper installed) is:

- 240 if no convenience I/O station is installed
- 210 if the 10 cartridge capacity convenience I/O station is installed
- 160 if the 30 cartridge capacity convenience I/O station is installed

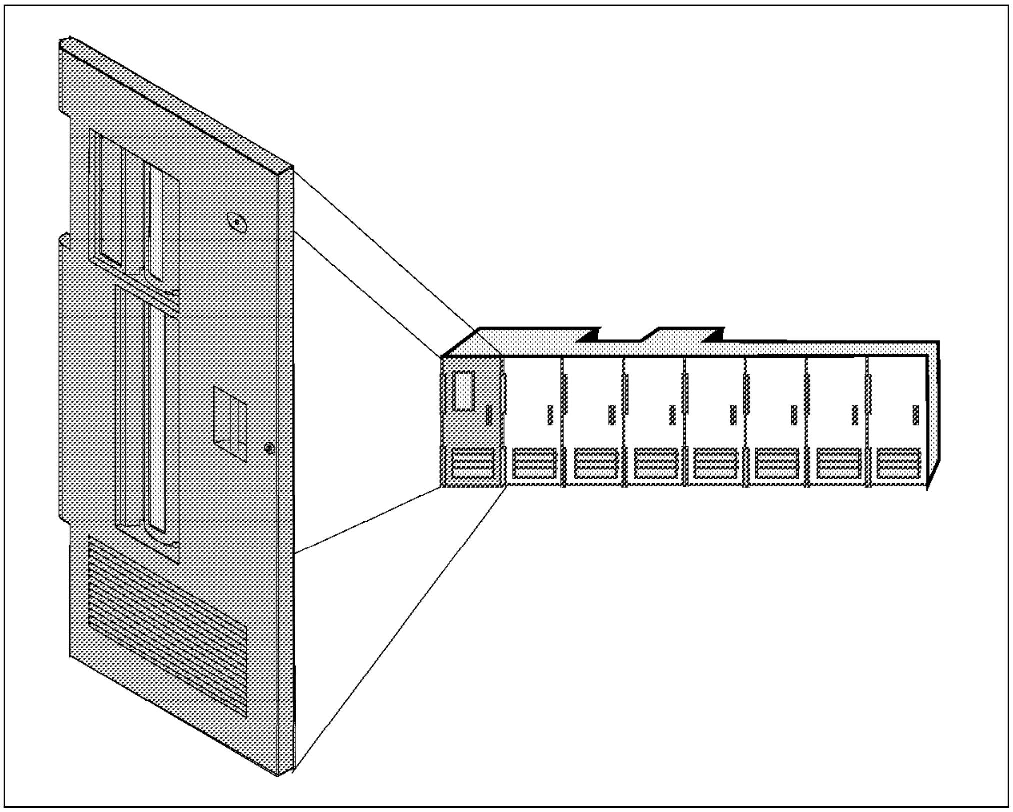


Figure 20. 30-Cartridge Convenience I/O Station

Figure 21 on page 32 shows the 10-cartridge convenience I/O station and the operator panel. There are four LED status indicators on the operator panel. Input Mode **1** indicates that cartridges have been entered into the convenience I/O station. Output Mode **2** indicates that the cartridge accessor is going to move cartridges to the convenience I/O station. Unload Required **3** shows that the convenience I/O station is full of cartridges that have been ejected from the library. I/O Locked **4** indicates that the library manager has locked the convenience I/O station. The library manager locks the convenience I/O station when it senses that cartridges have been inserted into the station and the door has closed, or before the cartridge accessor moves cartridges to the convenience I/O station. The convenience I/O station operation tab **5** is used to open the convenience I/O station door when the door is unlocked.

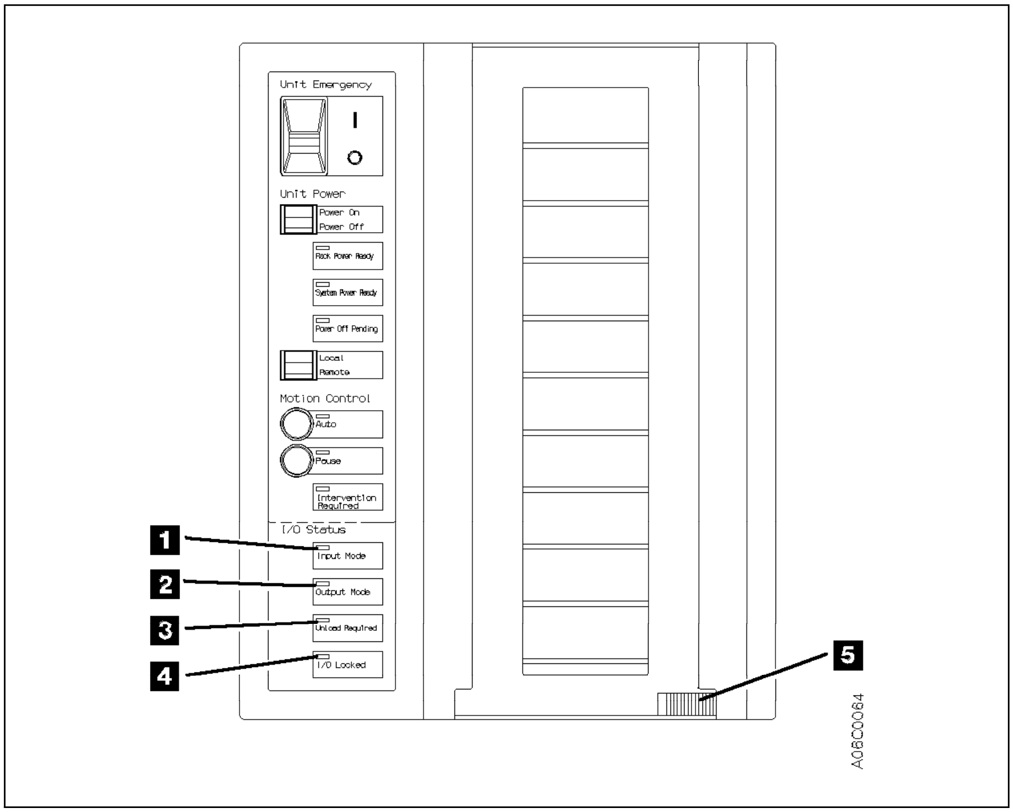


Figure 21. IBM 3494 Cartridge Convenience I/O Station and Operator Panel

2.2.11 High-Capacity Facilities

Two high-capacity handling facilities can be defined in an IBM 3494:

- High-capacity output
- High-capacity input/output

Only one type of high-capacity facility can be defined at a time in the library. The high-capacity facility type and size are not specified through a feature code; they are defined when the tape library is installed, during the teach process.

Cartridge cells allocated to the high-capacity facility are not available for cartridge storage.

2.2.11.1 High-Capacity Output Facility

The high-capacity output facility reserves a section of the cartridge storage area of the 3494 Model L1x front door for ejecting cartridges. Table 4 on page 33 shows the cartridge capacity sizes of the facility.

Table 4. IBM 3494 High-Capacity Output Facility Cartridge Capacity Sizes		
Feature	**Cartridge Capacity without Dual Gripper**	**Cartridge Capacity with Dual Gripper**
Without convenience I/O station	10, 20, 40, 80, 160	10, 20, 36, 72, 144
With 10 cartridge convenience I/O station	10, 20, 40, 80, 130	10, 20, 36, 72, 122
With 30 cartridge convenience I/O station	10, 20, 40, 80	10, 20, 36, 72

If a high-capacity output facility is not defined and a convenience I/O station is not installed, the library uses cartridge storage cell 2A1 as a default output facility (called the Single Cell Output Facility) when the dual gripper is not installed. Cell 2A3 serves the same purpose if the dual gripper is installed.

If a high-capacity output facility is defined, the first and last cell locations depend on the facility size you selected and whether you have the dual gripper feature installed. See Table 5 for the cell locations for the various high-capacity output facility sizes.

Table 5. IBM 3494 High-Capacity Output Facility Cell Locations		
Cartridge Capacity Size	**Without Dual Gripper**	**With Dual Gripper**
10	2A1 - 2A10	2A3 - 2A13
20	2A1 - 2A20	2A3 - 2A23
36	N/A	2A3 - 2A38
40	2A1 - 2A40	N/A
72	N/A	2A3 - 2A38 2B3 - 2B38
80	2A1 - 2A40 2B1 - 2B40	N/A
122	N/A	2A3 - 2A38 2B3 - 2B38 2C16 - 2C38
130	2A1 - 2A40 2B1 - 2B40 2C16 - 2C40	N/A
144	N/A	2A3 - 2A38 2B3 - 2B38 2C16 - 2 C38 2D16 - 2D38
160	2A1 - 2A40 2B1 - 2B40 2C16 - 2C40 2D16 - 2D40	N/A

2.2.11.2 High-Capacity Input/Output Facility

The high-capacity input/output facility reserves an area on an inside wall (drive side wall) of a frame other than the 3494 Model L1x so that both inserts (input) and ejects (output) can be performed. A 3494 Model S10 or the Magstar Virtual Tape Server Model B16 control unit frame can be configured to use the upper storage racks (100 cells without the dual gripper feature) or the whole wall (200 cells without the dual gripper feature) as input/output cells. A 3494 Model D1x frame is configured to use the available storage cells on the whole wall (50 to 135 cells depending on the model and the drive configuration). Only a single wall can be configured at any time.

2.2.12 Operator Panel

The operator panel is located on the front door of the 3494 Model L1x, to the left of the convenience I/O station if it is installed. Figure 22 on page 35 shows the operator panel (without the convenience I/O station). The controls enable most day-to-day library operations to be performed without using the library manager.

The operator panel controls are:

- Unit Emergency switch **1** Shuts down the IBM 3494. Use only in an emergency. Administrator level library manager authority is required to recover.
- Power On/Off **2** Normal way to shut down the IBM 3494. Once the IBM 3494 is powered off, at least 20 seconds should elapse before it is powered back on.
- Rack Power Ready **3** Indicates that power is on to the 3494 Model L1x.
- System Power Ready **4** Indicates that power is on to the tape subsystems within the IBM 3494.
- Power Off Pending **5** Indicates that the Power Off switch has been changed to the off position and the IBM 3494 is powering down.
- Local/Remote **6** Enables the IBM 3494 to be powered on or off by any attached AS/400s. If power is to be controlled by the operator panel, the switch should be in the local position. If power is under the control of a remote AS/400, the switch should be in the remote position.

ATTENTION:

If the switch is set to the remote position and no AS/400s are attached that can remotely control the IBM 3494, the IBM 3494 will power off.

- Auto **7** Changes the mode of the IBM 3494 from Pause to Auto. The LED indicator blinks while the mode of the IBM 3494 is in a transitional state. When the library is in Manual mode, both LED indicators blink together. It is not possible to change the mode of the library from Manual to Auto by using the Auto mode switch. (See 9.1, “Operational Modes and States” on page 291, for more information about the mode and operational states of the IBM 3494.)
- Pause **8** Changes the mode of the IBM 3494 from Auto to Pause. The LED indicator blinks while the mode of the IBM 3494 is in a transitional state. When the library is in Manual mode, both LED indicators blink together. It is not possible to change the mode of the library from Manual to Pause by using the Pause mode switch. (See 9.1, “Operational Modes and States” on page 291, for more information about the mode and operational states of the IBM 3494.)
- Intervention Required **9** Lit by the library manager when the IBM 3494 requires operator intervention. You would use the library manager or

remote library manager console to find out which operator intervention is needed. The library manager also sends messages to all attached hosts. How these messages are displayed varies from host to host.

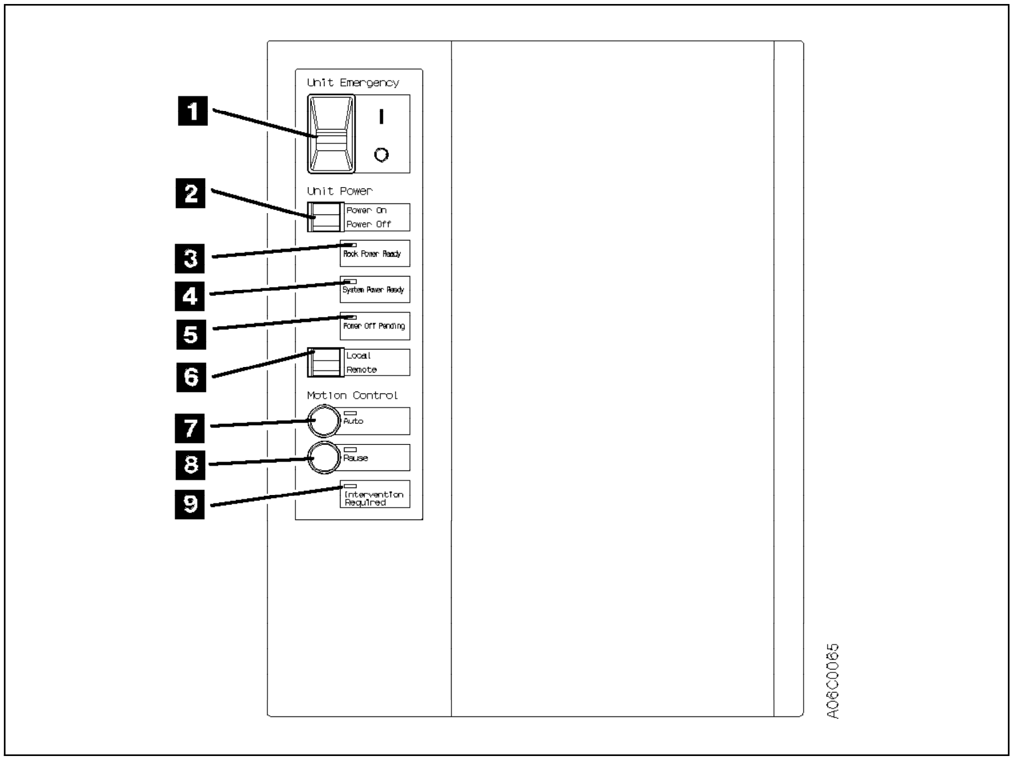


Figure 22. IBM 3494 Operator Panel (without Convenience I/O Station)

2.2.13 IBM Magstar 3494 Model HA1 High Availability Unit

When the High Availability unit is installed, the IBM 3494 configuration has two library managers and two cartridge accessors. Each library manager controls a cartridge accessor. In the event of a cartridge accessor or library manager failure, the IBM 3494 can continue operations after a short interruption. The High Availability unit also allows concurrent maintenance of these components while the IBM 3494 is operating.

The addition of the Dual Active Accessor feature allows higher library exchange performance while preserving the high availability aspects of the Model HA1 unit. The Dual Active Accessor feature is a chargeable microcode feature of the IBM 3494.

The components of the High Availability unit as shown in Figure 23 on page 36 are:

- A second library manager, located in the right-hand service frame
- A second cartridge accessor
- Communication links between the two library managers and a LAN Hub if a VTS is integrated with the IBM 3494.
- Shared nonvolatile random access memory (NVRAM) holding the current state of the active and standby library manager. It is used when a library manager cannot communicate with the second library manager on either of the links to decide whether this library manager is active.

- Hardware switches to switch the operator panel from one library manager to the other, or to switch hosts or tape controllers to either library manager.
- Digital input/digital output (DI/DO) lines to communicate component commands and status between both library managers and the library components, such as the accessors.
- Two service frames (or bays) for storage of the inactive cartridge accessors, service diagnostics, or accessor repair. Service frames contain rail extenders (to allow the accessor to be stored within the frame) and a barrier door. The right service frame (when you look at the library from the front) contains the second library manager. A barrier door in the service frame is used to keep the functioning cartridge accessor from entering the service frame during service. Each service frame has its own AC power control compartment, which is different from the compartment of the 3494 Model L1x.
- A second unit emergency power off (EPO) switch as in the 3494 Model L1x to drop power to the entire library.

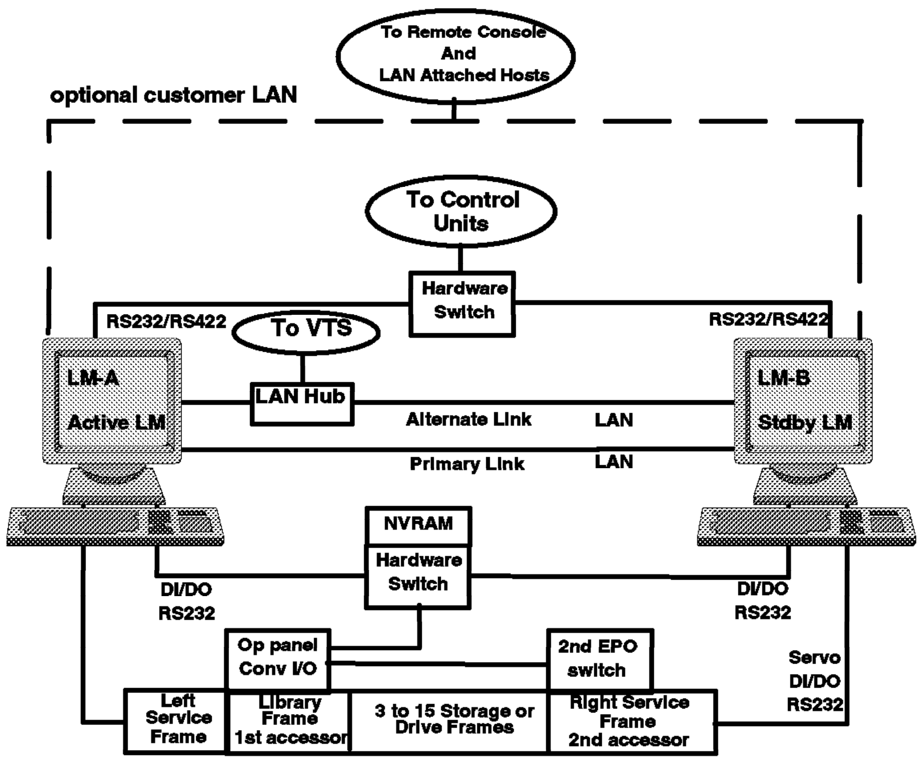


Figure 23. HA1 Functional Components

The active library manager controls the active accessor, receives host commands over the control paths, and controls the convenience I/O station. Either library manager can be the active library manager (LM) and either accessor can be the active accessor. If the remote accessor for an active library manager is the active accessor (that is, accessor B for LM A or accessor A for LM B), the active LM sends the accessor commands to the standby LM and the standby LM passes them on to the accessor.

There is only one operator panel, which is located on the 3494 Model L1x frame. It is controlled by the currently active library manager.

With the High Availability unit installed, the database on the primary disk in the active library manager is mirrored onto the primary disk of the standby library manager. If the standby library manager were to become unavailable, the secondary database would be mirrored onto the secondary disk of the active library manager.

With the High Availability unit, additional circuitry is installed that supports concurrent maintenance. Specifically, when an accessor is being serviced in its service bay and its barrier door is in place, the service bay door can be opened and closed without affecting the power of the other active accessor in the aisle.

The Model HA1 provides a high level of availability in the event of a failure of these two critical components of the IBM 3494:

- *Library manager*—The standby library manager (LM-B) knows that the active library manager (LM-A) is functioning properly by monitoring activity on the communication links between the two library managers. If LM-A fails, LM-B takes over the control of the library. This operation is called the *library manager switchover*. The host paths are now controlled by LM-B. The operator panel is switched to LM-B. To the hosts it appears as though the library manager failed and went through a recovery/restart procedure. The active library manager command queue is not maintained on the standby library manager, so jobs may abend. When the switchover begins, the host marks the library offline. Once the switchover is complete, the operator must vary the library online.

  If possible, LM-B will continue to use accessor A through LM-A. If LM-A cannot execute the accessor commands, accessor B will be activated.

  After the switchover, the primary database is on the primary disk of LM-B, and it is mirrored onto the secondary disk of LM-B. The copy from the primary database to the secondary database is done concurrently with online library manager operations, such as mounts and inserts. The copy operation involves copying the primary database record-by-record to the secondary database and mirroring any changes to the primary database as the library manager processes host commands.

  When LM-A comes back up, the secondary copy of the LM-B database is copied to the primary disk of LM-A. The primary disk of LM-A now becomes the secondary copy for the active library manager.

  If the Dual Active Accessor feature is installed and enabled, the operation of the library managers remains the same, as there is still only one library manager designated as active, and the other library manager, although it does control the robotics of the second accessor, is still designated as standby.

- *Cartridge accessor*— If accessor A fails, LM-A sends accessor commands to LM-B over the communication links. LM-B then executes the commands, using accessor B. The first operation is to gently push accessor A into its service bay (left side of the library) so that accessor B can access all cartridges in the library. A special pusher bar is added to one of the accessors for this purpose. This operation is called the *accessor switchover*. On completion, normal library function resumes using accessor B. LM-A remains the active library manager. Operation continues automatically after a short time. No operator involvement is required.

  If the Dual Active Accessor feature is installed and enabled, each accessor services the mounts within two zones. The partition between these zones is on a frame boundary, and this boundary may be defined as dynamic or static. If an accessor fails, the remaining accessor pushes the failed accessor into its service bay and takes over the operation of both zones until the failed accessor is repaired and reactivated.

For an overview of Model HA1, see 2.1.5, “IBM Magstar 3494 Model HA1 High Availability Unit” on page 19. For a detailed description of operation considerations related to the High Availability unit, refer to 10.2, “Operating and Monitoring the High Availability Unit” on page 340.

2.2.14 Dual Active Accessors

The Dual Active Accessor feature improves performance of the 3494 with an attached Model HA1. It takes full advantage of having two accessors active at the same time for performing commands. When the Dual Active Accessor feature is active, both accessors service mount requests at the same time. The high availability of an HA1 Model is maintained, because each active accessor can pick up the activities of the other accessor.

To reduce interference between accessors, the library is divided into two zones. The boundary between the two zones is established at library initialization and may change over time as the library manager attempts to keep the accessors equally busy.

For a detailed description of the techniques used to place and select tapes to better optimize performance of Dual Active Accessors refer to 3.2.2, “Performance with Dual Active Accessor Feature” on page 76.

Refer to 10.2.2, “DAA Recovery Scenarios” on page 347 for a detailed description of operational considerations related to the Dual Active Accessor.

2.3 Features

In this section we provide information about chargeable and nonchargeable feature codes and media, language, and power feature codes. We also present the RPQs available for the IBM 3494.

2.3.1 IBM 3494 Chargeable and Nonchargeable Feature Tables

The tables that follow list all of the IBM 3494 feature codes, showing the model and system attachment to which each feature pertains. Table 6 summarizes the IBM 3494 chargeable feature codes.

Table 6 (Page 1 of 3). IBM 3494 Chargeable Features Available per 3494 Model

Feature Code	Description	L10	L12	L14	B16	B18	D10	D12	D14	HA1	S10
2710	Remote support facility	1	1	1	1	1	-	-	-	-	-
2711	Remote support switch	1	1	1	1	1	-	-	-	1	-
2712	Remote support attachment	1	1	1	1	1	-	-	-	1	-
3000	3490E Model F1A control unit	1	-	-	-	-	1	-	-	-	-
3200	ESCON High Performance Option	-	-	-	-	1	-	-	-	-	-
3302	Additional Enhanced ESCON Channels	-	-	-	-	1	-	-	-	-	-
3320	ESCON host adapter for FC 3000	1	-	-	-	-	1	-	-	-	-
3358	Parallel host adapter for FC 3000	1	-	-	-	-	1	-	-	-	-

Feature Code	Description	L10	L12	L14	B16	B18	D10	D12	D14	HA1	S10
3701	Tape volume cache size (B16)	-	-	-	4	-	-	-	-	-	-
3702	Tape volume cache size (B18)	-	-	-	-	4	-	-	-	-	-
4630	Field install 3490-CxA or 3590-B1A	-	2	2	-	-	1	6	4	-	-
4632	Field install 3490-F1A	1	-	-	-	-	2	-	-	-	-
4633	Replace 3490-CxA with 3490-F1A	-	-	-	-	-	1	-	-	-	-
4634	Field install F1A FC 3000	1	-	-	-	-	1	-	-	-	-
4635	Field install 3590-A00	-	-	1	-	-	-	-	1	-	-
4650	Replace 3590-A00 with 3590-A50	-	-	1	-	-	-	-	1	-	-
4655	Field install 3590-A50	-	-	1	-	-	-	-	1	-	-
4700	Remove control unit (FC 3000)	1	-	-	-	-	1	-	-	-	-
4701	Remove 3490-F1A	1	-	-	-	-	2	-	-	-	-
4702	Remove ESCON adapter (FC 3320)	1	-	-	-	-	1	-	-	-	-
4703	Remove parallel adapter (FC 3358)	1	-	-	-	-	1	-	-	-	-
4730	Remove 3590-B1A	-	2	2	-	-	-	6	4	-	-
4734	Remove F1A FC 3000	1	-	-	-	-	1	-	-	-	-
4735	Remove 3590-A00	-	-	1	-	-	-	-	1	-	-
4755	Remove 3590-A50	-	-	1	-	-	-	-	1	-	-
5045	Enhanced library manager	1	1	1	-	-	-	-	-	-	-
5050	Dual Active Accessors	1	1	1	-	-	-	-	-	-	-
5210	10 cartridge convenience I/O station	1	1	1	-	-	-	-	-	-	-
5211	AS/400 attach (50 ft) •	8	8	8	-	-	-	-	-	-	-
5213	Extended length AS/400 attach •	8	8	8	-	-	-	-	-	-	-
5214	Second library manager disk drive	1	1	1	-	-	-	-	-	-	-
5215	Dual gripper	1	1	1	-	-	-	-	-	1	-
5216	Remote power sequence	1	1	1	-	-	-	-	-	-	-
5217	50 ft RS-232 cable	8	8	8	-	-	-	-	-	-	-
5219	Token ring LAN adapter	1	1	1	-	-	-	-	-	1	-
5220	Ethernet LAN adapter	1	1	1	-	-	-	-	-	1	-
5224	AIX parallel attachment	16	16	16	-	-	-	-	-	-	-
5226	Remote library manager console	1	1	1	-	-	-	-	-	-	-
5228	Tape unit expansion	2	2	2	-	-	-	-	-	-	-
5229	Expansion card	1	1	1	-	-	-	-	-	1	-
5230	30 cartridge convenience I/O station	1	1	1	-	-	-	-	-	-	-
5232	Attachment Concentrator	1	1	1	-	-	-	-	-	-	-
5233	SCSI Extender (attach to B18)	-	-	-	-	-	-	1	-	-	-
5234	18 M SCSI Cables (attach to B18)	-	-	-	-	-	-	1	-	-	-
5302	Upgrade FC 5300 to support 3590-B1A	7	-	-	-	-	-	-	-	-	-
5304	Upgrade FC 5300 to support 3590-A00/B1A	7	-	-	-	-	-	-	-	-	-
8002	One 3590 Cleaning Cartridge	10	10	10	-	-	10	10	10	-	10
8005	One 3490 Cleaning Cartridge	10	10	10	-	-	10	10	10	-	10

Table 6 (Page 2 of 3). IBM 3494 Chargeable Features Available per 3494 Model

Table 6 (Page 3 of 3). IBM 3494 Chargeable Features Available per 3494 Model											
Feature Code	**Description**	**L10**	**L12**	**L14**	**B16**	**B18**	**D10**	**D12**	**D14**	**HA1**	**S10**
8410	210 3490 Data Cartridges	1	1	1	-	-	1	1	1	-	1
8420	420 3490 Data Cartridges	1	1	1	-	-	1	1	1	-	1
8510	210 3590 Data Cartridges	1	1	1	-	-	1	1	1	-	1
8520	420 3590 Data Cartridges	1	1	1	-	-	1	1	1	-	1

Notes:

1. Any combination of feature codes 5211 and 5213 can total no more than eight with feature code 5229. If the LAN attachment is used, up to 32 processors can be attached with the appropriate drive switching equipment.

Table 7 summarizes the IBM 3494 nonchargeable feature codes.

Table 7. IBM 3494 Nonchargeable Features Available per 3494 Model											
Feature Code	**Description**	**L10**	**L12**	**L14**	**B16**	**B18**	**D10**	**D12**	**D14**	**HA1**	**S10**
2924 - 2935	Language Specify	1	1	1	-	-	-	-	-	-	-
5500	Storage Frame from B16	1	1	1	-	-	-	-	-	-	-
5502	Drive Frame from B16	1	1	1	-	-	-	-	-	-	-
9002	S10 (feature code 5400) attach	7	7	7	-	-	-	-	-	-	-
9003	D1x (feature code 5300) attach	7	7	7	-	-	-	-	-	-	-
9004	3494-S10 above 8 frames	8	8	8	-	-	-	-	-	-	1
9005	3494-Dxx above 8 frames	8	8	8	-	-	1	1	1	-	-
9006	3494-B16 in first 8 frames	1	1	1	-	-	-	-	-	-	-
9007	3494-B16 above 8 frames	1	1	1	1	-	-	-	-	-	-
9010	Virtual Tape Server attached	-	-	-	-	-	-	1	-	-	-
9020	3494 B18 VTS Attachment	1	1	1	-	-	-	-	-	-	-
9040	3494-HA1 attachment	1	1	1	-	-	-	-	-	-	-
9041	3494-HA1 direct attach	1	1	1	1	1	1	1	1	1	1
9104	AS/400 attach	1	1	-	-	-	1	1	-	1	1
9106	RS/6000 attach	1	1	-	-	-	1	1	-	1	1
9109	ES/9000 attach	1	-	1	1	1	1	-	1	1	1
9200	Open system device drivers	1	1	1	-	-	-	-	-	-	-
9203	VSE LAN device driver	1	1	1	-	-	-	-	-	-	-
9210	HP-UX attachment for FC 9200	1	1	1	-	-	-	-	-	-	-
9211	Sun attachment for FC 9200	1	1	1	-	-	-	-	-	-	-
9540	No Data Cartridges	1	1	1	-	-	1	1	1	-	1
9601	Factory install 3490-CxA	1	-	-	-	-	1	-	-	-	-
9602	Factory install 3490-F1A	1	-	-	-	-	2	-	-	-	-
9611	Field Merge FC5300 w/3490	1	-	-	-	-	-	-	-	-	-
9630	Field merge 3590-B1A	-	2	2	-	-	-	6	4	-	-
9631	Factory install 3590-B1A	-	2	2	-	-	-	6	4	-	-
9632	Field merge 3490-F1A	1	-	-	-	-	2	-	-	-	-
9633	Field merge 3490-F1A for FC 3000	1	-	-	-	-	1	-	-	-	-
9634	Factory install 3490-F1A for FC 3000	1	-	-	-	-	1	-	-	-	-
9635	Field merge 3590-A00	-	-	1	-	-	-	-	1	-	-
9636	Factory install 3590-A00	-	-	1	-	-	-	-	1	-	-
9655	Field merge 3590-A50	-	-	1	-	-	-	-	1	-	-
9656	Factory install 3590-A50	-	-	1	-	-	-	-	1	-	-

Table 8 on page 41 summarizes the IBM 3494 chargeable feature codes and shows the system attachment to which they might apply.

Table 8 (Page 1 of 2). IBM 3494 Chargeable Features Available by Platform

Feature Code	Description	ES	AS	RS	Sun	HP
2710	Remote support facility	Y	Y	Y	Y	Y
2711	Remote support switch	Y	Y	Y	Y	Y
2712	Remote support attachment	Y	Y	Y	Y	Y
3000	3490E Model F1A control unit	Y	-	-	-	-
3200	ESCON High Performance Option	Y	-	-	-	-
3302	Additional Enhanced ESCON Channels	Y	-	-	-	-
3320	ESCON host adapter for FC 3000	Y	-	-	-	-
3358	Parallel host adapter for FC 3000	Y	-	-	-	-
3701	Tape volume cache size (B16)	Y	-	-	-	-
3702	Tape volume cache size (B18)	Y	-	-	-	-
4630	Field install 3490-CxA or 3590-B1A	Y	Y	Y	Y	Y
4632	Field install 3490-F1A	Y	Y	Y	Y	Y
4633	Replace 3490-CxA with 3490-F1A	Y	Y	Y	-	-
4634	Field install F1A FC 3000	Y	-	-	-	-
4635	Field install 3590-A00	Y	-	-	-	-
4650	Replace 3590-A00 with 3590-A50	Y	-	-	-	-
4655	Field install 3590-A50	Y	-	-	-	-
4700	Remove control unit (FC 3000)	Y	-	-	-	-
4701	Remove 3490-F1A	Y	Y	Y	-	-
4702	Remove ESCON adapter (FC 3320)	Y	-	-	-	-
4703	Remove parallel adapter (FC 3358)	Y	-	-	-	-
4730	Remove 3590-B1A	Y	Y	Y	Y	Y
4734	Remove F1A FC 3000	Y	-	-	-	-
4735	Remove 3590-A00	Y	-	-	-	-
4755	Remove 3590-A50	Y	-	-	-	-
5045	Enhanced library manager	Y	Y	Y	Y	Y
5050	Dual Active Accessors	Y	Y	Y	Y	Y
5210	10 cartridge convenience I/O station	Y	Y	Y	Y	Y
5211	AS/400 attach (50 ft) •	-	-	Y	-	-
5213	Extended length AS/400 attach •	-	Y	-	-	-
5214	Second library manager disk drive	Y	Y	Y	Y	Y
5215	Dual gripper	Y	Y	Y	Y	Y
5216	Remote power sequence	-	Y	-	-	-
5217	50 ft RS-232 cable	-	Y	-	Y	Y
5219	Token ring LAN adapter	Y•	Y•	Y•	Y•	Y•
5220	Ethernet LAN adapter	Y•	Y•	Y•	Y•	Y•
5224	AIX parallel attachment	-	-	Y	-	-
5226	Remote library manager console	Y	Y	Y	Y	Y
5228	Tape unit expansion	Y	Y	Y	Y	Y
5229	Expansion card	Y	Y	Y	Y	Y
5230	30 cartridge convenience I/O station	Y	Y	Y	Y	Y
5232	Attachment Concentrator	Y	-	-	-	-
5233	SCSI Extender (attach to B18)	Y	-	-	-	-
5234	18 M SCSI Cables (attach to B18)	Y	-	-	-	-
5302	Upgrade FC 5300 to support 3590-B1A	-	Y	Y	Y	Y

Feature Code	Description	ES	AS	RS	Sun	HP
5304	Upgrade FC 5300 to support 3590-A00/B1A	Y	-	-	-	-
8002	One 3590 Cleaning Cartridge	Y	Y	Y	Y	Y
8410	210 3490 Data Cartridges	Y	Y	Y	Y	Y
8420	420 3490 Data Cartridges	Y	Y	Y	Y	Y
8520	420 3590 Data Cartridges	Y	Y	Y	Y	Y

Table 8 (Page 2 of 2). IBM 3494 Chargeable Features Available by Platform

Notes:

1. Used for remote library console
2. Used for remote library console and library command path

Table 9 summarizes the IBM 3494 nonchargeable feature codes, and shows the system attachment to which they might apply.

Table 9 (Page 1 of 2). IBM 3494 Nonchargeable Features Available by Platform

Feature Code	Description	ES	AS	RS	Sun	HP
2924 - 2935	Language Specify	Y	Y	Y	Y	Y
5500	Storage Frame from B16	Y	-	-	-	-
5502	Drive Frame from B16	Y	-	-	-	-
9002	S10 (feature code 5400) attach	Y	Y	Y	Y	Y
9003	D1x (feature code 5300) attach	Y	Y	Y	Y	Y
9004	3494-S10 above 8 frames	Y	Y	Y	Y	Y
9005	3494-Dxx above 8 frames	Y	Y	Y	Y	Y
9006	3494-B16 in first 8 frames	Y	-	-	-	-
9007	3494-B16 above 8 frames	Y	-	-	-	-
9010	Virtual Tape Server attached	Y	-	-	-	-
9020	3494 B18 VTS Attachment	Y	-	-	-	-
9040	3494-HA1 attachment	Y	Y	Y	Y	Y
9041	3494-HA1 direct attach	Y	Y	Y	Y	Y
9104	AS/400 attach	-	Y	-	-	-
9106	RS/6000 attach	-	-	Y	-	-
9109	ES/9000 attach	Y	-	-	-	-
9200	Open system device drivers	-	-	Y	Y	Y
9203	VSE LAN device driver	Y	-	-	-	-
9210	HP-UX attachment for FC 9200	-	-	-	-	Y
9211	Sun attachment for FC 9200	-	-	-	Y	-
9540	No Data Cartridges	Y	Y	Y	Y	Y
9601	Factory install 3490-CxA	Y	Y	Y	-	-
9602	Factory install 3490-F1A	Y	Y	Y	-	-
9611	Field Merge FC5300 w/3490	Y	Y	Y	Y	Y
9630	Field merge 3590-B1A	Y	Y	Y	Y	Y
9631	Factory install 3590-B1A	Y	Y	Y	Y	Y
9632	Field merge 3490-F1A	Y	Y	Y	-	-
9633	Field merge 3490-F1A for FC 3000	Y	-	-	-	-
9634	Factory install 3490-F1A for FC 3000	Y	-	-	-	-
9635	Field merge 3590-A00	Y	-	-	-	-
9636	Factory install 3590-A00	Y	-	-	-	-
9655	Field merge 3590-A50	Y	-	-	-	-

Table 9 (Page 2 of 2). IBM 3494 Nonchargeable Features Available by Platform						
Feature Code	Description	ES	AS	RS	Sun	HP
9656	Factory install 3590-A50	Y	-	-	-	-

2.3.2 IBM 3494 Feature Code Descriptions

2.3.3 Remote Support Facility (FC 2710)

The remote support feature codes (FC 2710, 2711, 2712) provide rapid diagnostic and remote support facility. The same modem and switch can be shared among the following units: 3494 Model B16, HA1, L10, L12 or L14, and 3590 Model A00 or A50. One of these three features should be selected based on the number of units in the installation. Each 3494 Model B16, L10, L12, and L14 must specify either FC 2710, 2711, or 2712. Model HA1 must specify either FC 2711 or 2712.

For a configuration example, see 2.3.6, “Remote Support Configuration Example.”

Feature code 2710 supplies a cable and connectors for connection to an IBM supplied modem to enable remote diagnostic support. This feature should be specified only on the first unit of each set of 14 units in an installation.

2.3.4 Remote Support Switch (FC 2711)

Feature code 2711 provides cable, connectors, and a switch for the attachment of multiple units through the switch to a modem. It should be ordered on the second unit attached to the modem in an installation. One switch should be specified for each set of 14 units in an installation.

2.3.5 Remote Support Attachment (FC 2712)

Feature code 2712 provides an additional cable and connector to attach to the remote support switch (FC 2711). It should be ordered on the third through the fourteenth unit attached to the switch in an installation.

2.3.6 Remote Support Configuration Example

This example shows how to configure feature codes 2710, 2711, and 2712. For instance, an IBM 3494 configuration with 1 Model L14, 1 Model HA1, 15 Model D14s, and 16 3590 Model A50 tape controllers represents 18 units in total to be connected to the remote support facility. The following feature codes must be configured:

- Two feature code 2710s. For example, on Model L14 and on one 3590 Model A50 tape controller, one modem is supplied with each feature code 2710.
- Two feature code 2711s. For example, on Model HA1 and on one 3590 Model A50 tape controller
- Fourteen feature code 2712s on the remaining 3590 Model A50 tape controllers

2.3.7 Language Feature Codes

Table 10 lists the nonchargeable language and power feature codes.

Table 10. IBM 3494 Model L1x Nonchargeable Language and Power Feature Codes

Feature Code	Description
2924	U.S. English
2928	French
2930	Japanese •
2931	Spanish
2932	Italian
2935	French Canadian •

Notes:

1. Operator panel only
2. Keyboard only

2.3.8 3490E Model F1A Control Unit (FC 3000)

This feature installs a control unit in an IBM 3494 Magstar Tape Library, models D10 and L10, at EC level C88765 or later. The control unit output is a differential SCSI bus intended to connect to two IBM 3490E Model F1A tape drives. At least one host adapter card (FC 3320 or FC 3358) must be ordered with FC 3000. At least one remote support feature (FC 2710, 2711, or 2712) must be ordered with FC 3000. Only one feature 3000 is allowed in each D10 or L10 frame.

2.3.9 ESCON High Performance Option (FC 3200)

Feature code 3200 provides enhanced ESCON host channel attachments with data compression, which provides larger effective disk capacities, improved performance, and 64 virtual device addressing. It replaces the two standard ESCON host channel attachments with two enhanced ESCON host channel attachments.

2.3.10 Additional Enhanced ESCON Channels (FC 3302)

Feature code 3302 provides two additional enhanced ESCON host channel attachments (for a total of four ESCON host channel attachments) for attachment of the Magstar 3494 Model B18 to host system ESCON channels.

2.3.11 ESCON Channel Host Adapter (FC 3320)

Feature code 3320 provides ESCON channel attachment for FC 3000. The maximum number allowed is two in any combination of FC 3320 and FC 3358.

2.3.12 Parallel Channel Host Adapter (FC 3358)

Feature code 3358 provides parallel channel attachment for FC 3000. The maximum number allowed is two in any combination of FC 3320 and FC 3358.

2.3.13 Disk Storage Capacity for the Tape Volume Cache (FC 3701)

Feature code 3701 provides the DASD arrays and instructions for installing 36 GB of usable storage capacity for the tape volume cache. Two or four feature code 3701s must be specified. This feature is available for the Model B16 only.

For more information about the Virtual Tape Server, see the *IBM Magstar Virtual Tape Server: Implementation Guide*.

2.3.14 Disk Storage Capacity for the Tape Volume Cache (FC 3702)

Feature code 3702 provides the DASD arrays and instructions for installing 72 GB of usable storage capacity for the tape volume cache. One, two, three, or four feature code 3702s must be specified. This feature is factory installed on the Model B18 only.

For more information about the Virtual Tape Server, see the *IBM Magstar Virtual Tape Server: Implementation Guide*.

2.3.15 Field Install Drive (FC 4630)

Feature code 4630 provides the necessary hardware to field install a 3590 Model B1A tape drive in a 3494 Model L12, L14, D12, or D14, or a 3490E Model CxA tape subsystem in a 3494 Model D10. It should be used when the plant has not installed drive-mounting hardware or feature code 9630, or to replace the filler plates when an odd number of drives is installed in a 3494 Model L12, L14, D12, or D14.

2.3.16 3490E Model F1A Field Installation (FC 4632)

Feature code 4632 provides the hardware needed to allow for field installation of one 3490E Model F1A tape drive. This feature code is ordered for the 3494 Model L10 (maximum of one) or D10 (maximum of two). A prerequisite of the L10 is feature code 9602.

2.3.17 Replace 3490 Model CxA with Model F1A (FC 4633)

Feature code 4633 provides the hardware needed in a 3494 Model D10 to replace a 3490E Model CxA tape subsystem with a 3490E Model F1A tape drive. A maximum of one FC 4633 is required per 3494 Model D10. This feature code cannot be ordered for a 3494 Model L10.

2.3.18 Field Install F1A FC 3000 (FC 4634)

Feature code 4634 provides the hardware needed to install FC 3000 in a 3494 Model D10 or 3494 Model L10.

2.3.19 3590 Model A00 Tape Controller Field Installation (FC 4635)

Feature code 4635 provides the necessary mounting hardware to field install a 3590 Model A00 tape controller in a 3494 Model L14 or D14. This would replace cartridge storage in the 3494 Model D14. If this feature code is ordered for the 3494 Model L14 or D14, feature code 4630 must also be ordered.

2.3.20 Replace 3590 Model A00 with Model A50 (FC 4650)

Feature code 4650 provides the hardware needed in a 3494 Model L14 or D14 to replace a 3590 Model A00 tape controller with a Model A50.

This feature code is not applicable to a feature code 5304 drive unit with a 3590 Model A00 tape controller installed.

2.3.21 3590 Model A50 Tape Controller Field Installation (FC 4655)

Feature code 4655 provides the hardware needed in a 3494 Model L14 or D14 to allow for field installation of one 3590 Model A50 tape controller. This would replace cartridge storage in the 3494 Model D14. If this feature code is ordered for the 3494 Model L14 or D14, feature code 4630 must also be ordered.

2.3.22 Remove FC 3000 (FC 4700)

Feature code 4700 removes the 3490E Model F1A control unit FC 3000.

2.3.23 Remove 3490E Model F1A from a 3494 (FC 4701)

Feature code 4701 removes a 3490E Model F1A tape drive from a 3494 Model L10 or D10. One feature code 4701 can be ordered for the 3494 Model L10, and two for the D10.

2.3.24 Remove FC 3320 (FC 4702)

Feature code 4702 removes the ESCON channel host adapter FC 3320.

2.3.25 Remove FC 3358 (FC 4703)

Feature code 4703 removes the parallel channel host adapter FC 3358.

2.3.26 Remove 3590 Model B1A from a 3494 (FC 4730)

Feature code 4730 removes a 3590 Model B1A tape drive from a 3494 Model L12, L14, D12, or D14. Two feature code 4730s can be ordered for a 3494 Model L12 or L14, six for a D12, and four for a D14.

2.3.27 Remove F1A FC 3000 (FC 4734)

Feature code 4734 removes FC 3000 from a 3494 Model D10 or 3494 Model L10.

2.3.28 Remove 3590 A00 (FC 4735)

Feature code 4735 allows field removal of an IBM 3590 Model A00 installed in a 3494 frame. This feature code is for currently installed units only.

2.3.29 Remove 3590 A50 (FC 4755)

Feature code 4755 allows field removal of an IBM 3590 Model A50 installed in a 3494 frame. This feature code is for currently installed units only.

2.3.30 Enhanced Library Manager (FC 5045)

Feature code 5045 is an MES that improves the performance of the library manager in a 3494 Model L10, L12, or L14 that does not have the Model HA1 installed.

The enhanced library manager is included with feature code 9040 when you install a Model HA1 High Availability unit and the existing library manager is not an enhanced library manager.

2.3.31 Dual Active Accessors (FC 5050)

Feature code 5050 must be specified to enable both accessors in an attached 3494 High Availability unit to be active at the same time. Prerequisite: A Model HA1 must be installed, and at least four frames (not counting the Model HA1 service bays or the Model B18 Virtual Tape Server) must be installed in the 3494 library.

2.3.32 10 Cartridge Convenience I/O Station (FC 5210)

Feature code 5210 enables the insertion or ejection (not at the same time) of up to 10 cartridges on the IBM 3494 without interrupting library operation. Only feature code 5210 can be installed in the 3494 Model L1x control unit frame. Therefore, feature codes 5210 and 5230 are mutually exclusive.

2.3.33 AS/400Host Attachment (FC 5211)

Feature code 5211 or 5213 is required when AS/400 processors are attached to the IBM 3494 through RS-232 and use OS/400 software earlier than Version 3 Release 6. Feature code 5211 provides communication between the AS/400 host and the 3494 library manager by using one 15 m (50 ft) cable. This feature includes the media library device drive (MLDD) for OS/400 (Program 5798-RZH). The AS/400 LAN device driver is included as part of this feature and provides the function for AS/400 to drive the IBM 3494 over a LAN.
One feature code 5211 or 5213 is required for each AS/400 system.

MLDD functions are included in OS/400 Version 3 Release 6 and later. For attachment through RS-232 to AS/400 systems with OS/400 V3 R6 and later, see 2.3.38, “50-Foot RS-232 Cable (FC 5217)” on page 48.

2.3.34 Extended Length RS-232 Host Attachment (FC 5213)

Feature code 5213 allows the RS-232 link to be extended to 122 m (400 ft). This feature code includes the MLDD for OS/400 releases earlier than Version 3 Release 6. This feature code is used in place of feature code 5211 when the AS/400 processor is located more than 15 m (50 ft) from the IBM 3494.

The AS/400 LAN device driver is included as part of this feature and provides the function for AS/400 to drive the IBM 3494 over a LAN.
One feature code 5211 or 5213 is required for each AS/400 processor.

MLDD functions are included in OS/400 Version 3 Release 6 and later. For attachment through RS-232 to AS/400 systems with OS/400 V3 R6 and later, see 2.3.38, “50-Foot RS-232 Cable (FC 5217)” on page 48.

2.3.35 Second Library Manager Hard Disk Drive (FC 5214)

Feature code 5214 applies to all 3494 Model L1xs. It permits a second copy of the library manager database to be kept. It reduces the time required to recover from a primary library manager disk failure.

It is strongly recommended that this feature be installed on all IBM 3494s.

Feature code 5214 is required on the 3494 Model L1x when a VTS Model B18 or a Model HA1 is installed.

2.3.36 Dual Gripper (FC 5215)

Feature code 5215 applies to all models of the 3494 Model L1x. It provides a second gripper, which is mounted below the first gripper on the cartridge accessor (see 2.2.8, “Cartridge Accessor” on page 28). When the dual gripper feature is installed, library cartridge capacity is reduced by approximately 10%. This feature increases library availability and improves performance.

Feature code 5215 is required on the 3494 Model HA1 when a FC 5215 is installed on the 3494 Model L1x.

2.3.37 AS/400Remote Power Sequencing (FC 5216)

Feature code 5216 enables the IBM 3494 to be powered up and down by an AS/400. Only one feature code 5126 can be ordered on any model of the IBM Magstar 3494 Model L1x. If this feature is installed, the switch on the operator panel should be in the remote position. The IBM 3494 is not powered off until the last AS/400 attached to the library through feature code 5216 is powered off. The IBM 3494 is powered on again when the first AS/400 is powered on. To avoid accidentally powering down the library, do not install feature code 5216 in an environment where more than one type of host is attached to the IBM 3494.

2.3.38 50-Foot RS-232 Cable (FC 5217)

Feature code 5217 is required to connect processors to the library manager for host command and response processing. This feature code is used with feature code 9200.

This feature code is also used for attachment to AS/400 systems with OS/400 Version 3 Release 6 or higher when attachment through RS-232 is desired.

2.3.39 Token Ring Adapter (FC 5219)

Feature code 5219 adds a token ring card to the library manager. This card can be used to connect the IBM 3494 to a LAN. LAN connection enables control command processing from hosts and is also required for attachment of the remote library manager console (feature code 5226). It supports both TCP/IP and advanced program-to-program communication (APPC). For the AS/400 and remote library manager console, only APPC is supported. Only one feature code 5219 can be ordered on any 3494 Model L1x. Feature codes 5219 and 5220 are mutually exclusive. The token ring card comes with a standard nine-pin D socket. If any other type of token ring connection is used, an adapter must be provided locally.

Feature code 5219 is required on the 3494 Model HA1 when it is installed on the 3494 Model L1x.

Before 1995, the library manager hardware could not support feature codes 5219 and 5229. If feature code 5220 is ordered for an IBM 3494 manufactured before 1995, new library manager hardware will also be installed.

2.3.40 Ethernet Adapter (FC 5220)

Feature code 5220 adds an Ethernet card to the library manager. This card can be used to connect the IBM 3494 to a LAN. LAN connection enables control command processing from hosts and is also required for attachment of the remote library manager console (feature code 5226). It supports both TCP/IP and APPC; the remote library manager console supports only APPC. Only one feature code 5220 can be installed on any 3494 Model L1x, and feature codes 5219 and 5220 are mutually exclusive. The Ethernet card comes with the following attachments:

- 10BaseT (twisted-pair)
- 10Base5 (thick coaxial)
- 10Base2 (thin coaxial)

If any other type of connection is required, an adapter must be provided locally.

Feature code 5220 is required on the 3494 Model HA1 when it is installed on the 3494 Model L1x.

Before 1995, the library manager hardware could not support feature codes 5220 and 5229. If feature code 5220 is ordered for a 3494 manufactured before 1995, new library manager hardware will also be installed.

2.3.41 AIX Parallel Tape Attachment/6000 (FC 5224)

Feature code 5224 provides the device driver to support a parallel attached RS/6000 and RS/6000 SP processor. One feature is required for each attached host. For ESCON attachment, the RS/6000 feature code 2754 should be configured; it provides an ESCON channel and the device driver.

2.3.42 Remote Library Manager Console (FC 5226)

Feature code 5226 allows for the remote operation of up to eight IBM tape libraries. The remote library manager console is attached to the library manager through a Token Ring (5219) or Ethernet (5220) LAN. APPC is used as the communication protocol. The remote library manager console uses the Distributed Console Access Facility (DCAF) to capture the library manager screens. The remote library manager console feature supplies the DCAF and library manager code only; the remote library manager console PC hardware, OS/2, and communications software are not supplied as part of the feature. One feature code 5226 is required for each IBM 3494 using the remote library manager console (see 9.11.7, “Remote Library Manager Console” on page 311, for more information about the remote library manager console).

We recommend that you load the remote library manager console software of feature code 5226 on the second library manager provided by the High Availability unit when it is installed. This will ensure that remote access to the library manager is still available after a library manager switchover has taken place.

2.3.43 Tape Unit Expansion (FC 5228)

The library manager has one or two RTIC cards that provide eight communication ports each. Each RTIC is programmed to provide four RS-232 host connections and four RS-422 tape control unit connections. This mix may be modified by ordering feature code 5228.

Feature code 5228 provides a set of four adapters that convert one to four of the RS-232 ports provided with both the base RTIC card in the library manager, and the port expansion feature code (second RTIC card feature code 5229 to RS-422 ports.

The mix of attached hosts, tape control units, and virtual tape servers installed in the IBM 3494 determines whether feature codes 5228 are required.

2.3.44 Expansion Adapter Card (FC 5229)

Feature code 5229 provides a second library manager RTIC card. Each RTIC card provides eight communication paths, which are used to connect tape control units or certain host types to the library manager. Each RTIC is programmed to provide four RS-232 host connections and four RS-422 tape control unit connections. This mix may be modified by ordering feature code 5228.

The mix of hosts, tape control units, and virtual tape servers installed in the IBM 3494 determines whether feature code 5229 is required.

Table 11 defines the number of control units or direct-attached drive connections available with feature codes 5228 and 5229 installed in the library.

Table 11. Supported Configurations for the IBM 3494 Expansion Features

Feature Code	RS-232 Direct-Attach Host Ports	Control Unit or Direct-Attached Drive Connection	SCSI Host Connection
None	4	4	RS-232 or LAN
5229	8	8	RS-232 or LAN
5228	0	8	LAN only
5229 + 5228	4	12	RS-232 or LAN
5229 + two 5228s	0	16	LAN only

The B16 VTS occupies RTIC ports as follows:

- Each 3590 B1A tape drive occupies an RS-422 port
- Each virtual 3490 control unit occupies an RS-422 port (two)
- The RS/6000 ADSM server occupies one RS-232 port

The B18 VTS does not occupy any RTIC ports for either its attached 3590 B1A drives or the RS/6000. The communication path for the B18 connection to the library manager is provided by an internal LAN.

The 3490E Model F1A subsystem requires one port for each F1A tape drive and another port for the feature code 3000 controller.

The 3490E Model CxA subsystem only requires one port per subsystem, regardless of whether one or two drives are present.

Feature code 5229 is required on the 3494 Model HA1 when it is installed on the 3494 Model L1x.

Feature code 5228 on the 3494 Model L1x is not required when the High Availability unit (feature code 9040) or the enhanced library manager (feature code 5045) is installed.

For more information about RTIC configurations, see 2.2.2, “Host Command and Response Processing” on page 23. For additional information about configuring tape subsystems in an IBM 3494, see 3.1.8, “Tape Subsystem Configuration” on page 64.

2.3.45 30-Cartridge Convenience I/O Station (FC 5230)

Feature code 5230 enables up to 30 cartridges to be entered into or removed from the IBM 3494 without interrupting library operation. Only one 5230 can be ordered for the 3494 Model L1x. Feature codes 5230 and 5210 are mutually exclusive.

2.3.46 Attachment Concentrator (FC 5232)

Feature code 5232 provides an internal LAN attachment for the 3494 Model B18 Virtual Tape Server to the 3494 library manager. This feature code is required to be added to any Model L1x control unit frame when a 3494 Model B18 will be attached.

2.3.47 SCSI Extender for B18 (FC 5233)

Feature code 5233 provides two SCSI extenders for attachment of Magstar 3590 Model B1A tape drives in the 3494 Model D12 to an externally attached Magstar 3494 Model B18 Virtual Tape Server. This feature code is required to be added to any 3494 Model D12 control unit frame when a 3494 Model B18 will be attached.

2.3.48 18M SCSI Cables for B18 Attachment (FC 5234)

Feature code 5234 provides two 18m SCSI cables for attachment of a 3494 Model B18 to the 3590 Model B1A drives in an associated 3494 Model D12. This feature must be specified on each Model B18.

2.3.49 Additional Drive Unit (FC 5300, withdrawn from market)

Before the IBM 3494 announcements of April 1995, additional IBM 3494 drive units containing 3490E Model CxA tape subsystems were ordered as feature code 5300. A 3490E Model F1A tape drive cannot be installed in a feature code 5300 drive unit. This feature code is no longer available.

2.3.50 Additional Storage Unit (FC 5400, withdrawn from market)

Before the IBM 3494 announcements of April 1995, additional IBM 3494 storage units were ordered as feature code 5400. This feature code is no longer available.

2.3.51 Upgrade Feature 5300 to 5302 (FC 5302)

Feature code 5302 provides the necessary hardware to upgrade a 3494 Model L10 feature code 5300 to accept SCSI-attached 3590 Model B1A tape drives. If you require more than two drives, RPQ 8B3166 should be configured to provide the hardware to install the third and fourth drives during the upgrade, and RPQ 8B3167 should be configured to provide the hardware to install the fifth and sixth drives during the upgrade. If the RPQs are not configured and additional drives are installed later, feature code 4630 will be required.

2.3.52 Upgrade Feature 5300 to 5304 (FC 5304)

Feature code 5304 provides the necessary hardware to upgrade a 3494 Model L10 feature code 5300 to accept 3590 Model B1A tape drives and the 3590 Model A00 tape controller. If you require more than two drives, RPQ 8B3168 should be configured to provide the hardware to install the third and fourth drives during the upgrade. If the RPQ is not configured and additional drives are installed later, feature code 4630 will be required.

2.3.53 Additional Storage Unit (from B16) (FC 5500)

Feature code 5500 must be ordered on an MES for the 3494 Model L1x control unit frame when a Model B16 Virtual Tape Server is converted to a Model B18 and the Model B16 frame is to be converted to a storage frame that becomes a feature on the Model L1x. This storage unit is a frame containing additional storage (up to 400 cartridges) that is attached to the IBM 3494.

2.3.54 Additional Drive Unit (from B16) (FC 5502)

Feature code 5502 must be ordered on an MES for the 3494 Model L1x control unit frame to convert a feature code 5500 storage unit frame to a drive unit frame that can be associated with a Model B18 Virtual Tape Server. It contains the mounting hardware for three to four Magstar 3590 Model B1A tape drives and the SCSI extender for attaching those drives to a Model B18 Virtual Tape Server. Instead of ordering the feature code 5500, this feature can also be ordered on an MES for the 3494 Model L1x control unit frame when a Model B16 Virtual Tape Server is upgraded to a Model B18 and the Model B16 frame is converted to a drive unit frame that becomes a feature on the Model L1x. This drive unit frame is a frame containing additional storage (up to 290 cartridges) that is attached to the IBM 3494. Feature code 5500, 9006, or 9007 must be removed from the Model L1x with installation of feature code 5502.

2.3.55 Media Feature Codes

Table 12 on page 53 lists the feature codes that cause the factory to deliver magnetic tapes along with the IBM 3494 frames. These tape volumes are shipped unlabeled both internally and externally.

Table 12. IBM 3494 Magnetic Media Feature Codes		
Feature Code	**Description**	**Maximum Quantity per Frame**
8002	3590 cleaning cartridge	10
8005	3490 cleaning cartridge	10
8410	210 3490E data cartridges	1 •
8420	420 3490E data cartridges	1 •
8510	210 3590 data cartridges	1 •
8520	420 3590 data cartridges	1 •
9540	no data cartridge	1 •
Note: 1. Only one must be ordered per IBM 3494 frame.		

Note: Initialized and labeled Magstar 3590 data cartridges can be ordered, thereby removing the requirement to install the external labels and run a program to initialize each tape volume before use in the IBM 3494. Machine types 3499 and 3599 provide 3490 or 3590 cartridges, respectively, in a variety of quantities that can be ordered with custom labels and initialized. (Example: Machine type/model 3599-001 with quantity feature code 0210 provides 210 3590 cartridges that are labeled and initialized). See your IBM representative for further information about ordering Magstar 3599 data cartridges or check the IBM Media website at

`http://www.storage.ibm.com/media/index.htm`

2.3.56 Storage Unit Attach (FC 9002)

Feature code 9002 informs the manufacturing plant of the number of storage frames in an IBM 3494 configuration, thus ensuring that the accessor cable shipped is the correct length. When storage units are added to an existing configuration, one feature code 9002 must be added to the library control unit for each additional storage unit ordered.

2.3.57 Drive Unit Attach (FC 9003)

Feature code 9003 informs the manufacturing plant of the number of drive frames in an IBM 3494 configuration, thus ensuring that the accessor cable shipped is the correct length. When drive units are added to an existing configuration, one feature code 9003 must be added to the library control unit for each additional drive unit ordered.

2.3.58 Storage Unit Attachment Greater Than Eight Frames (FC 9004)

Feature code 9004 notifies the manufacturing plant that a 3494 Model S10 is installed in a position beyond the first eight frames of the 3494. This feature is required to ensure that the proper cables for connection to the L1x are shipped. This feature code is required on the Model S10 and on the associated Model L1x for new orders and string reconfigurations.

For libraries with more than 8 frames, only 10-, 12-, and 16-frame configurations are supported.

2.3.59 Drive Unit Attachment Greater Than Eight Frames (FC 9005)

Feature code 9005 notifies the manufacturing plant that a 3494 Model D1x is installed in a position beyond the first eight frames of the 3494. This feature is required to ensure that the proper cables for connection to the L1x are shipped. This feature code is required on the Model D1x and on the associated Model L1x for new orders and string reconfigurations.

For libraries with more than 8 frames only 10-, 12-, and 16-frame configurations are supplied.

2.3.60 Virtual Tape Server Attachment (FC 9006)

Feature code 9006 must be ordered on the 3494 Model L1x when a Model B16 Virtual Tape Server is attached to the first eight frames of an IBM 3494. This feature is required to ensure that the proper cables for connection are shipped.

2.3.61 Virtual Tape Server Attachment Greater Than 8 Frames (FC 9007)

Feature code 9007 notifies the manufacturing plant that a Model B16 Virtual Taper Server is attached to the 3494 Model L1x in a position greater than the first eight frames of the 3494. This feature code is required on the Model B16 and the associated Model L1x. This feature is required to ensure that the proper cables for connection are shipped.

The only configurations greater than 8 frames that are supported are a the 10-, 12-, and -16 frame configurations.

2.3.62 Virtual Tape Server Attached 3494 Model D12 (FC 9010)

Feature code 9010 allows the appropriate internal SCSI cables to be provided for installation of the 3590 Model B1A tape drives. The individual SCSI cables do not have to be ordered separately for each tape drive. One feature code 9010 is required for the Model D12 attached to the Model B16 or B18.

2.3.63 B18 Virtual Tape Server Attachment (FC 9020)

Feature code 9020 notifies the plant of control that a 3494 Model B18 Virtual Tape Server is attached to the 3494 Model L1x to ensure that the proper cables are supplied for connection to the 3494 Model L1x control unit. One feature code is required to be added to any 3494 Model L1x control unit frame for each 3494 Model B18 that will be attached. Maximum: Two. (If a Model B16 is attached to the 3494, the maximum is one; that is, if feature 9006 or 9007 is present, the maximum of feature 9020 is one). Factory or field installable. Corequisite: Feature codes 5214 and 5232 are required on the Model L1x.

2.3.64 High Availability Attachment (FC 9040)

Feature code 9040 provides connection between the library manager in the 3494 Model L1x and the second library manager provided by the High Availability unit. One feature code 9040 is required on the Model L1x when a Model HA1 is ordered.

2.3.65 High Availability Direct Attach (FC 9041)

Feature code 9041 must be specified if there is a Model HA1 on the IBM 3494 with direct attachment for library control (AS/400, RS/6000, Sun, or VSE/LAN). It must be specified on all frames of the IBM 3494.

2.3.66 AS/400Attached Processor (FC 9104)

Feature code 9104 notifies the manufacturing plant that an IBM 3494 frame is to be attached to an AS/400. It is used for documentation. One feature code is required per frame.

2.3.67 RS/6000Attached Processor (FC 9106)

Feature code 9106 notifies the manufacturing plant that an IBM 3494 frame is to be attached to an RS/6000 processor. It is used for documentation. One feature code 9106 is required per frame.

This feature code must also be used when the IBM 3494 is attached to an RS/6000 SP or Sun processor.

2.3.68 ES/9000Attached Processor (FC 9109)

Feature code 9109 notifies the manufacturing plant that an IBM 3494 frame is to be attached to an ES/9000 processor. It is used for documentation. One feature code 9109 is required per frame.

2.3.69 Open System Device Drivers (FC 9200)

Feature code 9200 provides the device drivers to support 3590 Model B1A drive attachment to the IBM 3494 for AIX, HP-UX, and Sun systems. It replaces feature codes 9204 (Sun device driver) and 5212 (RS/6000 host attach). This attachment requires a LAN connection between the host processor and IBM 3494 for host command and response processing.

2.3.70 VSE Extended LAN Device Driver (FC 9203)

Feature code 9203 provides the library control device driver (LCDD) to support native VSE/ESA attachment to the IBM 3494. This attachment requires a LAN connection between the host processor and IBM 3494 for host command and response processing.

2.3.71 HP-UX Attachment (FC 9210)

Feature code 9210 provides the cabling for attachment of HP-UX systems to the IBM 3494.

2.3.72 Sun Attachment (FC 9211)

Feature code 9211 provides the cabling for attachment of Sun systems to the IBM 3494.

2.3.73 No Cartridges (FC 9540)

Feature code 9540 indicates that no 3490E ECCST cartridges or high performance 3590 cartridge tapes are to be shipped with this model.

2.3.74 3490 Model CxA Drive Installation (FC 9601)

Feature code 9601 indicates to the manufacturing plant to install a 3490E Model CxA tape subsystem in a 3494 Model L10 or D10. One feature code 9601 or one feature code 9602 must be ordered in the 3494 Model L10, but not both. One feature code 9601 can be installed in the 3494 Model D10. Feature codes 9601 and 9602 cannot be ordered for the same D10.

2.3.75 3490 Model F1A Attachment Hardware (FC 9602)

Feature code 9602 indicates to the manufacturing plant to install one or two 3490E Model F1A tape drives in a 3494 Model L10 or D10. One or two 9602s can be specified for the D10 and one for the L10. Feature codes 9601 and 9602 cannot be ordered for the same L10 or D10.

2.3.76 3590 B1A Attachment Hardware (FC 9630)

Feature code 9630 indicates to the manufacturing plant to fit a hole in the 3494 Model L12, L14, D12, or D14 for the mounting hardware required to install a 3590 Model B1A tape drive in the field. A maximum of two 9630s and 9631s are allowed for the L12 and D14, a maximum of six for the D12, and a maximum of four for the D14.

If feature code 9630 is ordered for the L14 or D14, feature code 9635 or 9636 must also be ordered for a 3590 Model A00 tape controller, or feature code 9655 or 9656 for a 3590 Model A50 tape controller.

2.3.77 3590 Model B1A Drive Installation (FC 9631)

Feature code 9631 indicates to the manufacturing plant to install one 3590 Model B1A tape drive in the 3494 Model L12, L14, D12, or D14. A maximum of two 9630s and 9631s for the 3494 Model L12 and L14, a maximum of four for the D14, and a maximum six for the D12 are allowed. The L14 and D14 also require feature code 9636 for a 3590 Model A00 tape controller or feature code 9656 for a 3590 Model A50 tape controller.

2.3.78 3490 Model F1A Attachment Hardware for Field Merge (FC 9632)

Feature code 9632 indicates to the manufacturing plant to install hardware to allow for field merge of one or two 3490E Model F1A tape drives in a 3494 Model L10 or D10. One or two can be ordered for the 3494 Model D10, and one for the L10.

2.3.79 FC 3000 Hardware for Field Merge (FC 9633)

Feature code 9633 indicates to the manufacturing plant to install hardware to allow for field merge of FC 3000 in a 3494 Model L10 or D10.

2.3.80 Factory Install of FC 3000 (FC 9634)

Feature code 9634 indicates to the manufacturing plant that one FC 3000 is to be installed in a 3494 Model L10 or D10.

2.3.81 3590 Model A00 Tape Controller Field Merge (FC 9635)

Feature code 9635 indicates to the manufacturing plant to fit a hole in the 3494 Model L14 or D14 for the mounting hardware required to install a 3590 Model A00 tape controller in the field. If feature code 9635 is ordered, at least one feature code 9630 or 9631 should also be ordered.

2.3.82 3590 Model A00 Tape Controller Factory Installation (FC 9636)

Feature code 9636 indicates to the manufacturing plant that one Magstar 3590 Model A00 tape controller is to be installed in a 3494 Model L14 or D14. If feature code 9636 is ordered, at least one feature code 9630 or 9631 should also be ordered.

2.3.83 3590 Model A50 Tape Controller Field Merge (FC 9655)

Feature code 9655 indicates to the manufacturing plant to fit a hole in the 3494 Model L14 or D14 for the mounting hardware required to install a 3590 Model A50 tape controller in the field. If feature code 9655 is ordered, at least one feature code 9630 or 9631 should also be ordered.

2.3.84 3590 Model A50 Tape Controller Factory Installation (FC 9656)

Feature code 9656 is provided so that the manufacturing plant will install one 3590 Model A50 tape controller in a 3494 Model L14 or D14. If feature code 9656 is ordered, at least one feature code 9630 or 9631 should also be ordered.

2.3.85 Request for Price Quotation

The IBM 3494 has the following RPQs:

- 8B3165 Data contents management

  The data contents management system provides software to manage the scratch levels and free-cell levels for the IBM 3494. Customers can specify objectives and criteria by which data cartridges will be selected for ejection. The initial release of the data contents management system supports the IBM 3494 in any currently supported MVS environment, either basic tape library support (BTLS) or system-managed tape. Tape management system support requires either CA-1(TMS) or CA-DYNAM/TLMS with the appropriate 3494 support levels. CA-EARL is a prerequisite for the implementation of the data contents management system in either of these two tape management system environments.

  For a volume to become eligible for ejection, it must be in the eligible volume serial number ranges, contain a data set matching a specified data set name (mask), and meet one of the following criteria:

  – Minimum days since last reference date
  – Minimum days since creation date
  – Last reference date
  – Creation date

  Parameters are also provided to exclude any volumes with data sets that will expire within a specified grace period and to limit the number of cartridges that will be ejected on a single batch run of the data contents management system.

- 8B3166 Add three or four drives for IBM 3494 feature code 5302

Provides necessary hardware to prepare installation of the third and fourth 3590 Model B1A tape drives in the feature code 5302 drive unit. Feature code 5302 must be installed on the 3494 Model L1x to remove feature code 5300.

- 8B3167 Add five or six drives for IBM 3494 feature code 5302

  Provides necessary hardware to prepare installation of the fifth and sixth 3590 Model B1A tape drives in the feature code 5302 drive unit. RPQ 8B3166 must be installed before the installation of RPQ 8B3167.

- 8B3168 Add three or four drives for IBM 3494 feature code 5304

  Provides necessary hardware to prepare installation of the third and fourth 3590 Model B1A tape drives in the feature code 5304 drive unit. Feature code 5304 must be installed on the 3494 Model L1x to remove feature code 5300.

- Other RPQs currently available at the time this book was written include but are not limited to:

  - 8B3173 Remove one FC 5300 drive unit from a 3494 Model L1x
  - 8B3174 Add one FC 5300 drive unit to a 3494 Model L1x
  - 8B3175 Remove one FC 5400 storage unit from a 3494 Model L1x
  - 8B3176 Add one FC 5400 storage unit to a 3494 Model L1x
  - 8B3179 Remove one FC 5302 drive unit from a 3494 Model L1x
  - 8B3180 Add one FC 5302 drive unit to a 3494 Model L1x
  - 8B3185 Remove the 3490-CxA from a FC 5300 drive unit
  - 8B3193 Remove the 3490-CxA from a 3494 Model D10
  - 8B3200 Remove one FC 5304 drive unit from a 3494 Model L1x
  - 8B3201 Add one FC 5304 drive unit to a 3494 Model L1x

See your IBM representative for a more detailed description of the above RPQs, a list of current RPQs, and ordering instructions.

Chapter 3. IBM Magstar 3494 Planning and Installation

In this chapter we present detailed information about planning for and installing your IBM 3494. We provide you with configuration guidelines illustrated by examples. These examples are based on an understanding of the features and functions described in Chapter 2, “IBM Magstar 3494 Tape Library” on page 11. We also cover performance, availability, serviceability and information to assist your installation planning.

3.1 Configuration Guidelines

In this section we describe how various hosts are attached to the IBM 3494 and explain the factors to consider when configuring an IBM 3494.

You can configure the IBM 3494 for performance, capacity, or both. With the wide range of features and host connectivity, configurations can become complex. Care must be taken in configuring the IBM 3494, and the following factors should be taken into consideration:

- Type and number of attached hosts
- Type and connectivity of the tape technology
- Number of tape control unit functions
- Rules for configuring and mixing 3494 frames
- Required number of cartridge storage locations
- Required number of active accessors

At the end of this section we provide an example of a mixed-host IBM 3494 configuration.

3.1.1 Host Attachment

The IBM 3494 can attach to a single host or multiple hosts through parallel (OEMI), ESCON, or SCSI-2 channels. Supported hosts are the S/390 systems (IBM S/390 Parallel Enterprise Server, and all ESA-capable S/370 and S/390 systems), RS/6000, AS/400, HP-UX, and Sun processors.

The types of attachment available depend on the tape subsystem and the host processor.

Figure 24 on page 60 through Figure 27 on page 62 illustrate four ways of connecting the different systems to an IBM 3494 and the corresponding data and control paths. For additional information about the control and data paths, see 2.2.2, “Host Command and Response Processing” on page 23.

Figure 24 on page 60 shows host attachment through a parallel channel.

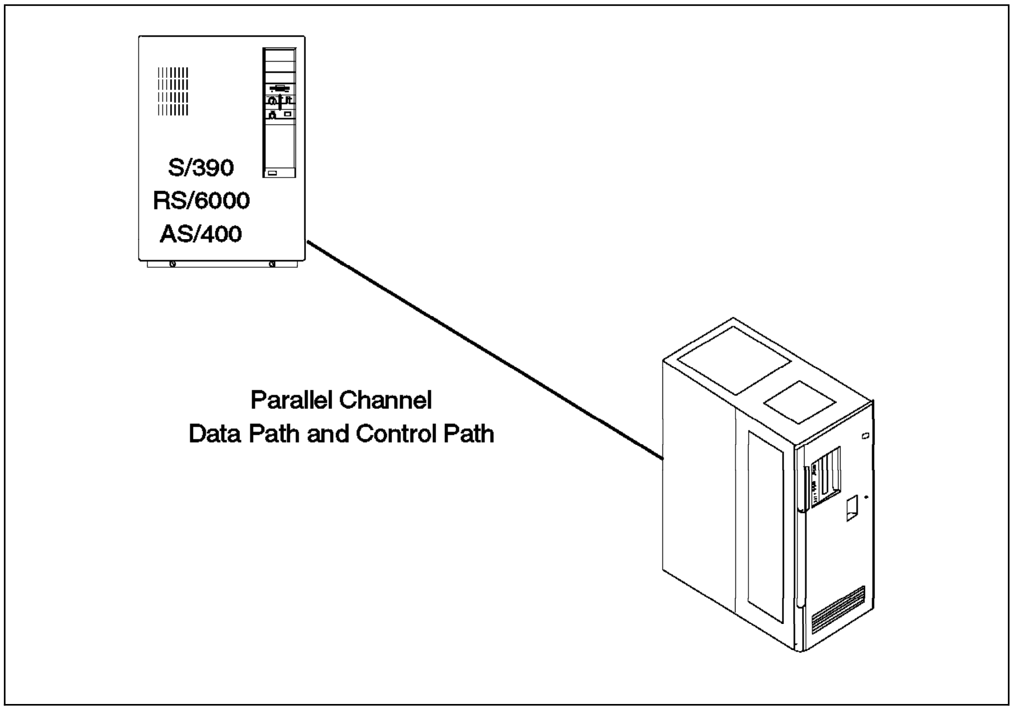


Figure 24. Host Attachment through a Parallel Channel

Figure 25 shows host attachment through an ESCON channel.

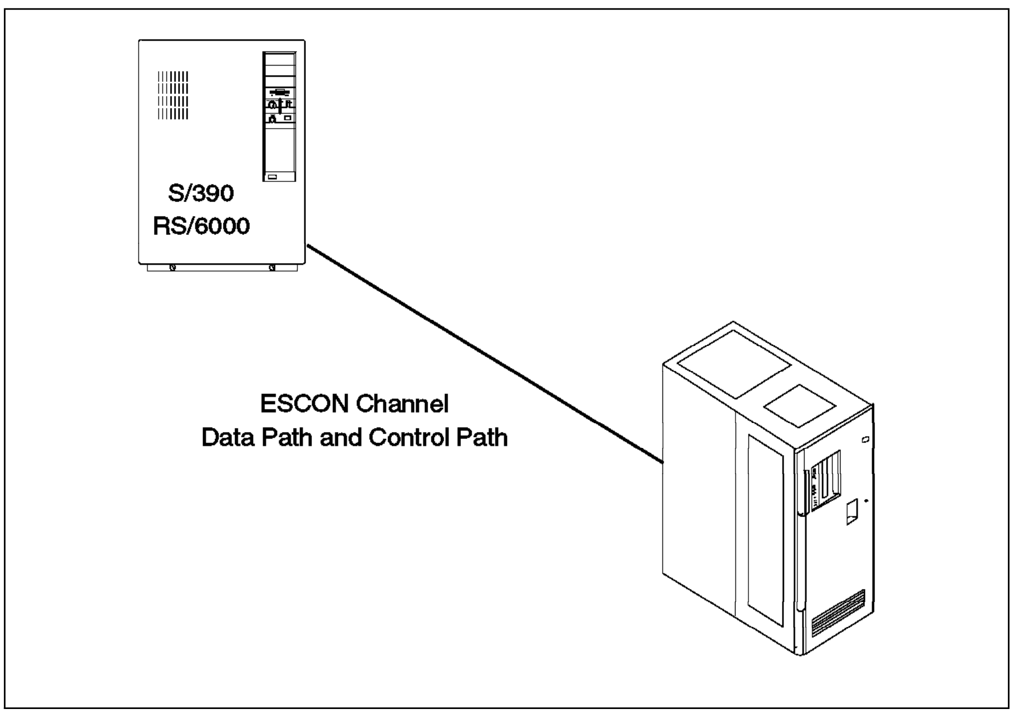


Figure 25. Host Attachment through an ESCON Channel

Figure 26 on page 61 shows host attachment through SCSI-2 and LAN connections.

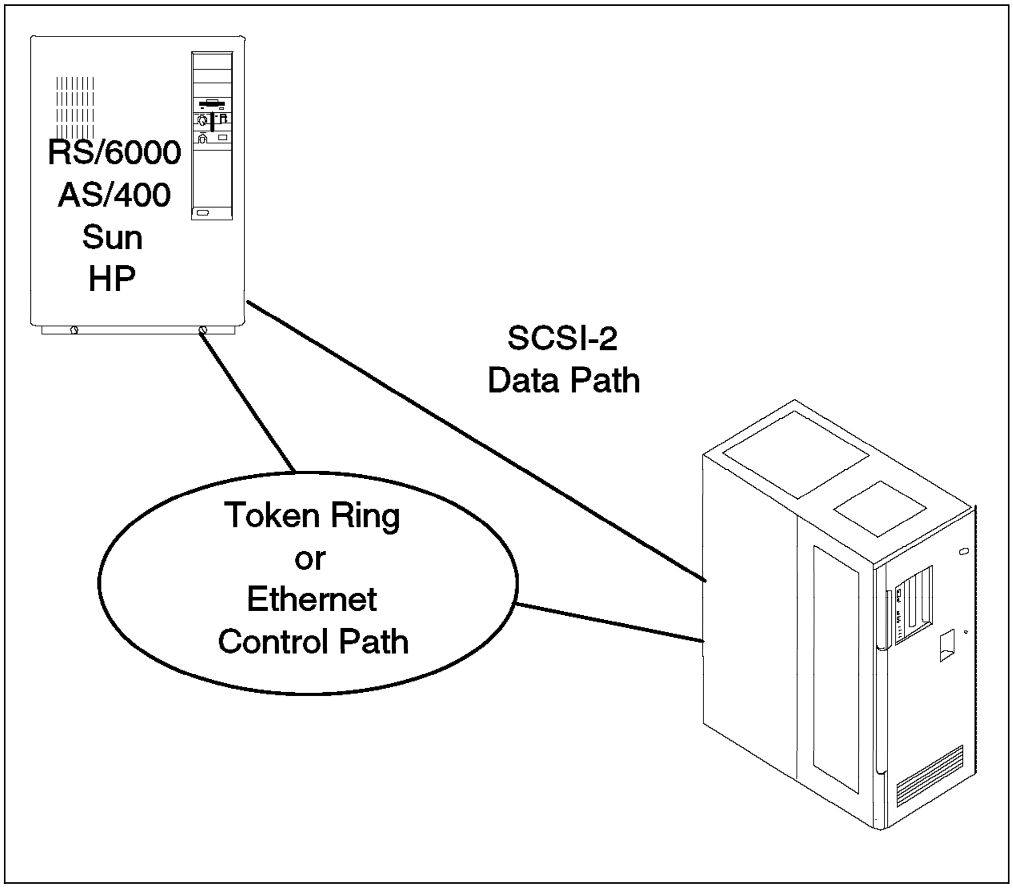


Figure 26. Host Attachment through SCSI-2 and LAN

Figure 27 on page 62 shows host attachment through SCSI-2 and RS-232 connections.

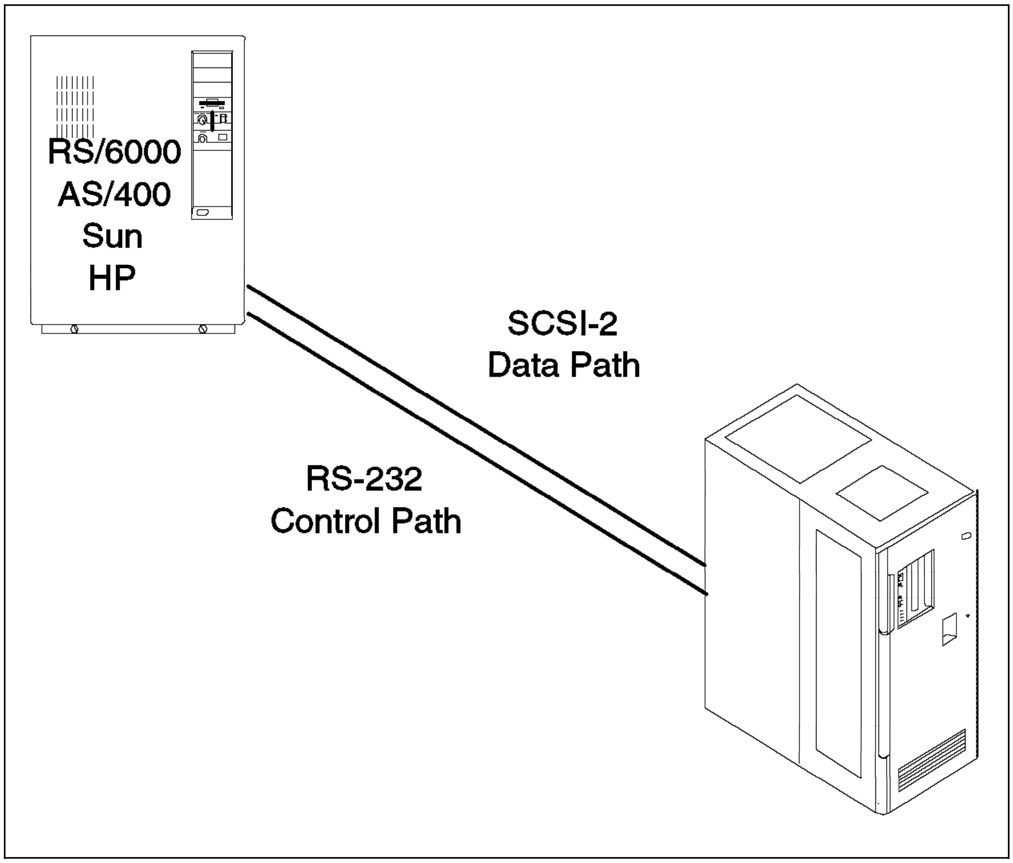


Figure 27. Host Attachment through SCSI-2 and RS-232

3.1.2 S/390 Systems

IBM S/390 Parallel Enterprise Servers and ESA-capable S/370 and S/390 systems can attach to the IBM 3494 through:

- An ESCON or parallel connection to the 3490E Model F1A tape drive
- An ESCON or parallel connection to the 3490E Model CxA tape subsystem
- An ESCON connection through a 3590 Model A50 tape controller to the 3590 Model B1A tape drives

Either type of channel provides a path for both data and commands, so that the only connection required between the host and the library is the channel(s) attaching the library-resident drives to the host(s). Library commands flow over these channels and are passed from the tape subsystem control units to the library manager for execution.

The one exception to this is attachment to native VSE systems. Native VSE requires a LAN attachment (token ring or Ethernet) to the library manager through a network controller such as a 3174 or 3745 using APPC. Here, a program running in a VSE partition, called the library control device driver (LCDD), provides the command interface between the library API and the network, which then passes the commands to the library manager.

The LCDD is an orderable feature code of the IBM 3494 (FC 9203).

3.1.3 AS/400

An AS/400 attaches to an IBM 3494 through:

- A SCSI-2 connection to a 3490E Model F1A tape drive
- A parallel connection or a SCSI-2 interface to a 3490E Model CxA tape subsystem
- A SCSI-2 interface to a 3590 Model B1A tape drive

An additional connection is required between the AS/400 and IBM 3494 library manager to pass library control commands. This additional connection can be either an RS-232 or LAN (APPC only). The library manager is limited to a maximum of eight RS-232 connections. If more than eight hosts must be attached to the IBM 3494, use a LAN connection, which can support up to 236 hosts.

The maximum distance for a parallel connection is 122 m (400 ft), and for a SCSI-2 connection, 25 m (82 ft). For a 122 m parallel connection, the extended length RS-232 host attachment (FC 5213) should be ordered.

3.1.4 RS/6000

An RS/6000, including RS/6000 SP, attaches to the IBM 3494 through:

- A SCSI-2 interface to the 3490E Model F1A tape drive
- A SCSI-2 interface to the 3590 Model B1A tape drive
- An ESCON, parallel, or SCSI-2 connection to the 3490E Model CxA tape subsystem

When attached through SCSI-2, the RS/6000 requires an RS-232 or LAN connection to the library manager to pass library control commands.

3.1.5 Sun Processors

Sun processors attach to the IBM 3494 through a SCSI-2 connection to the 3590 Model B1A tape drive, 3490E Model F1A tape drive, or 3490E Model CxA tape subsystem. When attached through SCSI, Sun processors also require an RS-232 or LAN connection to the library manager to pass robotic commands.

3.1.6 HP Processors

HP processors attach to the IBM 3494 through a SCSI-2 connection to the 3590 Model B1A tape drive, 3490E Model F1A tape drive, or 3490E Model CxA tape subsystem. When attached through SCSI, HP processors also require an RS-232 or LAN connection to the library manager to pass robotic commands.

3.1.7 Host Attachment Summary

Table 13 summarizes the available types of host system connections.

Table 13 (Page 1 of 2). Host System Connections

	For Data Transfer			For Library Control			
	ESCON	**Parallel**	**SCSI-2**	**ESCON**	**Parallel**	**RS-232**	**LAN**
S/390 System	X	-	-	X	-	-	-
S/390 System	-	X	-	-	X	-	-
S/390 System •	X	-	-	-	-	-	X •

Table 13 (Page 2 of 2). Host System Connections

	For Data Transfer			For Library Control			
	ESCON	**Parallel**	**SCSI-2**	**ESCON**	**Parallel**	**RS-232**	**LAN**
S/390 System •	-	X	-	-	-	-	X •
AS/400	-	X	-	-	-	X	-
AS/400	-	X	-	-	-	-	X
AS/400	-	-	X	-	-	X	-
AS/400	-	-	X	-	-	-	X
RS/6000	X	-	-	X	-	-	-
RS/6000	-	X	-	-	X	-	-
RS/6000	-	-	X	-	-	X	-
RS/6000	-	-	X	-	-	-	X
Sun	-	-	X	-	-	X	-
Sun	-	-	X	-	-	-	X
HP	-	-	X	-	-	X	-
HP	-	-	X	-	-	-	X

Notes:

1. For VSE/ESA only
2. Use APPC only

3.1.8 Tape Subsystem Configuration

The number of tape drives that can be installed in an IBM 3494 depends on the model. The number of tape drives can also be limited by the number of internal communication paths with the library manager. Many mixed configurations are possible, if the total number of tape control unit functions (RS-422 paths to the library manager) does not exceed 16. The different subsystems have different requirements:

- One path is required for each 3490E Model F1A tape drive.
- One path is required for each 3490E Model FC0 control unit (FC 3000)
- One path is required for each 3490E Model CxA tape subsystem.
- One path is required for each SCSI-2 attached 3590 Model B1A tape drive.
- One path is required for each 3590 Model A50 tape controller (3590 Model B1A tape drives attached to a 3590 Model A50 tape controller do not have a separate connection but share the one through the 3590 Model A50 tape controller.)
- Depending on the number of 3590 Model B1A tape drives installed (from three to six), six to nine paths are required for a model B16 Magstar Virtual Tape Server.
- For the B18 VTS and its associated 3590 B1A drives, no control unit connections are required. These connections are replaced by an internal LAN.

Note: If feature code 5228 or 5229 is not ordered, four tape control units can be connected. If the High Availability unit or the enhanced library manager is installed, however, eight control unit paths are available. See

Table 11 on page 50 for the number of control units or direct-attached drive connections available with features 5228 and 5229 installed in the IBM 3494.

If only 3590 Model B1A tape drives are used and all drives are direct SCSI-2 connected to the processors, the maximum number of drives is 16. Here all 16 paths of the library manager are used for connecting drives, and a LAN adapter card is required to provide host connection to the library.

With ESCON-attached 3590 Model B1A tape drives, up to 62 drives can be installed in a 16-frame IBM 3494. They are connected through sixteen 3590 Model A50 tape controllers to 32 ESCON channels to the S/390 processors. S/390 processors communicate with the library manager through the ESCON channel. Therefore a LAN adapter is not required although all 16 paths are used for connection to the 3590 Model A50 tape controllers.

An IBM 3494 with 14 Model 3590 A50 control units, attaching 56 3590 B1A drives, plus 2 B18 VTS subsystems each with 6 3590 B1A drives, provides the largest number of physical tape drives possible, a total of 66 drives. If the B18 VTSs are configured with 64 virtual 3490E drives, the host would see a total of 184 tape drive addresses with this configuration.

A 3590 Model B1A tape drive can have only one type of attachment to a host: either ESCON (using the 3590 Model A50 tape controller) or SCSI-2 direct. This fact may be important when tape drives are shared among different platforms using different channel protocols.

With ESCON-attached 3490E Model F1A tape drives, up to 10 drives can be installed in an IBM 3494. If only SCSI-attached 3490E Model F1A tape drives are used, the maximum number of drives that can be installed is 16, with 16 SCSI-2 connections to the host systems. In such a configuration, a LAN adapter is required to provide host connection to the tape library. Multiple RS/6000s can be connected to a 3490E Model F1A tape drive, but they cannot use the drive simultaneously. Only one AS/400 can be connected to a 3490E Model F1A tape drive.

If only 3490E Model CxA tape subsystems are used, the maximum number of drives that can be installed is 32, with 32 ESCON, parallel, or SCSI-2 connections to the host systems. One 3490E Model CxA tape subsystem can be attached to two different hosts, using different channel interfaces, and the tape drives can be switched between the two hosts as required.

The 3490E Model F1A tape drive(s) and 3490E Model CxA tape subsystem cannot be intermixed in the same 3494 Model L10 or D10.

When selecting the required IBM 3494 frames, take future drive requirements into consideration. For example, it may be better to provide an empty 3494 Model D1x than to have to replace a 3494 Model S10 in the future. If the configuration is to be a 3590 Model B1A tape drive, it may be better to have an empty 3494 Model L1x and a 3494 Model D12 with only two drives, so that additional 3590 Model B1A tape drives can be installed in the future.

For more information about issues regarding the configuration of tape subsystems, see the following publications: *IBM 3494 Tape Library Dataserver Introduction and Planning Guide*, and *IBM Magstar 3590 Tape Subsystem: Multiplatform Implementation*.

3.1.9 Tape Subsystem Installation Feature Codes

You can configure the tape subsystem installation of the IBM 3494 in three ways:

- The tape subsystem is installed in the IBM 3494 frames at the plant. This mode of installation is specified with the following feature codes:
  - FC 9601 - plant installation of 3490 Model CxA
  - FC 9602 - plant installation of 3490 Model F1A
  - FC 9631 - plant installation of 3590 Model B1A
  - FC 9636 - plant installation of 3590 Model A00
  - FC 9656 - plant installation of 3590 Model A50
- No tape subsystem is installed in the 3494 frame at the plant. The manufacturing plant prepares the frame, by leaving a hole and providing mounting hardware, so that tape subsystems can be field installed later. This mode of installation is specified with the following feature codes:
  - FC 9630 - plant installation of 3590 Model B1A mounting hardware
  - FC 9632 - plant installation of 3490 Model F1A mounting hardware
  - FC 9635 - plant installation of 3590 Model A00 mounting hardware
  - FC 9655 - plant installation of 3590 Model A50 mounting hardware
- No tape subsystem is installed in the 3494 frame at the plant and cartridge storage racking is installed where the tape subsystems would normally be. Later, a tape subsystem can be field installed in the IBM 3494. This mode of installation is specified with the following feature codes:
  - FC 4630 - field installation of 3490 Model CxA or 3590 Model B1A
  - FC 4632 - field installation of a 3490 Model F1A
  - FC 4635 - field installation of a 3590 Model A00
  - FC 4655 - field installation of a 3590 Model A50

Table 14 lists the required feature codes for parallel, ESCON, and SCSI-2 attachments to S/390, RS/6000, AS/400, HP, and Sun systems.

Table 14 (Page 1 of 2). Feature Code per Type of Attachment, Machine Type, and Platform

Type of Attachment	**Machine Type**	**Feature Code**				
		S/390	**RS/6000**	**AS/400**	**Sun**	**HP**
Parallel	Host system	OEMI channel	2759 •	2604, 2622, or 2644	N/A	N/A
	3490-CxA	5037	5037	5037	N/A	N/A
	3490-F1A	3358 on FC0	N/A	N/A	N/A	N/A
	3494-x10	-	9601 or 4630	9601 or 4630	N/A	N/A
	3494-L1x	-	5224	5211, 5213, 5217, 5219, or 5220	N/A	N/A

Table 14 (Page 2 of 2). Feature Code per Type of Attachment, Machine Type, and Platform						
Type of Attachment	**Machine Type**	**Feature Code**				
		S/390	**RS/6000**	**AS/400**	**Sun**	**HP**
ESCON	Host system	ESCON channel	2754, RPQ 8A1016 •	N/A	N/A	N/A
	3490-CxA	3319, 5045	3319, 5045	N/A	N/A	N/A
	3490-F1A	3320 on FC0	N/A	N/A	N/A	N/A
	3494-x10	9601 or 4630	9601 or 4630	N/A	N/A	N/A
	3494-x14	9630, 9631, 9635, 9636, 9655, 9656, 4630, 4635, or 4655	N/A	N/A	N/A	N/A
SCSI-2	Host system	N/A	2409, 2412, 2416, 2420, 6207, or 6209	2729, 6501, or 6534	SCSI adapter	SCSI adapter
	3490-CxA	N/A	5040, 5045	5040, 5045	5040, 5045	N/A
	3490-F1A	N/A	9602 or 9632	9602 or 9632	9602 or 9632	N/A
	3494-x10	N/A	9601, 9602, 9632, 4630, or 4632	9601, 9602, 9632, 4630, or 4632	9601, 9602, 9632, 4630, or 4632	N/A
	3590-B1A	N/A	9631	9631	9631	9631
	3494-x12	N/A	9630, 9631, or 4630	9630, 9631, or 4630	9630, 9631, or 4630	9630, 9631, or 4630
	3494-L1x	N/A	9200, 5219, or 5220	5211, 5213, 5217, 5219, or 5220	9200, 5217, 5219, or 5220	9200, 5217, 5219, or 5220

Note:

1. Parallel and ESCON attachment is supported only on microchannel-based RS/6000s that support these features. Refer to the appropriate RS/6000 model to determine the support.

The following feature codes must be ordered to replace a tape control unit or a tape controller with a new model:

- FC 4633 - field modification of a 3494 Model D10 to replace a 3490 Model CxA with a Model F1A
- FC 4650 - field modification of a 3494 Model L14 or D14 to replace a 3590 Model A00 with a Model A50

The following feature codes must be ordered to remove a tape subsystem from the IBM 3494:

- FC 4701 - removal of one 3490 Model F1A from a 3494 Model L10 or D10
- FC 4730 - removal of one 3590 Model B1A from a 3494 Model L12, L14, D12, or D14
- FC 4735 removal of one 3590-A00 from a Model L14 or D14
- FC 4755 removal of one 3590-A50 from a Model L14 or D14

For a detailed description of these IBM 3494 feature codes, see 2.3, “Features” on page 38.

3.1.10 Frame Configuration

The IBM 3494 can have a maximum of 16 frames plus the two attached service bays of the High Availability unit. Allowable configurations are 1 to 8, 10, 12, and 16 frames without the High Availability unit. When the High Availability unit is installed, configurations of 3, 4, 6, 8, 10, 12, and 16 frames are allowed, not counting the two service bays of the High Availability unit. With the Dual Active Accessor feature, at least four frames must be installed in the IBM 3494.

All configurations must have one 3494 Model L1x control unit frame. The subsystem can include up to 15 additional frames (not including the High Availability unit) in any combination of:

- 3494 Model D1x drive unit frames
- A maximum of one Model B16 frame (Virtual Tape Server)
- 3494 Model S10 storage unit frames

An IBM 3494 can support up to two VTS subsystems. If one is a B16, the other must be a B18 model. Each VTS requires a separate D12 frame to house the 3590 B1A drives. The B18 VTS frame is a stand-alone frame located within 14m of the attached D12. The B16 VTS frame is installed in the IBM 3494 and must be to the immediate left of the associated D12. Except for this one restriction, the frames associated with the VTS subsystems may be in any position in the IBM 3494.

The remainder of the 16 frames of the IBM 3494 equipped with VTS may be made up of optional 3494 Model D1x drive units or 3494 Model S10 storage units.

If more than eight frames are attached to a 3494 library, one drive frame (Model D10, D12, or D14, or feature code 5300, 5302, or 5304) must be installed in the first eight frames.

Feature codes are available to specify the number and position of frames installed in an IBM 3494. See 2.3, “Features” on page 38 for a detailed description of available feature codes.

If the configuration of frames in an installed IBM 3494 has to be changed, for example, if frames must be moved to install a Virtual Tape Server, or if frames must be moved from one IBM 3494 to another, an RPQ must be processed before the library can be reconfigured. An RPQ is required for moving feature codes 5300, 5302, 5304, and 5400, or models B16, D10, D12, D14, and S10. The RPQ provides the proper cables.

Figure 28 on page 69 shows examples of configurations that provide capacity, performance, or both.

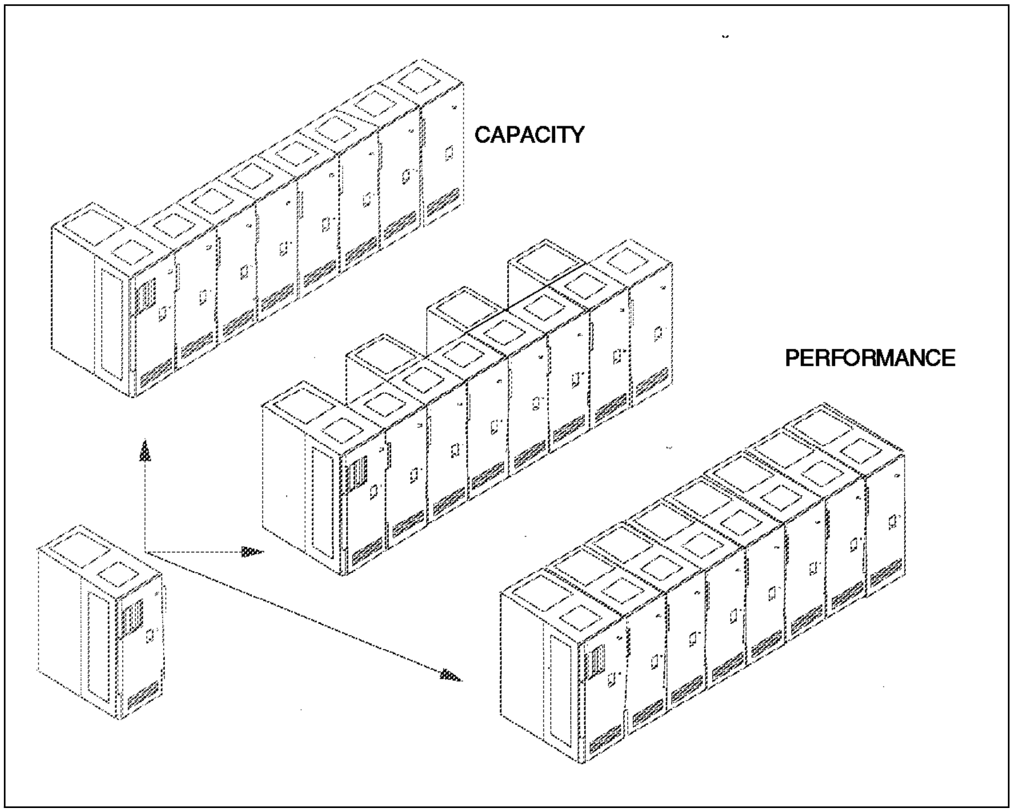


Figure 28. 3494 Capacity and Performance Configurations

In planning the configuration of an IBM 3494, consideration should be given to the relative ease with which additional frames may be added to the end of an existing library, in comparison to inserting additional frames. Similarly, it is easier to add drives to drive frames that are not fully populated with drives, than it is to remove S10 frames and replace them with Dxx frames, or even to add additional drive frames when ample storage slots are available.

3.1.11 Evaluating Cartridge Requirements

The IBM 3494 allows for expandable configurations; for example, it can hold from 160 to 6240 cartridges. The storage capacity is determined by the number of frames, installation of the optional convenience I/O station, installation of the optional dual gripper, the number and type of tape subsystems installed, and the definition of the high-capacity facility.

Table 15 shows the number of cartridge storage cells for each model of the IBM 3494.

Table 15 (Page 1 of 2). IBM 3494 Configuration Options and Frame Capacity

3494 Model/Feature	3490-F1A	3490-CxA	3590-B1A	3590-A50	Cartridges without Dual Gripper	Cartridges with Dual Gripper ●
Model L10	1, 2 ●	0	N/A	N/A	210(160)-240 ●	190(140)-216 ●
Model L10	0	1	N/A	N/A	210(160)-240 ●	190(140)-216 ●
Model L12	N/A	N/A	0, 1, 2	N/A	210(160)-240 ●	190(140)-216 ●
Model L14	N/A	N/A	0, 1, 2	0, 1	210(160)-240 ●	190(140)-216 ●
Model B16	N/A	N/A	N/A	N/A	400	360

Table 15 (Page 2 of 2). IBM 3494 Configuration Options and Frame Capacity						
3494 Model/Feature	**3490-F1A**	**3490-CxA**	**3590-B1A**	**3590-A50**	**Cartridges without Dual Gripper**	**Cartridges with Dual Gripper ●**
FC 5300	N/A	1	N/A	N/A	300	270
FC 5400	N/A	N/A	N/A	N/A	400	360
FC 5302 ●	N/A	N/A	1, 2	N/A	335	305
FC 5302 ●	N/A	N/A	3, 4	N/A	290	260
FC 5302 ●	N/A	N/A	5, 6	N/A	250	230
FC 5304 ●	N/A	N/A	1, 2	1 ●	345	315
FC 5304 ●	N/A	N/A	3, 4	1 ●	305	275
Model D10	0	0	N/A	N/A	400	360
Model D10	1, 2	0	N/A	N/A	300	270
Model D10	0	1	N/A	N/A	300	270
Model D12	N/A	N/A	0	N/A	400	360
Model D12 ●	N/A	N/A	1, 2	N/A	335	305
Model D12 ●	N/A	N/A	3, 4	N/A	290	260
Model D12 ●	N/A	N/A	5, 6	N/A	250	230
Model D14	N/A	N/A	0	0	400	360
Model D14 ●	N/A	N/A	1, 2	1	345	305
Model D14 ●	N/A	N/A	3, 4	1	305	275
Model S10	N/A	N/A	N/A	N/A	400	360
Model HA1 (service bays)	N/A	N/A	N/A	N/A	0	0

Notes:

1. Cartridge storage capacity is reduced by approximately 10% when the dual gripper feature is installed.
2. The 3490E Model F1A tape drive can be installed only in a new 3494 Model L10.
3. The convenience I/O station reduces the number of storage locations available in the 3494 Model L1x. The 10-cartridge convenience I/O station reduces total capacity by 30 storage cells, and the 30-cartridge convenience I/O station reduces capacity by 80 cells.
4. Plant mounting hardware feature codes in a 3494 frame reduce the cartridge storage capacity by the same amount as the installed tape drives in that frame.
5. The feature code 5304 drive unit only supports the 3590 Model A00 tape controller.

Note: Cartridge cells allocated to the high-capacity facility are not available for cartridge storage. See 2.2.11, "High-Capacity Facilities" on page 32 for a description of the high-capacity facility and the size of the corresponding reserved area.

You can gather information about the number of cartridge storage cells required inside the tape library by analyzing tape usage data generated by analysis tools, tape management software reports, or discussions with storage administrators. There is no one method of gathering this data that applies to all hosts that can be attached to the IBM 3494. For methods available on MVS/ESA see 8.1.1, "Tape Data Analysis" on page 274.

3.1.12 Multiple Host Configuration Example

Once you have determined the number and type of hosts to be attached to the library, the tape drive technology, and cartridge storage capacity, you can configure a library. Using Table 15 on page 69 and 2.3, “Features” on page 38, you can select the most cost-effective library configuration.

We propose an environment that consists of an RS/6000, an S/390 Parallel Enterprise Server, and an AS/400 sharing the IBM 3494 and a two-phase scenario:

- Phase 1
  - The RS/6000 requires the use of two 3590 Model B1A tape drives and 150 cartridges held in the IBM 3494.
  - The S/390 system requires four 3590 Model B1A tape drives and 700 cartridge slots in the IBM 3494.
  - The AS/400 requires two 3490E Model F1A tape drives and 150 cartridge slots in the IBM 3494.
  - A 10-cartridge convenience I/O station, the dual gripper, and second disk drive for the library manager are required.
- Phase 2
  - A Virtual Tape Server with three drives and 72 GB of DASD tape volume cache is installed.
  - A second RS/6000 shares the library. Two 3590 Model B1A tape drives are required for this system.
  - A High Availability unit is required to enhance the level of availability of the library.

3.1.12.1 Configuration Example: Phase 1

Figure 29 shows the recommended configuration for phase 1. Other configurations are possible, but this would probably be the most cost effective.

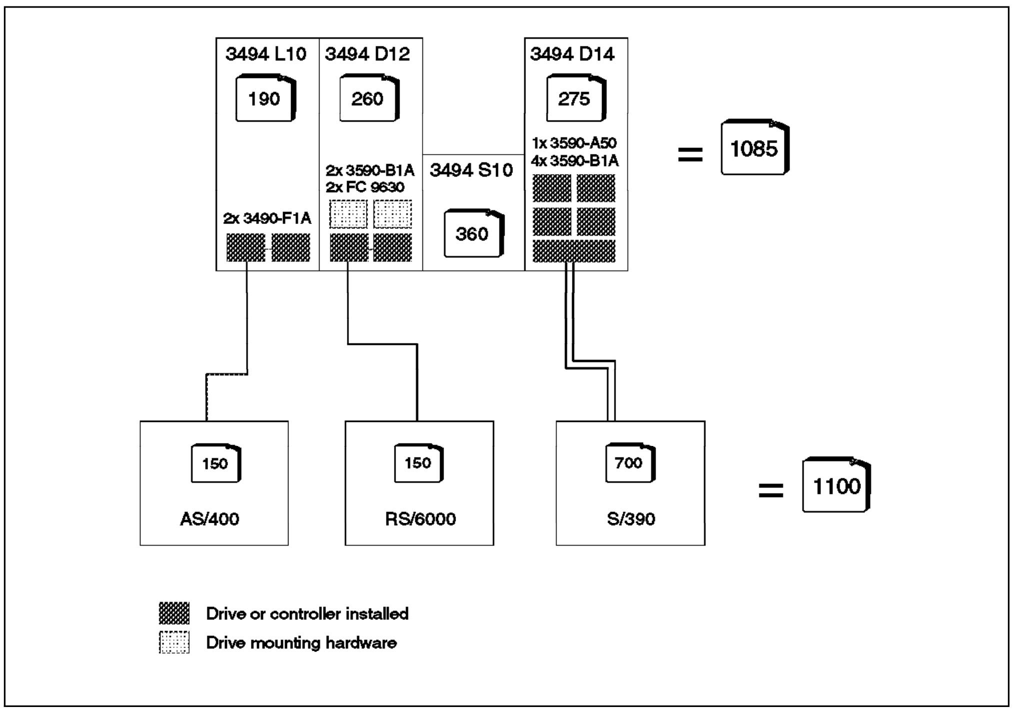


Figure 29. IBM 3494 Configuration Example: Phase 1

We selected:

- A 3494 Model L10 to house the two 3490E Model F1A tape drives SCSI-2 connected (and chained) to the AS/400
- A 3494 Model D12 with two 3590 Model B1A tape drives SCSI-2 connected (and chained) to the RS/6000. By specifying two feature code 9630s, we request the factory to fit two holes in the D12 and to provide the mounting hardware to field install the next two 3590 Model B1A tape drives.
- A 3494 Model D14 with one 3590 Model A50 tape controller and four 3590 Model B1A tape drives. The 3590 Model A50 tape controller is connected to the S/390 system through two ESCON channels.
- A 3494 Model S10 that provides cartridge slots

We attach the RS/6000 and AS/400 to the library manager through a token ring (feature code 5219). We configure feature code 9200, so that the AIX device driver is supplied, and we do not use the RS-232 cables. As the OS/400 release is later than Version 3 Release 6, MLDDs are integrated in OS/400, and a device driver feature code is not needed to connect the AS/400 through the LAN.

To support five tape control unit functions, and as the RS/6000 and AS/400 SCSI host connections are made through the token ring adapter, we specify feature code 5228 for the 3494 Model L10. See Table 11 on page 50 for the number of control unit or direct-attached drive connections available with feature codes 5228 and 5229 installed.

The total storage capacity is 1085 cells. For information on the cell capacity of each frame when the dual gripper is installed, refer to Table 15 on page 69.

Figure 30 lists the feature codes required for the phase 1 configuration. It does not show the drive configurations.

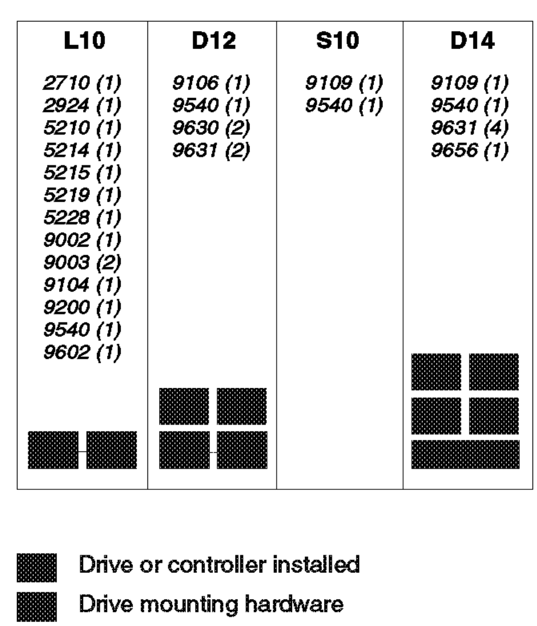


Figure 30. Feature Codes for IBM 3494 Configuration Example: Phase 1

3.1.12.2 Configuration Example: Phase 2

Figure 31 shows the recommended configuration for phase 2.

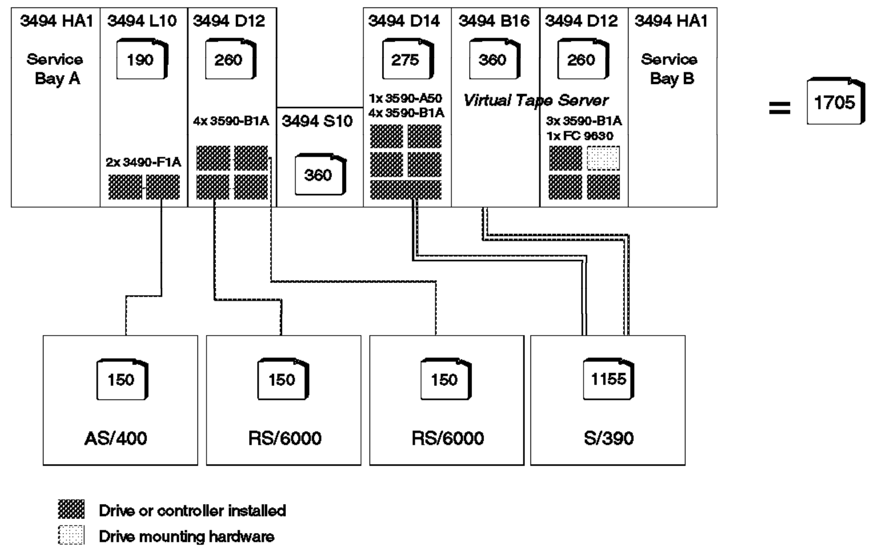


Figure 31. IBM 3494 Configuration Example: Phase 2

The six-frame configuration of Phase 1 is one of the supported configurations for the installation of the Model HA1 High Availability unit.

The 3494 Model L10 has the dual gripper installed (FC 5215), so the dual gripper feature must also be ordered for the Model HA1.

Because the 3494 Model L10 has a token ring adapter installed (FC 5219), a token ring adapter must also be ordered for the Model HA1.

Feature code 5229 must be ordered on the 3494 Model L10 when a Model B16 is installed. Feature codes 5228 and 5229 installed in the 3494 Model L10 are sufficient to support the tape drive configuration of this installation. Because feature code 5229 is installed in the 3494 Model L10, it must also be ordered for the Model HA1.

The total storage capacity is 1705 cells.

Figure 32 on page 74 lists the feature codes required for the phase 2 configuration.

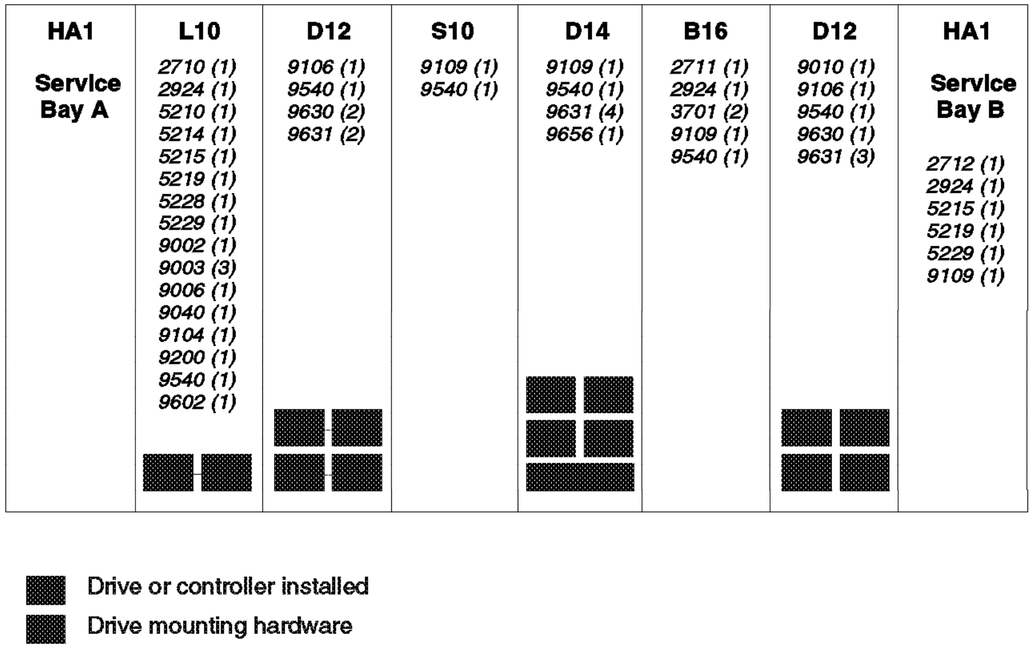


Figure 32. Feature Codes for IBM 3494 Configuration Example: Phase 2

3.1.13 Media Requirements

Depending on the migration approach you choose, you may want to order new cartridges. We recommend that you order preinitialized cartridges with the bar code labels attached. For hints and details on volume ranges and media planning, refer to 8.1.5, "MEDIA Considerations" on page 284, and 9.9, "Cartridge Labels and Bar Codes" on page 300. For information about the available media feature codes that enable you to order cartridges with the IBM 3494 frames, see Table 12 on page 53.

3.2 Performance

Expectations of performance play an important role in planning for your IBM 3494. In this section, we try to demystify some of the performance characteristics of an automated tape library. The discussion includes:

- Accessor exchange performance for:
  - Native drive libraries
  - Virtual Tape Server virtual drives
- Performance implications of the Dual Active Accessor feature
- Inventory performance
- Mount performance
- Drive subsystem performance

3.2.1 Accessor Exchange Performance

Library performance is the number of volumes that the tape library can exchange in a 1-hour period. An exchange involves moving a volume to a tape drive, drive residence time, and removal of the volume from the drive. In this section, we use ″exchange″ as a metric for hourly accessor performance, and we use ″mount″ to describe the mechanical actions of the library as the host sees them, such as ″specific mount″ or "scratch mount." The time to move a volume to a drive and remove the volume from the drive constitutes the library accessor capability. If the tape library has more tape drives, it can exchange more volumes concurrently. If the library is fitted with the Model HA1 and Dual Active Accessor feature, its hourly exchange rate may be increased. Therefore, tape library performance is affected by:

- Number of tape drives
- Drive residence time
- Library accessor exchange time affected by:
  - Number of active accessors (Dual Active Accessor feature)
  - Relative placement of drives and volumes within the library

For example, considering four drives with 5-minute residence time, it is impossible to have more than 48 exchanges per hour. Those values are obtained by multiplying the number of drives by the quotient of 1 hour (60 minutes) divided by the residence time in minutes:
(number of drives) * (1 hour / drive residence time)

The exchange capability provided by the tape library accessor is the quotient of 1 hour (3600 seconds) divided by the library accessor exchange time in seconds. If the library accessor exchange time is 15 seconds, the mount capability of the tape library accessor is 240, which far exceeds the availability of volumes to exchange. Current measurements indicate a maximum of 305 cartridge mounts or dismounts per hour for the IBM 3494. Therefore, the key to determining tape library performance is often based on drive residence time, not necessarily library accessor exchange time.

Figure 33 on page 76 shows a comparison between average volume residence time and the cartridge exchange capability provided by several different configurations of the IBM 3494. The six solid lines in the graph show the maximum exchanges per hour possible for 2, 4, 8, 16, 32, and 66 tape drives with varying drive residence times. Analyses of customer data show that average drive residence times typically range between 8 and 12 minutes. This range is indicated on the graph. The broken vertical lines are the maximum exchange rates that the IBM 3494 is capable of executing for several different-size tape libraries and with or without the dual gripper and Dual Active Accessor feature. The purpose of the graph is to show that residence time and number of drives should be used to determine the accessor performance required in a library.

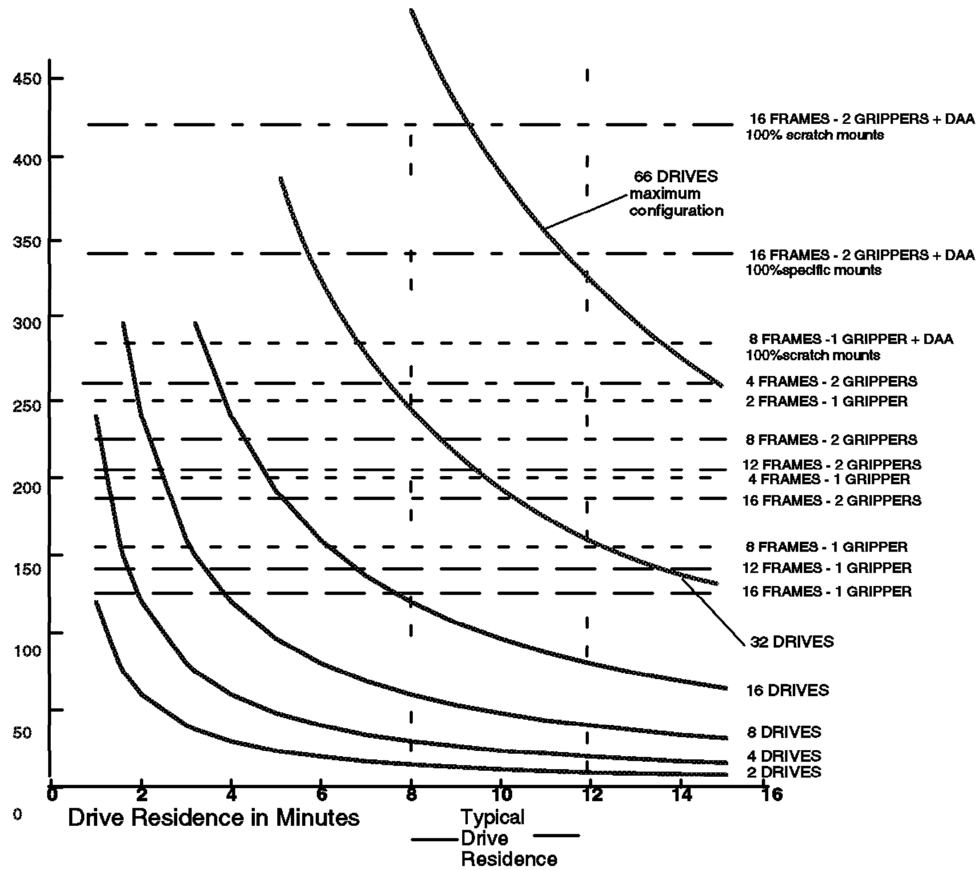


Figure 33. IBM 3494 Exchange Capability and Tape Drive Residence Time

3.2.2 Performance with Dual Active Accessor Feature

Exchange performance of the IBM 3494 with the Dual Active Accessor feature is dependent on the degree of independence with which the accessors can operate. Given totally independent operation, Dual Active Accessor can accomplish more than twice the number of exchanges possible for a single accessor in the same library. Given a high degree of interference between the two accessors, Dual Active Accessor may provide only slightly better exchange performance than a single accessor.

The two accessors service the drives in the library frames that are within the accessor′s zone (Figure 34 on page 77). The two zones are established by a dynamic or fixed boundary. A high degree of independence will occur when there is an affinity between the cartridge location and the location of the selected drive, so the accessor servicing the target drive does not have to cross the boundary line into the other accessor′s zone to pick the cartridge.

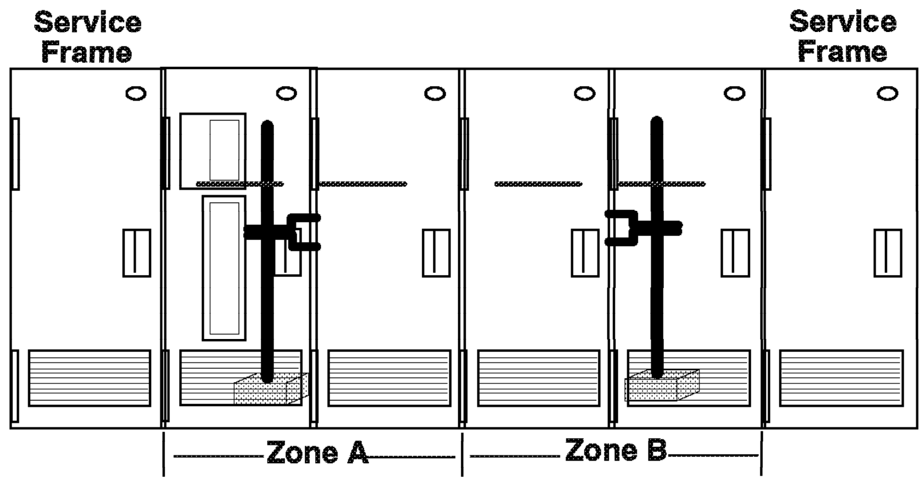


Figure 34. IBM 3494 Dual Active Accessor Feature

With the Dual Active Accessor feature, cartridge-drive affinity can occur for both scratch and specific mounts.

For scratch mounts, affinity is controlled by the library manager′s ability to select the volume to be mounted from the specified category. See 7.7.4, “Library Manager Scratch Selection” on page 247 for details on library manager scratch selection. This affinity will always occur when the scratch mount is a true scratch mount (mount from category) and not a specific mount from a private scratch pool. Affinity for scratch mounts is applied to the set of drives in the zone in which the accessor normally operates, not to individual drives.

For specific mounts, affinity will occur if:

- The operating system or tape application uses the drive-string priority list that the library manager will, on request, send to the host processor, and
- There is at least one unallocated drive in each zone.

Currently, OS/390 running JES2 is the only operating systems that exploits this priority list. In these environments, with a single accessor, cartridge-drive affinity also occurs (only for specific mounts), but the effect on exchange capability is not as dramatic as it is in a Dual Active Accessor library.

Table 16 summarizes the conditions under which the two types of cartridge-drive affinity occur.

Table 16. Cartridge-Drive Affinity for Scratch and Specific Mounts

ACCESSOR = >	**Single**	**Single**	**Dual**	**Dual**
MOUNT TYPE =>	**Scratch**	**Specific**	**Scratch**	**Specific**
OS/390	NO	YES	YES	YES
AS/400	NO	NO	YES	NO
RS/6000	NO	NO	YES	NO

A further natural cartridge-drive affinity will occur when the library is partitioned into sections by operating system and/or drive type, so that all cartridges in each section will be mounted only in the drives in that section.

Here are some Dual Active Accessor configuration scenarios that will result in a high degree of cartridge-drive affinity and thus optimal Dual Active Accessor exchange performance.

- An OS/390 environment where every host image has access to every library cartridge, and drives are balanced across the two library zones. For scratch mounts the library manager will always try to pick a scratch cartridge in the same zone as the target drive. See 7.7.4, “Library Manager Scratch Selection” on page 247 for details on library manager scratch selection. For specific mounts, the library manager will send to OS/390 an ordered list of drives, based on the zone containing the cartridge to be mounted. If not all drives in the cartridge′s zone are allocated, OS/390 will choose a drive from the ordered list that will result in at least cartridge-zone, if not cartridge-drive, affinity, thus also assuring optimal Dual Active Accessor exchange performance. Therefore, for applications with a high percentage of specific mounts, it is important to have sufficient drives so that cartridge-drive affinity can be achieved even in peak periods.
- An AS/400 or RS/6000 environment where applications use actual communal scratch pools for scratch mounts, and, if there are a significant number of specific mounts, the applications use the ordered list of drives to achieve cartridge-drive affinity. Note that neither the OS/400 nor AIX operating systems themselves use the ordered drive list for specific mounts.
- A mixed host environment where all cartridges and drives for one host are together in each library zone. The VTS drives and cartridges would fall within this scenario.
- Any host environment where two drive types are geographically separated enough to be in the two zones. The two different cartridge types would also be placed in the different zones. Fixing the zone boundary in the library manager may be advantageous for this scenario.

Here are some scenarios that do not result in a high degree of cartridge-drive affinity and thus show minimal performance benefit from the Dual Active Accessor feature:

- An AS/400 or RS/6000 environment where applications use private scratch pools, or where there are a significant number of specific mounts and the applications do not exploit the ordered drive list.
- Any host environment with a high percentage of specific mounts and it often occurs that all drives in a zone are allocated.

Laboratory measurements have shown that much better Dual Active Accessor exchange performance occurs when the library is in floating home cell mode rather than fixed home cell mode, for either single or dual grippers. Therefore, operation of Dual Active Accessor in floating home cell mode is strongly recommended. For both the single accessor and the Dual Active Accessor libraries, the best exchange performance occurs with dual grippers and floating home cell mode.

Configuration planning is very important for achieving optimal exchange performance for Dual Active Accessor. For sample IBM 3494 configurations, refer to *IBM 3494 Tape Library Dataserver Introduction and Planning Guide.*

Following these suggestions when planning the configuration of an IBM 3494 with the Dual Active Accessor feature will minimize accessor interference:

- Balance drive frames across both halves of the library, using expected mount activity as the determining factor. Best performance comes from evenly distributed mount activity. If you are adding the Dual Active Accessor feature to an existing 3494, it may be advisable to redistribute drives within existing or new drive frames.
- Try to put storage frames in the center of the configuration.
- Grouping 3490E drives at one end and 3590 drives at the other end will help migrate cartridges to provide cartridge-drive affinity. Each VTS-owned drive frame should be treated as a separate drive type, because these are logically separate libraries sharing the accessors and slots with the native drives.
- If a host has access to only a subset of the tape subsystems in a library, attempt to keep all those subsystems in the same half of the library so that the volumes associated with the subsystems remain in the same zone. This consideration also applies to the situation where a library is partitioned between two OS/390 hosts sharing all or a subset of the drives. If these drives are manually or automatically switched between the partitions, the volumes owned by the each partition will lose the cartridge-drive affinity performance benefit that would otherwise arise with the Dual Active Accessor feature. **Be prepared to weigh the benefits of sharing drives against the benefits of increased exchange performance with the Dual Active Accessor feature.**
- With the Dual Active Accessor feature installed, the library should be using floating home cell mode even with single gripper accessors.
- On initial loading or inventory update, cluster cartridges around the subsystems that will be mounting them.
- Define the high capacity I/O near the drives that will be writing tapes that will be ejected.
- If you plan to grow the number of drive subsystems in the library over time, provide a balance of empty drive frames in both zones. These D-frames may be used for cartridge storage.

IBM provides a spreadsheet tool to Marketing Specialists to assist in predicting the performance benefits of the Dual Active Accessor feature in a given library configuration. See *http://w3.rmss.tucson.ibm.com/software/tapetools.htm* for the PERF3494.123 or PERF3494.wk4 packages.

3.2.3 Mount Performance in the VTS

Usually, the mount performance of IBM Magstar 3494 Virtual Tape Server is not tied to the accessor exchange performance of the physical library. Most virtual mounts, that is, all scratch and most specific, do not involve a physical exchange. Thus, it is unlikely that one or even two VTS logical libraries installed in an IBM 3494 will tax the accessor system. The average time for a virtual mount, however, may be affected by a high demand for accessor movement in the native (nonvirtual) portion of a mixed library.

The VTS offers very fast mount times for scratch mounts and specific mounts satisfied in the tape volume cache. The remaining mounts (cache-miss mounts) are subject to possible queuing against the VTS 3590 drives, the individual stacked volumes, and/or the accessor resources. This queuing can extend the time for these mounts to complete to several minutes.

3.2.4 Inventory Performance

The inventory performance of the IBM 3494 is improved with the addition of the Dual Active Accessor feature. Inventory update processing for four frames of library storage was measured in the laboratory. Without the Dual Active Accessor feature, the inventory took 25 minutes; with the Dual Active Accessor feature, the inventory took 13 minutes, which calculates to 3 to 4 minutes per frame.

3.2.5 Drive Subsystem Performance

The 3590 Model A50 tape controller offers up to twice the data rate of the predecessor Model A00. A fully configured IBM 3494 with 16 3590 Model A50 tape controllers can provide a total throughput of up to more than 250 MB/s for those applications that need very high throughput.

The 3490E Model FC0 control unit and its (up to) two attached F1A drives offer an uncompacted throughput of 6 MB/s, and with compaction, 10 MB/s. Up to five such subsystems can be installed in an IBM 3494.

With 32 or 64 virtual IBM 3490E tape drives and a large DASD buffer, the Magstar Virtual Tape Server significantly modifies the performance paradigm in there respects:

- With only a few tape drives (from 3 to 6 Magstar 3590s), it provides 32 or 64 IBM 3490E virtual addresses to the host system and applications.
- It fully exploits the bandwidth of the Magstar 3590 and avoids multiplying the number of physical tape drives needed to perform a specific task.
- The allocations and write operations are performed on the disk buffer and are therefore much faster than on tapes. For example, a scratch tape mount operation consists of opening a new file on disk and is a matter of seconds, whereas a traditional tape subsystem requires physical library and tape drive operations to complete.
- The disk buffer also acts as a cache for read operations. Depending on its size and the pattern of activities, it can save a significant amount of physical cartridge mounts.

The Magstar Virtual Tape Server offers a new class of tape automation solution compared to traditional tape storage products. Performance with a Virtual Tape Server is no longer a matter of mounts per hour or number of physical tape drives. Because a Virtual Tape Server and native Magstar 3590 tape subsystems can be mixed in the same library, the IBM 3494 offers a complete and integrated solution for all types of workloads. For more information, refer to *IBM Magstar Virtual Tape Server: Implementation Guide*.

3.3 Availability

Where redundancy exists in the configuration, the IBM 3494 attempts to dynamically reconfigure around failing components to maintain the availability of the library to the attached hosts (see 9.4.1, “Degraded Operation” on page 294). To improve the overall availability of your tape operations, we recommend that you consider these optional features available for the IBM 3494 or the tape subsystems:

- The dual gripper (FC 5215) provides a second gripper. In the event of a gripper failure, the IBM 3494 can continue operations with the remaining gripper. For more information, see 2.2.8, “Cartridge Accessor” on page 28 and 2.3.36, “Dual Gripper (FC 5215)” on page 48.

- The second hard disk drive (FC 5214) allows the library manager to maintain a secondary copy of the database. If the primary disk fails, the secondary disk will be used to restore the primary database and thereby shorten the time needed to recover the library manager. For more information, see 2.3.35, “Second Library Manager Hard Disk Drive (FC 5214)” on page 48.
- The 3494 Model HA1 High Availability unit provides a high level of availability by including a second library manager and a second accessor. If one of these components fails, the library operations can continue after a short interruption. This redundancy also improves the serviceability of the IBM 3494. For more information, see 2.1.5, “IBM Magstar 3494 Model HA1 High Availability Unit” on page 19; 2.2.13, “IBM Magstar 3494 Model HA1 High Availability Unit” on page 35; and 3.4, “Serviceability.”
- The Dual Active Accessor feature adds operational and switchover improvements to the HA1, in addition to the possible performance improvements. See 10.2, “Operating and Monitoring the High Availability Unit” on page 340 for Dual Active Accessor feature recovery scenarios.
- The 3590 Model A50 tape controller can be configured with one or two ESCON adapters (respectively, FC 3311 and 3312). Besides providing a second ESCON adapter, feature code 3312 also doubles the internal SCSI paths from the 3590 Model A50 tape controller to the 3590 Model B1A tape drives. The second adapter provides ESCON and SCSI-2 redundancy and should be considered even when the 3590 Model A50 tape controller is connected to a single S/390 processor. For more information, see *IBM Magstar 3590 Tape Subsystem: Multiplatform Implementation*.

3.4 Serviceability

The IBM 3494 provides remote service support connectivity. Through modem connections the following advanced service support is provided:

- Rapid analysis of error logs, system state, and register status with the ability for development engineering to analyze microcode errors on the fly. This facility minimizes outages and permits expedient fixes for problems.
- The ability to download microcode fixes to units for specific problems and thereby expedite problem resolution and outage.
- The ability for support centers to include multiple levels of engineering expertise to aid in the diagnosis of difficult problems.

The remote support connection has secure dial-in capability with password-protected access at both the modem and machine level. No uninitiated dial-out or ″call home″ is performed by the modem. The modem can be shared between the 3494 Model L10, L12, L14, or B16 and a 3590 Model A50 tape controller. For information about the available feature codes, see 2.3.3, “Remote Support Facility (FC 2710)” on page 43; 2.3.4, “Remote Support Switch (FC 2711)” on page 43; and 2.3.5, “Remote Support Attachment (FC 2712)” on page 43.

When the High Availability unit is installed, concurrent maintenance can be performed on the second accessor or second library manager while the IBM 3494 remains active and in Auto mode. Emergency fixes can be applied on the standby library manager while the active library manager continues to operate.

When the Dual Active Accessor feature is enabled, it is possible to switch library managers to allow concurrent maintenance of a library manager. It is also possible to deactivate an accessor to perform repair or maintenance while the other accessor continues to operate alone.

If a Virtual Tape Server is installed, most disk cache and tape subsystem failures can be repaired concurrently with functional operation.

The 3590 Model B1A tape drives and 3490E Model F1A tape drives are serviced from the rear of the IBM 3494, alleviating the need to open the front doors of the library, which would cause a transition to PAUSE mode. The drives can be concurrently maintained if more than one subsystem is installed in the library.

3.5 Installation Planning

In the sections that follow we provide information to assist in installation planning. We cover site preparation, CE initial operations, and environmental specifications.

3.5.1 Site Preparation

The information presented below must be included in the floor plan for the installation of an IBM 3494. For additional detailed plan specifications, see the *IBM 3494 Tape Library Dataserver Introduction and Planning Guide*.

- The installation planning representative and the customer are responsible for:
  - Power outlet types, locations, and power ratings
  - Operator area (work area) for the library manager, convenience I/O station, and access doors
  - Locations of emergency power-off (EPO) switches
  - Frame locations
  - Service clearances
  - Total IBM 3494 area dimensions
- The customer is also responsible for:
  - Cabling and wiring for connections to the host processor
  - Cabling for connection for the remote library manager console (feature code 5226). The remote library manager console also requires the Token Ring Adapter (feature code 5219) or the Ethernet Adapter (feature code 5220) in the IBM 3494.
  - Cooling
  - Telephone lines for remote service support
  - Safety and security
  - Fire detection and suppression
  - Floor, raised or not raised, that meets the operational and structural requirements imposed by the IBM 3494. For a raised floor, we recommend that stringers be installed between all corner posts and that a post be placed under the areas where the 3494 leveling pads will sit.

- Associated tape library cartridge storage for nonautomated tape library activities
- Acoustic requirements

3.5.2 CE Initial Operations (Teach and Initial Inventory)

After an IBM 3494 is first installed, a teach process must be performed. The teach process sets up and initializes the library manager database before the customer uses it. An IBM CE does the teach operation from the library manager service menu.

For the teach operation, the CE specifies the following configuration information from the library manager pop-up windows:

- Customer identifier — Enter the customer's name.
- Library sequence number—Enter a unique five-digit number for each logical library in the IBM 3494. A logical library is really a group of tape drives. All non-VTS drives are in one logical library. Each VTS within an IBM 3494 has its own library sequence number as well. The frame serial numbers of the L frame and any B frames are often used as the library sequence numbers, but this is not a requirement.
- Default media type — The options are *1* for CST cartridges (MEDIA1), *E* for ECCST (MEDIA2), *J* for Magstar 3590 (MEDIA3), or *none* in mixed 3490 and 3590 device type libraries.

  This default is used if a cartridge is inserted that is neither labeled with the seventh character identifying the media type nor defined to the library manager in a range of a given media type. You may specify *none*.

  Support for bar-coded seventh character, default media type, and definitions of volume ranges to the library manager are three ways that the IBM 3494 can distinguish to which media type a volume belongs (see 9.11.9, "Volser Range for Media Types" on page 316), and all three may be in use.
- Password required—Specify whether the library manager systems administrator level and service level functions are to be password protected.
- Adjacent frame inventory update—Specify whether the IBM 3494 should inventory only the frame whose operator door has been opened or the frames next to that frame as well.

  At any time, the inventory update can be enabled or disabled through the operator menu of the library manager.
- Library frames—Specify the number and types of frames in the IBM 3494 configuration: control unit frame, drive unit frames, storage unit frames, and Virtual Tape Server.
- High Availability unit — When installed, specify the dual accessors and service bays.
- Dual Active Accessor — When installed, specify enabled or disabled.
- Tape subsystems—Specify the number and type of tape drives installed in the control unit frame and each drive unit frame.
- The device addresses—Specify the customer-defined tape drive addresses to simplify identifying the drive if a problem occurs.
- Dual gripper—Specify whether the dual gripper (feature code 5215) is installed.

- High-capacity output facility—Specify the number of cells to reserve for the high-capacity output facility.
- High-capacity input/output facility—Specify the number of cells to reserve for the high-capacity input/output facility.
- Convenience I/O station—Specify whether the control unit frame contains the convenience I/O station (feature code 5210 or 5230).
- Plant of manufacture—Enter the prefix from the machine serial number.
- Home cell Mode—Specify the home cell Mode as either fixed home cell mode or floating home cell mode. The floating home cell mode is allowed only when the dual gripper or Dual Active Accessor feature is installed.

The library manager database is then created with one cell table, one device table, and the system files.

Starting with the first component in the configuration and continuing until all components are taught, the cartridge accessor is directed to find one or more teach points on the components. The initial location for a teach point is established by the component type and location in the library. A sensor system is then used to center the cartridge accessor on a teach target.

When the High Availability unit is installed, the teach process is repeated with the second cartridge accessor.

When all component positions have been taught, the library manager reinitializes itself with the created database. The library can then proceed to the initial inventory operations.

If features or frames are added or removed, certain options are modified, or an untaught component exists from a previously taught configuration, a partial teach process is allowed. A partial teach does not create a new library manager database; it only updates the information for those components that have been changed.

Once the library has been taught, but before it can be placed in the online operational state (see Chapter 9, “Operational Considerations” on page 291), an initial inventory operation, *Inventory New Storage*, must be performed to create entries in the database. The inventory operation uses the bar code reader to scan all cartridge storage cells of the library, looking for volumes with their volser and media type labels. Once all frames have been inventoried, the database is completed and the library is made available to enter the online operational state.

For libraries equipped with one or two VTS units, it is necessary to perform *Insert Virtual Volumes*. This insert is permanent and should be carefully planned. The key points are that you should not insert more virtual volumes than are necessary, and even though they can be *ejected* one at a time, this is not desirable. It is simple to add more at virtual volumes any time. See *Enhanced IBM Magstar Virtual Tape Server: Implementation Guide*.

The IBM 3494 Tape Library Dataserver Introduction and Planning Guide provides you with information about the tasks you must perform to continue the installation of the IBM 3494. The other chapters of this redbook provide detailed information about installation verification and software implementation.

3.5.3 Environmentals

The temperature and humidity ranges for the IBM 3494 vary according to environmental conditions.

The environmental specifications shown in Table 17 apply to the components of the IBM 3494 (not to tape subsystems inside the tape library).

Table 17. IBM 3494 Environmental Specifications

Condition	Temperature	Relative Humidity	Maximum Wet Bulb
Operating	10° to 30°C (50° to 110°F)	20 to 80	23°C (73.4°F)
Nonoperating	10° to 51.7°C (50° to 125°F)	8 to 80	27°C (80°F)
Storage	1° to 60°C (34° to 140°F)	5 to 80	29°C (84°F)
Shipping	-40° to 60°C (-40° to 140°F)	5 to 100 (excluding precipitation)	29°C (84°F)

Chapter 4. Software Environments

To use the IBM 3494 tape library, in addition to device support for 3490 and 3490E (and 3590 if applicable) tape subsystems, you must have software that can communicate with the library manager to control the tape library. In this chapter we briefly describe the following host software environments that provide this support:

- OS/390 or MVS/ESA using system-managed tape
- MVS/ESA using Basic Tape Library Support
- VM/ESA using DFSMS/VM
- MVS/ESA as a guest of VM/ESA
- VSE/ESA using VSE guest support under VM/ESA
- VSE/ESA using Library Control Device Driver for VSE/ESA
- AIX and optionally using ADSM for AIX
- OS/400 and optionally using Backup Recovery and Media Services/400
- Transaction Processing Facility (TPF)

The operating systems and platforms listed below are known to support the IBM 3494 tape libraries provided through either IBM or vendors. However, not all of them are covered in this book.

- AIX/ESA Version 2 Release 2.0 and later releases
- Sun operating systems (SunOS 5.x, Solaris 2.2 or later releases)
- HP-UX (HP-UX 10.0x through 10.3x)
- CRAY J Series (UNICOS 8.0.4.x or later releases)
- Silicon Graphics – URIX 5.3 (B11 only)
- Convex

4.1 OS/390 and System-Managed Tape

In this section we discuss the system-managed tape environment. If you want to use an IBM 3494 tape library in an OS/390 environment without system-managed tape, refer to 4.2, “MVS/ESA and Basic Tape Library Support” on page 91.

System-managed tape allows you to manage tape volumes and 3494 IBM tape libraries through a set of policies that determine the kind of service to be given to the data sets on the volume.

The automatic class selection (ACS) routines process every new tape allocation in the system-managed storage (SMS) address space. The production ACS routines are stored in the active control data set (ACDS). These routines allocate to each volume a set of classes that reflect your installation′s policies for the data on that volume. The ACS routines also direct the volume to a storage group.

The storage class routine determines whether or not a request is SMS-managed. If no storage class is assigned, the request is not SMS-managed, and allocation for nonspecific mounts is thus made outside the IBM 3494.

For SMS-managed requests, the storage group routine assigns the request to a storage group. The assigned storage group determines which IBM 3494 are to be used. A tape storage group is associated with one to eight tape libraries and the tape volumes stored inside the libraries. All volumes of a multivolume data set must be contained within a single library and a single storage group.

With system-managed tape you can:

- Direct all of your offsite backup volume allocations to an IBM 3494 tape library in an offsite, protected location for disaster recovery.
- Ensure that all volumes for a particular application are written on 18-track tape drives without compaction.

The ACS routines are invoked for every new allocation. Tape allocations are passed to the object access method (OAM), which uses its library control system (LCS) component to communicate with the library manager.

Figure 35 shows an overview of the system-managed tape environment.

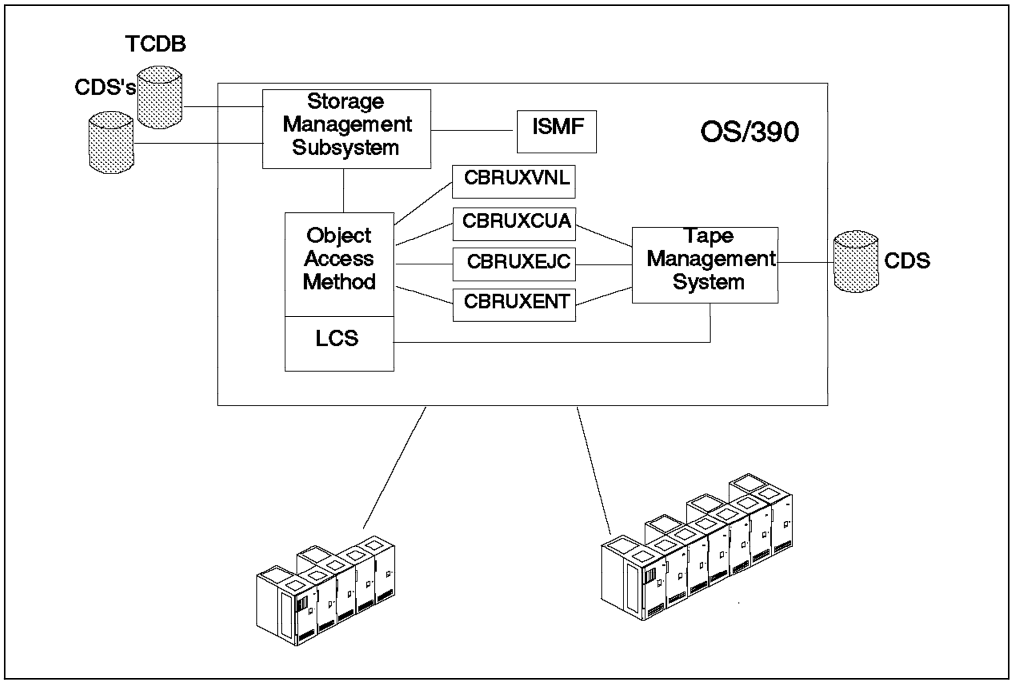


Figure 35. System-Managed Tape Overview

The components of system-managed tape are:

- OAM and its LCS
- Storage management subsystem
- Integrated Storage Management Facility (ISMF)
- Installation wide exits
- Tape management system

4.1.1 Library Manager Interface

To use system-managed tape, the OAM address space must be active. Its LCS component interfaces with the library manager.

The OAM is used for management and control of the physical location and tracking of tape cartridges. OAM has three components: object storage and retrieval (OSR), OAM storage management component (OSMC), and LCS. We discuss only the use of LCS, as the other components of OAM are used to control IBM's optical tape libraries, that is, the IBM 3995.

For more information about OAM, see *DFSMS/MVS OAM PISA for Tape Libraries.*

The external interface to an IBM 3494 tape library is through:

- ISMF, to work with the tape libraries and library-resident volumes and alter the tape configuration database (TCDB) entries. The following are typical tasks to be performed with ISMF:
  - Defining and redefining tape libraries
  - Displaying tape library attributes
  - Altering tape library definitions
  - Copying tape library definitions
  - Deleting tape library definitions
  - Listing tape libraries and volumes
  - Displaying tape volumes
  - Auditing tape volumes and libraries
  - Altering tape volumes and libraries
  - Ejecting tape volumes

  Note: Because Access Method Services (IDCAMS) commands will not interface with the library manager inventory in an IBM 3494 tape library, use ISMF to perform functions against a tape library. Use IDCAMS CREATE, ALTER, and DELETE commands only to recover from volume catalog errors.
- The OS/390 operator command, LIBRARY, to reenable exits, eject volumes, query and set cartridge loaders, and display the status of tape drives.
- The OS/390 operator command, DISPLAY SMS, to display library information or data about a volume
- The DFSMSrmm TSO subcommand to manage tape volumes in the tape library
- The programming interface provided by the LCS External Services macro (CBRXLCS) to query the name and type of the tape library in which a volume resides
- Installation exits CBRUXENT, CBRUXEJC, CBRUXCUA, and CBRUXVNL to manage entry, exit, change use attribute, and volume-not-in-library handling. Use of these exits is optional and depends on how your tape management system supports the IBM 3494 tape library.

4.1.2 Control Data Sets

For system-managed tape, information about volumes is stored in the TCDB, which is an integrated catalog facility (ICF) catalog of type VOLCAT. The TCDB consist of one or more volume catalogs. A volume catalog contains entries for tape volumes and tape libraries but does not contain entries for individual data sets. At least one general volume catalog and any number of specific volume catalogs must be defined. Storing the information for any particular range of volume serial numbers in a specific volume catalog aids performance in accessing the TCDB and may ease the use of TCDBs across systems and applications.

For a full description of setting up system-managed tape for an IBM 3494 tape library, see Chapter 5, "Implementing Software" on page 119 and *DFSMS/MVS Implementing System Managed Storage.*

4.1.3 Prerequisites and Considerations

Here are some points to consider when you use an IBM 3494 tape library in a system-managed tape environment:

- DFSMS/MVS must be installed with the MVS/ESA operating system at level 4.3 or higher.
- On a JES3 system, JES3 4.2.1 or higher plus SPEs is required.
- EREP 3.5 plus SPEs is mandatory.
- The OS/390 hardware configuration definition (HCD) uses the LIBRARY parameter to define drives configured to a tape library.
- A set of SMS systems can be grouped together by sharing SMS control data sets. This group is called an *SMSplex.* With DFSMS/MVS Version 1.1, up to eight SMS systems can be grouped together into a SMSplex.

  DFSMS/MVS Version 1.2 introduced SMS system group-name support to remove the eight-system limit in an SMSplex and allows up to 32 systems in a JES2 SMSplex. That level of system group-name support has some limitations, however; for example, it cannot be used in JES3 environments.

  DFSMS/MVS Version 1.3 introduced SMS 32-name support to remove the above limitations. SMS 32-name support requires JES3 Version 5.2.1 plus PTF (APAR OW12573).
- The TCDB is a control data set for SMS and must be shared in an SMSplex. Thus it is possible to allow access to a volume by more than one system in the SMSplex.
- Users of a Virtual Tape Server should install APAR OW27369. It adds new statistics to SMF Record Type 9, which is logged every hour.
- All volumes should be standard label (SL) or ANSI label (AL) tapes. APARs OW01530 and OW02211 are available to support nonlabeled (NL) and bypass label processing (BLP) volumes for input processing. APARs OW05934 and OW06305 are available for output processing. These APARs have been integrated into DFSMS/MVS V1.3.
- Magstar 3590 device support is provided with the following software releases:
  - MVS/ESA SP 4.3 + SPE
  - MVS/ESA SP 5.1.0 + SPE
  - MVS/ESA SP 5.2.0 + SPE
  - JES3 4.2.1 + SPE
  - JES3 5.1.1 + SPE
  - JES3 5.2.1 + SPE
  - DFSMS/MVS 1.2.0 or higher + SPE
  - EREP 3.5.0 + PTF
  - ADSM V2 or highe
  - DFSORT Release 12 + SPE
  - DITTO/ESA Release 1

  Note:

Toleration PTFs are required for DFSMS/MVS 1.1.0 and DFSMS/MVS 1.2.0 without the IBM 3590 Support SPE when sharing an IBM 3494 Automated Tape Library Dataserver with DFSMS/MVS 1.2.0 that has the IBM 3590 SPE installed.

DFDSS V2.5 does not support the IBM 3590, but DFSMSdss 1.2.0 does.

- DFSMSrmm, IBM′s tape management system and optional feature of DFSMS/MVS, interfaces fully with OAM. DFSMSrmm records all tape data set and volume information and provides utilities to perform expiration processing and vaulting. It retains information about volumes whether or not they are in a library, part of system-managed tape, onsite, or offsite.

  Tape management system products of many other vendors also have exits that support the IBM 3494 tape libraries. If you are using such a product, contact the vendor to check which release provides this support.

4.2 MVS/ESA and Basic Tape Library Support

BTLS offers support for IBM tape libraries in MVS/ESA environments where system-managed tape is not available.

System-managed tape may not be available for one of the following reasons:

- The level of MVS/ESA is earlier than Version 4.3 and therefore does not support DFSMS/MVS.
- DFSMS/MVS is installed, but you do not want to implement system-managed tape.
- DFSMS/MVS is installed, but you do not want to migrate to HCD.
- DFSMS/MVS is installed, but you want to use scratch pools at a level other than media type. (BTLS supports up to eight scratch pools.)

You can use BTLS for IBM 3494 tape library support even if you are using SMS to manage disks, redirect tape data sets to disk (tape mount management), or both. Note that only system-managed tape provides the support necessary to fully manage an IBM 3494 tape library. Should you choose to a migrate to DFSMS/MVS system-managed tape environment from the BTLS environment, refer to Appendix D “Migration to DFSMS/MVS” in the *BTLS V1R1 User′s Guide and Reference*.

4.3 Comparison: BTLS and System-Managed Tape

BTLS and System-managed tape differ in a number of ways: BTLS is primarily aimed at those installations that do not have the software installed to support system-managed tape or decide that BTLS provides all the function they require. As system-manged tape is an integrated part of DFSMS, there is no additional charge, but BTLS is a separate, chargeable program product. System-managed tape does not support multiple scratch pools; media type selection is carried out through the data class SMS construct, whereas BTLS provides support for up to eight scratch pools.

Other areas where BTLS and system-managed tape differ are:

- Volume entry
- Allocation

- Mount and demount
- Utility functions
- Logging

4.3.1 Volume Entry

On volume entry the IBM 3494 tape library sends a message to attached hosts. System-managed tape receives this message, and cartridge insert processing is completed automatically. Insert processing is not automatic in BTLS. Instead, a set of IDCAMS LIBRARY commands is used to first inventory the cartridges added to the library and then complete insert processing.

4.3.2 Allocation

In system-managed tape, specific requests use the TCDB; for nonspecific requests, the SMS constructs are used, and SMS builds a list of eligible devices and passes them to MVS for data set allocation. The BTLS allocation assist uses the BTLS volume catalog records for specific requests; for nonspecific requests, allocation is determined by job name, procedure name, user exit, or esoterics.

4.3.3 Mount and Demount

In system-managed tape, all components that issue mount or demount calls (for example, open/close/end of volume and allocation) are modified to replace write to operator (WTO) messages with calls to OAM to perform mount and demount. A wait function allows its caller to wait until the mount is complete and the external volser has been returned to the host (the volser is read by the IBM 3494 tape library vision system). This process provides for external or internal label verification. Demounts are issued for canceled jobs. At open time, unlabeled tapes are labeled without operator confirmation.

BTLS causes a mount or demount to occur in the IBM 3494 tape library. If the mount fails, the operator receives a message, but the mount requester is not informed that the mount has failed. No external or internal label verification is done, and unlabeled tapes are not automatically labeled. Canceled jobs do not demount mount-pending tapes; instead, the tapes are demounted during the next mount to that drive. There is an AUTODEMOUNT function in BTLS to demount these volumes automatically.

4.3.4 Utility Functions

System-managed tape uses the ISMF library and volume application panels. The operator can also issue MVS LIBRARY and SMS commands. BTLS uses the IDCAMS LIBRARY command that is issued from a TSO/E or batch job. There are no BTLS operator commands.

4.3.5 Logging

Both system-managed tape and BTLS provide error notification at the MVS console; however, the error notification messages are different. Both system-managed tape and BTLS collect the library statistics that the library manager sends out hourly and save them as SMF record type 94.

BTLS provides the LIBRARY command for IDCAMS to manage the interface to the library manager. There are other modifications to MVS/DFP to support IBM tape libraries; for example, dynamic device reconfiguration (DDR) ensures that when a drive is reallocated the second drive is within the same library.

Figure 36 on page 93 gives an overview of BTLS.

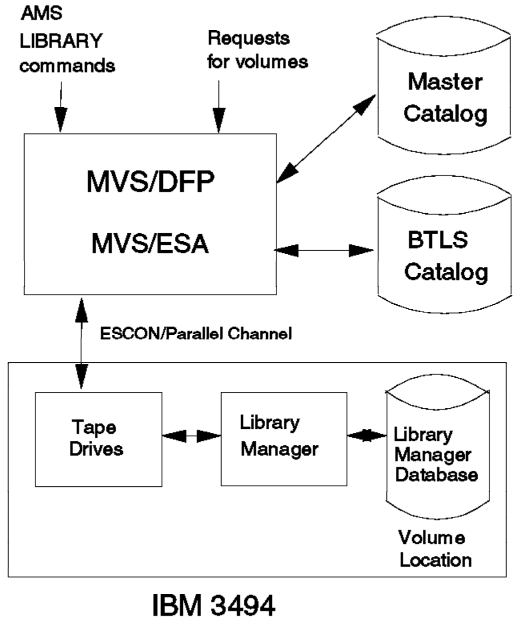


Figure 36. MVS/ESA and Basic Tape Library Support

4.3.6 Library Manager Interface

Communication with the IBM 3494 tape library is achieved through use of the AMS LIBRARY commands.

The details of these commands are in the *BTLS V1R1 User's Guide and Reference*.

BTLS provides support to:

- Load the ICL or ACF with volumes from a particular category or unload the ICL or ACF
- Associate a particular scratch category of volumes with a particular tape device (so that only that category can be used on that unit), or reset the device to be associated with the installation's default category
- Assign a volume, or a set of volumes, to a particular category, by either direct command or through the IDCLI04 exit.
- Ensure that when a device is allocated for a volume mount, both the volume and device reside in the same library (in case of DDR)
- Ensure that reallocation of a device (for example, because of an unusable drive) is made within the same library

The BTLS exits are documented in the *BTLS V1R1 User's Guide and Reference*.

4.3.7 Control Data Sets

BTLS uses four types of catalog records. It stores records with volume information in an ICF user catalog named *BTLS*. The other three catalog records (whose names start with SYS1) are stored in the master catalog. Two of those catalog records deal with options used at allocation, and one stores the unit addresses of the tape devices in the library. Information pertaining to volumes that are outside a library is not stored in the BTLS user catalog.

4.3.8 Prerequisites and Considerations

BTLS is supported in the following environments:

- BTLS for MVS/DFP (5655-057) in JES2 environments
  - DFP 3.1.1
  - DFP 3.2.0
  - DFP 3.2.1
  - DFP 3.3.0
  - DFP 3.3.1
  - DFP 3.3.2
- BTLS for MVS/DFP (5655-057) in JES3 environments
  - DFP 3.3.0 (HDP3330)
  - DFP 3.3.1 (HDP3331)
  - DFP 3.3.2 (HDP3332)
- BTLS for DFSMS/MVS (5655-056) in JES2 environments
  - DFSMS 1.1
  - DFSMS 1.2
  - DFSMS 1.3
  - DFSMS 1.4
- BTLS for DFSMS/MVS (5655-056) in JES3 environments
  - None

    BTLS for DFSMS/MVS is not supported with JES3.

Note: You should always check Washington Systems Center Flash Numbers 9525 and 9421 for the latest updates on PTFs and APARs before installation.

Here is a list of maintenance required for BTLS for various levels of operating system software:

- BTLS requires PTF UW02439 when running under MVS/SP Version 2.
- BTLS requires the PTF for APAR OY63009 when running under MVS/SP Version 3 and MVS/ESA Version 4.
- BTLS for MVS/DFP (5655-057) requires the PTF for APAR OW11086 when running under MVS/ESA Version 4.3 or MVS/ESA Version 5.1.
- BTLS for DFSMS/MVS Release 1.1 (5655-056, BTLS FMID JDZ111S) requires the PTF for APAR OW11087 when running under MVS/ESA Version 4.3 or MVS/ESA Version 5.1. This PTF is included in the BTLS for DFSMS/MVS Release 1.2 base product (5655-056, BTLS FMID JDZ11BS).
- Functions introduced with the release of BTLS for DFSMS/MVS 1.2 are supported on previous offerings of BTLS when the PTFs for APAR OW12877 (DFSMS/MVS 1.1) or APAR OW12886 (MVS/DFP 3.3) are applied. These PTFs also provide support for MVS/ESA Version 5.2.
- Internal and external volsers must match. BTLS does not check that there is an internal label on the volume, so NL and BLP tapes are supported. The

IBM 3494 tape library requires every volume to have an external volser that is unique to that library. However, because all volume records are stored in the BTLS catalog, each volser within the system must be unique.

- There is no interface to allow the automatic update of BTLS records during the housekeeping functions of DFSMSrmm. Therefore you must update the BTLS catalog accordingly, using the AMS LIBRARY command.

4.4 OS/390 As a Guest of VM/ESA

It is possible for the environments described in 4.2, “MVS/ESA and Basic Tape Library Support” on page 91 and 4.1, “OS/390 and System-Managed Tape” on page 87 to operate when OS/390 is running as a guest of VM/ESA Release 2 or higher. The considerations are the same as when OS/390 runs natively without VM/ESA.

In this environment no additional software products are required.

Note: When OS/390 is installed as a VM/ESA guest on a virtual machine, specify the following statement in the virtual machine directory entry to allow OS/390 to control a tape library:

```
STDEVOPT LIBRARY CTL
```

4.5 VM/ESA Native Support Using DFSMS/VM

In this section we briefly describe the support for the IBM 3494 in a VM/ESA native environment.

DFSMS/VM Function Level 221 (FL221) is the only means for a VM/ESA system to communicate with an IBM 3494 tape library. DFSMS/VM FL221 is part of VM/ESA 2.2.

The removable media services (RMS) function of DFSMS/VM FL221 provides the IBM 3494 tape library support in VM/ESA environments at Version 1 Release 2 and all higher levels. The RMS support code runs in a service virtual machine called the *removable media services master* (the default name is RMSMASTR). Based on requests from a user′s virtual machine (the mount requester is typically your tape management system), RMSMASTR provides the following services:

- Mounts a specific volume or a volume from a scratch category to a library tape device
- Demounts a volume currently mounted on a specific device
- Queries information about the IBM 3494 Tape Library resources, including volumes, devices, categories, and overall inventory
- Associates a specific scratch pool with a library tape device and resets that association
- Assigns a category to a specific volume

In practice, when a user wants to use a volume inside the tape library, the sequence of steps shown in Figure 37 on page 96 is required.

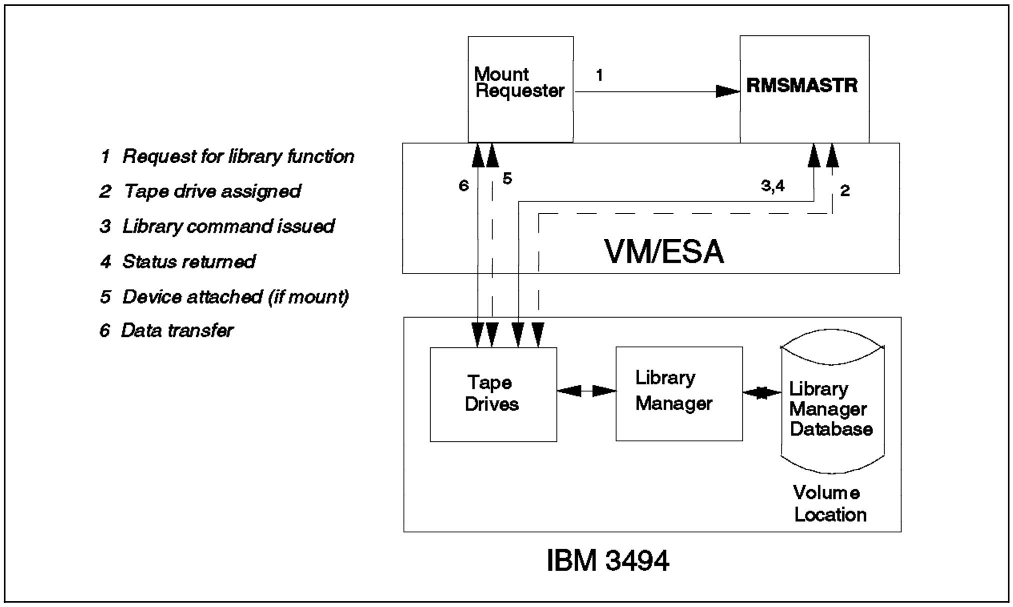


Figure 37. VM/ESA Using DFSMS/VM

The process is:

1. A user sends a request (such as mount a volume) for a library function to RMSMASTR.

2. RMSMASTR uses the 3490 device specified on the request or attempts to find an available device if one was not specified. If a specific device is requested and that device is not available, the request fails. If a specific device is not requested but no available device can be found, the request fails.

   In a VM/ESA environment, communication between RMSMASTR and the library manager uses the channel path of the tape drives inside the tape library. With VM/ESA Version 2.2 request processing does not require a free real address of a tape drive (for example, Query LIBrary command). Diagnose 254 (access real subsystem), also called *free drive support*, allows the RMS virtual machine to issue non-drive-dependent I/Os to a 3494 tape library.

3. If the specified device is available (or if one is free for a non-device-specific request), the device is attached to RMSMASTR, and the library control command is issued to the library manager through the device path.

4. Status is returned to RMSMASTR when the command completes.

5. If a free device was used and no mount request was issued, the device is detached. If it was a mount request, the device is detached from RMSMASTR with the LEAVE option to avoid rewind and unload and is attached to the requester.

6. The requester of the tape library device does its own data transfer. RMSMASTR is not involved.

Access to the IBM 3494 tape library is provided by an interface that includes both RMS commands (DFSMSRM) for interactive control and callable services library (CSL) routines for program control. You can call RMS CSL routines (FSMRMxxx) from a program that is written in any of these programming languages:

- REXX
- C

- Assembler
- COBOL (IBM COBOL II and OS/VS COBOL Program Products)
- PL/I
- VS FORTRAN
- VS Pascal

RMS functions do not include tape management system services such as maintaining a removable-media inventory, performing tape-label verification, performing authorization access checks at the volume level, or managing and selecting tape drives. RMS functions are designed to interface with a tape management system. For systems without a tape management system, tape management system-like functions can be added by means of tailoring installation wide exits.

4.5.1 Library Manager Interface

The interface to the IBM 3494 tape library is through RMSMASTR, which provides removable media services to requesting virtual machines.

The requesting virtual machine communicates with RMSMASTR by use of RMS commands and/or the CSL programming interface.

With RMS it is possible to:

- Assign volumes (either one volume or a list of volumes) to categories—DFSMSRM SET VOLCAT
- Assign a particular category of volumes to a tape drive—DFSMSRM SET DEVCAT. You would usually use the SET DEVCAT command to assign a category of scratch volumes to a tape drive equipped with an ICL or ACF. The idea is that scratch performance is increased by getting the scratch tapes preloaded into the ICL or ACF. In an IBM 3494, which has neither ICL nor ACF, the command still works—the tape drive simply becomes reserved for use by only that category. (By default, at the end of this command the tape drive is not attached to any user; however, a command option can attach the tape drive to the command issuer or another user ID.)
- Query the library′s inventory—DFSMSRM Query LIBrary (potentially this could be all volumes in a library)
- Assign a volume to a category
- Perform security checking by means of a supplied exit

For more information about RMS see the *DFSMS/VM FL221 Removable Media Services User′s Guide and Reference*.

4.5.2 Control Data Sets

RMS maintains data about the tape drive configuration in its internal storage and re-creates it, if needed, by rereading the RMCONFIG DATA file.

DFSMS/VM can use RMS bulk processing files to define the category in which to place volumes when they are entered into the IBM 3494 tape library. There is one bulk processing file for every IBM 3494 tape library known to the RMS machine. The files can be used for either automatic-insert or on-request bulk processing. An automatic-insert file name is of the form RMBxxxxx DATA, where xxxxx is a number unique to the IBM 3494 tape library installed. The name is placed in the Shared File System VMSYS:DFSMS.CONTROL directory for access by RMSMASTR. An on-request bulk processing file can have any name and can be in any directory accessible to RMSMASTR and the requesting user.

RMS does not keep a record of the volumes in the IBM 3494 tape library. RMS is provided as an interface to an IBM 3494 tape library and not for the management of volumes within a library. The library manager stores the information for the volumes in the IBM 3494 tape library. A tape management system provides management of volumes for VM/ESA users, keeping an inventory of volumes and their location (for example, the library name or offsite location in which a volume is stored).

4.5.3 Prerequisites and Considerations

Here are some points to consider when you use the IBM 3494 tape library in a VM/ESA environment:

- DFSMS/VM must be at Function Level 221. VM/ESA must be at Version 1 Release 2 or higher. DFSMS/VM FL221 is part of VM/ESA 2.2.
- RMS does not check that the internal label of a volume matches the external label.
- An installation wide exit, FSMRMSHR, provides the facility to check that a request is for a volume or category that the requester is allowed to use. Use this exit when you are sharing the library with more than one system.
- Automatic insert processing does not immediately occur when a volume is put into the input station because RMSMASTR cannot receive unsolicited interruptions of cartridge insertion without a tape drive attached. RMSMASTR periodically queries the insert category to find out whether there are volumes in it.
  Automatic insert processing occurs when the insert category is not empty and:
  - RMSMASTR is initially started.
  - RMSMASTR is restarted.
  - RMSMASTR receives a valid MOUNT command.
  - RMSMASTR receives a valid SET DEVCAT command.

  In the last two cases, automatic insert processing is totally independent of the actual command issued, but the command must be valid.
  Automatic insert processing itself uses a different tape device address, which RMSMASTR selects. If an unused tape device address is not available when insert processing starts, the process will not continue. Because insert processing will most likely start before the MOUNT (or SET DEVCAT) finishes with its tape device, another device must be available for this insert processing. If a device is not free, you can move volumes from the insert category to the category of choice by using the SET VOLCAT BULK command.

  Note: You can disable automatic insert processing simply by not having an automatic-insert file of the name RMBxxxxx DATA. You may want to disable automatic insert processing on a particular VM/ESA system when you share your IBM 3494 Tape Library with multiple VM/ESA systems.
- It is not possible to create an SMSplex between a VM/ESA system and an OS/390 system.

- RMS does not provide tape management functions. (A number of software vendor products provide VM tape management functions.) It is possible, however, to use the Programmable Operator (PROP) facility of VM to intercept commands to the operator interface originating from a tape management system. PROP can then redirect the commands to RMS for processing.
- Additional information can be found in *Lights Out! Advanced Tape Automation Using VM/ESA*.
- The following software releases provide IBM 3590 software support:
  - VM/ESA Version 2
  - EREP 3.5.0 + PTF
  - DITTO/ESA Release 1

4.6 VSE/ESA As a VM/ESA Guest Using the VSE Guest Server

In this section we describe VSE/ESA support of the IBM 3494 tape library when VSE/ESA is running as a guest of VM/ESA. Information about native VSE/ESA support can be found in 4.7, "VSE/ESA Native Support Using Library Control Device Driver for VSE/ESA" on page 104.

When a VSE/ESA guest machine uses a tape drive in the tape library, the tape drive must be attached to that machine and the tape volume must be mounted on the drive. Because VSE/ESA as a virtual machine cannot communicate with the library manager to request a tape mount, RMSMASTR must attach the tape drive and mount the volume. VSE/ESA cannot use RMSMASTR directly, however, because RMS functions run only in CMS mode. Therefore the VSE/ESA guest typically uses the CMS service machine called the VSE Guest Server (VGS) to communicate with RMSMASTR. Some vendor tape management support scenarios do not use the VGS but communicate directly with RMSMASTER through CSL calls.

VSE/ESA communicates with the VGS through an application programming interface (API) provided by the LBSERV macro of VSE/ESA. The library control API uses VSE′s cross-partition communication capability (XPCC) to invoke APPC/VM to communicate with the VGS.

RMSMASTR handles all requests to the library manager. VSE/ESA uses tape drives inside the library in the same way it uses drives outside the library. This operation is the same as in VM/ESA native support. To enable VSE/ESA guest support on VM/ESA, PTFs to both VSE/ESA and VM/ESA provide an API in VSE/ESA and the VGS.

Note that the VGS is only a way of communicating between RMSMASTR and the VSE/ESA guest machine. There is no direct interface from the VGS to the IBM 3494 tape library and the tape drive inside the library.

Figure 38 on page 101 shows the VSE/ESA guest support of the IBM 3494 tape library. Although only a single VSE/ESA guest machine is shown in the figure, you can have multiple VSE/ESA guests sharing one VGS machine.

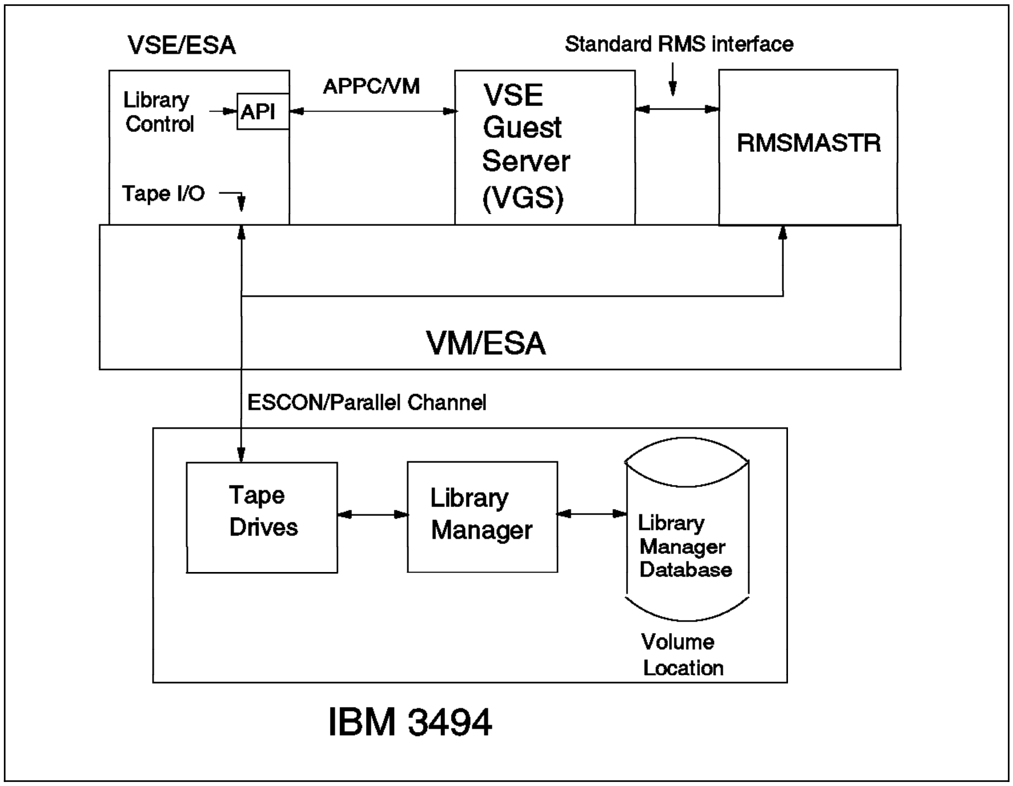


Figure 38. VSE/ESA As a VM/ESA Guest Using the VSE Guest Server

The VGS supports a full set of library functions, including inventory functions, which entail reading and updating inventory lists that reside on VSE/ESA as librarian members. Because the interactions required for processing the inventory functions are elaborate and may be long-running, a secondary VGS for inventory support is required to exploit these functions on the CMS side. In addition, a librarian server runs in a VSE/ESA partition. Figure 39 on page 102 shows the flow of an inventory request, as follows:

1. The inventory request is sent by means of the LBSERV macro API from the VSE/ESA guest to the VGS.
2. The VGS presents the inventory request to the inventory support server machine.
3. The inventory support server requests the librarian server on VSE/ESA to read a librarian-managed file in the VSE/ESA librarian files and gets the result.
4. The inventory support server sends the request to RMSMASTR.
5. RMSMASTR sends the request to the library manager and gets the result.
6. RMSMASTR returns the result (inventory list for query, result for changing volume category) to the inventory support server.
7. The inventory support server sends the result to the librarian server on VSE/ESA, and the librarian server writes a new copy of the librarian file.
8. The inventory support server notifies the VGS that processing is complete.
9. The VGS replies to the LBSERV macro request.

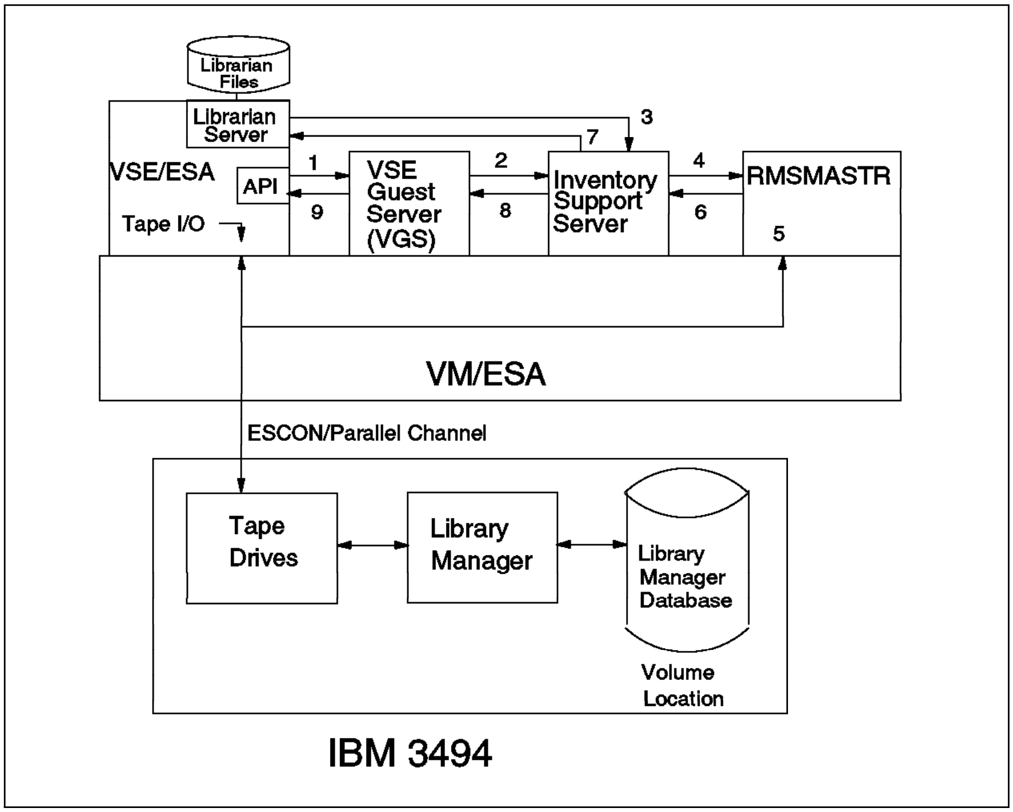


Figure 39. VSE Guest Support: Flow of an Inventory Request

4.6.1 Library Manager Interface

The VSE/ESA LBSERV macro is used to access volumes in an IBM 3494 tape library. LBSERV can request a mount, query a specific volume's location, release a drive, cancel a previous request, and eject a volume from the IBM 3494 tape library. The LBSERV macro is used under program control, and LIBSERV attention routines (ARs) and JCL statements are available external interfaces.

Other functions, such as insert and category management, can be performed through existing DFSMS/VM RMS library control interfaces.

The LBSERV macro accepts requests from VSE application programs as well as LIBSERV ARs and JCL statements and sends them to the VGS, which in turn passes them on to the IBM 3494 tape library through DFSMS/VM RMS.

The VGS supports the following types of requests for library control:

- Query a volume, checking a single library
- Query a volume, checking all attached libraries
- Query a category count
- Query status of the IBM 3494 tape library
- Query status of a drive
- Mount a volume
- Mount from category
- Release a drive
- Cancel a mount
- Eject a volume

- Set a volume category
- Query the inventory
- Manage the inventory

Note: The VGS uses the inventory support server as a secondary VGS when processing the above query and manage inventory requests.

An interface for explicit demount is intentionally not provided. The IBM 3494 tape library automatically queues demount operations at rewind-unload time.

The VGS is given privilege class B in order to perform these functions and to attach and detach tape drives to and from VSE/ESA.

4.6.2 Control Data Sets

The VGS keeps a file (on a CMS minidisk) of in-process and completed work.

The VGS keeps a file, LIBCONFG LIST, that contains the VSE/ESA library names and the corresponding DFSMS/VM library names. This file is optional where only one IBM 3494 tape library is installed.

The inventory support server (as a secondary VGS) uses a LIBRCMS SRVNAMES file in its 191 minidisk to handle library control for multiple VSE/ESA guests.

The librarian server on VSE/ESA uses the VSE/ESA librarian files for inventory processing such as query and manage.

As with the VM/ESA native environment (see 4.5, “VM/ESA Native Support Using DFSMS/VM” on page 95), the tape management system is responsible for keeping an inventory of volumes in the IBM 3494 tape library belonging to VSE/ESA.

Note: The VGS customization exit, FSMRMVGC, is highly important and just as critical to the system as the above control data sets.

4.6.3 Prerequisites and Considerations

Here are some points to consider when you use VGS:

- The API support in VSE/ESA is provided by PTFs associated with APAR DY43306 on top of VSE/ESA Version 1.3.5.
- The VGS support in VM/ESA is provided by PTFs associated with APAR VM58436 and VM58787 for DFSMS/VM FL221. DFSMS/VM FL221 is part of VM/ESA 2.2.
- Multiple VSE/ESA guests can share one VGS machine.
- A VGS machine can manage more than one IBM 3494 tape library.
- VSE/ESA guests have access to the same set of scratch pools that RMS uses.
- VSE/ESA can cause volumes to be ejected from the library by direct command and can change the category of volumes in the insert category. However, a VSE/ESA guest lacks the capability to be automatically notified that new volumes are being inserted, and there is no IBM-provided mechanism to check whether new volumes are inserted.
- IBM-supplied tape management system products are not available for VSE/ESA.

4.7 VSE/ESA Native Support Using Library Control Device Driver for VSE/ESA

In this section we describe the support for the IBM 3494 provided in a native VSE/ESA environment using the library control device driver (LCDD) for VSE/ESA.

Unlike the IBM 3494 tape library support of VSE/ESA as a VM/ESA guest machine, VSE/ESA native support requires the LAN attachment feature of the IBM 3494 to communicate with the library manager. A Token Ring or Ethernet is used for the LAN. In this environment, the VSE/ESA host uses tape drives inside the tape library in the usual way, through ESCON or parallel channels. The VSE/ESA program uses this channel path for normal tape device operations. For library control, the LCDD for VSE/ESA is required. LCDD runs an application program in a VSE/ESA partition and communicates with the library manager by using VTAM APPC (LU6.2) through a LAN. The LBSERV macro API is provided in VSE/ESA to communicate with the library manager through the LCDD. See Figure 40 on page 105.

There are five interfaces to the LCDD:

- LIBSERV ARs
- LIBSERV JCL statements
- LBSERV API
- MSG operator command
- Batch program LCABAT

The LCDD interfaces enable the mounting of cartridges, managing the inventory, and retrieving IBM 3494 information. For mount services, specific volume (PRIVATE) mounts and 32 scratch pools (SCRTCH00 to SCRTCH31) are supported. Users can set a default scratch pool by specifying an LCDD control statement.

Automatic insert processing is optional and can be specified by an LCDD control statement with a target category. Users can also dynamically change the automatic insert processing through an MSG operator command. In addition to this, disposition of inserted volumes is handled by the tape management system product through the LBSERV API, or by LCABAT batch jobs that specify a list of volumes.

Ejecting or changing the category of cartridges can be handled on an individual volume basis or by specifying the file name of a list of volumes to be processed.

Query functions return status information about IBM 3494 tape units and cartridges and the IBM 3494 library manager. Library member files of a VSE/ESA Librarian facility are created when inventory lists are requested. The library member files can be used, in turn, as volume lists for other processing requests. An inventory list for the entire IBM 3494 serves as a point in time host backup of the IBM 3494 status of tape processing. This list is potentially useful for recovery purposes because VSE/ESA has no permanent tape inventory data set, as DFSMS/MVS and BTLS systems have.

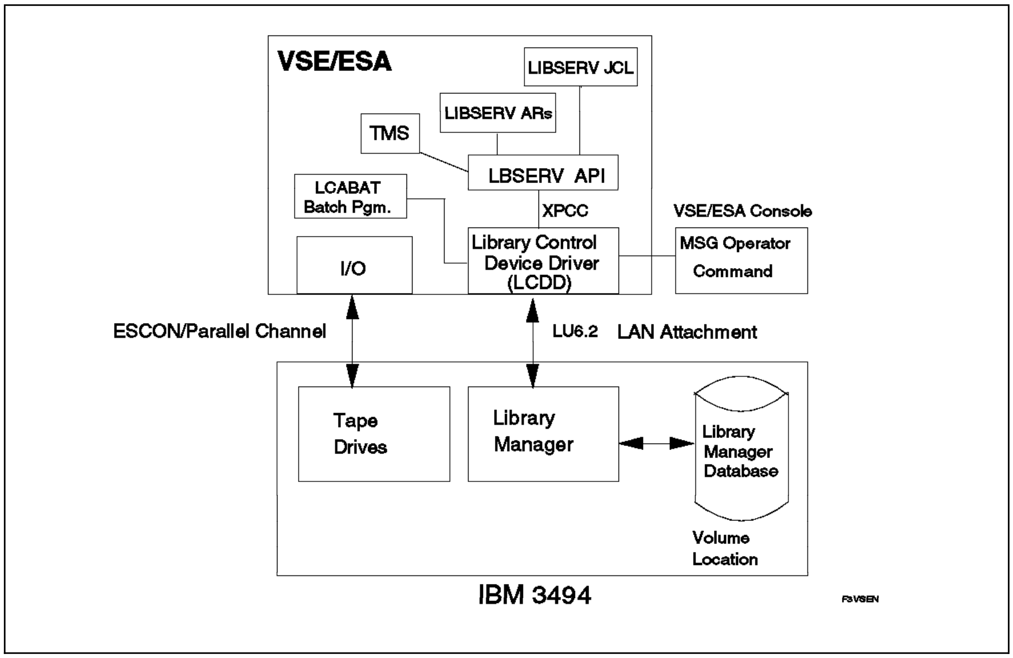


Figure 40. VSE/ESA and the Library Control Device Driver

When jobs running on VSE/ESA are to use the 3494, typically the tape management system product gets control at data set OPEN time and requests the tape mount by means of the LBSERV API.

A tape management system may help this operation, but IBM does not provide a tape management system for VSE/ESA. Ask the software vendors who offer tape management systems which systems support VSE/ESA products.

4.7.1 Library Manager Interface

Communication between the host and the library manager is through a different physical path (LAN) from the path used for the data (ESCON or parallel channel).

The LBSERV API handles interaction between the user application and the LCDD. Commands can be sent to the LCDD through the VSE/ESA operator command, MSG.

A batch interface that uses the LCABAT batch program is provided.

LIBSERV ARs provide an additional interactive interface for library control.

LIBSERV JCL statements allow library control functions in job steps.

4.7.2 Control Data Sets

The VSE/ESA librarian facility is used. Volume lists for the complete IBM 3494 inventory or specified categories can be maintained in VSE/ESA librarian files. The volume lists are created only by user request, however, and are not updated automatically by the LCDD.

The tape units and library names are held in the LCDD initialization deck.

4.7.3 Prerequisites and Considerations

Here are some points to consider when you use the LCDD for VSE/ESA:

- Native VSE/ESA supports the IBM 3494 only.
- VSE/ESA Version 1.3.5 with relevant PTFs is required (see the "Preventive Service Planning bucket" for such information).
- The LCDD for VSE/ESA is provided by the no-charge Feature 9203 on the IBM 3494. One of the LAN adapter features is required for the IBM 3494—the choice is Ethernet (FC 5220) or Token Ring (FC 5219).
- LCDD requires the following network hardware (or equivalent) and software to attach a native VSE/ESA system to a 3494:
  - ACF/VTAM
    - VSE/ESA 1.3 and ACF/VTAM 3.4
    - VSE/ESA 1.4 and ACF/VTAM 3.4
    - VSE/ESA 2.1 and ACF/VTAM 4.2
  - IBM 3174 Establishment controller
  - IBM 3745, 3720, or 3725 Communication controller
  - IBM 9221 with a token ring communications subsystem
- Volumes can be mounted in any of the scratch categories.
- All volumes in a library are potentially accessible by VSE/ESA. In a shared environment, the tape management system on the VSE system must provide protection to prevent erroneous access of another system′s volumes.
- IBM does not provide a tape management system for VSE/ESA.
- Any other vendor′s tape management system must be able to use the LBSERV API of the LCDD.
- VSE/ESA with the LCDD can be run as a guest of VM/ESA. DFSMS/VM is not required in this environment.
- The batch program interface, LCABAT, should not be used to mount a volume.
- The following software releases provide IBM 3590 software support:
  - VSE/ESA Version 2
  - EREP 3.5.0 + PTF
  - DITTO/ESA Release 1

4.8 AIX Support

In this section we describe the support of IBM 3494 tape libraries for applications running on an RS/6000 using AIX. Two environments are discussed: the library device driver environment and the ADSM for AIX application environment. The application environment provides IBM 3494 tape library management functions in addition to backup and restore and archive and retrieve functions.

In an RS/6000 environment, there are three types of supported channel attachments for the IBM 3490 tape subsystems: ESCON, parallel, and SCSI. With parallel or ESCON channels, the RS/6000 uses the same path for library control commands and data transfer (see Figure 41 on page 107).

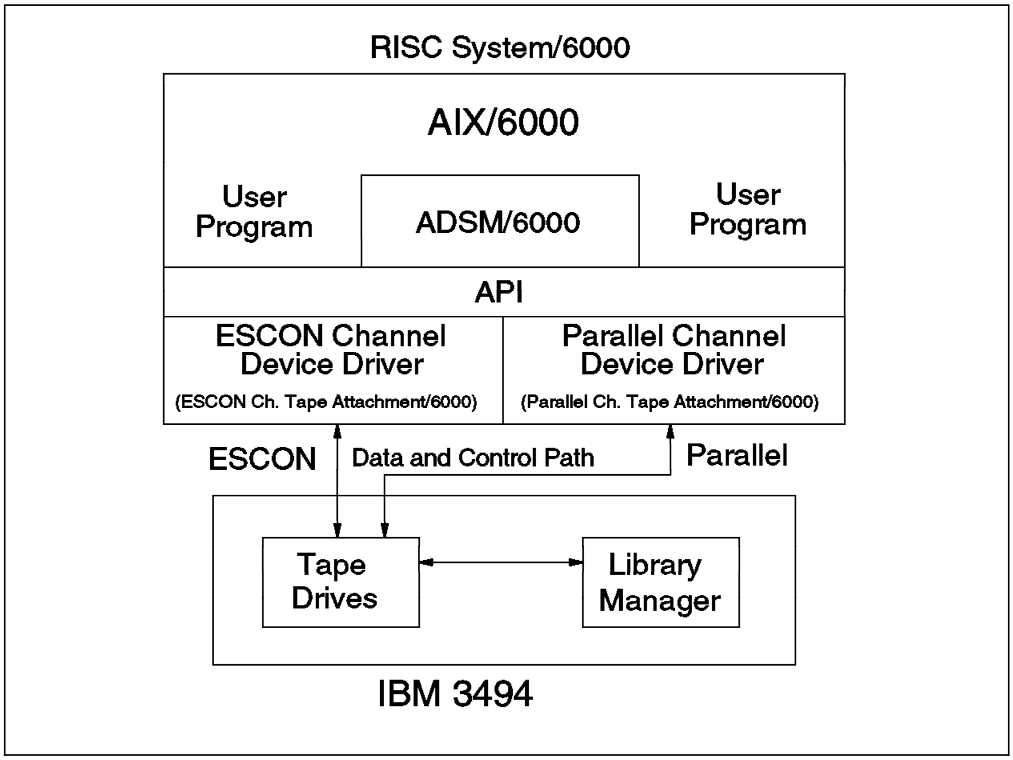


Figure 41. AIX ESCON and Parallel Channel Attachment

If the tape drive is attached through SCSI channels, the data is sent through the SCSI path, but the library control commands are sent through an RS-232 or LAN connection to the library manager (see Figure 42). The LAN physical link is Token Ring or Ethernet.

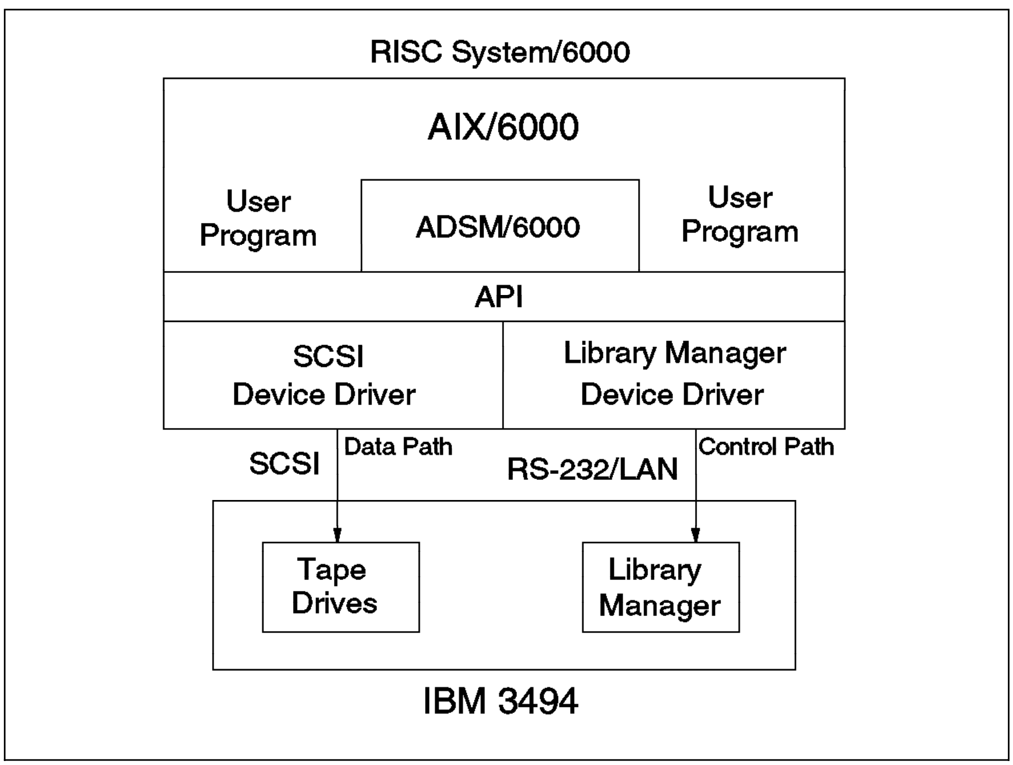


Figure 42. AIX and 3494 Tape Library: SCSI Attachment

For ESCON attachment, the ESCON Channel Tape Attachment/6000 is required on the RS/6000 to provide device drivers for both the tape device and library manager. These device drivers are available as FC 2754 (S/390 ESCON Channel Emulator) of the RS/6000.

For parallel channel support, the Parallel Channel Tape Attachment/6000 is required on AIX. This program is available as PRPQ 5799-QDA or as Feature 5224 (AIX Parallel Channel Tape Attachment/6000) of the 3494.

In the case of SCSI, FC 5212 (RS-232 RISC System/6000 Host Attachment) of the 3494 is required. This feature contains the AIX Enhanced SCSI device driver (for the data path) and the RS-232/LAN device drivers (for the library manager command path) in addition to the hardware feature on the 3494.

Although all of the above device drivers differ, the APIs are the same.

Communication with the library manager is achieved through either the AIX system calls provided or ADSM for AIX. RS/6000 can be networked together to share the IBM 3494 tape library functions through one machine. This approach could be used, for example, to provide a common backup and restore function. The machines could use basic support or ADSM for AIX.

4.8.1 Library Manager Interface

Both the library device driver support and ADSM for AIX communicate with the IBM 3494 tape library through special device files called library manager control points (LMCPs). There is one LMCP for every tape drive known to the system.

The library device driver uses *ioctl()* system calls to control the IBM 3494 tape library. The relevant calls are:

- Change the category of a specified volume—MTIOCLSVC
- Reserve a category for a specified host—MTIOCLRSC
- Release a category for a specified host—MTIOCLRC

An easy-to-use AIX command is provided with the tape library device driver to control the tape library, tape drive, and tape volumes. This command is called by MTLIB.

The full syntax of these and other library device driver commands can be found in the *SCSI Device Drivers: Installation and User′s Guide* and *IBM AIX Parallel and ESCON Channel Tape Attachment/6000*.

ADSM for AIX provides various functions to manage the IBM 3494 tape library. Of most interest here is UPDATE LIBVOLUME, which allows the change of a volume′s category (from PRIVATE to SCRATCH or SCRATCH to PRIVATE).

4.8.2 Control Data Sets

The system keeps only the drive and library information when using the IBM 3494 tape library with the library device driver.

ADSM for AIX keeps records about its volumes in its own database.

4.8.3 Prerequisites and Considerations

Here are some points to consider when you use AIX with the IBM 3494 tape libraries:

- The basic level of support is provided in AIX Version 3 Release 2.0, for AIX. There are various dependencies of software levels and hardware; each situation must be checked individually.
- In an ADSM for AIX environment, Release 2 is required.
- With the library device driver, it is possible to use as many volume categories as desired. The volume categories are assigned by specifying a library manager number, not by a generic name such as SCRATCHx. The library device driver is not written to use a particular range of volume categories.
- With ADSM for AIX you explicitly state which volume categories are assigned for it to access in the IBM 3494 tape library. Once you have done that, ADSM uses two categories: SCRATCH and PRIVATE. ADSM provides management functions to return volumes to scratch once they contain no more active data. In both, the library device driver and ADSM for AIX environments, keeping the commands secure is vital to avoid erroneously mounting a volume that belongs to another system.
- The following software releases provide IBM 3590 software support.
  - AIX 3.2.5
  - AIX 4.1.1
  - ADSM for AIX Version 2.1 or later
  - IBM Client Input Output/Sockets (CLIO/S)
  - Remote Tape Application Interface (RTAPI) service offering
  - REELlibrarian Release 4.2
  - NSL UniTree Release 2.1

4.9 Sun Solaris Support

In a Sun Solaris environment, the data is sent through the SCSI path to the attached devices, and the library control commands are sent through an RS-232 or LAN connection to the library manager. The LAN physical link is Token Ring or Ethernet. See Figure 43 on page 110 for an example of this type of implementation.

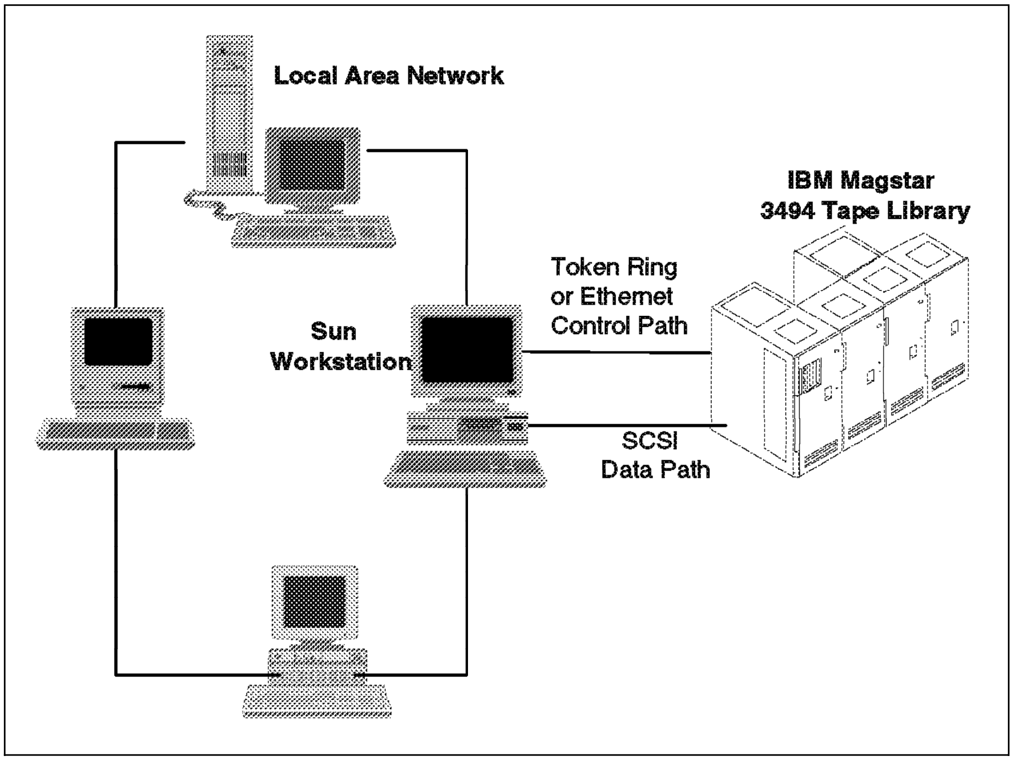


Figure 43. 3494 Connection to Sun Host

The IBM Automatic Tape Library Device Driver for Solaris provides support for attaching the IBM 3494 to a Sun workstation. It is used in conjunction with the IBM SCSI Tape and Medium Changer Device Driver for Solaris to provide support for the SCSI tape subsystems in the IBM Magstar 3494.

4.9.1 Library Manager Interface

The Sun Tape Library Driver consists of:

- A daemon, the library manager control point daemon (LMCPD), that communicates directly with the library manager of the IBM 3494 through RS-232 or a LAN
- A utility program that provides a command-line interface to the daemon
- A C object module that can be linked with user applications to provide a communication interface with the daemon.

The LMCPD is a process that is always running on the system. An application links with the supplied C object module by using the interface described in the *SCSI Device Drivers: Installation and User's Guide* and *IBM SCSI Tape Drive, Medium Changer, and Library Device Drivers Programming Guide*. The subroutines in this module communicate with the LMCPD to perform the various library operations by using standard UNIX namespace sockets. The LMCPD communicates with the library manager through either a standard 25-pin null modem D-shell RS-232 cable or TCP/IP. The */etc.ibmatl.conf* configuration file is used to define the type of attachment for each 3494. Figure 44 on page 111 shows the logical components for data flow in this environment.

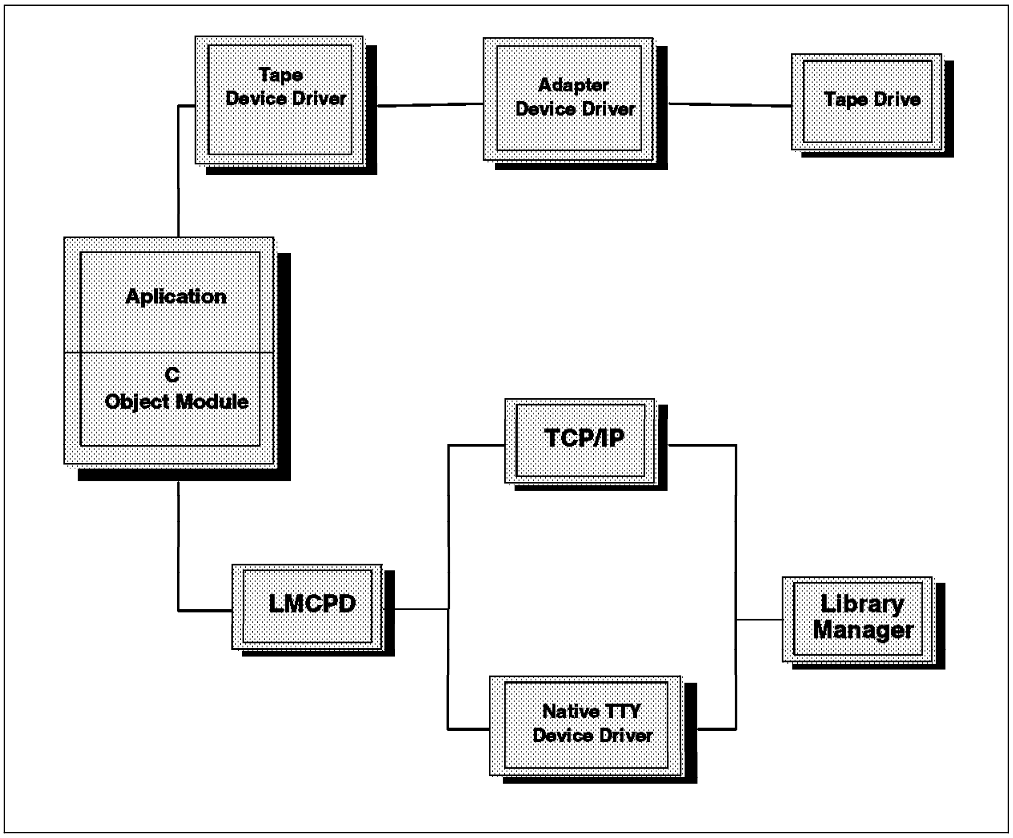


Figure 44. IBM Automatic Tape Library Device Driver Data Flow for Solaris

A typical implementation for the IBM Automatic Tape Library Device Driver for Solaris is a Sun workstation that acts as a dataserver on a network with SCSI tape devices providing a common backup or restore and tape dataserver function.

4.9.2 Prerequisites and Considerations

The following software is required and supported by the IBM SCSI Tape Medium Changer Device Driver for Solaris:

- Sun Microsystems Solaris Version 2.2 through 2.5 (SunOS Version 5.2 through 5.5)
- One of the following SCSI-2 Adapter Device Drivers (appropriate for the SCSI-2 adapter hardware being used):
  - Sun ISP SCSI Host Bus Adapter Driver (isp)
  - Sun ESP SCSI Host Bus Adapter Driver (esp)
  - Performance Technologies PT-SBS430A SCSI Host Bus (ptscII)
  - Performance Technologies PT-SBS440A SCSI Host Bus (ptisp)

The following software is required for the library driver:

- Sun Microsystems Solaris Version 2.2 through 2.5
- IBM SCSI Tape and Medium Changer Device Driver for Solaris

The following hardware is required and supported by the IBM SCSI Tape and Medium Changer Device Driver for Solaris:

- One of the following SCSI-2 Differential-Ended Adapters:
  - Sun Microsystems Differential SCSI-2 Host Adapter
  - Performance Technologies PT-SBS430A SBus SCSI-2 Fast Host Adapter

– Performance Technologies PT-SBS440A SBus SCSI-2 Fast/Wide Host Adapter

The IBM SCSI Tape and Medium Changer Device Driver for Solaris provides support for the following IBM tape devices when installed in the IBM 3494, and it works in conjunction with the IBM Automatic Tape Library Device Driver for Solaris:

- IBM 3490E Magnetic Tape Subsystem Model C1A, C2A or FC3000
- IBM Magstar 3590 Tape Subsystem Model B1A

4.10 HP-UX Support

In an HP-UX environment, connections are through a SCSI adapter to the attached devices for data transfer and through either an Ethernet or Token Ring LAN connection to the library manager for the library control commands. See Figure 45 for an example of this type of implementation.

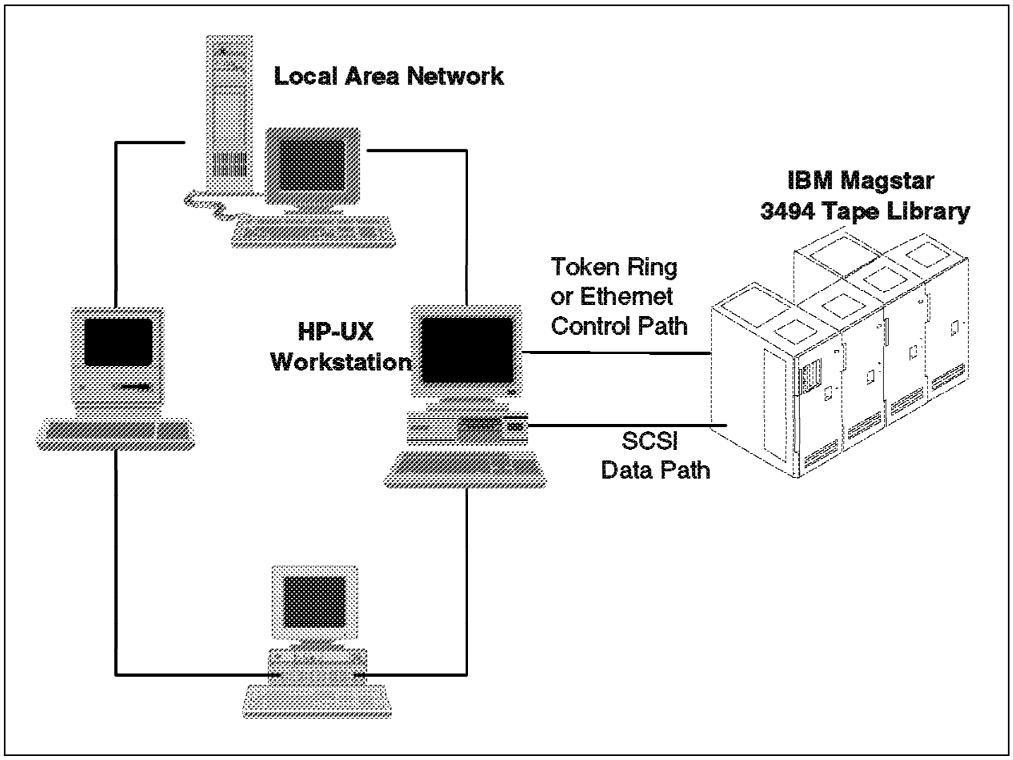


Figure 45. 3494 Connection to HP Host

The HP-UX Tape Library Driver provides support for attaching the IBM 3494 to an HP-UX workstation. It is used in conjunction with the IBM SCSI Tape and Medium Changer Device Driver for HP-UX to provide support for the SCSI tape subsystems in the IBM Magstar 3494 Tape Library.

4.10.1 Library Manager Interface

The HP-UX Tape Library Driver consists of:

- A daemon, the library manager control point daemon (LMCPD), that communicates directly with the library manager of the IBM Magstar 3494 Tape Library.
- A utility program that provides a command-line interface to the daemon

- A C object module that can be linked with user applications to provide a communication interface with the daemon.

The LMCPD is a process that is always running on the system. An application links with the supplied C object module by using the interface described in *SCSI Device Drivers: Installation and User's Guide* and *IBM SCSI Tape Drive, Medium Changer, and Library Device Drivers Programming Guide*. The subroutines in this module communicate with the LMCPD to perform the various library operations by using standard UNIX namespace sockets. The LMCPD communicates with library manager through TCP/IP and each 3494 is defined to the HP-UX system in the */etc/ibmatl.conf* configuration file. Figure 46 shows the logical components for data flow in this environment.

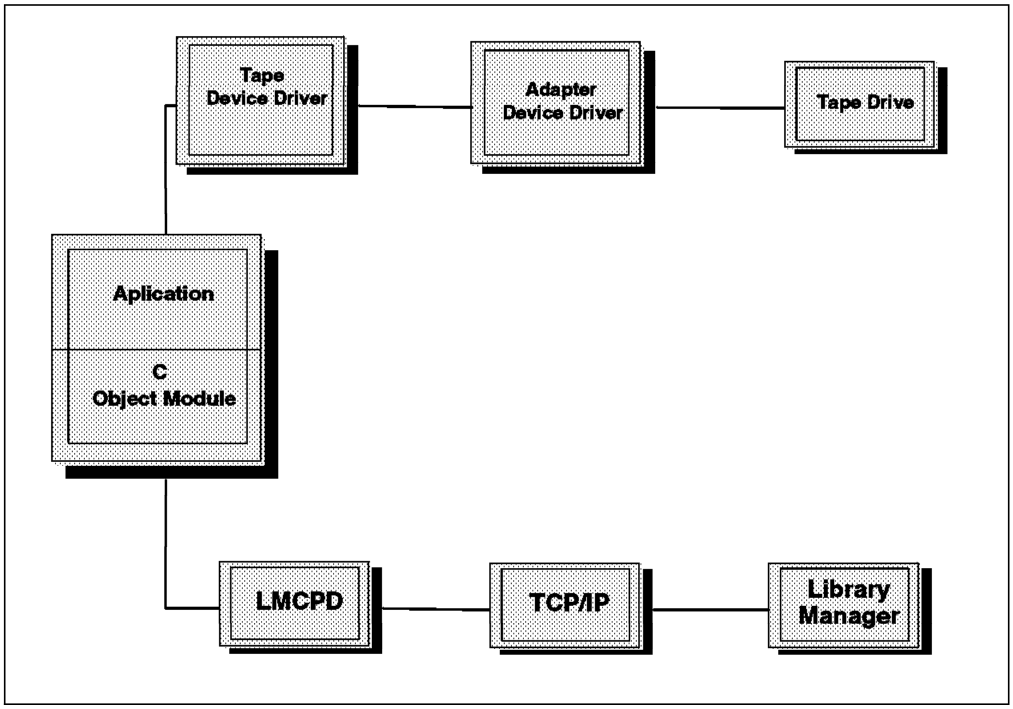


Figure 46. Automatic Tape Library Device Driver Data Flow for HP-UX

A typical environment for the HP-UX Automated Tape Library Driver is an HP-UX workstation that acts as a dataserver on a network with SCSI tape devices providing a common backup or restore and tape dataserver function.

4.10.2 Prerequisites and Considerations

The following software is required and supported by the HP-UX Tape and Medium Changer Device Driver and the IBM SCSI Tape Library Device Driver for HP-UX:

- HP-UX Version 10.01 through 10.30
- The HP-PB FWD SCSI-2 Host adapter (HP #28696A) with firmware revision level 3543 or higher
- Several HP-UX patches may be required (check with HP for the appropriate patches)

The following hardware is required and supported by the IBM SCSI Tape Library Device Driver for HP-UX:

- IBM Magstar 3494 Tape Library Model L12 with SCSI-attached IBM 3590 Model B1A drives
- One of the following options depending on which LAN connection is used for the IBM 3494 library manager:
  – Token Ring Attach:
    - 3494 Feature Code 5219 (Token Ring)
    - Token Ring adapter card for HP workstation
    - Token Ring cables (as required)
  – Ethernet Attach:
    - 3494 Feature Code 5220 (Ethernet)
    - Ethernet port or adapter for HP workstation
    - Ethernet cables (as required)

4.11 OS/400 Support

The term for an IBM 3494 tape library in this environment is a *media library device*, thus the basic driver is called the media library device driver (MLDD). In this section we describe the support for the IBM 3494 from an AS/400 running OS/400 using the MLDD. This is the basic support to control an IBM 3494 from AS/400. We also describe the additional support offered with Backup Recovery and Media Services/400 (BRMS/400).

MLDD provides the basis of support for the IBM 3494, but it is expected that most AS/400 users with an IBM 3494 will use a product such as BRMS/400 (see Figure 47 on page 115). This product uses the MLDD commands to interact with the IBM 3494 and provides tape management functions in addition to backup and recovery functions. We strongly recommend the use of a product such as BRMS/400.

The AS/400 attaches to an IBM 3494 with one connection for the library manager and one or more connections for the tape drives. The library manager connection, for routing library control commands, uses a communications line. This connection can be either RS-232 or a LAN; the LAN physical link is either Token Ring or Ethernet, but the protocol on the LAN can be APPC only. The tape drive connection could be a parallel channel or SCSI attachment.

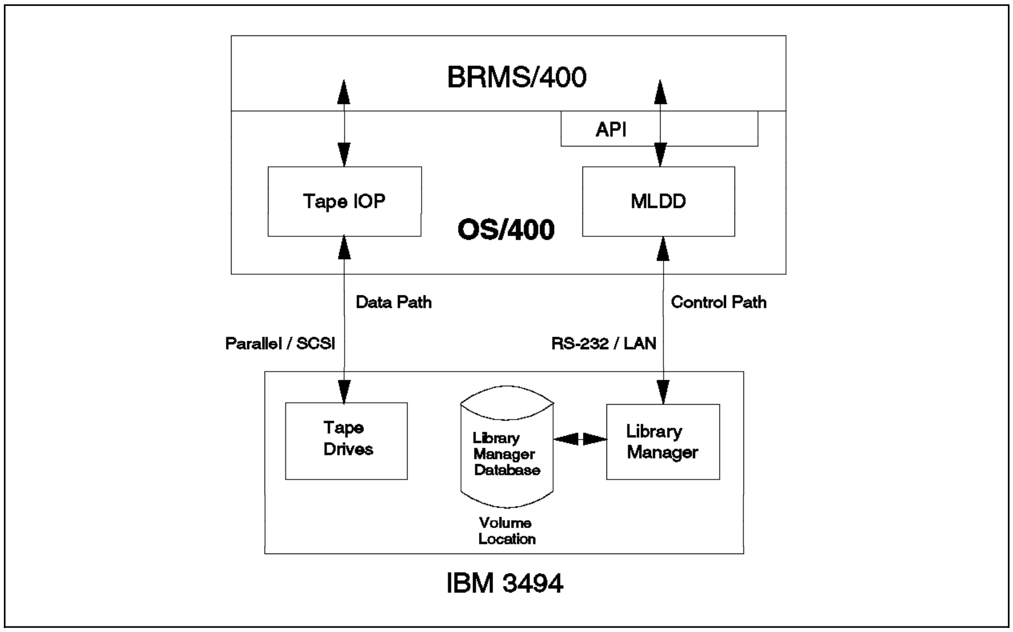


Figure 47. OS/400 Using MLDD and BRMS/400

4.11.1 Library Manager Interface

The physical interface to the library manager is an RS-232 or LAN link, which is used to send commands to the library manager. Some commands are passed down the data connection to the tape drive, but library manager commands are not passed that way: Each AS/400 using the library must be attached to the library manager through a separate RS-232 or LAN interface in order to send library manager commands.

The OS/400 device driver for the library manager is MLDD. MLDD commands are available for interactive use, or in command language (CL) for application or interactive use.

BRMS/400 uses the MLDD commands to interface with the 3494. BRMS/400 uses the WRKMLDBRM command to allow the user to work with functions related to the IBM 3494 and issue MLDD commands without needing to be familiar with the MLDD command set.

4.11.2 Control Data Sets

MLDD stores the information about the IBM 3494 units in a library on the AS/400 called QUSRMLD. It does not store information about the volumes held in the library, but it can request a list of volumes from the library manager. BRMS/400 also retains a list of volumes, both those within the IBM 3494 and those in an offsite storage location.

If more than one AS/400 is sharing an IBM 3494, these systems can be defined in BRMS/400 as being in a *network group*. The network group enables a common scratch pool to be used by all AS/400s in the group. Therefore, for instance, a request for a scratch volume on system A is fulfilled by BRMS/400 by issuing the MLDD command to mount a volume. As BRMS/400 knows which volumes are in scratch status, it decides which volume is to be mounted to fulfill the request. For example, system TUC400A could use a special category of volumes called *SHARE400 (which is defined on installation of MLDD). A second system (for example, TUC400B) could also access this same category. Each system is notified of any changes to the IBM 3494′s contents by another system in the network group. With BRMS/400, the systems share a common media inventory.

4.11.3 Prerequisites and Considerations

Here are some points to consider when you use the IBM 3494 in an OS/400 environment:

- Up to 16 AS/400s can share an IBM 3494. The maximum number of data path connections to the IBM 3494 is 16 (2 for each of the eight control unit functions). The maximum number of library manager connections is:
  - 8 if all are RS-232 connections
  - 256 if all are LAN connections
  - Four RS-232 and 256 LAN connections if mixed. The maximum number of RS-232 connections is reduced from eight to four when the library manager has a LAN card installed.

  So the limiting number is the 16 data path connections. Using an IBM 3490E tape configuration you would get 16 tape drives, one for each of the attached AS/400s. Using an IBM 3590 tape configuration, you would get only 8 tape drives, which would have to be manually switched in order for the 16 attached AS/400s to share them.

- You can usually daisy-chain multiple processors from a SCSI channel on the IBM 3590-B1A tape drive. AS/400 systems are the exception: An AS/400 cannot be on a SCSI bus with any other processor.
- A single AS/400 system can be connected to multiple tape drive controllers. However, a single AS/400 system cannot be connected twice to the same tape drive controller, as this creates a serial number conflict and results in nonfunctional drives. Such a scenario would be evident during an IPL.
- You must not use the Electronic Communications Adapter on the AS/400 system as a connection to the library manager in the IBM 3494. It is reserved for obtaining electronic customer support.
- The number of IBM 3494s that can attach to one AS/400 is determined by the hardware attachment capability of the AS/400 (for example, tape and communications I/O processors).
- OS/400 Version 2 Release 3.1 or later is required to support the IBM 3494. MLDD is shipped with the IBM 3494.
- BRMS/400 is available as a separate product. IBM recommends that you use this or an equivalent product to manage the volumes in an IBM 3494.
- BRMS/400 Version 2 Release 3 or later supports the IBM 3494. It must be installed on all systems in a group of multiple AS/400s to synchronize the common media inventory.
- The following software releases provide IBM 3590 software support:
  - OS/400 Version 3 Release 1, with PTF and subsequent releases
  - BRMS/400 Version 3.1 with PTF
  - ADSM for OS/400 Version 1.2 with PTF
  - Report/Data Archive and Retrieval System (R/DARS) Version 1.3 for OS/400.

4.12 Transaction Processing Facility

In this section we describe the support for an IBM 3494 tape library in a native transaction processing facility (TPF) environment.

The TPF control program as well as a number of new and modified TPF E-type programs support the IBM 3494.

The support is limited to a command-based interface. There is currently no IBM tape management system for TPF.

4.12.1 Library Manager Interface

The TPF operator′s only interface to the IBM 3494 tape library is a new TPF functional message, ZTPLF. The various ZTPLF functions provided allow the operator to manipulate the tapes in the library as operational procedures require.

The relevant ZTPLF functions are:

Reserve Request or reserve a tape category from the list of general-purpose categories. Any category number that has no volumes or other hosts associated with it is returned to the operator.

Release Release a previously reserved tape category.

Move Reassign the tape category of a tape volume.

Query Query tape volume, device, or category status.

Load Have the IBM 3494 tape library load (mount) a volume onto a specified device.

Unload Have the IBM 3494 tape library unload a volume from a specified device or unload all volumes from the device and from ICL or ACF and remove the Fill category. Removing the Fill category removes the association of a category with a device.

Fill Keep the tape device (and ICL or ACF if installed) filled with tape volumes of a specific category.

Note: The TPF system handles all subsequent LOAD requests without additional operator intervention. Therefore, although continual library requests are being issued, there is only one ZTPLF command.

4.12.2 Control Data Sets

The TPF host does not keep a record of the volumes in the IBM 3494 tape library or manage the tape volumes within it. You can use the Query command to obtain information about the tape volumes held in the IBM tape library.

4.12.3 Prerequisites and Considerations

Here are some points to consider when you use the IBM 3494 tape library in a TPF environment:

- Reserving a tape category does not prevent another host from using that category. It is the user′s responsibility to monitor the use of reserved categories.
- There is currently no IBM tape management system for TPF.
- Automatic insert processing is not provided within TPF.

- To attach the IBM 3494:
  - TPF3.1 must be upgraded using PTF20. The software requires the TPF C feature, so this must be present in the system.
  - TPF4.1 requires PUT01. TPF4.1 contains the C support as standard.

Chapter 5. Implementing Software

In this chapter we summarize the basic software implementation steps required to support tape libraries on multiple platforms. You can implement the software before you install the IBM 3494 tape library or after you have installed the IBM 3494 tape library hardware and populated the storage cells with some cartridges.

5.1 OS/390 and System-Managed Tape

System-managed tape requires the minimum software levels as outlined in 4.1.3, "Prerequisites and Considerations" on page 90. Refer to the Preventive Service Planning (PSP) bucket available on ServiceLink.

For more details and checklists, refer to
DFSMS/MVS OAM PISA for Tape Libraries and the
DFSMS/MVS DFSMSrmm Implementation and Customization Guide.

System-Managed Tape requires that the hardware be defined through HCD.

After you have defined the devices through the HCD dialog, you must prepare the SMS environment. Figure 48 shows all components involved in system-managed tape and summarizes the implementation steps required to allocate the necessary control data sets and activate the address spaces that communicate with your IBM 3494 tape library through the library manager.

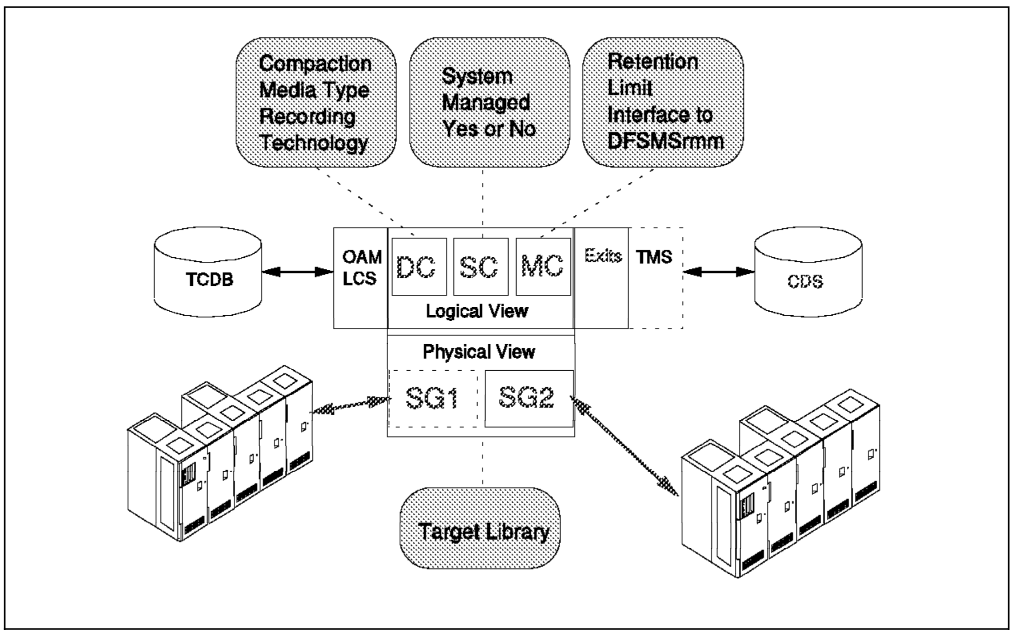


Figure 48. System-Managed Tape Components

Refer to *DFSMS/MVS Implementing System Managed Storage* for more information about implementing and activating SMS. We cover only those steps necessary to implement system-managed tape.

The steps are:

1. Set up the HCD.
2. Update SYS1.PARMLIB.

3. Allocate the catalogs for the TCDB.
4. Prepare and start OAM.
5. Define security profiles.
6. Define the library.
7. Define the DFSMS constructs.
8. Write or adapt ACS routines.
9. Validate and activate the SMS configuration.
10. Inventory the IBM 3494 tape library.

Additional optional tasks might include:

- Prepare for partitioning (if applicable).
- Make changes to the tape management system and install the OAM exits (if applicable).
- Initialize JES3 (if applicable).

Note that HCD setup and OAM activation may require an IPL, and you might want to schedule this in advance.

5.1.1 Set Up the HCD

HCD is used to define the tape drives that belong to an IBM 3494 tape library to the I/O definition file. The LIBRARY-ID and LIBPORT-ID are defined optionally to the I/O definition file.

Below we describe how to define a Magstar 3590-A50 control unit with four tape drives attached to it. Notes on how to define a 3490E are added in Table 18 on page 124 and Table 19 on page 129. The HCD panels shown starting at Figure 49 are for OS/390 Release 5 HCD. If you have a different level of OS/390 installed, the panels may differ slightly.

```
CBDPM000              OS/390 Release 5 HCD
Command ===> ______________________________________________________

                           Hardware Configuration

Select one of the following.

_1  1.  Define, modify, or view configuration data
    2.  Activate or process configuration data
    3.  Print or compare configuration data
    4.  Create or view graphical configuration report
    5.  Migrate configuration data
    6.  Maintain I/O definition files
    7.  Query supported hardware and installed UIMs
    8.  Getting started with this dialog
    9.  What's new in this release

For options 1 to 5, specify the name of the IODF to be used.

I/O definition file . . . 'SYS1.IODF02.ATLGUIDE.WORK'           +


 F1=Help      F2=Split     F3=Exit      F4=Prompt    F9=Swap     F12=Cancel
F22=Command
```

Figure 49. Hardware Configuration Definition: Primary Panel

From the HCD primary panel (see Figure 49) enter the name of the IODF file that you want to update and select Option 1.

If this is not an IODF work file, you are prompted to create one. The name of the IODF file is in the format shown in Figure 50,

```
'hlq.IODFcc.yyyyyyyy'
```

Figure 50. IODF Data Set Name Format

where

- hlq is a high-level qualifier of up to eight characters.
- cc is any two hexadecimal characters.
- yyyyyyy is up to eight optional characters.

To define the control unit, select Option 4 from the Define, Modify, or View Configuration Data panel shown in Figure 51.

```
------------ Define, Modify, or View Configuration Data -------------
CBDPHW10
    Select type of objects to define, modify, or view data.

     _4 1. Operating system configurations
             consoles
             system-defined generics
             EDTs
               esoterics
               user-modified generics
        2. Switches
             ports
             switch configurations
               port matrix
        3. Processors
             partitions
             channel paths
        4. Control units
        5. I/O devices

 F1=Help    F2=Split   F3=Exit    F9=Swap   F12=Cancel
```

Figure 51. HCD Panel: Define, Modify, or View Configuration Data

On the Control Unit List panel (Figure 52 on page 122), press PF11 (Add).

```
  Goto  Filter  Backup  Query  Help
------------------------------------------------------------------------------
CBDPCUF0                     Control Unit List
Command ===> __________________________________________ Scroll ===> PAGE

Select one or more control units, then press Enter. To add, use F11.

/ CU   Type +        Serial No. Description
_ 0098 9033          55-9999    First switch
_ 0099 9032          55-8888    Second switch
_ 00C1 3490          __________ First tape control unit
_ 00C2 3490          __________ Backup tape control unit
_ 00D1 3990-6        __________ DASD control unit
_ 00D2 3990-6        __________ ________________________________
_ 00E1 3274          __________ Terminal control unit
_ 00E2 3174          __________ Terminal control unit
_ 00E3 3174          __________ ________________________________
****************************** Bottom of data *****************************



 F1=Help      F2=Split     F3=Exit      F4=Prompt    F5=Reset     F7=Backward
 F8=Forward   F9=Swap     F10=Actions  F11=Add      F12=Cancel   F13=Instruct
F22=Command
```

Figure 52. HCD: Control Unit List

When the Add Control Unit panel is displayed (Figure 53), enter the responses that match your environment. You may want to update this panel with the machine's serial number and a description. If you are uncertain of any of the required responses, help is available by pressing PF1. Fields that have a plus sign beside them will return prompts when you press PF4. We do not have a switch in our configuration.

```
------------------------- Add Control Unit ---------------------
CBDPCU10

Specify or revise the following values.

Control unit number  . . . . 0700  +

Control unit type  . . . . . 3590          +

Serial number  . . . . . . . __________
Description  . . . . . . . . ________________________________

Connected to switches  . . . __  __  __  __  __  __  __  __  +
Ports  . . . . . . . . . . . __  __  __  __  __  __  __  __  +

If connected to a switch, select whether to have CHPIDs/link
addresses, and unit address range proposed.

Auto-assign  . . . . . . . . 2   1.  Yes
                                 2.  No

 F1=Help    F2=Split   F3=Exit    F4=Prompt  F5=Reset   F9=Swap
F12=Cancel
```

Figure 53. HCD Panel: Add Control Unit

When you press Enter, the Select Processor / Control Unit panel will be displayed (Figure 54 on page 123). Select the processor to which the control unit is to be attached by placing an *s* next to its entry and pressing Enter. If the control unit is to be attached to multiple processors, place a *g* beside all of the processors that you want attached to the control unit.

```
--------------------- Select Processor / Control Unit --------------------
CBDPCUP0                                           Row 1 of 3 More:
Command ===> __________________________________________ Scroll ===> PAGE

Select processors to change CU/processor parameters, then press Enter.

Control unit number . . : 0700     Control unit type . . . : 3590

/ Proc. ID Att. Log. Addr. ------Channel Path ID . Link Address + --------
                (CUADD) +  1---- 2---- 3---- 4---- 5---- 6---- 7---- 8----
s PROC1         _          _____ _____ _____ _____ _____ _____ _____ _____
_ PROC2         _          _____ _____ _____ _____ _____ _____ _____ _____
_ P9021         _          _____ _____ _____ _____ _____ _____ _____ _____
**************************** Bottom of data ****************************




 F1=Help        F2=Split       F3=Exit        F4=Prompt      F5=Reset
 F6=Previous    F7=Backward    F8=Forward     F9=Swap       F12=Cancel
F20=Right      F22=Command
```

Figure 54. HCD Panel: Select Processor / Control Unit

The Add Control Unit panel will be displayed (see Figure 55 on page 124). For each of the processors to which the control unit is to be attached, add the channel path ID (CHIPID), the base unit address, the number of units (this must be 4 for the 3590), and the type of channel.

```
-------------------------- Add Control Unit -------------------------
CBDPCU12

Specify or revise the following values.

Control unit number  . : 0700        Type . . . . . . : 3590
Processor ID . . . . . : PROC1       This is the main processor

Channel path IDs . . . . 38   39   __   __   __   __   __   __  +
Link address . . . . . . __   __   __   __   __   __   __   __  +

Unit address . . . . . . 00   __   __   __   __   __   __   __  +
Number of units  . . . . 4__  ___  ___  ___  ___  ___  ___  ___

Logical address  . . . . _  + (same as CUADD)

Protocol . . . . . . . . __  + (D,S or S4)
I/O concurrency level  . 2  + (1, 2 or 3)


 F1=Help     F2=Split    F4=Prompt   F5=Reset    F9=Swap    F12=Cancel
```

Figure 55. HCD – Add Control Unit

This completes the definition of the control unit.

Table 18 summarizes the major HCD panel fields for IBM 3590 and IBM 3490 control unit definitions.

Table 18. IBM 3494 HCD Configuration Options for 3490 and 3590 Control Units

Model	**3590-A50**	**FC3000**	**3490E-C1A**	**3490E-C2A**
Control unit type	3590	3490C2A •	3490C1A	3490C2A
Unit address	0	0	0	0
Number of units	4	4 •	2 •	2 •

Notes:

1. The FC-3000 controller with attached 3490E-F1A devices is defined as a 3490-C2A controller in the HCD dialog.
2. APAR OW16279 allows the 3490-CxA to be defined with only 2 device addresses on a control unit instead of the previous requirement of 16.

We now need to define the devices that are attached to this controller. Exit from the control unit definition menu, by pressing PF3 and exit (saving your responses).

To get to the Add Device panel (Figure 56 on page 125), you can either go through Options 1 then 5 from the main panel (Figure 51 on page 121) or place an *s* next to the control unit you defined on the Control Unit List panel (see Figure 52 on page 122).

On the Add Device panel, you must add the device number, number of devices (this must be 4 for the 3590), device type, and connected control unit.

```
------------------------------- Add Device ---------------------------
CBDPDV10

Specify or revise the following values.

Device number  . . . . . . . . 0700  (0000 - FFFF)
Number of devices  . . . . . . 4___
Device type  . . . . . . . . . 3590_________  +

Serial number  . . . . . . . . __________
Description  . . . . . . . . . ________________________________

Connected to CUs . . 0700  ____  ____  ____  ____  ____  ____  ____  +


 F1=Help     F2=Split    F3=Exit     F4=Prompt   F5=Reset    F9=Swap
F12=Cancel
```

Figure 56. HCD Panel: Add Device

After you press Enter, the Device / Processor Definition panel is displayed (see Figure 57). Place an *s* next to the processor that will use the devices.

```
------------------- Device / Processor Definition --------------------
CBDPDV11                                              Row 1 of 1
Command ===> ____________________________________ Scroll ===> PAGE

Select processors to change device/processor definitions, then press
Enter.

Device number  . . : 0700           Number of devices  . : 4
Device type  . . . : 3590

/ Processor ID   UA +  Time-Out  STADET  Preferred Explicit Device
                                         CHPID +   Candidate List
s_ PROC1         __     No        Yes     __        No
************************* Bottom of data ***************************






 F1=Help       F2=Split      F3=Exit       F4=Prompt     F5=Reset
 F6=Previous   F7=Backward   F8=Forward    F9=Swap      F12=Cancel
F22=Command
```

Figure 57. HCD Panel: Device / Processor Definition

After you press Enter, the Define Device / Processor panel is displayed (see Figure 58 on page 126). This panel describes the processor's view of the device.

```
------------------------ Define Device / Processor -------------------
CBDPDV12

Specify or revise the following values.

Device number  . : 0700          Number of devices . . . . : 4
Device type  . . : 3590
Processor ID . . : PROC1         This is the main processor

Unit address . . . . . . . . . . 00  + (Only necessary when different from
                                     the last 2 digits of device number
Time-Out . . . . . . . . . . . . No   (Yes or No)
STADET . . . . . . . . . . . . . Yes  (Yes or No)

Preferred CHPID  . . . . . . . . __  +
Explicit device candidate list . No   (Yes or No)

 F1=Help     F2=Split    F4=Prompt   F5=Reset    F9=Swap    F12=Cancel
```

Figure 58. HCD Panel: Define Device / Processor

Press Enter, and the Define Device to Operating System Configuration panel will be displayed (see Figure 59). Place an *s* next to the operating system or systems that will use the IBM 3494 tape library and press Enter.

```
----------- Define Device to Operating System Configuration ----------
 CBDPDVOS                                                   Row 1 of 5
 Command ===> ____________________________________ Scroll ===> PAGE

 Select OSs to connect or disconnect devices, then press Enter.

 Device number  . : 0700          Number of devices  : 4
 Device type  . . : 3590

 / Config. ID   Type     Description                      Defined
 s AB           MVS      MVS operating system
 _ AC           MVS      MVS operating system
 _ MVSFP1       MVS
 _ OPSYS01      MVS      MVS operating system
 _ OPSYS02      VM       VM operating system
 ************************* Bottom of data **************************



  F1=Help       F2=Split      F3=Exit       F4=Prompt     F5=Reset
  F6=Previous   F7=Backward   F8=Forward    F9=Swap      F12=Cancel
 F22=Command
```

Figure 59. HCD Panel: Define Device to Operating System Configuration

The Define Device Parameters / Features panel will then be displayed (see Figure 60 on page 127). On this panel you link the operating system to the tape subsystem you are going to install.

```
 CBDPDV13          Define Device Parameters / Features          Row 1 of 9
Command ===> __________________________________________ Scroll ===> PAGE

Specify or revise the values below.
Configuration ID . : AB          MVS operating system
Device number  . . : 0A40        Number of devices  :4
Device type  . . . : 3590

Parameter/  Value    P Req.  Description
Feature
OFFLINE     No               Device considered online or offline at IPL
DYNAMIC     Yes              Device supports dynamic configuration
LOCANY      Yes              UCB can reside in 31 bit storage
LIBRARY     Yes              Device supports auto tape library
AUTOSWITCH  Yes              Device is automatically switchable
LIBRARY-ID  12345            5 digit library serial number
LIBPORT-ID  02               2 digit library string ID (port number)
SHARABLE    No               Device is Sharable between systems
COMPACT     Yes              Compaction
***************************** Bottom of data ****************************


 F1=Help       F2=Split      F4=Prompt     F5=Reset      F7=Backward
 F8=Forward    F9=Swap      F12=Cancel    F22=Command
```

Figure 60. HCD Panel: Define Device Parameters / Features

All of the default parameters can be accepted with the exception of the following:

- For **LIBRARY** and **COMPACT**, enter YES.

  For **LIBRARY**, specify YES to indicate that the device belongs to an automated tape library.

  For **COMPACT**, specify YES to indicate that compaction is available for tape devices. Compaction is standard on 3490 and 3490E drives.

- **LIBRARY-ID** and **LIBPORT-ID** are new optional parameters provided by the following APARs:

  – OW25291 CL97/03/19 R110 UR1 TAPE LIBRARY HCD SUPPORT

  – OW25292 CL97/03/19 R110 UR1 TAPE LIBRARY HCD SUPPORT

  – OW25293 CL97/03/19 R110 UR1 TAPE LIBRARY HCD SUPPORT

  – OW27801 CL97/07/22 R521 UR1 TAPE LIBRARY HCD SUPPORT

  – OW29692 CL97/10/13 R1C0 PER GET MESSAGE MSGIGD306I RC12 RSN56

  The **LIBRARY-ID** is the unique identification number of a tape library. It specifies the hardware ID associated with the tape library being defined. It is defined by the customer engineer at the time of the library installation. The value is returned by the control unit in response to a Read Device Characteristics command. See 5.1.7, “Define the Library” on page 142 for the method to identify the LIBRARY-ID to DFSMS.

  In terms of OS/390 operating system the **LIBPORT-ID** reflects the order in which the tape control units are connected to the library manager and provides the tape drive pool-id, which is transparent and only used by allocation.

  For each logical library (LIBRARY-ID) in the 3494, the LIBPORT numbers always start with 01 and increment as you move away from the L frame.

Therefore 3490 or 3590 drives in the L frame have a LIBPORT of 01, and each frame as you move out increments by 1. There is one **exception** to this rule. Each of the IBM 3490E Model F1A tape drives has its own LIBPORT-ID; that is, the devices do not share LIBPORTS. Even though they look like CxA devices, they are configured more like SCSI-attached devices. If there is an empty frame – Dxx, S10, Lxx, B16, or D12 with Virtual Tape Server (VTS) drives attached to a B16 or B18 – you do not skip the number. The numbers must always be in order, with no skips.

This is fine until you have some SCSI drives in the mix. Each SCSI-attached drive (non-VTS, non-ESCON) counts as one LIBPORT, even though it is not defined through HCD. For example: If you have two ESCON C2A 3490Es in the L frame, they are 01. The next frame is six SCSI drives attached to SP2, so they occupy the numbers 02, 03, 04, 05, 06, and 07. The next frame is an empty D14, and no numbers are assigned. The next frame is A50 with four drives, so all four of its drives are given 08. The next frame is a D12 with drives attached to a B18 VTS. No numbers are assigned because they are in a different logical library. The next frame is the FC3000 with two 3490E F1A drives. These two get 09 and 10. Let′s say that you add another A50 to the empty frame that was skipped. Its drives get 08, the old 08 drives become 09, and the old 09/10 F1A drives become 10/11.

For the VTS, it is much simpler. Each VTS has its own LIBRARY-ID, so the LIBPORTs start at 01 again. The lowest order logical drives attached to the first control unit (with a CUADD or logical address of 0) are given 01 as LIBPORT. Each group of 16 is then incremented by 1. In the B18 with HPO where there are four control units, with logical addresses of 0, 1, 2, and 3, the drives attached to these logical CUs will be LIBPORTs 01, 02, 03, and 04.

These parameters allow HCD to provide the library configuration information that is normally obtained from the device at IPL time. For devices that are available during IPL, the HCD information is redundant. However, for devices that are unavailable during IPL, the HCD information allows the library device to be varied online (when it subsequently becomes available to the system) without reactivating the IODF.

In an existing installation you can use the new DEVSERV QTAPE system command to see the LIBRARY-ID and LIBPORT-ID. Refer to 9.12.2.1, “MVS Operator Commands” on page 322 for the syntax of the OS/390 DEVSERV QTAPE operator command. The LIBRARY-ID can also be displayed on the library manager screen.

- **OFFLINE** and **AUTOSWITCH** depend on your environment.

  OFFLINE specifies whether OS/390 is to consider the device online or offline at IPL. If YES, the device is considered offline at IPL. If NO (the default), the device is considered online at IPL. We recommend specifying YES and using the COMMNDxx member of PARMLIB to vary drives online.

  AUTOSWITCH defines the devices as automatically switchable. Specify YES to indicate that the device should be treated as automatically switchable. For tape drives to be automatically switchable, they must be shared by systems in a Parallel Sysplex with MVS/ESA V5.2 and DFSMS/MVS 1.3 or above.

After you press Enter, the Assign/Unassign Device to Esoteric panel is displayed. IBM 3494 tape library resident devices do not have to be defined to an esoteric in system-managed tape. Esoteric device names should be used when the number of physical installed drives is less than the number of devices defined to the HCD, to prevent allocations going to offline devices in the tape library. You must handle the esoteric device names in your SMS ACS routines and assign them to an appropriate tape storage group. Your IBM 3494 tape library and drives should now be defined, and a production IODF is built and then activated.

Table 19 summarizes the major HCD panel fields for IBM 3590 and IBM 3490 tape device definitions.

Table 19. IBM 3494 HCD Configuration Options for 3490 and 3590 Devices

Model	**3590-B1A**	**3490E-F1A**	**3490E-C1A**	**3490E-C2A**
Number of devices	4 •	4 •	2 •	2 •
Device type	3590	3490	3490	3490
Number of LIBPORT-IDs	1 •	1 to 2 •	1 •	1 •

Notes:

1. The number of devices to be specified for the IBM 3590-A50 and IBM FC3000 control units is always 4.
2. The number of devices to be specified for the IBM 3490-CxA control unit is always 2.
3. Specify one LIBPORT-ID. Each tape unit attached to the control unit has the same LIBPORT-ID assigned.
4. Specify one LIBPORT-ID per F1A tape unit. Each physical installed F1A tape unit attached to the FC3000 control unit has its own LIBPORT-ID assigned.

Note: The HCD definitions for a VTS are described in the *Enhanced IBM Magstar Virtual Tape Server: Implementation Guide.*

5.1.2 Update SYS1.PARMLIB

You have to update or verify the following SYS1.PARMLIB members:

- **SCHEDxx**: Add the OAM initialization module CBROAM to the system program properties table (PPT).
- **IGDSMSxx**: Add the OAMPROC and OAMTASK optional parameters if you want the OAM address space to start automatically as part of the SMS initialization. If you use a vendor′s tape management system, it may require that the OAM address space be started after the tape management system initialization. In such a case, do not start the OAM automatically. Check with the vendor of the tape management system product.
- **IEFSSNxx**: Add or update the OAM1 entry with the name of the initialization module (CBRINIT) executed at IPL.
- **CONSOLxx**: Update the CONSOLxx member referenced by IEASYSxx if you want to receive library messages at a specific console. You must also define this console name during ISMF library definition to SMS.
- **DEVSUPxx**: If you use volume partitioning (hard partitioning), you can specify volume category codes in this member to provide a unique range of tapes for each attached system. The VOLNSNS=YES parameter allows you to relabel volumes for use as scratch tapes in 18-track mode after they have been used in 36-track mode.
- **COMMNDxx**: Add the VARY SMS,LIBRARY command if you want the library to be brought online automatically after IPL processing.

- **GRSCNFxx (optional)**: If you are going to share the tape library among two or more systems in an SMS complex, a global resource serialization ring can be created to include all sharing systems. This allows OAM to serialize the cartridge entry process.
- **LOADxx (optional)**: Update columns 64 through 71 of the SYSCAT statement with the high-level qualifier of your TCDB, if you do not want to use the default (SYS1).

  Note: The LOADxx member can reside in SYS1.PARMLIB or SYSn.IPLPARM. When used, SYSn.IPLPARM must reside on the IODF volume. If your system is IPLed using the SYSCATLG member of SYS1.NUCLEUS, the respective update is done there.
- **COFVLFxx (optional)**: Add the volume catalogs to the IGGCAS class definitions where you have other ICF catalogs.
- **ALLOCxx (optional)**: Add policies for tape automation.
- **IECIOSxx (optional)**: Set values for missing interrupt handler.

5.1.2.1 SCHEDxx Member of SYS1.PARMLIB

SCHEDxx is used to define programs requiring special attributes that are to be included in the (PPT):

```
PPT   PGMNAME(CBROAM)  /* OAM ADDRESS SPACE
      KEY(5)           /* USE DFP PROTECT KEY
      NOSWAP           /* NONSWAPPABLE
      SYST             /* PROGRAM IS SYSTEM TASK--WILL NOT BE TIMED
```

The OAM module has to be added. If you already use OAM for object support, you may not need to change this member, but we recommend that you review the definition.

5.1.2.2 IGDSMSxx Member of SYS1.PARMLIB

IGDSMSxx contains the definitions for SMS. It is updated with information about OAM. If you already use OAM for object support, you may not need to change this member, but we recommend that you review the definition:

```
OAMPROC(OAM)
OAMTASK(ATLOAM)
DB2SSID(NONE)
```

OAMPROC specifies the name of the procedure that is to start the OAM address space when SMS is initialized. You must specify this keyword if you want the OAM address space to be started during IPL. The procedure name can be from one to eight characters.
OAMTASK is optional and is used if you prefer to use an identifier other than the procedure name when starting the OAM address space.
DB2SSID(NONE) is optional and is used if your installation is not using OAM to store objects but is using OAM for tape library management only.

5.1.2.3 IEFSSNxx Member of SYS1.PARMLIB

IEFSSNxx is used to define the primary and secondary subsystems that are to be created at system initialization:

```
SUBSYS SUBNAME(OAM1) INITRTN(CBRINIT) INITPARM('MSG=EM')
```

OAM1 is the name by which the subsystem is known, and CBRINIT is the name of the OAM initialization program. It is mandatory to specify the CBRINIT keyword. The MSG parameter is optional. It allows you to control the format of OAM messages: EM is Mixed Case English, EU is UPPER CASE ENGLISH. (If MSG is omitted, EU is the default.)

5.1.2.4 CONSOLxx Member of SYS1.PARMLIB

You update the CONSOLxx member only if you want to receive library messages at a specific console:

```
CONSOLE   DEVNUM(device number)
          NAME(library console name)
          UNIT(terminal type)
          AUTH(SYS,IO)
          (...)
```

You must also define this console name during ISMF library definition to SMS. (See Figure 68 on page 144.) The library console name would be the name used when defining the IBM 3494 tape library to SMS through the ISMF panels. We recommend that the console be authorized for SYS and IO, which allows an operator to issue OS/390 MODIFY and VARY commands.

5.1.2.5 DEVSUPxx Member of SYS1.PARMLIB

DEVSUPxx controls installation wide default tape device characteristics:

```
COMPACT = YES,
VOLNSNS = YES,
MEDIA1  = xxxx,
MEDIA2  = xxxx,
MEDIA3  = xxxx,
ERROR   = xxxx,
PRIVATE = xxxx
```

COMPACT = YES With COMPACT set to YES, the installation will use the compaction feature. With COMPACT set to NO by default, the installation will not use the compaction feature of the tape drive. The JCL parameter (TRTCH) and the DATACLAS will override this setting. The DATACLAS cannot override the JCL parameter if specified.

VOLNSNS = YES Setting VOLNSNS to YES allows 18-track scratch cartridges to be mounted and used in 36-track mode. A similar parameter may also exist for the tape management system.

To partition the tape library into logically independent libraries, the following parameters are available. Use these parameters only if you are planning to share the library among other systems. You cannot specify the default values in DEVSUPxx for MEDIA1, MEDIA2, MEDIA3, MEDIA4, ERROR, and PRIVATE. The DEVSUPxx parameters are used to specify volume category codes for library partitioning:

MEDIA1 = xxxx Specifies a 2-byte hexadecimal value to be used as the 3490 CST scratch volume category code. The default value is 0001.

MEDIA2 = xxxx Specifies a 2-byte hexadecimal value to be used as the 3490 ECCST scratch volume category code. The default value is 0002.

MEDIA3 = xxxx Specifies a 2-byte hexadecimal value to be used as the 3590 high performance cartridge tape scratch volume category code. The default value is 0003.

ERROR = xxxx Specifies a 2-byte hexadecimal value to be used as the error volume category code. The default value is 000E.

PRIVATE = xxxx Specifies a 2-byte hexadecimal value to be used as the private volume category code. The default value is 000F.

Note: xxxx must be a four-character hexadecimal value within the 0010 to FEFF range. To avoid conflicting volume categories with platforms other than OS/390, use only the 0010 through 007F range. Refer to Appendix A, "Library Manager Volume Categories" on page 353 for the volume categories that are used by other platforms.

This enhancement is available with DFSMS/MVS 1.4 or PTF UW90300 (APAR OW20735) for DFSMS 1.2 and PTF UW90348 (APAR OW21351) for DFSMS 1.3.

Note that updating DEVSUPxx may require an IPL, and you might want to schedule this in advance.

5.1.2.6 COMMNDxx Member of SYS1.PARMLIB

When defining the tape drives to the HCD, the specification of OFFLINE on the Define Device Parameters / Features panel (Figure 60 on page 127) controls whether or not the devices are brought online automatically at IPL time:

```
COM='VARY dddd,ONLINE'
```

It is a common practice not to bring tape drives online at IPL time, but to vary them online with the COMMNDxx.

If the drives have been defined in the HCD to come online at IPL, and no cartridge is mounted in the drive, the drive will not be ready and will remain OFFLINE. We recommend that you add VARY statements for all drives that need to be online to a particular system after it has been IPLed.

5.1.2.7 GRSCNFxx Member of SYS1.PARMLIB (Optional)

If you are going to share the tape library among two or more systems in an SMS complex, a global resource serialization ring can be created to include all sharing systems. This allows OAM to serialize the cartridge entry process. The global resource serialization (GRS) configuration is defined in member GRSCNFxx of SYS1.PARMLIB, which is described in the *OS/390 MVS Initialization and Tuning Reference*. OAM sends a SYSTEMS level enqueue around the global resource serialization ring, so there is no need to include the QNAME or RNAME in the system inclusion RNL. The QNAME and RNAME are provided here for documentation purposes:

```
QNAME-SYSCBR
RNAME-CARTIDGE_ENTRY_libname
```

SYSCBR is the major resource name given to OAM, and CARTRIDGE_ENTRY_libname is the minor resource name. The libname is the friendly SMS name given to the library when it is defined to SMS through the ISMF panels.

If you do not use GRS to control resource serialization in a multisystem environment, review the documentation and make the appropriate changes to ensure that the use of CBRUXENT is correctly serialized. *DFSMS/MVS OAM PISA for Tape Libraries* contains the relevant information.

5.1.2.8 LOADxx Member of SYS1.PARMLIB (Optional)

Update columns 64 through 71 of the SYSCAT statement with the high-level qualifier of your TCDB, if you do not want to use the default (SYS1). Use:

```
1       10       20                                              64
SYSCAT  CATRES   SYS1.MASTER.CATALOG                             USERHLQ1
```

USERHLQ1 is any name not used as an alias entry in the master catalog.

Note that updating LOADxx may require an IPL, and you might want to schedule this in advance.

5.1.2.9 COFVLFxx Member of SYS1.PARMLIB (Optional)

Add the volume catalogs to the IGGCAS class definitions as shown:

```
/*                                                                 */
CLASS NAME(IGGCAS)                /* CATALOG in Data space        */
      EMAJ(ICFCAT.USERCAT)        /* User Catalog                 */
      EMAJ(SYS1.VOLCAT.VGENERAL)  /* SMT general VOLCAT           */
      EMAJ(SYS1.VOLCAT.VT)        /* SMT specifc VOLCAT           */
      MAXVIRT(256)                /* MAXVIRT = 256 4K blocks      */
                                  /*         = 1Mb (minimum value) */
```

As a VOLCAT may have many updates against volume entries, use the virtual lookaside facility (VLF) function with caution. The F CATALOG,REPORT,VLF command displays the hit rates for each catalog defined for VLF use. If hit rates are below 50% for a catalog, we recommend not using VLF for that catalog.

5.1.2.10 ALLOCxx Member of SYS1.PARMLIB (Optional)

When introducing automation, you have to review the settings of the ALLOCxx member. By default, most of the parameters cause WTOR messages. They have to be automated to achieve real lights-out operation. The parameters that affect tape handling are:

VOLUME_ENQ **POLICY (WTOR|CANCEL|WAIT)** Specifies the installation policy for enqueuing on volumes when an allocation request has to wait for a volume or a series of volumes.

WTOR The installation policy is to issue the message and let the operator make the decision about the allocation request. The system displays one of the following messages on the operator's console:

- IEF690I - The following volumes are unavailable to <jobname>...
- IEF235D - <jobname> is waiting for volumes. To cancel wait, reply no.

  In addition, the system issues message IEF369D (invalid reply) in response to an invalid reply to IEF235D.

CANCEL The installation policy is to cancel a job that needs an unavailable volume.

WAIT The installation policy is to let a job that needs an unavailable volume wait until the volume is available.

CAUTION: When WAIT is used as the default, tape volumes may encounter deadlocks with other jobs in the system.

Default: WTOR

VOLUME_MNT POLICY (WTOR|CANCEL) Specifies the installation policy for mounting a volume when an allocation request requires a volume to be mounted.

WTOR The installation policy is to issue the message and let the operator make the decision about the volume mount. The system displays one or more of the following messages on the operator's console:

- IEF233A - Mount volume <ser>.
- IEF233D - Mount volume <ser> or respond to IEF455D message.
- IEF455D - Mount <ser> on <device> for <jobname> or reply no.

  In addition, the system issues message IEF369D (invalid reply) in response to an invalid reply to IEF455D.

CANCEL The installation policy is to cancel a job that needs a volume mounted.

Default: WTOR

SPEC_WAIT POLICY (WTOR|WAITHOLD|WAITNOH|CANCEL) Specifies the installation policy to be followed when an allocation request must wait for a specific volume or unit.

WTOR The installation policy is to issue the message and let the operator make the decision about the wait request. The system displays one or more of the following messages on the operator's console:

- IEF238D – Reply device name, wait or cancel.
- IEF244I – Unable to allocate <nnn> units(s). At least <nnn> allocated or offline units are needed.
- IEF433D – Wait requested, reply hold or nohold.
- IEF488I – Must wait for a unit, or volume on unit.

  In addition, the system issues one or more of the following messages in response to an invalid reply to the preceding messages:

  – IEF434D – Invalid reply (to message IEF433D). Reply hold or nohold.
  – IEF490I – Invalid reply (to message IEF238D) for one of the following reasons:
    - Device is not accessible (no paths available, boxed, or cannot be assigned).
    - Required system-managed volume is not available.
    - Required volume is not available.
    - Replied device is not eligible.
    - Device is found in an offline library.
    - Coupling facility error.

WAITHOLD The installation policy is for the system not to release any of the devices that have already been allocated to this job before it waits for the required units or volumes.

Note: Use of WAITHOLD might result in a deadlock, particularly when the device is being used by a job that is going to wait. The system does not release any non-DASDs that have already been allocated to the job before it waits for required units and volumes. To avoid this problem, do not specify WAITHOLD. When devices for a job are held during a wait, and a device that was eligible for allocation to the job becomes ineligible for allocation (because of its use by a system utility, for example), the job may fail because it does not have enough devices to complete successfully. Message IEF700I in the job log identifies this failure. Refer to message IEF700I for information on how to respond to this failure.

WAITNOH The installation policy is to let the job wait while not holding the obtained resources. The system releases those devices that have been allocated to this job but cannot be shared with other jobs. For an example of the WAITHOLD versus WAITNOH options, consider that Job A owns an automatically switchable device and is waiting for a printer. Job B owns the printer Job A needs and is waiting for the automatically switchable device Job A owns.

- If the reply is WAITHOLD for each job, the two jobs will wait until one job is canceled. This deadlock can be even more complex, depending on the number of jobs waiting.
- If the reply is WAITNOH for each job, allocation responds on a first-come, first-served basis. After the first job finishes using a resource, it is available to the second.

CANCEL The installation policy is to cancel the allocation request. If a TSO/E user issued the allocation request, the user receives an error message. If a batch job or started task issued the request, the system cancels the job or task.

Default: WTOR

MAXNWAIT(nnn) Specifies the number of WAITNOH decisions allowed to be made for the specific volume or unit allocation request before the default specified on the POLICYNW parameter will take effect. The WAITNOH decisions counted are those that are specified either through the default on the POLICY parameter or through an installation exit. WAITNOH decisions made by the operator are not included in the MAXNWAIT count.

Value Range: 1 to 255
Default: 5

POLICYNW(CANCEL|WTOR) Specifies how the system should handle the allocation request under the following circumstances:

- Either WAITHOLD or WAITNOH is specified on the POLICY parameter, and the system does not allow the job to wait for resources.

The system is to either cancel the allocation request (CANCEL) or issue a WTOR. When CANCEL is selected, the system cancels the allocation request depending on how the request was issued. If a TSO/E user issued the allocation request, the user receives an error message. If a batch job or started task issued the request, the system cancels the job or task.

Default: WTOR

Figure 61 on page 136 shows a sample ALLOCxx member in an unattended environment. Only those parameters affecting tape allocation are shown.

```
VOLUME_ENQ    POLICY(CANCEL)       /*Always cancel job*/

VOLUME_MNT    POLICY(WTOR)         /*Always issue the WTOR*/

SPEC_WAIT     POLICY(WAITNOH)      /*Wait while
                                       not holding resources*/
              MAXNWAIT(7)          /*7 "wait nohold"
                                     decisions allowed*/
              POLICYNW(CANCEL)     /*Cancel if wait is
                                     not allowed*/

ALLC_OFFLN    POLICY(WAITNOH)      /*Wait
                                      while not holding resources*/
              MAXNWAIT(7)          /*7 "wait nohold"
                                     decisions allowed*/
              POLICYNW(CANCEL)     /*Cancel if wait is
                                     not allowed*/
```

Figure 61. Sample ALLOCxx Member

5.1.2.11 IECIOSxx Member of SYS1.PARMLIB (Optional)

Update or set values for the missing interrupt handler (MIH).

The IBM 3590 returns recommended MIH timeout values to the host operating system in Read Configuration Data. Therefore it is not necessary to specify MIH timeout values for IBM 3590 devices; the device-supplied values handle all MIH timeouts.

The VTS emulates 3490E devices and does not automatically upload the MIH timeout values to the host operating system in Read Configuration Data. Therefore you must specify MIH timeout values for IBM 3490E devices.

If you currently specify your own MIH timeout values for non-3590 tape devices, we recommend that you review your procedures to see whether a timeout value other than the IBM-supplied default of 3 minutes should be used. If so, specify the timeout for each individual device. MIH timeout values are specified only by class (for example, all tapes) or on an individual device basis. Specification of an MIH timeout value for the entire tape class would negate the 3590 device′s recommended values and adversely affect MIH recovery processing on 3590 devices. You can specify the MIH values either in PARMLIB member IECIOSxx or with the OS/390 operator command, SETIOS.

Figure 62 on page 137 shows how to specify MIH values for IBM 3480 devices (addresses 800 through 807); IBM 3490E drives using CST cartridges (addresses 900 through 907); IBM 3490E drives with ECCST cartridges (addresses 9E0 through 9EF); and the VTS virtual drives (A40 through A5F) at 25 minutes. This is a starting point. Under certain conditions you may experience missing interrupts at 25 minutes. If you experience missing interrupts, increase the time to 45 minutes.

```
MIH=(0800-0807),TIME=03:00
MIH=(0900-0907),TIME=10:00
MIH=(09E0-09EF),TIME=20:00
MIH=(0A40-0A5F),TIME=25:00
```

Figure 62. Sample MIH Specification in PARMLIB Member IECIOSxx

5.1.3 Allocate Tape Configuration Database

The TCDB consists of one or more volume catalogs that contain information about the tape libraries and tape volumes. Two types of entries are maintained: library records and volume records.

Each library record contains information related to an IBM 3494 tape library. Each volume record contains information related to a system-managed tape volume.

The library record is also contained in the SMS control data set. Table 20 shows the contents of the TCDB library and volume records.

Table 20. Contents of TCDB Library and Volume Records

Library Record	**Volume Record**
Library name	Volume serial number
Library ID	Tape device selection information
Library description	Library name
Library device type	Storage group name
Library type	Volume use attribute
Number of slots	Volume error status
Number of empty slots	Write protect status
Number of scratch volumes	Checkpoint volume indicator
Scratch volume message threshold	Volume location code
Library console name	Shelf location
	Volume owner information
	Volume record creation date
	Last entry or eject date
	Last mounted date
	Last written date
	Volume expiration date

You must allocate the TCDB before you can define an IBM 3494 tape library to the system. Define one general VOLCAT in a system-managed-tape SMSplex.

Figure 63 on page 138 shows a sample job to allocate the TCDB.

```
//DEVCAT   JOB ...
//STEP1   EXEC PGM=IDCAMS
//SYSPRINT  DD SYSOUT=*
//SYSIN     DD *
  DEFINE USERCATALOG -
         (NAME(SYS1.VOLCAT.VGENERAL) -
         VOLCATALOG -
         VOLUME(volser)-
         CYLINDERS (1 1))
/*
```

Figure 63. Create a General SYS1.VOLCAT.VGENERAL

Notice

Instead of SYS1 you can use a different high-level qualifier. To do so, you have to update the LOADxx member in PARMLIB. Select the HLQ name carefully: There is no documented easy way to rename the VGENERAL once it has been defined and used.

In a multihost environment, allocate a general VOLCAT on a shared volume and use the IDCAMS IMPORT CONNECT command on all other OS/390 systems in the SMSplex to define the VOLCAT to the respective master catalogs.

The volume catalogs are defined with SHAREOPTIONS(3,4), so the TCDB can be fully shared among two or more systems. To get exclusive control of the catalog's volume, a task in any accessing system issues the RESERVE macro. If multiple systems share the library (and thus share the TCDB), we strongly recommend that you use GRS or another means to serialize access to tape drives. Figure 64 shows a sample job to connect the TCDB to a shared system.

```
//SYSMVCT EXEC PGM=IDCAMS
//SYSPRINT DD SYSOUT=A
//SYSIN    DD *
    IMPORT CONNECT -
           VOLCATALOG -
           OBJECTS((hlq.VOLCAT.VGENERAL -
              DEVICETYPE(3390) -
              VOLUMES(volser))) -
           CATALOG(SYSB.MASTER.CATALOG)

/*
```

Figure 64. Import Connect TCDB

Optionally, you can define one or more specific VOLCATs: for example, SYS1.VOLCAT.Vx, where x represents the first character of the tape volume serial numbers to be stored in this specific volume catalog and must have a valid character value (A-Z and 0-9). A specific volume catalog might be appropriate because of:

- Performance considerations
- Multisystem considerations
- Application's use of confined tape ranges

See Figure 65 on page 139 for a sample job defining a specific VOLCAT. This VOLCAT contains all of the system managed tape volume entries starting with the character *T*.

```
//DEFVCAT  JOB ....
//STEP1    EXEC PGM=IDCAMS
//SYSPRINT DD  SYSOUT=A
//SYSIN    DD  *
   DEFINE USERCATALOG -
          (NAME(SYS1.VOLCAT.VT) -
          VOLCATALOG -
          VOLUME(volser) -
          CYLINDERS(1 1))
/*
```

Figure 65. Create a Specific SYS1.VOLCAT.VT

Note: In a multihost environment, the same considerations apply as for a general VOLCAT.

5.1.4 Prepare and Start OAM

Object Access Method (OAM) is used for management and control of the physical location and tracking of tape cartridges.

The procedure to start OAM must be added to one of your procedure libraries. You can use CBRAPROC in SYS1.SAMPLIB to create the OAM procedure in PROCLIB (see Figure 66).

```
//OAM PROC OSMC=YES,MAXS=2,UNLOAD=9999,EJECT=LRW,RESTART=YES
//IEFPROC EXEC PGM=CBROAM,REGION=0M,
// PARM=('OSMC=&OSMC,APLAN=CBROAM,MAXS=&MAXS,UNLOAD=&UNLOAD',
//    'EJECT=&EJECT','RESTART=&RESTART')
//SYSABEND DD SYSOUT=A
```

Figure 66. OAM Procedure

If you already use OAM for object access, you may not have to change this member, but we recommend that you review the definition.

Of importance to tape library users is the RESTART parameter: It allows you to indicate whether, on an SCDS activation, you want the OAM address space to automatically restart or not. Thus, if your SCDS changes rarely affect the tape-library-related constructs, the OAM address space will stay up during an SCDS activation. If the SCDS activation affects OAM, you can subsequently issue the command:

```
F OAM,RESTART
```

You must start the OAM address space to allow communication with your IBM 3494 tape library. Issue the START command from the OS/390 console. If you have updated the IGDSMSxx member accordingly, OAM is started automatically during IPL.

When the IBM 3494 tape library comes online for the first time, OAM requests information from the library manager about volumes in the insert category and performs insert processing. Volume records in the TCDB will be created or updated.

Vary the IBM 3494 tape library online, using this OS/390 operator command:
VARY SMS,LIBRARY(libname),ONLINE
If the IBM 3494 tape library was defined as online during library definition, it is brought online as part of the OAM address space initialization.

5.1.5 Define Security Profiles

You must prevent unauthorized users from modifying or using information in the system-managed-tape environment. In this section, we explain how to use the Resource Access Control Facility (RACF) to establish authorization levels for protecting these functions, data sets, and commands. There are five areas of protection you may want to cover:

ISMF: You can use RACF to limit access to individual ISMF applications such as TAPE LIBRARY CONFIGURATION or STORAGE CLASS DEFINITION, and you can protect ISMF line operators such as AUDIT.

For example, you can protect the EJECT line operator

```
RDEFINE PROGRAM DGTFEJ01 UACC(NONE) +
        ADDMEM('loadlib'/volser/NOPADCHK)
PERMIT DGTFEJ01 CLASS(PROGRAM) ACCESS(READ) ID(userid)
```

See the *DFSMS/MVS DFSMSdfp Storage Administration Reference* for a complete list of all profiles and command-to-program tables.

SMS constructs: You can restrict the use of SMS storage and management classes to certain users. In a system-managed-tape environment, this restriction is negligible because the storage and management class do not have much influence on resource usage.

STGADMIN: To control the ability to perform functions associated with storage management, define profiles in the FACILITY class whose profile names begin with STGADMIN. For tape library operations, the following profiles are important:

Control the ability to activate an SMS configuration:

```
RDEFINE FACILITY STGADMIN.IGD.ACTIVATE.CONFIGURATION UACC(NONE)
PERMIT STGADMIN.IGD.ACTIVATE.CONFIGURATION CLASS(FACILITY)
       ACCESS(READ) ID(userid)
```

Control the ability to DEFINE, DELETE, or ALTER library and volume entries in a tape library (TCDB updates):

```
RDEFINE FACILITY STGADMIN.IGG.LIBRARY UACC(NONE)
PERMIT STGADMIN.IGG.LIBRARY CLASS(FACILITY)
       ACCESS(READ) ID(userid)
```

For a complete list of RACF profiles protecting storage administration functions, refer to the *DFSMS/MVS DFSMSdfp Storage Administration Reference*

DFSMSrmm: By defining RACF profiles, you authorize DFSMSrmm users to various levels of access:

Access to information in the DFSMSrmm control data set:

```
REDFINE FACILITY STGADMIN.EDG.MASTER UACC(NONE)
PERMIT STGADMIN.EDG.MASTER CLASS(FACILITY)
       ACCESS(CONTROL) ID(userid)
```

Use of the INIT and ERASE function:

```
REDFINE FACILITY STGADMIN.EDG.OPERATOR UACC(NONE)
PERMIT STGADMIN.EDG.OPERATOR CLASS(FACILITY)
       ACCESS(UPDATE) ID(userid)
```

Changing of information recorded by DFSMSrmm during O/C/EOV processing:

```
REDFINE FACILITY STGADMIN.EDG.FORCE UACC(NONE)
PERMIT STGADMIN.EDG.FORCE CLASS(FACILITY)
       ACCESS(UPDATE) ID(userid)
```

For a complete list of RACF profiles protecting DFSMSrmm resources, refer to the *DFSMS/MVS DFSMSrmm Implementation and Customization Guide*.

OS/390 Operator Commands: An installation with both MVS/SP Version 4 and RACF 1.9 or later can audit the use of commands and limit the use of commands by operator as well as by console. You can restrict access to OS/390 commands such as LIBRARY or VARY SMS that affect the operation of your 3494 tape library:

Access to the OS/390 LIBRARY command:

```
REDFINE OPERCMDS MVS.LIBRARY UACC(NONE)
PERMIT MVS.LIBRARY CLASS(OPERCMDS) ACCESS(UPDATE) ID(userid)
```

Access to the OS/390 VARY SMS command:

```
REDFINE OPERCMDS MVS.VARY.SMS UACC(NONE)
PERMIT MVS.VARY.SMS CLASS(OPERCMDS) ACCESS(UPDATE) ID(userid)
```

See *OS/390 MVS Planning: Operation* for a complete list of RACF profiles to protect OS/390 commands.

5.1.6 Define Library and DFSMS Constructs

You define your IBM 3494 tape library to the system through the ISMF library application.

Note: The ISMF definition dialog works only if OAM is active.

For details on defining your library, refer to the *DFSMS/MVS DFSMSdfp Storage Administration Reference*.

When you define your library, you specify:

- **Library ID**, the five-character hardware ID associated with the IBM 3494 tape library
- **Console name**, the optional OS/390 console name if you have defined one in SYS1.PARMLIB member CONSOLxx
- **Entry default data class**, the name of the data class that you want as the default for tape cartridges entered into the IBM 3494 tape library being defined
- **Entry default use attribute**, the use attribute for cartridges entered into the library (SCRATCH or PRIVATE)
- **Eject default**, the default action for the TCDB volume record when a tape cartridge is ejected from the library (PURGE or KEEP)

- **Scratch threshold**, for MEDIA1, MEDIA2, and MEDIA3, the threshold below which a message is issued to the operator requesting that scratch volumes of the specified media type be entered into the library
- **Initial online status**, specifies whether the IBM 3494 tape library will be online, offline, or not connected to the systems or system groups in the SMSplex each time the SCDS is activated. We recommend specifying *online* to ensure that the library is accessible after activation of an updated SCDS.

  Note: When you connect an IBM 3494 tape library to a system group rather than a system, you lose the ability to vary that library online or offline to the individual system in the group. We strongly recommend that the IBM 3494 tape library be connected to individual systems only.

In addition, you have to define *data classes* to specify the media type, the recording technology, and whether to use hardware compaction when allocating a system-managed-tape data set.

You do not have to specify new storage classes; you can use existing classes. The storage class is used only to indicate that this is an allocation to a system-managed tape library. However, we recommend that you create new storage classes for tape, so that you can select storage groups on the basis of the storage class assignment and keep the ACS routines simple.

As for system-managed DASD allocations, the management class is optional. System-managed tape uses only the expiration attributes and retention limit parameters. If you are using a tape management system, specify a retention limit of NOLIMIT.

You need to define a tape storage group and specify which IBM 3494 tape libraries belong to that storage group. You also define the storage group status.

Although a blank storage group is allowed for system-managed tape volumes, we strongly recommend assigning a storage group to private volumes when they are entered into the IBM 3494 tape library. The blank storage group is always enabled for all attached systems. You can specify the storage group during definition of an existing private volume to DFSMSrmm or during cartridge insert processing.

5.1.7 Define the Library

An IBM 3494 is defined through the standard SMS interface, ISMF:

1. Choose Option 10 (Library Management) on the ISMF PRIMARY OPTION MENU panel to display the LIBRARY MANAGEMENT SELECTION MENU.
2. Choose Option 3 (Tape Library) to display the TAPE LIBRARY APPLICATION SELECTION as shown in Figure 67 on page 143.

```
  Panel  Utilities  Help
------------------------------------------------------------------------------
                      TAPE LIBRARY APPLICATION SELECTION
Command ===>

To Perform Library operations, Specify:

  CDS Name  . . . . . . . 'SMS.SCDS'
                              (1 to 44 Character Data Set Name or 'Active')
  Library Name  . . . . . LIBLCL          (For Tape Library list, fully or
                                          Partially Specified or * for all)

Select one of the following options  :
  1  1. List    - Generate a list of Libraries
     2. Display - Display a Library
     3. Define  - Define a Library
     4. Alter   - Alter a Library

If List option is chosen,
   Enter "/" to select option   _  Respecify View Criteria
                                _  Respecify Sort Criteria

Use ENTER to Perform Selection;
Use HELP Command for Help; Use END Command to Exit.
```

Figure 67. ISMF Panel: Tape Library Application Selection

In the Library Name field enter the SMS friendly name for your tape library. This name will relate your tape library to your SMS tape storage group, which you define later on. There is a minor restriction when you name the library: The first character of a library name must not be *V* or one of the DFSMSrmm-defined locations (LOCAL, REMOTE, DISTANT).

3. Choose Option 3 (Define) to display the TAPE LIBRARY DEFINE panel, as shown in Figure 68 on page 144 and Figure 69 on page 144.

Note: Deleting a tape library from this panel has no effect on the TCDB. Instead, the library definition is removed only from the specified SCDS. To delete a tape library from the TCDB, use the IDCAMS DELETE command.

```
  Panel  Utilities  Scroll  Help
------------------------------------------------------------------------------
                              TAPE LIBRARY DEFINE                  Page 1 of 2
Command ===>

SCDS Name  . : SMS.SCDS
Library Name : LIBLCL

To Define Library, Specify:
  Description ==> 'My one and only tape library dataserver'
              ==>

  Library ID . . . . . . . . . . . 10435     (00001 to FFFFF)
  Console Name . . . . . . . . . . MC01
  Entry Default Data Class . . . . ECCST
  Entry Default Use Attribute  . . S         (P=PRIVATE or S=SCRATCH)
  Eject Default  . . . . . . . . . P         (P=PURGE or K=KEEP)

  Media Type:          Scratch Threshold
    Media1  . . . . 0            Media3  . . . . 0          (0 to 999999)
    Media2  . . . . 100          Media4  . . . . 0          (0 to 999999)

Use ENTER to Perform Verification; Use DOWN Command to View next Panel;
Use HELP Command for Help; Use END Command to Save and Exit; CANCEL to Exit.
```

Figure 68. ISMF Panel: Tape Library Define (Page 1 of 2)

```
  Panel  Utilities  Scroll  Help
------------------------------------------------------------------------------
                              TAPE LIBRARY DEFINE                  Page 2 of 2
Command ===>

SCDS Name  . : SCDS.TEMP.PRIMARY
Library Name : LIB1

Initial Online Status (Yes, No, or Blank):
*SYSPLX01 ===> YES  *SYSPLX02 ===>      *SYSPLX03 ===> NO   *SYSPLX04 ===>
 SYSSTM01 ===> YES   SYSSTM08 ===> YES   SYSSTM15 ===>       SYSSTM22 ===>
 SYSSTM02 ===>       SYSSTM09 ===>       SYSSTM16 ===>       SYSSTM23 ===>
 SYSSTM03 ===>       SYSSTM10 ===>       SYSSTM17 ===>       SYSSTM24 ===>
 SYSSTM04 ===>       SYSSTM11 ===>       SYSSTM18 ===>       SYSSTM25 ===>
 SYSSTM05 ===>       SYSSTM12 ===>       SYSSTM19 ===>       SYSSTM26 ===>
 SYSSTM06 ===>       SYSSTM13 ===>       SYSSTM20 ===>       SYSSTM27 ===>
 SYSSTM07 ===>       SYSSTM14 ===>       SYSSTM21 ===>       SYSSTM28 ===>
WARNING:
  When you connect a tape library to a system group rather than a system,
  you lose the ability to vary that library online or offline to the
  individual systems in the system group.  It is strongly recommended that
  the tape library be connected to individual systems only.
Use ENTER to Perform Verification; Use UP Command to View Previous Panel;
Use HELP Command for Help; Use END Command to Save and Exit; CANCEL to Exit.
```

Figure 69. ISMF Panel: Tape Library Define (Page 2 of 2)

Specify the following information for the tape library:

Description – This is a 120-byte field that allows you to enter a description of the library definition for use by the installation. There are no restrictions on its content.

Library ID – Specify the hardware ID associated with the tape library being defined. One physical 3494 library will have more than one library ID if it holds native drives and VTS subsystems. All library IDs have to be defined to ISMF. A valid value is entered as five hexadecimal digits. This value is displayed on the library manager screen by:

1. Selecting the **Status** pull-down on the primary menu.
2. Selecting **Operational status**.
3. Scrolling until you see the ″Library sequence number: NNNNN″ field

as shown in Figure 70.

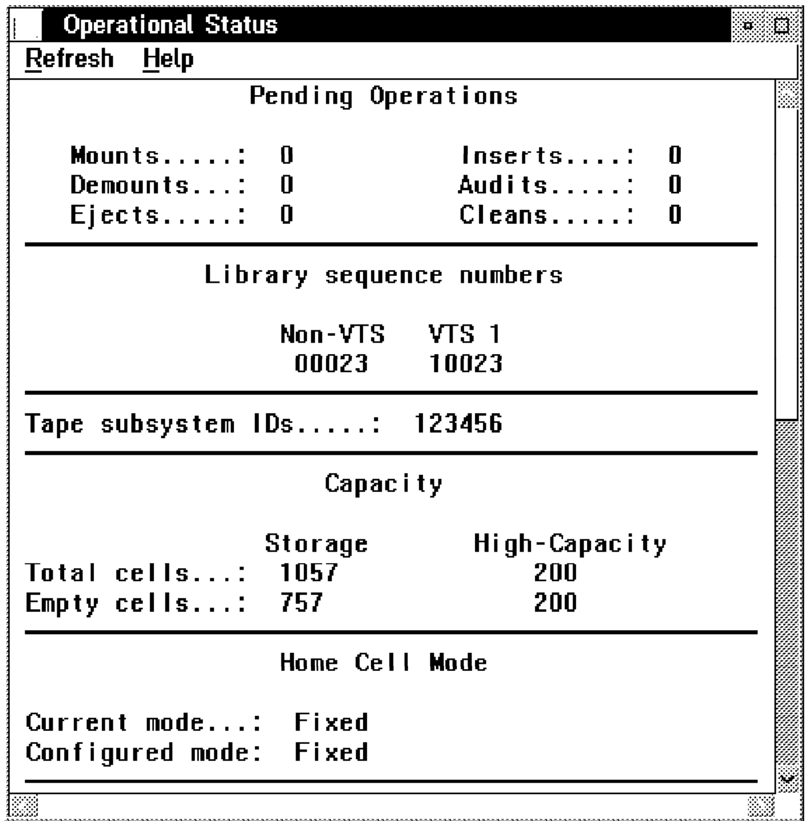


Figure 70. Operational Status Menu

Console Name – Specify the name of the OS/390 console associated with the tape library being defined in CONSOLxx PARMLIB member.

Entry Default Data Class – Specify the name of the data class that you want as the default for tape cartridges entered into this tape library.

Entry Default Use Attribute – Specify the default cartridge use attribute for the cartridges entered into this library:
PRIVATE – These tape cartridges can be used to satisfy specific cartridge requests.
SCRATCH – These tape cartridges can be used to satisfy nonspecific cartridge requests.

Eject Default – Specify the default action for the TCDB cartridge record when a tape cartridge is ejected from this library:
PURGE – The cartridge record is deleted from the TCDB.
KEEP – The cartridge record is kept in the TCDB.

Note: PURGE is always used if DFSMSrmm is installed. DFSMSrmm stores all tape-specific information, so there is no need to keep redundant information in the TCDB while the cartridge is not in the library.

Scratch Threshold – Specify the minimum acceptable number of scratch cartridges for each media type in this library. There are three recognized media types (uncompacted capacity indicated):

- MEDIA1 IBM CST (200 or 400 MB)
- MEDIA2 IBM ECCST (800 MB)
- MEDIA3 Magstar Tape Cartridge (10 GB)

Note: When the number of scratch cartridges in the library falls below the scratch cartridge threshold for that media type, an operator action message is issued requesting that scratch cartridges of the required media type be entered into the library. When the number of scratch cartridges exceeds twice the scratch cartridge threshold for that media type, the message disappears. In the case of the VTS, the above numbers apply to the amount of logical cartridges (CST or ECCST) available inside the VTS.

Initial Online Status – Specify whether the library being defined will be online (YES), offline (NO), or not connected (blank) to each system in the SMSplex defined by this SCDS each time it is activated. YES is equivalent to VARY SMS,LIBRARY(libname),ONLINE.

Once all the information is entered, an entry containing that information is added to the TCDB.

Note: Only one SCDS can be activated at any time. Activating another SCDS or reactivating the current SCDS while OAM is running causes OAM to restart. During this restart, all libraries are set to either online or offline according to the attributes defined in the SCDS that caused the restart. After the restart completes, all libraries should be displayed to verify that they are set to the desired operational status.
Care must be taken when OAM is restarted with actions pending that have not been accepted by the library manager, for example, mass ejects. They may be discarded during restart.

5.1.8 Define SMS Constructs

Compared to the implementation of DFSMS for DASD, system-managed tape has the following differences:

- Tape data sets do not have to be cataloged. If they are to be cataloged, this is done at step termination time.
- System-managed tape is the management of tape cartridges, not tape data sets. No data-set-related information is stored in the TCDB.
- A DASD (type POOL) storage group comprises one or more DASD volumes.

A tape (type TAPE) storage group comprises one or more tape libraries. Cartridge information is stored in the TCDB, not in the SMS active control data set (ACDS).

- A blank storage group is allowed for system-managed tape.

The SMS constructs you must to define for system-managed tape are described below.

5.1.9 Define Data Classes

A data class provides the tape device selection information for tape data sets. The attributes you can specify are:

- The type of media to use
- Whether the data is to be compacted
- Recording technology (18 track, 36 track, or 128 track)

Use ISMF panels to define your data classes:

1. Choose Option 4 (Data Class) on the ISMF PRIMARY OPTION MENU panel to display the DATA CLASS APPLICATION SELECTION panel.
2. On that panel, specify the SCDS name and the name of the data class you are about to define.
3. Choose Option 3 (Define) on the panel to display the DATA CLASS DEFINE panel.

Have all fields blank on page 1 of 3 and use defaults on page 3 of 3. Go to page 2 of 3 and add definitions, as shown in Figure 71.

```
  Panel  Utilities  Scroll  Help
------------------------------------------------------------------------------
                              DATA CLASS DEFINE                 Page 2 of 3
Command ===>


SCDS Name  . . : SMS.SCDS
Data Class Name: DCTAPLR
To DEFINE Data Class, Specify:
  Retpd or Expdt  . . . . . .            (0 to 9999, YYYY/MM/DD or blank)
  Volume Count  . . . . . . . 1          (1 to 59 or blank)
    Add'l Volume Amount . . .            (P=Primary, S=Secondary or blank)
  Imbed . . . . . . . . . . .            (Y, N or blank)
  Replicate . . . . . . . . .            (Y, N or blank)
  CIsize Data . . . . . . . .            (1 to 32768 or blank)
  % Freespace CI  . . . . . .            (0 to 100 or blank)
              CA  . . . . . .            (0 to 100 or blank)
  Shareoptions Xregion  . . .            (1 to 4 or blank)
               Xsystem  . . .            (3, 4 or blank)
  Compaction  . . . . . . . . Y          (Y, N, T, G or blank)
  Media Interchange
    Media Type  . . . . . . . 2          (1, 2, 3, 4 or blank)
    Recording Technology  . . 36         (18, 36, 128 or blank)
  Use ENTER to Perform Verification; Use UP/DOWN Command to View other Panels;
  Use HELP Command for Help; Use END Command to Save and Exit; Cancel to Exit.
```

Figure 71. ISMF Panel: Data Class Define (Page 2 of 3)

Specify the following information for the data class definition in the current SCDS:

Retpd or Expdt – Specify how long the data sets in this data class remain valid (see Figure 73 on page 150).

Volume Count – Specify the maximum number of cartridges you expect to use to store a data set in this data class. Does not apply to tape (use default).

Compaction – Specify whether or not data compaction should be used for data sets assigned to this data class. Improved Data Recording Capability (IDRC) uses a binary arithmetic compression algorithm and is used with 3490 MEDIA1 and MEDIA2 cartridges. A modified and more efficient Ziv-Lempel algorithm (IBMLZ1) is used with 3590 MEDIA3 and MEDIA4 cartridges. We recommend always setting the compaction to Y, even when you use a VTS. The compaction attribute overrides the system default, located in PARMLIB member DEVSUPxx, but is overridden by JCL specification TRTCH. The valid data class values for the compaction attribute are Y, N, or blank.

Media Type – Specify the tape cartridge type used for data sets associated with this data class. If this field is not specified (is blank), the library that has the most SCRATCH cartridges is selected, then a media type in a drive that has an active ICL is selected. This field is optional. However, we recommend that you specify MEDIA3/MEDIA4 or MEDIA2 for large tape data sets and use MEDIA1 for smaller files if you have mixed types of hardware. If you use a VTS, you must verify the type of logical volumes you have defined on the library manager and select MEDIA accordingly. See 8.1.5, “MEDIA Considerations” on page 284 for data migration considerations.

Recording Technology – Specify the number of tracks on tape cartridges used for data sets associated with this data class. This field is optional unless MEDIA TYPE is specified. MEDIA2 is recorded only in 36-track mode, and MEDIA3/MEDIA4 in 128-track mode. Table 3 on page 27 shows media and recording technology compatibility.

Note: Remember that the data class ACS routine is driven for both system-managed and non-system-managed data sets.

5.1.10 Define Storage Classes

A data set is system-managed only when a storage class is assigned to it. For tape data sets, specialized performance and availability services are not required (see Figure 72 on page 149).

```
  Panel  Utilities  Scroll  Help
------------------------------------------------------------------------------
                              STORAGE CLASS DEFINE              Page 1 of 2
Command ===>

SCDS Name . . . . . : SMS.SCDS
Storage Class Name  : SCTAPLCL
To DEFINE Storage Class, Specify:
  Description ==>
              ==>
  Performance Objectives
   Direct Millisecond Response . . . .             (1 to 999 or blank)
   Direct Bias . . . . . . . . . . . .             (R, W or blank)
   Sequential Millisecond Response . .             (1 to 999 or blank)
   Sequential Bias . . . . . . . . . .             (R, W or blank)
   Initial Access Response Seconds . .             (0 to 9999 or blank)
   Sustained Data Rate (Mb/sec)  . . .             (0 to 999 or blank)
  Availability . . . . . . . . . . . . N           (C, P, S or N)
  Accessibility  . . . . . . . . . . . N           (C, P, S or N)
   Backup  . . . . . . . . . . . . . .             (Y, N or Blank)
   Versioning  . . . . . . . . . . . .             (Y, N or Blank)

Use ENTER to Perform Verification; Use DOWN Command to View next Page;
Use HELP Command for Help; Use END Command to Save and Exit; CANCEL to Exit.
```

Figure 72. ISMF Panel: Storage Class Define (Page 1 of 2)

You can define the storage class with defaults, because none of the attributes applies to system-managed tape. The one and only purpose of STORCLAS is to drive the ACS routines and assign a STORGROUP with connected tape libraries to the data set being allocated.

If you do not want a data set to be system-managed, such as a data set that belongs to a job with special requirements, you can assign a null ('') storage class by ACS routine filtering.

If you have a VTS subsystem installed and use native 3490 drives within the library, we recommend using the STORCLAS as a means of distinguishing between native and emulated drives. The STORCLAS would then allow you to influence allocation by using simple ACS routines. Should you want to migrate a given subset of tape data to VTS, you only have to define another STORGROUP for the respective STORCLAS.

5.1.11 Define Management Classes

As no management class attributes are available for tape cartridges, defining management classes is optional and not recommended.

1. Choose Option 3 (Management Class) on the ISMF PRIMARY OPTION MENU panel to display the MANAGEMENT CLASS APPLICATION SELECTION panel.
2. On that panel, specify the Management Class Name.
3. Choose Option 3 (DEFINE) on the panel to display the MANAGEMENT CLASS DEFINE panel shown in Figure 73 on page 150.

```
  Panel  Utilities  Scroll  Help
------------------------------------------------------------------------------
                         MANAGEMENT CLASS DEFINE               Page 1 of 5
Command ===>

SCDS Name . . . . . . . : SMS.SCDS
Management Class Name : MCTAPE

To DEFINE Management Class, Specify:

  Description ==>
              ==>

  Expiration Attributes
    Expire after Days Non-usage  . . NOLIMIT     (1 to 9999 or NOLIMIT)
    Expire after Date/Days . . . . . NOLIMIT     (0 to 9999, yyyy/mm/dd or
                                                 NOLIMIT)

  Retention Limit  . . . . . . . . . NOLIMIT     (0 to 9999 or NOLIMIT)



Use ENTER to Perform Verification; Use DOWN Command to View next Panel;
Use HELP Command for Help; Use END Command to Save and Exit; CANCEL to Exit.
```

Figure 73. ISMF Panel: Management Class Define (Page 1 of 5)

The SCDS Name and Management Class Name are output fields that you specified in the MANAGEMENT CLASS APPLICATION SELECTION panel.

Expiration Attributes – The attributes are required values that indicate when a data set becomes eligible for expiration. They have no impact on tape data.

Retention Limit – This is a required value that limits the use of retention period (RETPD) and expiration date (EXPDT) values. RETPD and EXPDT are:

- Explicitly specified in JCL
- Derived from data class definitions

If the value of a user-specified RETPD or EXPDT is within the Retention Limit value, it is saved for the data set. If values specified by end users or the Expiration Attributes values exceed the Retention Limit value, the Retention Limit is saved. If the Retention Limit is 0, any user-specified or data class values are ignored, and the Expiration Attributes of the management class are used.

We recommend using the tape management system to control the retention policy and assigning no management class, or assigning a management class Retention Limit of NOLIMIT.

Note: If you are using DFSMSrmm, you can use the management class name to select vital record specifications (VRSs) for the cartridge.

5.1.12 Defining Storage Groups

The storage group type TAPE is provided to classify tape cartridges in DFSMS. A tape storage group consists of tape libraries and the tape cartridges associated with them. A tape storage group can contain one to eight tape libraries specified by their library name, and one tape library can contain more than one tape storage group. Figure 74 shows these possibilities.

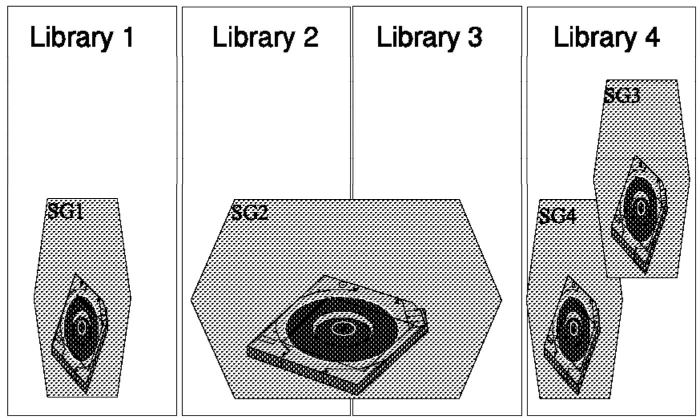


Figure 74. Relationship between Libraries and Storage Groups

1. Choose Option 6 (Storage Group) on the ISMF PRIMARY OPTION MENU to display the STORAGE GROUP APPLICATION SELECTION menu, as shown in Figure 75.

```
  Panel  Utilities  Help
------------------------------------------------------------------------------
                     STORAGE GROUP APPLICATION SELECTION
Command ===>

To perform Storage Group Operations, Specify:
  CDS Name  . . . . . . . 'SMS.SCDS'
                                (1 to 44 character data set name or 'Active' )
  Storage Group Name  . . SGTAPLCL          (For Storage Group List, fully or
                                            partially specified or * for all)
  Storage Group Type  . . TAPE              (VIO, POOL, DUMMY, OBJECT, OBJECT
                                            BACKUP, or TAPE)

Select one of the following options  :
  1  1. List    - Generate a list of Storage Groups
     2. Define  - Define a Storage Group
     3. Alter   - Alter a Storage Group
     4. Volume  - Display, Define, Alter or Delete Volume Information

If List Option is chosen,
   Enter "/" to select option      Respecify View Criteria
                                   Respecify Sort Criteria
Use ENTER to Perform Selection;
Use HELP Command for Help; Use END Command to Exit.
```

Figure 75. ISMF Panel: Storage Group Application Selection

2. On that panel, specify the Storage Group Name and a Storage Group Type (TAPE in our case).

3. Choose Option 2 (Define) to display the TAPE STORAGE GROUP DEFINE panel, as shown in Figure 76 on page 152.

```
  Panel  Utilities  Help
------------------------------------------------------------------------------
                         TAPE STORAGE GROUP DEFINE
Command ===>

SCDS Name . . . . . : SMS.SCDS
Storage Group Name  : SGTAPLCL

To DEFINE Storage Group, Specify:

  Description ==> My local tape library
              ==>

  Library Names  (1 to 8 characters each):
    ===> LIBLCL    ===>           ===>           ===>
    ===>           ===>           ===>           ===>



===> DEFINE SMS Storage Group Status . .... N  (Y or N)


Use ENTER to Perform Verification and Selection;
Use HELP Command for Help; Use END Command to Save and Exit; CANCEL to Exit.
```

Figure 76. ISMF Panel: Tape Storage Group Define

Figure 77 shows the panel that results from specifying *Y* for the DEFINE SMS Storage Group Status field in Figure 76.

```
  Panel  Utilities  Scroll  Help
------------------------------------------------------------------------------
                      SMS STORAGE GROUP STATUS DEFINE
Command ===>

SCDS Name  . . . . : SMS.SCDS
Storage Group Name : SGTAPE
Storage Group Type : TAPE
To DEFINE Storage Group System/                              ( Possible SMS SG
Sys Group Status, Specify:                                  Status for each:
                                                            - Pool SG Type
 System/Sys      SMS SG    System/Sys      SMS SG             NOTCON, ENABLE
 Group Name      Status    Group Name      Status             DISALL, DISNEW
 ----------      ------    ----------      ------             QUIALL, QUINEW
 MVS1       ===> ENABLE    MVS2       ===> ENABLE           - Tape SG Type
 *SYSPLX1   ===> NOTCON               ===>                    NOTCON, ENABLE,
            ===>                      ===>                    DISALL, DISNEW )
            ===>                      ===>
            ===>                      ===>                  * SYS GROUP = sysplex
            ===>                      ===>                    minus Systems in the
            ===>                      ===>                    Sysplex explicitly
            ===>                      ===>                    defined in the SCDS
Use ENTER to Perform Verification; Use DOWN Command to View next Panel;
Use HELP Command for Help; Use END Command to Save and Exit; CANCEL to Exit.
```

Figure 77. ISMF Panel: SMS Storage Group Status Define

Description – This is a 120-byte field that allows you to enter a description of the tape storage group you are creating. There are no restrictions on its content.

Library Names – Use this field to specify the name of the tape library or libraries to which the cartridges will be assigned. A value must appear in this field to generate a new list. An * or the last used value is displayed for this field.

DEFINE SMS Storage Group Status – Use this field to indicate that the SMS Storage Group Status Define panel is to be displayed after the Enter key is pressed. Up to 32 systems can be enabled to the storage group; additional systems are on page 2 of 2.

System/Sys Group Name – The column lists the names of systems known to SMS through the base configuration definition.

SMS SG STATUS – Use this field to define or alter the relationship between the storage group and each system in the same SMSplex. Normally, you should specify ENABLE for all systems that are going to use the IBM 3494. A storage group can share up to 32 systems, and each system must be physically connected to the storage devices in its group. To change the status of a system, type one of the values described.

Note: When a PRIVATE cartridge is entered into the library, and the cartridge entry exit (CBRUXENT) does not supply a storage group name, OAM sets the storage group name to blank. The blank storage group name is enabled on all systems within the SMSplex.

For considerations on sharing and partitioning tape storage groups among systems in an SMSplex, see the *Guide to Sharing and Partitioning IBM Tape Library Dataservers*.

Care must be taken when multiple libraries are to be connected to the same storage group. The algorithm used to select a library and drive takes into account the following information at time of allocation:

1. A list of tape device pools is built for all tape libraries belonging to the storage group.

   A device pool is a collection of tape drives attached to one controller that is part of a system-managed tape library.

2. Based on SMS DATACLAS attributes for MEDIA for this allocation, drives that cannot satisfy the request are removed from the list.

3. The preferred tape device pools belong to tape libraries that are above their scratch volume threshold.

4. Drives with an active cartridge loader of the appropriate media type get a high priority.

5. The ordered list of tape device pools is used to select the tape drive, thus randomizing the library selection.

Not considered in the allocation process are:

- Number of available drives inside the library, as long as there are enough drives to satisfy the total number of concurrent allocation requests
- Number of available scratch cartridges, as long as the library is above the defined threshold

- Busy condition of control unit or accessor
- Busy condition of VTS subsystem or its components

5.1.13 Write ACS Routines

To direct new tape allocations to an IBM 3494 tape library, you have to update your ACS routines. For system-managed DASD, new data sets that have a storage class assigned are allocated to system-managed devices.

Refer to *DFSMS/MVS Implementing System-Managed Storage* for more information about implementation and activation of SMS. We cover only those steps necessary to implement system-managed tape.

You can use ACS routines to direct a new data set to a storage group according to the ACS variables and SMS constructs you have created. An active configuration must have only one set of ACS routines. To update ACS routines, choose Option 7, Automatic Class Selection, from the ISMF PRIMARY OPTION MENU panel. The ACS APPLICATION SELECTION panel appears; select Option 1, Edit, on the panel and press Enter to update ACS the routines.

In Table 21 through Table 24, we present sample attributes for data classes, storage groups, management classes, and storage classes used in the ACS routine examples in the next section.

Table 21. Sample Data Class Attributes

Data Class Name	**DCTAPEX**	**DCTAPSM**	**DCTAPLR**	**DCTAPMG**
COMPACTION	NO	YES	YES	YES
MEDIA TYPE	1	1	2	3
REC. TECHNOLOGY	36	36	36	128

Table 22. Sample Storage Group Attributes

Storage Group Name	**SGTAPLCL**	**SGTAPRMT**
Library Name	LIBLCL	LIBRMT
Accessible systems	MVS1,MVS2	MVS1,MVS2

Table 23. Sample Management Class Attributes

Management Class Name	**MCTAPE**
RETENTION LIMIT	NOLIMIT

Table 24. Sample Storage Class Attributes

Storage Class Name	**SCTAPLCL/SCTAPRMT**
AVAILABILITY	NOPREF
ACCESSIBILITY	NOPREF
GUARANTEED SPACE	NO
GUARANTEED SYNCHRONOUS WRITE	NO

For the ACS routines, we made the following assumptions:

- 3490E and 3590 subsystems are configured in an IBM 3494.
- MEDIA1, MEDIA2, MEDIA3, 36-track and 128-track read/write are possible.

- Tape mount management (TMM) methodology is not included.
- DASD DFSMS is not described.
- The libraries contain DFSMShsm-owned data.

5.1.13.1 Data Class ACS Routine

The data class ACS routine (Figure 78) is driven for both system-managed and non-system-managed data sets. NON-IDRC should be specified on data sets used by applications that invoke the READ BACKWARDS commands or data sets that are shipped to facilities that do not have IDRC-capable drives. Refer to 8.1.5, “MEDIA Considerations” on page 284 for more information about this topic.

```
PROC DATACLAS
/****************************************************/
/* DEFINE TAPE DATA SETS FILTERING CATEGORY         */
/****************************************************/

FILTLIST CSTTAPE INCLUDE('3490',348%,'3590','CART','LIBLCL')

FILTLIST LARGE_TAPE INCLUDE(GSNATE.*.DBSAV*,
                            **.*TAG*.**,
                            ADA%.SAVE.**)

FILTLIST VITALREC INCLUDE(**.LEGAL.**)

FILTLIST EXCHANGE INCLUDE(PORTABLE.**,CITI*.**,SWISSBNK.CORP.**)

FILTLIST HSM     INCLUDE(*.HMIGTAPE.DATASET,
                         *.BACKTAPE.DATASET)

FILTLIST HSMCOPY  INCLUDE(*.COPY.HMIGTAPE.DATASET,
                          *.COPY.BACKTAPE.DATASET)

FILTLIST DUMPATL INCLUDE(*.DMP.*.V*.D*.T*)
                 EXCLUDE(*.DMP.OUTLIB.V*.D*.T*)

FILTLIST PGMATL INCLUDE('ADRDSSU',I%%GENER)

FILTLIST ABARS INCLUDE(outputdatasetprefix.%.C%%V%%%%)

FILTLIST TAPEDC INCLUDE(DCTAP*)

FILTLIST TAPESC INCLUDE(SCTAP%%%)

/***************************************************/
/* SELECT DATA CLASS FOR DATA SET GOOD FOR ATL     */
/***************************************************/

SELECT
  WHEN (&DATACLAS = &TAPEDC && &UNIT = &CSTTAPE)
    DO
      SET &DATACLAS = &DATACLAS    /* Allow users to specify */
```

Figure 78 (Part 1 of 2). Sample Data Class ACS Routine

```
        EXIT                         /* data class for tape */
      END

    WHEN (&UNIT = 'LIBLCL')
      DO
        SET &DATACLAS = DCTAPLR      /* Allow users to specify */
                                     /* unit for atls */
        WRITE 'DC: DEFAULT DC ASSIGNED DUE TO ATL UNIT SPECIFICATION'
        EXIT
      END

    WHEN (&UNIT = &CSTTAPE)
      DO
        SELECT
          WHEN (&DSN = &LARGE_TAPE | &DSN = DFSMShsm | &DSN = &HSMCOPY)
             DO
               SET &DATACLAS = 'DCTAPLR'
               EXIT
             END
          WHEN ( &DSN = &DUMPATL | &DSN = &ABARS)
            DO
              SET &DATACLAS = 'DCTAPSM'
              EXIT
            END

          WHEN ( &PGM = &PGMATL )
            DO
              SET &DATACLAS = 'DCTAPLR'    /* Route        */
              EXIT                         /* specified pgms  */
            END                            /* to atl    */

          WHEN (&DSN = &EXCHANGE )
            DO
              SET &DATACLAS = 'DCTAPEX'
              EXIT
            END
          END
      END

   /*********************************************************/

   OTHERWISE
      DO
        SET &DATACLAS = ''
        EXIT
      END
   END
END
```

Figure 78 (Part 2 of 2). Sample Data Class ACS Routine

5.1.13.2 Storage Class ACS Routine

If you do not want data sets to be system-managed, you can assign a null ('') storage class to them by ACS routine filtering. Because the disposition processing for tape data sets is not changed with system-managed tape, the DISP parameter affects the entry point to the ACS routines. Figure 79 shows a sample storage class routine.

```
PROC STORCLAS
/***************************************************/
/* DEFINE TAPE DATA SETS FILTERING CATEGORY        */
/***************************************************/

/*ALL FILTERLISTS COPIED FROM DATACLAS ROUTINE TO   */
/*ENSURE CONSISTENCY                                */

FILTLIST CSTTAPE INCLUDE('3490',348%,'3590','CART','LIBLCL')

FILTLIST LARGE_TAPE INCLUDE(GSNATE.*.DBSAV*,
                            **.*TAG*.**,
                            I0000.**.SARTAPE.T*)

FILTLIST VITALREC INCLUDE(**.LEGAL.**)

FILTLIST EXCHANGE INCLUDE(PORTABLE.**,CITI*.**,SWISSBNK.CORP.**)

FILTLIST HSM     INCLUDE(*.HMIGTAPE.DATASET,
                         *.BACKTAPE.DATASET)

FILTLIST HSMCOPY  INCLUDE(*.COPY.HMIGTAPE.DATASET,
                          *.COPY.BACKTAPE.DATASET)

FILTLIST DUMPATL INCLUDE(*.DMP.*.V*.D*.T*)
                 EXCLUDE(*.DMP.OUTLIB.V*.D*.T*)

FILTLIST PGMATL INCLUDE('ADRDSSU',I%%GENER)

FILTLIST ABARS INCLUDE(outputdatasetprefix.%.C%%V%%%%)

FILTLIST TAPEDC INCLUDE(DCTAP*)

FILTLIST TAPESC INCLUDE(SCTAP%%%)


/***************************************************/
/* SELECT STORAGE CLASS FOR DATA SET GOOD FOR 3494  */
/***************************************************/

SELECT


  WHEN (&DSN = &HSMCOPY | &DSN = &DUMPATL) DO
```

Figure 79 (Part 1 of 2). Sample Storage Class ACS Routine

```
      SET &STORCLAS = 'SCTAPRMT'
      EXIT
    END

    WHEN (&DSN = DFSMShsm )
      DO
        SET &STORCLAS = 'SCTAPLCL'
        EXIT
      END

    WHEN (&DATACLAS = DCTAP* )
      DO
        SET &STORCLAS = 'SCTAPLCL'
        EXIT
      END

  /****************************************************/
  /* ABARS OUTSIDE Tape Library                              */
  /****************************************************/

     WHEN (&DSN = &ABARS)
       DO
        SET &STORCLAS = ''
        EXIT
      END

  /****************************************************/
  /* WE DO NOT INTEND MANAGE ANYTHING ELSE           */
  /****************************************************/

      OTHERWISE
        DO
          SET &STORCLAS = ''
          EXIT
        END
     END        /* END OF DATA SET SELECTION              */
  END           /* END OF STORAGE CLASS PROC FOR DATA SET */
```

Figure 79 (Part 2 of 2). Sample Storage Class ACS Routine

5.1.13.3 Management Class ACS Routine

The management class ACS routine (see Figure 80 on page 159) has very limited function. Its intent is solely to assign a MGMTCLAS to each tape allocated under system-managed tape. For detailed coverage of how MGMTCLAS works with system-managed tape, see Figure 73 on page 150.

```
PROC MGMTCLAS
/***************************************************/
/* DEFINE TAPE DATA SETS FILTERING CATEGORY        */
/***************************************************/


/***************************************************/
/* SELECT MGMT CLASS FOR DATA SET GOOD FOR 3494  */
/***************************************************/

SELECT
  WHEN (&DATACLAS = DCTAP* ) DO
    SET &MGMTCLAS = 'MCTAPE'
    EXIT
  END

/***************************************************/
/* WE DO NOT INTEND MANAGE ANYTHING ELSE           */
/***************************************************/

    OTHERWISE
      DO
        SET &MGMTCLAS = ''
        EXIT
      END
   END        /* END OF DATA SET SELECTION              */
END           /* END OF MGMT CLASS PROC FOR TAPE DATA SET */
```

Figure 80. Sample Management Class ACS Routine

5.1.13.4 Storage Group ACS Routine

The storage group ACS routine (see Figure 81 on page 160) determines the tape cartridge group and the library name group for a data set. If the user requests OS/390 to catalog the data set, unlike DASD, the data set is cataloged at disposition time, rather than at allocation time.

```
PROC STORGRP

/****************************************************/
/* DEFINE TAPE DATA SETS FILTERING CATEGORY        */
/*****************************************************/

/* Since all filtering is done in the SC routine, no */
/* additional code is needed                         */

/*****************************************************/
/* DETERMINE STORAGE GROUP FOR DATA SET GOOD FOR ATL */
/*****************************************************/

SELECT

   WHEN (&STORCLAS = 'SCTAPLCL')
     DO
       SET &STORGRP = 'SGTAPLCL'
       EXIT
     END

   WHEN (&STORCLAS = 'SCTAPRMT')
     DO
       SET &STORGRP = 'SGTAPRMT'
       EXIT
     END


END        /* END OF DATA SET SELECTION */
END        /* END SG PROC                */
```

Figure 81. Sample Storage Group ACS Routine

5.1.14 Translate and Validate ACS Routines

After updating the ACS routines, you translate them into executable form. A successful translation places the ACS routine object in the SCDS you specified.

After translation has been successfully completed and syntax checking has been performed, you validate your routines against the constructs and libraries defined. You can validate an entire SCDS or a specific set of constructs within an SCDS, by selecting Option 3 from the ACS APPLICATION SELECTION panel. In the SCDS Name field, specify the name of your SCDS. Enter an asterisk in the ACS Routine Type field to indicate that you want to validate the entire SCDS. The validation process reports any logical errors and, if not successful, prevents the configuration from being activated.

5.1.15 Test ACS Routines

You can write and execute test cases, using Option 4 in ACS APPLICATION SELECTION panel. The input test cases are saved in a partitioned data set. You can edit its contents directly without going through the panels. Just add the variables as you use them in the ACS routines. An example is provided in Figure 82 on page 161.

We recommend that you prepare a set of test cases for all applications that are system managed on either DASD or tape. Using this kit of test cases, you can verify the logic of your ACS routines after introducing changes and updates. In this way errors can be detected before you activate a new configuration and run into any trouble that might affect your production environment. Refer to 8.1.2, “Testing ACS Logic with NaviQuest” on page 275 for additional information about testing ACS routines.

```
DESCRIPTION1:
TESTCASE FOR HSM DATA
DSN: HSM.HMIGTAPE.DATASET
ACSENVIR: ALLOC
PGM: ARCCTL
UNIT: 3490
LABEL: SL
FILENUM: 1
```

Figure 82. ACS Test Sample Member

The result of checking the specified input against the SCDS you are about to test looks somewhat like the ACS TESTING RESULTS panel shown in Figure 83:

```
                               ACS TESTING RESULTS

CDS NAME         : SMS.SCDS0
ACS ROUTINE TYPES: DC SC MC SG
ACS TEST LIBRARY : SMS.TESTCASES.DATA

  ACS TEST
  MEMBER       EXIT CODE   RESULTS
  ---------    ----------  ------------------------------------
  NONLIB1               0  DC = NULL VALUE ASSIGNED
    MSG : ANY-MESSAGE-YOU-WRITE-IN-THE-ACS-ROUTINES
                        0  SC = NULL VALUE ASSIGNED
    NOTE: MC AND SG NOT EXECUTED WHEN ACS READ/WRITE VARIABLE STORCLAS = ''

  TAPE1                 0  DC = DCTAPLR
                        0  SC = SCTAPLCL
                        0  MC = MCTAPE
                        0  SG = SGTAPLCL

  TAPE2                 0  DC = DCTAPSM
                        0  SC = SCTAPRMT
                        0  MC = MCTAPE
                        0  SG = SGTAPRMT
```

Figure 83. ISMF Panel: ACS Testing Results

5.1.16 Activate SMS Configuration and Start OAM

You must activate the SMS configuration before you can start to use your IBM 3494 tape library. Activating an SCDS validates its contents and copies the contents into the ACDS specified in IGDSMSxx. If the SCDS is not valid, activation fails.

Note: If you are activating another SCDS or reactivating the current SCDS while OAM is running, OAM will restart. During this reinitialization, all IBM 3494 tape libraries are set either offline or online according to the attributes defined in the active SCDS.

5.1.17 Inventory and Insert Processing

During initial installation, you must start an inventory operation from the library manager console to have all of the cartridge storage cells inspected and all existing volume labels and locations stored in the library manager database. This is part of the initial installation process. If you later insert volumes into the IBM 3494 tape library, they are inventoried.

During inventory processing, all volumes are placed in the library manager INSERT category (FF00). OAM requests information about volumes in the INSERT category as soon as the IBM 3494 tape library comes online for the first time. Regular insert processing then takes place. If the TCDB does not contain a volume record for a volume processed, the volume record is created according to information from:

- DFSMSrmm, provided through the CBRUXENT installation wide exit
- The library manager for the media type
- The default data class specified in the ISMF library definition.

Refer to 9.7, "Library Inventory" on page 297 for operational considerations regarding inventory.

Note: Before you vary the IBM 3494 tape library online, make sure the tape management system is active and the tape management system control data set is loaded with all tapes in your tape library, because the TCDB is updated with information (such as SCRATCH or PRIVATE) from your tape management system control data set through CBRUXENT.

5.1.18 Tape Management System Considerations

The tasks to be performed to integrate the IBM 3494 tape library vary according to the tape management system you are going to use. If you are using a vendor tape management system, the primary source of information about how to set up the tape management system software should be provided by the vendor's support organization. Ask for the support available for the IBM 3494 tape libraries and the software level needed for that support. Most vendors have this information available.

DFSMSrmm is the tape management component of DFSMS/MVS. It is optional and is enabled in the IGDDFPKG member of PARMLIB.

You will find some hints on DFSMSrmm and the 3494 in 7.2, "DFSMSrmm Customization" on page 225

For detailed information refer to the *DFSMS/MVS DFSMSrmm Implementation and Customization Guide* and the *DFSMS/MVS DFSMSrmm Guide and Reference*.

5.1.19 JES3 Support for System Managed Tape

In this section we describe JES3 IBM 3494 tape library support with DFSMS/MVS. The primary purpose of this support is to maintain JES3 resource allocation and sharing for tape allocations. For detailed information, see the *OS/390 JES3 Initialization and Tuning Reference*.

DFSMS/MVS has support that provides JES3 allocation with the appropriate information to select an IBM 3494 tape library device. This is done by referencing device strings with a common name among systems within a JES3 complex.

The following setups are required in the JES3 initialization deck:

1. Define all devices in the IBM 3494 tape libraries through DEVICE statements.
2. Set JES3 device names through the SETNAME statement.
3. Define which device names are subsets of other device names through the HWSNAME statement.

JES3 device, volume, and data set allocation are still supported for the IBM 3494 tape library allocations. However, volume verification is deferred until job execution. JES3 selects devices in the IBM 3494 tape library when a data set is system-managed.

All IBM 3494 tape library units can be shared between processors in a JES3 complex and must be shared among systems within the same SMSplex. Tape drives in the IBM 3494 tape library cannot be used by JES3 dynamic support programs (DSPs).

The device pools or tape subsystems are used internally much like an esoteric device group but have no meaning to end users. The device pool characteristics are:

- A string of tape drives is attached to a single 3490 control unit.
- All devices have the same device type, either 3490 or 3490E.
- Up to four device pools can be contained in an IBM Automated Tape Library Dataserver.

The device pool is used to assign UNITNAMEs on the IBM 3494 tape library for JES3 allocation.

5.1.19.1 Library Device Groups

Library device groups (LDGs) isolate the IBM 3494 tape library drives from other tape drives in the complex and allow JES3 main device scheduler (MDS) allocation to select an appropriate set of library-resident tape drives.

The DFSMS/MVS JES3 support requires that LDGs be defined to JES3 for SETNAME groups and HWSNAME names in the JES3 initialization statements. Before the devices are defined within a library to JES3, they must be properly defined to OS/390 through the HCD. Unlike a JES2 environment, a JES3 operating environment requires the specification of esoteric unit names for the devices within a library. These unit names are used in the required JES3 initialization statements. The device pool name list is used to select the LDG name.

The rules for defining the LDG names are:

1. All library drives within a complex use the same library name. This complexwide library name must be **LDGW3495**.

   Note: This name will always be LDGW3495, regardless of whether you have installed an IBM 3494, an IBM 3495, or both.

2. All tape drives within each library use the same name. It is a library-specific name that consists of *LDG* plus the five-digit IBM 3494 tape library hardware library ID. See 5.1.7, "Define the Library" on page 142, to see where to find the library ID.

   Note: The library ID is very important. It is required for the definition of JES3 UNITNAMEs and for the SETNAME and HWSNAME statements. An example of a real library ID is F4006.

3. All library drives of a specific device type within a complex use the same device name. This complexwide device-type name must be composed of the *LDG* prefix followed by either *3490*, *3490E*, or *3591*.

4. All library drives of a specific device type within each library use the same name. The library-specific device type name must be composed of the *LDE* prefix followed by the library ID number for 3490E drives in a library, the *LDD* prefix followed by the library ID number for 3490 base drives in a library, or the *LDB* prefix followed by the library ID number for 3590 drives in a library.

5.1.19.2 JES3 Support Requirements

The following steps are required in the JES3 initialization stream:

1. Define all devices in the libraries through DEVICE statements. All IBM 3494 tape library tape drives within a complex should be either JES3 managed or non-JES3 managed. Do not mix managed and nonmanaged devices because mixing may prevent the nonmanaged devices from being used for new data set allocations and reduce device eligibility for existing data sets. Allocation failures or delays in job setup result.

2. Define HWSNAME and SETNAME statements. These statements require the special UNITNAME definitions for the IBM 3494 tape library. During converter/interpreter (C/I) processing for a job, the LDG names are passed to JES3 by DFSMS/MVS for use by MDS in selecting library tape drives for the job.

Neither JES3 nor DFSMS/MVS verifies that a complete and accurate set of initialization statements is defined to the system. Incomplete or inaccurate IBM 3494 tape library definitions may result in jobs failing to be allocated.

Existing tape JCL does not require changes. For IBM 3494 tape library data sets, any "UNIT=" specified in the JCL is ignored. Because only DFSMS/MVS determines eligible LDG names at converter time, LDG names should not be used in JCL. Specifying an LDG name in JCL results in an allocation failure for nonlibrary data sets.

5.1.19.3 Configuration Example

Figure 84 on page 165 shows a JES3 triplex with two 3494 tape libraries attached to it. Library 1 has a library ID of F4006 and 3490E tape drives only. Library 2 has a library ID of F4001 and 3490 and 3490E tape drives.

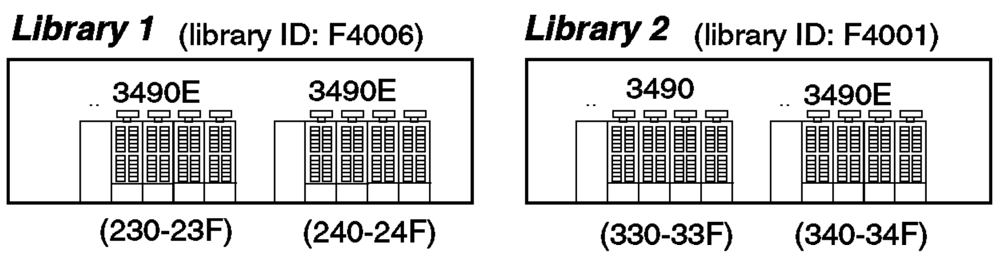


Figure 84. 3495 JES3 Configuration Example

5.1.19.4 OS/390 UNITNAMEs for JES3 Configuration

OS/390 UNITNAMEs are required for all IBM 3494 tape library LDGs. As discussed in 5.1.19.1, "Library Device Groups" on page 163, the rules for possible LDG names for the configuration example are:

- The complexwide name, *LDGW3495*, includes all devices in all libraries.
- The library-specific names, *LDGF4006* and *LDGF4001*, include devices in their respective libraries.
- The complexwide device type names, *LDG3490* and *LDG3490E*, include all devices of the same type in all libraries.
- The library-specific device type names, *LDDF4001*, *LDEF4001*, and *LDEF4006*, include all devices of the same type within their respective libraries.

Table 25 on page 165 shows the OS/390 UNITNAMEs and the address ranges in the configuration example for each name.

Table 25. OS/390 UNITNAMEs and Device Address Ranges

UNITNAME	**Device Address Range**
LDGW3495	230-23F, 240-24F, 330-33F, 340-34F
LDGF4006	230-23F, 240-24F
LDGF4001	330-33F, 340-34F
LDG3490	330-33F
LDG3490E	230-23F, 240-24F, 340-34F
LDDF4001	330-33F
LDEF4001	340-34F
LDEF4006	230-23F, 240-24F

5.1.19.5 Define I/O Devices for IBM 3494 Tape Libraries

Use the DEVICE format to define a device so that JES3 can use it. A device statement must be defined for each string of IBM 3494 tape library drives in the complex. In the example in Figure 85 on page 166, all devices available in the two libraries must be defined to JES3.

```
*/  Devices 230 to 23F --- and --- 240 to 24F .................../*

 DEVICE,XTYPE=(LB13490E,CA),XUNIT=(230,MVS1,S3,OFF,230,MVS2,S3,OFF,230,MVS3,S3,OFF)
               ⇕                   ⇕
 DEVICE,XTYPE=(LB13490E,CA),XUNIT=(24F,MVS1,S3,OFF,24F,MVS2,S3,OFF,24F,MVS3,S3,OFF)


*/  Devices 330 to 33F ........................................./*

 DEVICE,XTYPE=(LB23490,CA),XUNIT=(330,MVS1,S3,OFF,330,MVS2,S3,OFF,330,MVS3,S3,OFF)
               ⇕                  ⇕
 DEVICE,XTYPE=(LB23490,CA),XUNIT=(33F,MVS1,S3,OFF,33F,MVS2,S3,OFF,33F,MVS3,S3,OFF)


*/  Devices 340 to 34F ........................................./*

 DEVICE,XTYPE=(LB23490E,CA),XUNIT=(340,MVS1,S3,OFF,340,MVS2,S3,OFF,340,MVS3,S3,OFF)
               ⇕                   ⇕
 DEVICE,XTYPE=(LB23490E,CA),XUNIT=(34F,MVS1,S3,OFF,34F,MVS2,S3,OFF,34F,MVS3,S3,OFF)
```

Figure 85. DEVICE Statement Sample

Note: IBM 3494 tape library tape drives cannot be used as support units by JES3 DSPs. Therefore, do not specify DTYPE, JUNIT, and JNAME parameters on the DEVICE statements. No check is made during initialization to prevent IBM 3494 tape library drives from being defined as support units, and no check is made to prevent the drives from being allocated to a DSP if they are defined. Any attempt to call a tape DSP by requesting an IBM 3494 tape library fails because the DSP is unable to allocate an IBM 3494 tape library drive.

5.1.19.6 Set JES3 Device Names

Use the SETNAME format to specify relationships between user-specified names and device-type names associated with MDS-managed devices. A SETNAME statement must be defined for each XTYPE in device statements. The rules for LDG SETNAME statements (see Figure 86) are:

- The complexwide library name must be included in all statements.
- A library-specific name must be included for XTYPEs within the referenced library.
- The complex device type name must be included for all XTYPEs of the corresponding device type in the complex.
- A library-specific device type name must be included for the XTYPE associated with the devices within the library.

```
SETNAME,XTYPE=LIB3490E,
       NAMES=(LDGW3495,LDGF4006,LDG3490E,LDEF4006)
                  ↓       ↓         ↓        ↓
             Complex   Library   Complex   Library
             Wide      Specific  Wide      Specific
             Library   Library   Device    Device
             Name      Name      Name      Name
```

Figure 86. SETNAME Rules

Note: Do not specify esoteric and generic unit names such as 3480, 3480X, 3490, SYS3480R, and SYS348XR. Also, never use esoteric names such as TAPE and CART.

The SETNAME statements for devices in LIBRARY1 and LIBRARY2 are required for proper allocation of units in the IBM 3494 tape library. Three XTYPEs are required because of the two different device types in one of the two libraries. XTYPE has to be a unique name that can be used to refer to the specific device group. The definitions are shown in Figure 87.

```
SETNAME,XTYPE=(LB13490E,CA),NAMES=(LDGW3495,LDGF4006,LDG3490E,LDEF4006)

SETNAME,XTYPE=(LB23490,CA),NAMES=(LDGW3495,LDGF4001,LDG3490,LDDF4001)

SETNAME,XTYPE=(LB23490E,CA),NAMES=(LDGW3495,LDGF4001,LDG3490E,LDEF4001)
```

Figure 87. SETNAME Definition Sample

5.1.19.7 High Watermark Setup Names

Use the HWSNAME format (see Figure 88) to define which device names are subsets of other device names,

```
HWSNAME,TYPE=(groupnam{,altnam}...)
```

Figure 88. HWSNAME Rules

where:

groupnam Specifies a device type valid for high watermark setup.

altnam Specifies a list of valid user-supplied or IBM-supplied device names. These are alternate units to be used in device selection.

The rules for LDG HWSNAME statements are:

- The complexwide library name, *LDGW3495*, must include all other LDG names as alternates.
- The library-specific name, *LDGF4006*, must include all LDG names for the corresponding library as alternates. When all tape devices of a type within the complex are within a single IBM 3494 tape library, the complex device type name must also be included as an alternate name.
- The complex device type name, *LDG3490* or *LDG3490E*, must include all library-specific device type names. When all devices of one type in the complex are within a single IBM 3494 tape library, the complex device type name is equivalent to that library name. In this case, the library name should also be specified as an alternate.
- The library-specific device type name, *LDEF4001* or *LDDF4001*, must be included. Alternate names can be specified as follows:
  - When all drives within the IBM 3494 tape library have the same device type, the library-specific device type name is equivalent to the library name. In this case, the library-specific name should be specified as an alternate.
  - When these are the only drives of this type in the complex, the complex device type name is equivalent to the library-specific device type name.

Make sure that all valid alternate names are specified.

Figure 89 on page 168 shows a sample HWSNAME definition.

```
HWSNAME,TYPE=(LDGW3495,LDGF4006,LDGF4001,LDEF4006,LDEF4001,
                LDDF4001,LDG3490,LDG3490E)

HWSNAME,TYPE=(LDGF4006,LDEF4006)
HWSNAME,TYPE=(LDGF4001,LDEF4001,LDDF4001,LDG3490)

HWSNAME,TYPE=(LDG3490,LDDF4001)
HWSNAME,TYPE=(LDG3490E,LDEF4006,LDEF4001,LDGF4006)

HWSNAME,TYPE=(LDEF4006,LDGF4006)
HWSNAME,TYPE=(LDEF4001)
HWSNAME,TYPE=(LDDF4001,LDG3490)
```

Figure 89. HWSNAME Definition Sample

LDG3490 is a valid alternate name for LDGF4001 and LDDF4001 because there are no 3490s in the other library.

LDGF4006 is a valid alternate name for LDG3490E because all devices in the library are the same type as LDG3490E.

Note: Referring to Table 25 on page 165, you can verify the HWSNAME statements by using the address range of the groupnam and altnam. See if the address range for the groupnam includes the address range of the altnam.

5.1.19.8 3590 Definitions

If IBM Magstar 3590 tape subsystems are installed in an IBM Magstar 3494 tape library, you must define the following esoteric names:

LDBsssss, which includes all IBM 3590 devices in the library with library ID sssss.

LDG3591, which includes all IBM 3590 devices in any library.

Note: The name 3590-1 and any nonlibrary esoteric unit name must not include any library devices.

Figure 90 on page 169 shows the sample JES3 definitions for an IBM 3494 with one string of four IBM 3590s. The library name in this example is F4006.

```
SETNAME,XTYPE=LB135901,NAMES=(LDGW3495,LDGF4006,LDG3591,LDBF4006)
                                 |        |       |        |
                                 V        V       V        V
                              Complex  Library  Complex Library
                              Wide     Specific Wide    Specific
                              Library  Library  Device  Device
                              Name     Name     Name    Name
DEVICE,XTYPE=(LB135901,TA),XUNIT=(500,SY1,TAP,OFF)
DEVICE,XTYPE=(LB135901,TA),XUNIT=(501,SY1,TAP,OFF)
DEVICE,XTYPE=(LB135901,TA),XUNIT=(502,SY1,TAP,OFF)
DEVICE,XTYPE=(LB135901,TA),XUNIT=(503,SY1,TAP,OFF)
HWSNAME,TYPE=(LDGW3495,LDGF4006,LDG3591,LDBF4006)
HWSNAME,TYPE=(LDGF4006,LDG3591,LDBF4006,LDGW3495)
HWSNAME,TYPE=(LDG3591,LDBF4006,LDGW3495,LDGF4006)
HWSNAME,TYPE=(LDBF4006,LDGW3495,LDGF4006,LDG3591)
```

Figure 90. Sample JES3 Definitions for IBM 3590 with an IBM Magstar 3494 Tape Library

5.1.20 Processing Changes

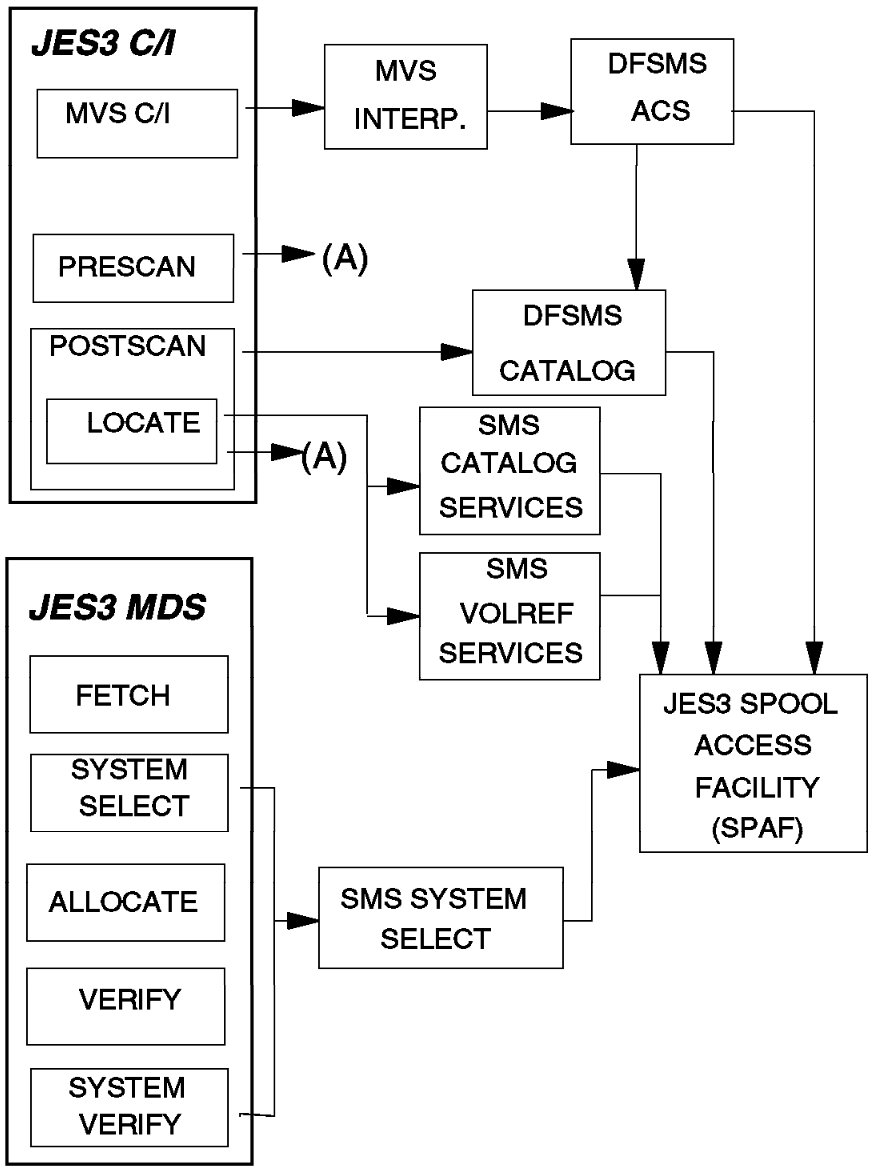
Although no JCL changes are required, a few processing restrictions and limitations are associated with using the IBM 3494 tape library in a JES3 environment:

- JES3 spool access facility (SPAF) calls are not used.
- Two calls, one from the prescan phase and the other from the locate processing phase, are made to the new DFSMS/MVS support module, as shown in Figure 91 on page 170.
- The MDS processing phases, system select and system verify, are not made for tape data sets.
- The MDS verify phase is bypassed for IBM 3494 tape library mounts, and mount processing is deferred until job execution.

Figure 91 on page 170 shows the JES3 processing phases for C/I and MDS. The processing phases shown include the support for system-managed DASD data sets.

The basic differences between IBM 3494 tape library deferred mounting and tape mounts for nonlibrary drives are:

- Mounts for nonlibrary drives by JES3 are only for the first use of a drive, and mounts for the same unit are issued by OS/390 for the job. All mounts for IBM 3494 tape library drives are issued by OS/390.
- If all mounts within a job are deferred because there are no nonlibrary tape mounts, that job is not included in the setup depth parameter (SDEPTH).
- MDS mount messages are suppressed for the IBM 3494 tape library.



(A). Calls to the DFSMS/MVS JES3 support module: IFG0JES3

Figure 91. JES3 C/I and MDS Processing Phases

5.1.20.1 JES3/DFSMS Processing

DFSMS is called by the OS/390 interpreter to:

- Update the scheduler work area (SWA) for DFSMS tape requests
- Call ACS exits for construct defaults

DFSMS/MVS system-managed tape devices are not selected by using the UNIT parameter in the JCL. For each DD request requiring an IBM 3494 tape library unit, a list of device pool names is passed and from that list an LDG name is assigned to the DD request. This results in an LDG name being passed to JES3 MDS for that request. Device pool names are never known externally.

5.1.20.2 Selecting UNITNAMEs

For a DD request, the LDG selection is based on the following conditions:

- When all devices in the complex are eligible to satisfy the request, the complexwide *LDGW3495* name is used.
- When the list of names contains names of all devices of one device type in the complex, the corresponding complex device type name, *LDG3490E*, must be used.
- When the list of names contains all subsystems in one IBM 3494 tape library, the library-specific LDG name, *LDGF4006*, is used.
- When the list contains only subsystems for a specific device type, within one IBM 3494 tape library, the LDG device type library name, *LDEF4001*, is used.

Refer to Table 25 on page 165 for the results of the LDG selection.

5.1.20.3 New or Modified Data Sets

For new data sets, ACS directs the allocation by providing storage group, storage class, and data class. When the storage group specified by ACS is defined in the active DFSMS configuration as a tape storage group, the request is allocated to an IBM 3494 tape library tape drive.

DFSMS managed DISP=MOD data sets are assumed to be new until locate processing. If catalog locate determines that the data set is OLD by the volser specified, then a new LDG name is determined based on the rules for old data sets.

5.1.20.4 Old Data Sets

Old data set allocations are directed to a specific IBM 3494 tape library when the volumes containing the data set are located within that IBM 3494 tape library. For old data sets, the list is restricted to the IBM 3494 tape library that contains the volumes.

5.1.20.5 DFSMS Catalog Processing

JES3 catalog processing determines all of the catalogs required by a job and divides them into two categories: DFSMS-managed user catalogs, and JES3-managed user catalogs.

DFSMS catalog services, a subsystem interface call to catalog locate processing, is used for normal locate requests. DFSMS catalog services is invoked during locate processing, and it invokes SVC 26 for all existing data sets when DFSMS is active. Locates are required for all existing data sets to determine whether they are DFSMS managed, even if VOL=SER= is present on the DD statement. If the request is for an old data set, catalog services determines whether it is for a library volume. For multivolume requests that are system-managed, a check is made to determine whether all volumes are in the same library.

5.1.20.6 DFSMS VOLREF Processing

DFSMS VOLREF services are invoked during locate processing if VOL=REF= is present on a DD statement for each data set that contains a volume reference to a cataloged data set.

DFSMS VOLREF services determine whether the data set referenced by a VOL=REF= parameter is DFSMS managed. Note that VOL=REF= now maps to the same storage group for a DFSMS-managed data set, but not necessarily to the same volume. DFSMS VOLREF services also collect information about the job′s resource requirements.

The new support for the IBM 3494 tape library:

- Identifies the DDs that are IBM 3494 tape library managed mountable entries
- Obtains the associated device pool names list
- Selects the LDG that best matches the names list
- Provides the LDG name to JES3 for setup
- Indicates to JES3 that the mount is deferred until execution

5.1.20.7 Fetch Messages

As IBM 3494 tape library cartridges are mounted and dismounted by the library accessor, fetch messages to an operator are unnecessary and could be confusing. With this support, all fetch messages (IAT5110) for IBM 3494 tape library requests are changed to be the nonaction informational USES form of the message. These messages are routed to the same console destination as other USES fetch messages. The routing of the message is based on the UNITNAME.

5.1.20.8 JES3 Allocation and Mounting

JES3 MDS controls the fetching, allocation, and mounting of the tape volumes requested in the JCL for each job to be executed on a processor.

The scope of MDS tape device support is complexwide, unlike OS/390 job resource allocation, whose scope is limited to one processor. Another difference between JES3 MDS allocation and OS/390 allocation is that MDS considers the resource requirements for all the steps in a job for all processors in a loosely coupled complex; OS/390 allocation considers job resource requirements one step at a time in the executing processor.

MDS processing also determines which processors are eligible to execute a job based on resource availability and connectivity in the complex.

OS/390 allocation interfaces with JES3 MDS during step allocation and dynamic allocation to get the JES3 device allocation information and to inform MDS of resource deallocations. OS/390 allocation is enhanced by reducing the allocation path for mountable volumes. JES3 supplies the device address for the IBM 3494 tape library allocation request through an SSI request to JES3 during step initiation when the job is executing under the initiator. This support is not changed from previous releases.

DFSMS/MVS and OS/390 provide all the IBM 3494 tape library support except the interfaces to JES3 for MDS allocation and processor selection.

JES3 MDS continues to select tape units for the IBM 3494 tape library. MDS no longer uses the UNIT parameter for allocation of tape requests for IBM 3494 tape library requests. DFSMS/MVS determines the appropriate LDG name for JES3 setup, from the storage group and data class assigned to the data set, and replaces the UNITNAME from the JCL with that LDG name. Because this is done after the ACS routine, the JCL-specified UNITNAME is available to the ACS routine. This capability is used to disallow JCL-specified LDG names. If LDG names are permitted to be used in the JCL, the associated data sets must be in a DFSMS tape environment. Otherwise, the allocation fails, because an LDG name restricts allocation to IBM 3494 tape library drives that can be used only for system-managed volumes.

Note: An LDG name specified as a UNITNAME in JCL can be used only to filter requests within the ACS routine. Because DFSMS/MVS replaces the externally specified UNITNAME, it cannot be used to direct allocation to a specific library or library device type.

All components within OS/390 and DFSMS/MVS request tape mounting and dismounting inside an IBM 3494 tape library by calling a DFP service, library automation communication services (LACS), instead of issuing a WTO. This is done by OS/390 allocation, so all mounts are deferred until job execution, and the IBM 3494 tape library LACS support is called at that time.

MDS allocates an available drive from the available unit addresses for LDGW3495 and passes that device address to OS/390 allocation through the JES3 allocation SSI. At data set OPEN time, LACS are used to mount and verify a scratch tape. When the job finishes with the tape, either CLOSE or deallocation issues a dismount request through LACS. This removes the tape from the drive. MDS does normal breakdown processing and does not need to communicate with the IBM 3494 tape library.

5.2 Basic Tape Library Support Environment

In this section we review the basic factors to consider when implementing BTLS. First we explain the logic of BTLS and the basic BTLS installation tasks. Then we address tape management system and JES3 considerations in a BTLS environment. For details of BTLS, see the *BTLS V1R1 User's Guide and Reference*.

Installation of the BTLS software changes the following components:

- Message display
- Allocation
- Dynamic device reconfiguration (DDR)
- IDCAMS LIBRARY command
- Tape library attention messages
- Tape library statistics SMF type 94 record

Message display is the OS/390 function that sends messages to the tape drive message displays. BTLS modifies these messages to send mount and demount commands to the library manager. Mount causes a cartridge to be mounted on a drive, and demount causes a cartridge to be demounted from a drive and returned to the storage cells.

Allocation has been changed to use the BTLS rules as defined in the records in the master catalog. These rules are defined through the IDCAMS LIBRARY command. Allocation can be controlled by an esoteric or jobname, a procedure name, and a user exit. BTLS modifies the list of eligible devices to include all library-resident or library-nonresident devices before device allocation.

DDR controls the swapping of cartridges after an I/O error. BTLS changes DDR to ensure that the swap goes to the same device type in the same library. DDR swaps within a library no longer require operator intervention.

BTLS provides an IDCAMS LIBRARY command for the control and definition of the IBM 3494 tape library. The command enables functions such as:

- Change cartridge status from private to scratch.
- Define library devices.
- Define allocation rules.
- Obtain lists of cartridges from the library manager.
- Issue commands to the IBM 3494 tape library such as mount, demount, and load or unload ICLs.

Through the IDCAMS LIBRARY commands, a set of rules by which BTLS controls tape allocations is defined in the master catalog. BTLS also maintains a catalog of library-resident volumes to satisfy specific mount requests. BTLS can support up to eight tape libraries. Table 26 lists the IDCAMS LIBRARY commands.

Table 26. BTLS LIBRARY Commands

LIBRARY	**AUDIT**	**UNIT(***unit***)** [**VOLSER(***volser***)**] [**FORCE**]
	COUNTS	**UNIT(***unit***)**
	DEFINE	[**VOLSER(***volser***)**] [**LIBNAME(***libname***)**]
	DELETE	[**VOLSER(***volser***)**] [**LIBNAME(***libname***)**]
	DEMOUNT	**UNIT(***unit***)**
	DEVICES	**(***devicerange devicerange ...***)** [**LIBNAME(***libname***)**]
	INVENTORY	**UNIT(***unit***) CATEGORY(***category***)**
	JOBNAMES	**(***jobname...***)** [**LIBNAME(***libname***)**]
	LISTVOL	[**LIBNAME(***libname***)**]
	MOUNT	**UNIT(***unit***)** [**VOLSER(***volser***)**]
	OPTIONS	**(***option***)**
	REPORT	[**LIBNAME(***libname***)**]
	RESETACL	**UNIT(***unit***)**
	RESETDEVICE	**UNIT(***unit***)**
	SETACL	**UNIT(***unit***) CATEGORY(***category***)**
	SETCATEGORY	**UNIT(***unit***) CATEGORY(***category***)** [**VOLSER(***volser***)**]
	SETCEXIT	**UNIT(***unit***)**
	SETDEVICE	**UNIT(***unit***) CATEGORY(***category***)**
	THRESHOLD	**(***count***)** [**CATEGORY(***category***)**] [**LIBNAME(***libname***)**]

The IBM 3494 tape library reports the completion of a mount or demount and error conditions to the host through attention messages. BTLS provides the support to read the messages and report relevant ones to the system operator.

5.2.1 Control Data Sets

BTLS uses catalog records to define a library configuration and allocation rules. Each volume in an IBM 3494 tape library is also defined by a catalog record that names the library in which the volume resides. You need to allocate a user catalog for the BTLS volume entries. Table 27 on page 175 shows the catalog records that BTLS uses.

Table 27. BTLS Catalog Records		
	Catalog Record Name	**Description**
Library	SYS1.BTLS.LIB.LIBn	Defines the device addresses in library LIBn
Options	SYS1.BTLS.LIB.OPT	Defines the options used by an allocation
Jobname	SYS1.BTLS.JOBn	Defines the job names that should use a library scratch allocation
Volume	BTLS.BTLS.VOL.vvvvvv	Indicates the library containing volume vvvvvv

Catalog records whose names start with SYS1 are cataloged in the master catalog. The volume catalog records are cataloged in the BTLS user catalog.

Figure 92 shows the BTLS catalog record structure.

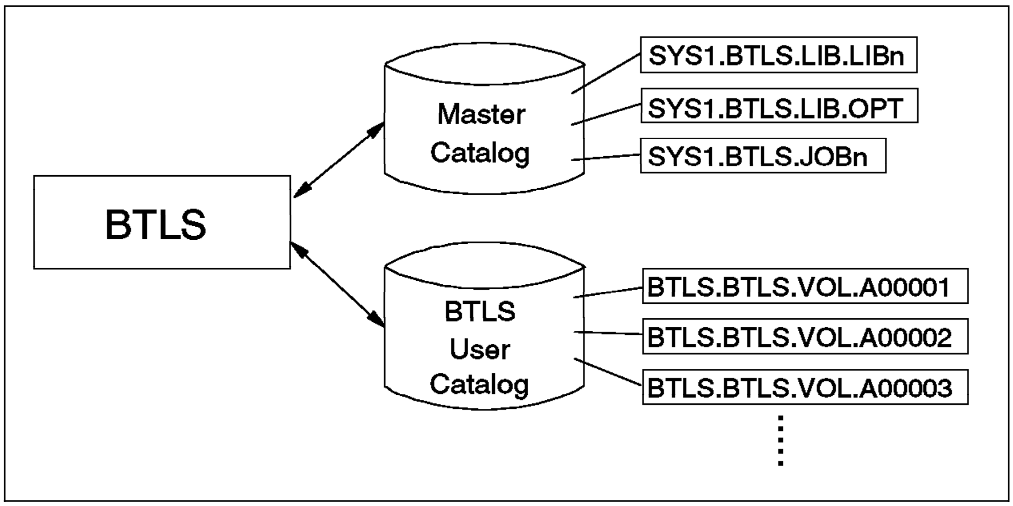


Figure 92. BTLS Catalog Record Structure

5.2.2 Installation Tasks

In this section we describe the BTLS installation tasks. For more information about installation tasks and details of the IDCAMS command, LIBRARY, see the *BTLS V1R1 User's Guide and Reference*.

The installation tasks are these:

1. Define the IDCAMS command, LIBRARY, as a TSO command.

   To define the IDCAMS command, LIBRARY, as a TSO command, use the JCL shown in Figure 93 on page 176.

```
//COMMAND  JOB ,
//         TIME=(0,5),MSGCLASS=A
//LKED     EXEC  PGM=HEWL,REGION=2048K,
//       PARM='XREF,LET,RENT,LIST,NCAL'
//SYSUT1   DD  DSN=&&SYSUT1, UNIT=SYSDA,
//       SPACE=(1024,(50,20))
//SYSPRINT DD  SYSOUT=*
//SYSLMOD  DD  DSN=SYS1.LINKLIB,DISP=SHR
//SYSLIB   DD  DSN=SYS1.CMDLIB,DISP=SHR
//SYSLIN   DD
  INCLUDE SYSLIB(IDCAM01)
  ALIAS   LIBRARY
  SETCODE AC(1)
  NAME IDCAM01(R)
/*
```

Figure 93. Sample JCL to Define IDCAMS Command, LIBRARY, As a TSO Command

Authorize the IDCAMS command, LIBRARY, by adding it to IKJTSO00 in SYS1.PARMLIB. After updating IKJTSO00, the PARMLIB UPDATE(00) command authorizes the IDCAMS command, LIBRARY.

2. Define library devices.

   Use the IDCAMS command, LIBRARY DEVICES, to define the device addresses for a library. A 3490 control unit can contain up to 16 tape drives. Even if any of the control units in an IBM 3494 tape library has fewer than 16 drives, all 16 possible addresses still must be defined in the host system. It is necessary to include uninstalled devices in the IDCAMS command, LIBRARY DEVICES. If invalid addresses are specified, the results are unpredictable. Figure 94 shows a sample job to define library devices. Library LIB1 (default) is defined as containing devices 180-18F and 190-19F. One BTLS system supports up to eight libraries, which must be called LIBn, where n is 1 to 8.

```
//LIBJOB     JOB
//           EXEC PGM=IDCAMS
//SYSPRINT   DD   SYSOUT=*
//SYSIN      DD   *
  LIBRARY DEVICES ( 18018F 19019F )
/*
```

Figure 94. Sample JCL to Define Library Devices

Recording technology (18-track or 36-track) information is not kept in a BTLS environment. Therefore, with mixed device types and mixed media types in an IBM 3494 tape library, we recommend that you define two logical libraries, such as LIB1 for the IBM 3490 tape subsystem and LIB2 for the IBM 3490E tape subsystem, to facilitate the conversion to DFSMS tape and control use of the device and media types. Figure 95 shows a sample command to define two logical libraries.

```
LIBRARY DEVICES (17017F) LIBNAME(LIB1)
LIBRARY DEVICES (18018F) LIBNAME(LIB2)
```

Figure 95. Sample Command to Define Two Logical Libraries

Note: BTLS support for four-digit device numbers is provided as follows:

- Support is provided with JDZ11BS.
- For releases before JDZ11BS, support is provided by OW12877.
- Library devices must be restricted to the four-digit address range, 0000-0FFF.
- All other devices, including tape drives, can use any of the four-digit addresses in the 0000-FFFF range.
- BTLS commands and messages use only the three significant digits 000-FFF and assume that the fourth digit is always zero.

3. Create an esoteric device group name.

   Create an esoteric device group name for the library devices to facilitate allocation to the IBM 3494 tape library. The esoteric device group name does not have to match the library name (for example, LIB1), but the address range of the esoteric device group name must match the library device definitions to ensure that allocation recovery messages include only the appropriate set of tape drives.

4. Create SYS1.PARMLIB member BTLPRM00.

Define the defaults used by BTLS in SYS1.PARMLIB member BTLPRM00. Each parameter statement must begin in column 1. The following definitions are supported:

THRESHOLD(count) establishes a low threshold value for scratch volumes. When the number of scratch volumes falls below the *count*, the operator receives a warning message.

The threshold value established at IPL by the THRESHOLD parameter is replaced when the IDCAMS command, LIBRARY THRESHOLD, is executed. If more than one threshold value is required, use the IDCAMS command, LIBRARY THRESHOLD, after IPL. The command supports multiple libraries and multiple scratch categories. The LIBRARY REPORT command can be used to display the threshold values that have been established.

SCRTCHn establishes a default category for scratch mounts. Unless specified, scratch mounts use volumes assigned to the SCRTCH1 volume category (X′0FFF′). When more than one host shares a library, a different scratch volume category is used by each host. The BTLPRM00 PARMLIB member for each host names the scratch volume category that host will use for scratch mounts.

AUTODEMOUNT indicates that library volumes should be automatically demounted if they become mounted on unallocated devices. When AUTODEMOUNT is specified and BTLS detects a mount completion for an unallocated device, the volume is unloaded and demounted automatically.

In a BTLS library, a volume can become mounted on an unallocated device when a job is canceled or abends during *mount pending*. Because the mount is not completed before the job terminates, a demount is not sent to the library. Even though the job is terminated, the mount will eventually be completed in the library. If the device has not yet been allocated to another job, the volume will stay mounted.

The purpose of AUTODEMOUNT is to solve the following two problems created by volumes mounted on unallocated drives:

- If another job allocates the drive and needs a private volume mounted, the job will demount but keep the previously mounted volume. The demount will cause a scratch volume to be assigned to the private category even though it was never used.
- If another job allocates a different tape drive and needs a volume that is already mounted on an unallocated drive, the mount will fail with the message ERA=64 (volume in use).

LIBAFFINITY indicates that BTLS should break affinity when an invalid UNIT=AFF condition is detected. If LIBAFFINITY is not used, invalid affinity is reported by message BTLS104I, and the job is terminated.

To validate affinity, BTLS compares the allocation requirements of the target DD(DD1) and the UNIT=AFF DD(DD2). The following conditions are valid:

- Both DD1 and DD2 require drives in the same library.

- Both DD1 and DD2 require nonlibrary drives.
- Either DD1 or DD2 can use *any* drive. BTLS allows *any* drive when Option I is used (see Table 28 on page 182) to control scratch allocation and for any SCRTCH request that specifies UNIT=AFF.

When an invalid condition is detected, and the LIBAFFINITY option is in effect, BTLS breaks the invalid affinity. The following example shows how BTLS breaks affinity:

```
//DD1  DD  VOL=SER=VOL001,UNIT=TAPE
//     DD  VOL=SER=VOL002,UNIT=AFF=DD1
//     DD  VOL=SER=VOL003,UNIT=AFF=DD1
//     DD  VOL=SER=VOL004,UNIT=AFF=DD1
```

Note: VOL001 and VOL004 are defined to BTLS as LIB1; VOL002 and VOL003 are not defined to BTLS.

When the above JCL is executed, BTLS directs the allocation for DD1 to LIB1 but detects an error because VOL002 is not in LIB1 yet specifies affinity with DD1. When the LIBAFFINITY option is in effect, BTLS causes the JCL to allocate as if it were written as follows:

```
//DD1  DD  VOL=SER=VOL001,UNIT=TAPE
//DD2  DD  VOL=SER=VOL002,UNIT=TAPE
//     DD  VOL=SER=VOL003,UNIT=AFF=DD2
//     DD  VOL=SER=VOL004,UNIT=AFF=DD1
```

In order for LIBAFFINITY to successfully break affinity, the set of devices determined by the UNIT parameter of the target DD must include devices that will also satisfy the requirements of the broken DD.

If the sample JCL were coded as follows, the allocation for VOL002 would fail because UNIT=LIB1DEVS names an esoteric unit that does not include any devices in LIB2 (and VOL002 is defined to BTLS as a LIB2 volume):

```
//DD1  DD  VOL=SER=VOL001,UNIT=LIB1DEVS
//     DD  VOL=SER=VOL002,UNIT=AFF=LIB1
//     DD  VOL=SER=VOL003,UNIT=AFF=LIB1
//     DD  VOL=SER=VOL004,UNIT=AFF=LIB1
```

Note: LIBAFFINITY is not supported when MVS/SP 5.2 is installed.

EXPDT98000 | EXPD option allows a duplicate of a BTLS library volume to be mounted on a drive outside the library.

BTLS does not check that there is an internal label on the cartridge, so NL and BLP tapes are supported. The IBM 3494 tape library requires every volume to have an external volser number that is unique to that library. However, because all volume records are stored in the BTLS catalog, each volser number that BTLS manages must be unique.

When the EXPDT98000 option is used, and a DD statement includes EXPDT=98000, BTLS will not validate or interfere with the allocation. Thus you can allocate a drive outside the library for a volser number that is defined to BTLS as a library volume.

Figure 96 on page 180 shows an example of BTLMPRxx parameters.

```
THRESHOLD(50)    /* Minimum scratch threshold warning to ops
AUTODEMOUNT      /* Demount cartridges from unallocated drives
SCRTCH3          /* if no scratch pool is specified use SCRTCH3
```

Figure 96. Example of BTLMPRxx PARMLIB Member

5. Define user catalog for BTLS volume records.

   Define a user catalog named BTLS that will be used by BTLS to define 'BTLS.BTLS.VOL.volser' catalog records. The catalog must be an ICF catalog and may be defined as shared if library volumes are to be shared by more than one host. If this catalog is to be shared by more than one host, the catalog must reside on a shared DASD volume and be connected to the master catalogs of the other hosts.

   Note: The name of the catalog cannot be changed to a user-defined name.

   Figure 97 shows a sample command to define the user catalog.

```
DEFINE UCAT  (NAME(BTLS) MEGABYTES(1 1) ICFCATALOG -
              VOLUME(COMCAT) SHAREOPTIONS(3 4))
```

Figure 97. Sample Command to Define the User Catalog

6. Install the BTLS allocation interface.

   For releases earlier than MVS/SP 5.1, ensure that APAR OY63009 is installed (OY63009 is included with MVS/SP 5.1). OY63009 provides the interface used by BTLS to control tape allocations.

   OY63009 is not used with MVS/SP 5.2. Instead, BTLS uses the tape allocation subsystem interface. When MVS/SP 5.2 is installed, add the following command to SYS1.PARMLIB member IEACMD00:

   ```
   SETSSI ADD,SUBNAME=BTLS,INITRTN=AOMALSSI
   ```

   You can also issue the SETSSI command from the operator's console. The SETSSI command activates the BTLS tape allocation SSI so that BTLS can begin to control tape allocations. When the command executes, the following messages should be received at the operator console:

   ```
   BTLS401I START OF BTLS INITIALIZATION
   BTLS402I BTLS INITIALIZATION COMPLETE
   ```

7. Obtain an inventory list from the library.

   Once inventory processing has been completed at the IBM 3494 tape library, use the IDCAMS command, LIBRARY INVENTORY, to obtain a list of the volumes in the INSERT category in the IBM 3494 tape library. The volume list is printed in the data set of the LIBOUT DD statement.

   Figure 98 on page 181 shows the sample JCL to obtain a list of the volumes in the INSERT category.

```
//LIBJOB     JOB
//           EXEC PGM=IDCAMS
//SYSPRINT   DD   SYSOUT=*
//LIBOUT     DD   DSN=dsname,
//         DISP=(NEW,CATLG),UNIT=SYSDA,
//         DCB=(LRECL=80,BLKSIZE=0,RECFM=FB)
//SYSIN      DD   *
  LIBRARY INVENTORY UNIT(180) CATEGORY(INSERT)
/*
```

Figure 98. Sample JCL to Obtain a List of Volumes in the INSERT Category

8. Assign volume category.

   Determine which volser number should be assigned to the private category and which to the scratch. Then issue LIBRARY SETCATEGORY to assign each volume to the appropriate category. Figure 99 shows sample JCL where all volumes specified in the LIBIN DD data set are assigned to the SCRTCH category.

```
//LIBJOB     JOB
//           EXEC PGM=IDCAMS
//SYSPRINT   DD   SYSOUT=*
//LIBIN      DD   DSN=dsname,DISP=SHR
//SYSIN      DD   *
  LIBRARY SETCATEGORY UNIT(180) CATEGORY(SCRTCH)
/*
```

Figure 99. Sample JCL to Assign Volumes to the Scratch Category

   With mixed media types in an IBM 3494 tape library, we recommend that you assign different volume categories for each media type to facilitate the conversion to DFSMS tape and control the use of the media types.

   If you plan to use multiple scratch pools, you must decide how you will control scratch selection. The selection can be done by assigning a device to a specific scratch pool or using the message display exit IGXMSGEX.

   BTLS can support a maximum of eight scratch pools, which must be called SCRTCH1 to SCRTCH8. SCRTCH1 is an alias for SCRTCH when only one media type is used. BTLS determines which scratch pool to use by first checking the UCB to see whether a specific scratch pool has been assigned to the device. If a scratch pool has not been assigned, BTLS uses the default scratch pool unless ISGMSGEX passes BTLS a scratch pool name from the mount message (see 5.2.3.2, "Message Display" on page 184). Note that DFSMSrmm and other tape management systems can use the mount message to pass BTLS the scratch pool name.

   To assign a scratch pool to a specific device, use the LIBRARY SETDEVICE command (see Figure 100).

```
 LIBRARY SETDEVICE UNIT(700) CATEGORY(SCRTCH3)
 LIBRARY SETDEVICE UNIT(701) CATEGORY(SCRTCH7)
```

Figure 100. BTLS Scratch Pool Allocation Options

9. Create volume records.

Use the IDCAMS command, LIBRARY DEFINE, to create a volume record for each volume. Figure 101 on page 182 shows the sample JCL to create volume records for the volumes. All volumes specified in the LIBIN DD data set are cataloged as residing in library LIB1 (default).

```
//LIBJOB     JOB
//           EXEC PGM=IDCAMS
//SYSPRINT   DD   SYSOUT=*
//LIBIN      DD   DSN=dsname,DISP=SHR
//SYSIN      DD   *
  LIBRARY DEFINE
/*
```

Figure 101. Sample JCL to Create Volume Records

For a specific volume request (PRIVATE volume), if the volume is not defined in this catalog entry as a library volume, the volume is assumed to reside outside the library, and only nonlibrary devices are used to satisfy the allocation.

10. Create operator procedure.

    Create a procedure to be used by the operator to issue the IBM 3494 tape library mounts and demounts. The procedure should invoke the IDCAMS LIBRARY command.

11. Define options for scratch allocation.

    Before setting the BTLS options, you must first decide how you want BTLS to act. BTLS can influence allocation in the following ways (see Table 28):

    - Esoteric
    - Jobname, procedure name
    - All allocations to library devices
    - No allocations to library devices

Table 28. BTLS Library Options

Option 1	Option 2	Option 3	Description
J			Scratch allocation is based on JOBNAME. When this option is used, only job names or procedure names defined with LIBRARY JOBNAME are directed to the IBM 3494 tape library for scratch allocation.
A			All scratch allocations should go to a library device.
M			All scratch allocations should go to a nonlibrary device, that is, a normal manual tape device.
I			All scratch allocations are controlled by esoteric name.
	E		Enables BTLS allocation support
	D		Disables BTLS allocation support
	T		Traces BTLS allocation support for diagnostic purposes
		E	Enables DDR support
		D	Disables DDR support
		T	Traces DDR support for diagnostic purposes

If you decide to control allocation by job name or procedure name, a maximum of 50 names (or masks) can be specified per library. If fewer than eight characters are defined as a name, then BTLS will use this as a mask and will match these characters with the start of job or procedure name. If you decide to control allocation by an esoteric name, the esoteric unit can only contain library-resident drives. Sending all allocations to library-resident drives can be used if nonlibrary devices are not installed or are no longer being used. Sending all allocations to nonlibrary devices could be used during installation or for problem analysis.

The LIBRARY OPTIONS command is used to indicate how BTLS should control allocation. The LIBRARY OPTIONS command is also used to change the BTLS defaults set in BTLSPRM00 or to display the BTLS options currently set. The sample LIBRARY OPTIONS command in Figure 102 tells BTLS to base allocation on job or procedure name and that its allocation assist and DDR support are enabled.

```
LIBRARY OPTIONS(JEE)
```

Figure 102. BTLS Library Options Command

For further control over allocation when you use JOBNAME, you can use the allocation installation exit, AOMABEXT. For example, if you want a workload to go to any IBM 3494 tape library, you must code the exit to pass the addresses of all eligible library-resident drives.

Figure 103 shows an example of a LIBRARY JOBNAMES command. In this example, PRODAHSM will be directed to LIB1, TESTJOB2 will go to LIB2, any job or procedure starting with GO2LIB1 will go to LIB1, and any job or procedure starting with GO2LIB2 will go to LIB2.

```
LIBRARY JOBNAMES(PRODAHSM GO2LIB1) LIBNAME(LIB1)
LIBRARY JOBNAMES(TESTJOB2 GO2LIB2) LIBNAME(LIB2)
```

Figure 103. BTLS LIBRARY JOBNAMES Command

If you later decide to add to or change the list of names BTLS is to use, you must include in the command the names you want BTLS to continue to control. The original BTLS record is overwritten each time you issue the LIBRARY JOBNAMES command.

12. Secure the IDCAMS command, LIBRARY.

    If you want to control use of the IDCAMS command, LIBRARY, define IDCLI01 to RACF as a resource name within the RACF resource class, PROGRAM. This definition allows only authorized users to send requests to the IBM 3494 tape libraries. Figure 104 shows a sample command to define IDCLI01 to RACF.

```
RDEFINE PROGRAM IDCLI01 UACC(NONE)
PERMIT IDCLI01 CLASS(PROGRAM) -
       ID(oper)               -
       ACCESS(READ)
```

Figure 104. Sample Command to Define IDCLI01 to RACF

13. Create internal volume label.

    Use IEHINITT to label any cartridges that require internal volume labels.

    Reply “M” to console message IEC701D for each volume. When volumes are demounted by IEHINITT, they are assigned to the PRIVATE category. Use the

LIBRARY SETCATEGORY command to assign the volumes to the appropriate category.

5.2.3 Installation Exits

Installation exits are provided to enable you to extend or replace the BTLS replaceable module. The exits are optional. For sharing and partitioning an IBM 3494 tape library in a BTLS environment, you do not have to customize the system by using the installation exits.

For details on the installation exits discussed below, see the *BTLS V1R1 User's Guide and Reference*.

5.2.3.1 Set Volume Category

The set volume category installation exit, IDCLI04, is called by IDCLI01 when the SETCEXIT command is specified. Use the installation exit to specify the volser number and category to be sent to the IBM 3494 tape library as a SETCATEGORY request. Some tape management system vendors use this exit to drive their own programs in support of the IBM 3494 tape library functions.

5.2.3.2 Message Display

The message display installation exit (IGXMSGEX) can be used to select a BTLS scratch category that will satisfy a library scratch mount. If one of the supported scratch categories is specified to the message display installation exit, that scratch category is used to override the scratch category that would otherwise be used.

5.2.3.3 Allocation

The allocation installation exit, AOMABEXT, can be used to control library allocation. It can influence an allocation in one of the following ways:

- Do nothing.
- The allocation should be directed to a device in the specified library.
- The allocation should be directed to a device in any library.
- The allocation should exclude all library devices.

5.2.4 Tape Management System Considerations

Tape management systems cannot interface with a BTLS system. When you install a tape management system, you have to define the volumes to both the tape management system and the BTLS system. To have both control data sets match, if the tape management system changes a volume's status from PRIVATE to SCRATCH, you must use the LIBRARY SETCATEGORY command or the SETCEXIT (set volume category exit) to update the library manager volume category for the volume.

5.2.5 JES3 Support for BTLS

There is no interface to allow the automatic update of BTLS records during the housekeeping functions of DFSMSrmm. Therefore, you must update the BTLS catalog accordingly using the IDCAMS LIBRARY command:

- The tape subsystems in the IBM 3494 tape library must not be defined in the JES3 initialization deck and therefore are not managed by JES3.

- OS/390 performs all IBM 3494 tape library tape device allocations with the allocation assist function of BTLS. BTLS is responsible for communication with the library manager in the IBM 3494 tape library.
- BTLS functions in the JES3 environment are identical to the BTLS functions in the JES2 environment.
- JES3 DSPs or JES3 tape commands for tape drives inside an IBM 3494 tape library are not supported.

JES3 can continue to manage tape devices outside the IBM 3494 tape library as long as those devices do not belong to the same generic or esoteric unit types as tape devices inside the IBM 3494 tape library. For example, you must not have JES3-managed 3490E devices outside the IBM 3494 tape library while there are IBM 3490E devices inside the IBM 3494 tape library. You can have JES3-managed IBM 3480 and/or 3490 base devices (non-3490E) outside the IBM 3494 tape library while the devices inside the IBM 3494 tape library are all IBM 3490Es.

IBM 3490 base devices (non-3490E) are identical to IBM 3480 devices as far as OS/390 JES3 is concerned. Therefore you cannot have IBM 3490 base devices (non-3490Es) inside the IBM 3494 tape library and JES3-managed IBM 3480 or 3490 base (non-3490E) devices outside the library.

5.2.6 BTLS Library Manager Categories

When volumes are added to the IBM 3494 tape library they are placed in the library manager INSERT category. BTLS does not support automatic insert processing. To tell BTLS which cartridges it will manage in the library, you must first ask the library manager which cartridges are in the INSERT category and then update the library manager to reflect their true status as SCRATCH or PRIVATE. If multiple scratch pools are used, each pool is assigned to a different library manager category. Table 29 lists the library manager volume categories used by BTLS.

Table 29 (Page 1 of 3). BTLS Library Manager Volume Categories

Name	**Use•**	**LM Code•**	**Category Description**
INSERT	I	FF00	Volumes received in the library that are not yet assigned to another category
EJECT	S	FF10	Convenience I/O eject
XEJECT	S	FF10	Same as EJECT. *X* indicates that, in addition to ejecting the volume from the library, the catalog record for the volume should be deleted.
EJECTB	S	FF11	Bulk I/O eject
XEJECTB	S	FF11	Same as EJECTB. *X* indicates that, in addition to ejecting the volume from the library, the catalog record for the volume should be deleted.
SCRTCH	IASDT	0FFF	Default scratch volume category

Table 29 (Page 2 of 3). BTLS Library Manager Volume Categories			
Name	**Use•**	**LM Code•**	**Category Description**
SCRTCH1	IASDT	0FFF	Default scratch volume category (alias name for SCRTCH)
SCRTCH2	IASDT	0FF2	Alternate scratch volume category
SCRTCH3	IASDT	0FF3	Alternate scratch volume category
SCRTCH4	IASDT	0FF4	Alternate scratch volume category
SCRTCH5	IASDT	0FF5	Alternate scratch volume category
SCRTCH6	IASDT	0FF6	Alternate scratch volume category
SCRTCH7	IASDT	0FF7	Alternate scratch volume category
SCRTCH8	IASDT	0FF8	Alternate scratch volume category
PRIVATE	IS	FFFF	Private volume category
ERROR	I	F00E	Error volume category. Volumes are assigned to the error category during demount if the volser number specified for demount does not match the external label of the volume being demounted.
CLEANER	I	FFFE	Cleaner volume
SERVICE		FFF6	3590 Service volume. This category is reported by the COUNTS command but is not valid with any other LIBRARY command (such as SETACL or INVENTORY).
SERVICE		FFF9	3490 Service volume. This category is reported by the COUNTS command but is not valid with any other LIBRARY command (such as SETACL or INVENTORY).
EJECTM	I	FFFA	Manually ejected volume. Volumes in this category still have an entry in the library manager database. The entry can be deleted from the library manager database by specifying the PURGE category in a SETCATEGORY command.

Table 29 (Page 3 of 3). BTLS Library Manager Volume Categories			
Name	**Use•**	**LM Code•**	**Category Description**
PURGE	S	FFFB	Purge volume. The PURGE category name is used to remove the library manager database record for a volume that is either manually ejected or misplaced.
Notes: •Describes which LIBRARY command can read or change the library manager category. I=INVENTORY, A=SETACL, S=SETCATEGORY, D=SETDEVICE, T=THRESHOLD •The hexadecimal library manager category code			

5.3 VM/ESA and VSE/ESA Support

In this section we describe in detail the steps required to implement an IBM 3494 tape library in a native VM/ESA or VSE/ESA environment or in an environment running VSE/ESA as a guest of VM/ESA.

We recommend that you review 4.6, "VSE/ESA As a VM/ESA Guest Using the VSE Guest Server" on page 100; 4.7, "VSE/ESA Native Support Using Library Control Device Driver for VSE/ESA" on page 104; and 4.5, "VM/ESA Native Support Using DFSMS/VM" on page 95.

5.3.1 VM/ESA and VSE/ESA Tape Management Systems

Table 30 shows the third-party tape management systems that provide support for the IBM 3494 in the VM and VSE environment. New product announcements may have been made since the publication of this book.

Table 30. VM/ESA and VSE/ESA Tape Management Software Support			
	Release	**Vendor**	**Environment**
BVS VM/ESA and VSE/ESA	3	Pfeilschifter GmbH (Germany)	Native or guest
CA-Dynam for VSE	6.0	Computer Associates	Native or guest
CA-EPIC for VSE	5.1	Computer Associates	Native or guest
VM:Tape and VM:Backup	2.1	Sterling	Native VM

5.3.2 Related Documentation

Before you install an IBM 3494 tape library we recommend that you obtain the complete set of *DFSMS/VM FL221 Removable Media Services User's Guide and Reference* documentation.

Further information can be found on the IBM VSE/ESA home pages on the Internet:

`http://www.s390.ibm.com/vse/`

On the IBM VSE/ESA home page menu, select “Documents, demos, and coding examples on an FTP server.” On the “Resources available via FTP.” menu, the following unclassified documents (ZIPed PostScript files) are offered to customers over an FTP server:

- vse3494s.zip, *VSE/ESA Support of the IBM 3494 Tape Library Dataserver* by Gerhard Schneidt, has a “VSE point of view.” It describes VSE′s IBM 3494 API and documents API reason codes.
- vse3494h.zip, *Native Support of the IBM 3494 Tape Library Dataserver with VSE/ESA* by Friedrich Hahn and Joerg Haertel, includes two customer scenarios for implementing an IBM 3494.
- 3494_vse.zip, *Support for the IBM 3494 Tape Library Dataserver in a VSE/ESA Environment* by Kathy Eldred, offers information about the IBM 3494.

These files are also available on the IBMVSE tools disk, which is available through your IBM Service Representative. To obtain the documents from an IBM internal tools disk, issue the following command from VM:
TOOLS SENDTO BOEVM3 VMTOOLS IBMVSE GET VSE3494 PACKAGE

The VGS Machine for VM/ESA library control support for VSE/ESA guest systems and the LIBRCMS documentation and code are available from your IBM Service Representative. To obtain the documents from an IBM internal tools disk, issue the following command from VM:
TOOLS SENDTO BOEVM3 VMTOOLS IBMVSE GET VGSUSERD PACKAGE

5.3.3 Customize DFSMS/VM RMS Service Machine

In this section we describe the steps required to customize RMS to provide support for an IBM 3494 tape library. If you already use DFSMS/VM for minidisk and space management, some of the customization will already be complete.

5.3.3.1 CP Directory Entry and PROFILE EXEC

The RMS service machine requires a CP directory entry (see Figure 105). The user ID of RMSMASTR must be the same as that defined in DFSMS_MASTER_VM. See 5.3.3.4, “DGTVCNTL DATA” on page 189.

```
USER RMSMASTR password 32M 32M BG
 ACCOUNT 12345678
 MACHINE XA
 STDEVOPT LIBRARY CTL
 IPL CMS
 IUCV ALLOW
 IUCV *IDENT RESANY GLOBAL REVOKE
 OPTION MAXCONN 400 QUICKDSP ACCT
 SHARE RELATIVE 1300
 CONSOLE 009 3215 T DFSMS
 SPOOL 00C 2540 READER *
 SPOOL 00D 2540 PUNCH  A
 SPOOL 00E 1403 A
 MDISK 0191 3390 scyl 001 RMSDISK MR
 LINK DFSMS 01B5 0192 RR
 LINK MAINT 0190 0190 RR
 LINK MAINT 019E 019E RR
```

Figure 105. Sample RMS Service Machine CP Directory Entry

The PROFILE EXEC for the RMS service machine is placed on its A disk during the installation of DFSMS/VM. In the CP directory entry, modify the device type, starting cylinder, and device ID of the disk.

5.3.3.2 RMSMASTR ATL Authorization

To authorize RMSMASTR to interact with the IBM 3494 tape library, add the STDEVOPT control card to its CP directory entry (see Figure 106).

```
STDEVOPT LIBRARY CTL
```

Figure 106. Sample STDEVOPT Control Statement for RMSMASTR

5.3.3.3 DFSMS/VM Control Files

There are three control files:

- DGTVCNTL DATA
- RMCONFIG DATA
- RMBnnnnn DATA

They are all in the shared file system VMSYS:DFSMS.CONTROL directory. The use of the RMBnnnnn DATA file is optional.

5.3.3.4 DGTVCNTL DATA

The DGTVCNTL DATA file is where you define:

- DFSMS RMS machine name
- IBM 3494 tape library name and library ID
- Name of the APPC resource to be used
- Name of the DFSMS work directory
- Default scratch pool
- Severity level of messages to be written to the RMS console
- Severity level of messages written to the RMS machine log file
- Whether library requests are to be queued in the library manager
- Whether write protection is to be enabled when a tape is mounted

The DFSMS_MASTER_VM parameter defines the name of the RMS machine. The name is one to eight characters long and must be unique. The default name provided is RMSMASTR (see Figure 107).

```
DFSMS_MASTER_VM  RMSMASTR
```

Figure 107. Sample DFSMS_MASTER_VM Parameter

The RM_AUTO_LIBRARY parameter defines the name and sequence number (the five digits of the IBM 3494 tape library's serial number) of every IBM 3494 tape library you use.

In the example in Figure 108, the "friendly" name of the IBM 3494 tape library is MARVIN, the library sequence number is 12345, and messages relating to RMS processing will be sent to the OPER user ID.

```
RM_AUTO_LIBRARY MARVIN 12345 OPER
```

Figure 108. Sample RM_AUTO_LIBRARY Parameter

To find the library sequence number on the library manager, refer to Figure 70 on page 145 for guidance.

The GLOBAL_RESOURCE_ID parameter defines the name of the global APPC resource by which DFSMS/VM is to be known. The name must be unique; if it is not, DFSMS/VM will not start. There is no default but the sample name used is DFSMS001 (see Figure 109).

```
GLOBAL_RESOURCE_ID DFSMS001      * Global APPC Resource
```

Figure 109. Sample GLOBAL_RESOURCE_ID Parameter

The WORK_DIRECTORY parameter defines the name of the work directory that DFSMS will use (see Figure 110). The first five characters must be DFSMS. The file pool must be enrolled and running before DFSMS will start.

```
WORK_DIRECTORY VMSYSU:DFSMS.WORK
```

Figure 110. Sample WORK_DIRECTORY Parameter

The RM_DEFAULT_SCRATCH_POOL parameter is optional. It defines the default scratch pool to be used for the SCRATCH category (see Figure 111).

```
RM_DEFAULT_SCRATCH_POOL SCRATCH0
```

Figure 111. Sample RM_DEFAULT_SCRATCH_POOL Parameter

The RM_ACCOUNTING parameter is optional (see Figure 112). It defines whether or not RMS should provide accounting information. The default is that accounting is turned off.

```
RM_ACCOUNTING  N
```

Figure 112. Sample RM_ACCOUNTING Parameter

Further information about accounting can be found in the *DFSMS/VM FL221 Removable Media Services User's Guide and Reference*.

The RM_LOG_TO_CONSOLE parameter defines the severity of messages that are to be sent to the RMS machine. The message severity levels are:

- ***0***: No messages are to be logged.
- ***1***: Severe messages are to be logged.
- ***2***: Severe and error messages are to be logged.
- ***3***: Severe, error, and warning messages are to be logged.
- ***4***: Severe, error, warning, and informational messages are to be logged.

RM_LOG_TO_CONSOLE and RM_LOG_TO_FILE are paired parameters. You cannot code 0 for both; we recommend that you code 4 at least once to aid problem determination. Figure 113 on page 191 shows a sample RM_LOG_TO_CONSOLE parameter.

```
RM_LOG_TO_CONSOLE   3    * Messages logged to console
```

Figure 113. Sample RM_LOG_TO_CONSOLE Parameter

The RM_LOG_TO_FILE parameter defines the severity of messages that are to be written to the RMS machine's log file and the name of the directory that will contain the log file. Because DFSMS holds this file open, to browse it, use XEDIT with the NOLOCK option. The message severity levels are the same as for the RM_LOG_TO_CONSOLE parameter. Figure 114 shows a sample of an RM_LOG_TO_FILE parameter.

```
RM_LOG_TO_FILE  4  DFSMS.WORK   * Messages logged to file
```

Figure 114. Sample RM_LOG_TO_FILE Parameter

The RM_REQUEST_QUEUING parameter defines whether or not requests sent to the library manager will be queued if the IBM 3494 tape library is in PAUSE mode. Y is the default and recommended value (see Figure 115).

```
RM_REQUEST_QUEUING   Y
```

Figure 115. Sample RM_REQUEST_QUEUING Parameter

The RM_WRITE_PROTECT parameter defines the default write protect mount if it has not been specified on the mount request. Acceptable values are READONLY and READWRITE. The default and recommended value is READONLY (see Figure 116), which will set logical write protection on in the tape control unit.

```
RM_WRITE_PROTECT   READONLY
```

Figure 116. Sample RM_WRITE_PROTECT Parameter

5.3.3.5 RMCONFIG DATA

RMS maintains data about the tape drive configuration in its internal storage by rereading the RMCONFIG DATA file. Figure 117 on page 192 shows an example of an RMSCONFIG DATA file.

```
* +----------------------------------------------------------------
* ] DFSMS RM MASTER CONFIGURATION FILE
* +----------------------------------------------------------------
*
*  5684-112
*  CONTAINS RESTRICTED MATERIALS OF IBM
*  (C) COPYRIGHT IBM CORP.
*  LICENSED MATERIALS - PROPERTY OF IBM
*  REFER TO COPYRIGHT INSTRUCTIONS
*
* =================================================================
*      Required file name, type, and location:
*      RMCONFIG DATA in VMSYS:DFSMS.CONTROL.
* =================================================================
*      Required record format: Fixed
* =================================================================
*      Maximum logical record length: 255
* =================================================================
*      Comments:
*
*      Comments begin with an asterisk (*).
*
*      Comments do not span lines.  That is, a comment is
*      considered to be completed when the end of line (logical
*      record length) is reached.  To continue a comment on the
*      next line, start the next line with the comment indicator.
*
*      Comments can start anywhere on the line.  However, anything
*      following the comment indicator is considered to be a
*      comment.
* =================================================================
*      Blank Lines:        Blank lines are ignored.
* =================================================================
*
*      Formats of entries:
*
*      Each non-comment entry in this file is a single device
*      address, or a range of addresses.
*
*      If a range, the beginning and ending addresses of the range
*      must be separated by a dash (-), and optionally by one or
*      more spaces.  Ranges can not span lines.
*
*      The ending address of the range must be greater than the
*      beginning address.
*
* =================================================================

*180                    * Sample entry for a single device
*181 - 18F              * Sample entry for a range of devices

 3B0 - 3B1              * Live entry for library devices
```

Figure 117. Sample RMSCONFIG DATA File

5.3.3.6 RMBnnnnn DATA

DFSMS/VM can use RMS bulk processing files to define the category in which to place volumes when they are entered into the IBM 3494 tape library. There is one bulk processing file for every IBM 3494 tape library known to the RMS machine. The files are used for either automatic-insert or on-request bulk processing.

An automatic-insert file name is of the form RMBnnnnn DATA, where nnnnn is a library sequence number that is defined in the RM_AUTO_LIBRARY parameter. The file would be located in VMSYSU:DFSMS.WORK or whichever directory has been defined by the RM_WORK_DIRECTORY parameter. Notification of insert processing is sent to the user ID as specified in RM_AUTO_LIBRARY.

An on-request bulk processing file can have any name and be in any directory accessible to RMSMASTR and the requesting user. On-request bulk processing is initiated through either the DFSMS SET VOLCAT BULK command or a CSL call to RMS.

Figure 118 shows an example of an RMS bulk configuration file, when the host is notified that cartridges are in the library manager INSERT category. RMS sets the cartridges defined in RMBnnnnnn to the category defined. Volumes that are not defined in the RMBnnnnnn DATA file are ignored, and insert processing can be completed on other hosts. In the example, we have set cartridges with volsers in ranges 000001 through 000849 and VM0000 through VM0099 to the VOLUME SPECIFIC or private category, and cartridges with volsers UN0000 to UN0099 range to the EJECT category. This enables you to stop cartridges from being entered into the IBM 3494 tape library. We recommend that you assign all volumes to the VOLUME SPECIFIC category, and then the tape management system can assign a cartridge′s true library manager category.

```
000001-000849     VOL      INSERT
VM0000-VM0099     VOL      INSERT
UN0000-UN0099     EJECT    INSERT
```

Figure 118. Sample RMBxxxxxx DATA File

RMS does not keep a record of the volumes in the IBM 3494 tape library. RMS is provided as an interface to an IBM 3494 tape library and not for the management of volumes within a library. The library manager stores the information for the volumes in the IBM 3494 tape library. A tape management system provides management of volumes for VM/ESA users, keeping an inventory of volumes and their location (for example, the library name or offsite location in which a volume is stored).

5.3.3.7 RMS Security

RMS functions can be protected by the use of RACF/VM by setting up RMS so that it uses the RACROUTE interface. You should authorize users through the use of the STGADMIN or user-defined group.

5.4 VSE Guest Server

In this section we describe the steps required to customize the VSE guest server. You perform these steps only if the tape management system you have installed uses the services provided. We will be customizing:

- The VGS machine, which is required for all LBSERV-initiated IBM 3494 tape library control functions
- The secondary inventory support machine, which is required to support LBSERV inventory functions
- The VSE/ESA librarian server for CMS users, which passes the inventory lists created by the LBSERV inventory function. The VGS code is provided with DFSMS/VM.

5.4.1 VGS and Secondary Inventory Support Machines

The VGS and secondary inventory support machines can be started either by manually logging on and then disconnecting or by using local procedures that you may keep to autolog service machines. We have assumed that the VGS machine is called VGSLIBSRV and the secondary inventory support machine, VGSINVHLP. Figure 119 shows the CP directory entry for the VGS service machine, and Figure 120 on page 195 shows the CP directory entry for the VGS secondary inventory support machine.

Both machines require the special privilege class of B to allow them to control and query library resources.

The LBSERV API requires intermachine communication to be enabled; VGS identifies itself as the manager of a local APPC/VM resource. An interuser communication vehicle (IUCV) statement is required in the CP directory to identify this resource: the resource is called *VGSLIBSRV*.

```
USER VGLIBSRV ******** 32M 32M BG
MACH XA
ACCOUNT SYSVM SYSTEMS
IPL CMS
OPTION ACCT
IUCV ALLOW
IUCV *IDENT RESANY GLOBAL
CONSOLE 01F 3215
SPOOL 00C 2540 READER B
SPOOL 00D 2540 PUNCH B
SPOOL 00E 1403 A
LINK DFSMS    1B5 1B5 RR
LINK MAINT    190 190 RR
LINK MAINT    19E 19E RR
MDISK 191 3390 999 5 ESAR20 MR ******** ******** ********
```

Figure 119. VGS Service Machine CP Direcory Entry

```
USER VGINVHLP ******** 32M 32M BG 64
XAUTOLOG VGLIBSRV
MACH XA
ACCOUNT SYSVM SYSTEMS
IPL CMS
OPTION ACCT
IUCV ALLOW
IUCV *IDENT RESANY GLOBAL
CONSOLE 01F 3215
SPOOL 00C 2540 READER B
SPOOL 00D 2540 PUNCH B
SPOOL 00E 1403 A
LINK DFSMS    1B5 1B5 RR
LINK MAINT    190 190 RR
LINK MAINT    19E 19E RR
MDISK 191 3390 2134 5 ESAR21 MR ******** ******** ********
```

Figure 120. VGS Secondary Inventory Support Machine CP Directory Entry

Figure 121 and Figure 122 on page 196 show examples of the PROFILE EXEC for the VGS service and secondary inventory support machines. Both use the Common Programming Interface (CPI) to communicate with the VSE machine. To enable this communication, SET SERVER ON, SET FULLSCREEN OFF, and SETAUTOREAD OFF must be included.

To access the DFSMS/VM code so that VGS can use the CSL calls to request library functions, the machines must be authorized to access the DFSMS/VM RMS functions and the DFSMS product disk.

Both machines maintain CMS files with in-process and completed work on a CMS minidisk. The size and age of these files can be controlled through customization options. When the secondary inventory machine is to be used, both machines require read access to each other's A disks.

```
/* PROFILE EXEC for RMSVGS machine (RMS VSE Guest Server)    */
/* Nige 17Jan96                                              */

'ACCESS 1B5 B'                /* access DFSMS code mdisk     */

'CP TERM MORE 1 1 HOLD OFF'
'CP SPOOL CON START HOLD'
'CP SPOOL RDR HOLD'
'CP SET RUN ON'
'CP SET EMSG ON'
'CP SET IMSG ON'
'CP SET SMSG ON'

'SET SERVER ON'               /* enable incoming IUCV comms */
'SET FULLSCREEN OFF'          /* NOT   fullscreen CMS       */
'SET AUTOREAD OFF'            /* disble auto console reads  */
'RTNLOAD * (FROM FSMPPSI'     /* access CSL                 */
'EXEC FSMRMVGS'               /* Invoke VGS EXEC            */
exit
```

Figure 121. VGS Service Machine PROFILE EXEC

```
/* PROFILE EXEC for secondary VGS machine VGINVHLP */
/* Nige 17Jan96                                         */

'CP TERM MORE 1 1 HOLD OFF'
'CP SPOOL CON START HOLD'
'CP SP READER HOLD'
'CP SET RUN ON'
'CP SET EMSG ON'
'CP SET IMSG ON'
'CP SET SMSG ON'
'ACC 1B5 B'
'RTNLOAD * (FROM FSMPPSI'
'EXEC FSMRMVGH'
exit
```

Figure 122. Secondary Inventory Support Machine PROFILE EXEC

On both machines the A disk is a $SERVERS$ NAMES file (see Figure 123). You add the :list. entry only if you want to restrict the user machines that are allowed to use VGS and the secondary inventory support machine.

```
:nick.VGLIBSRV
   :list.USERID1 USERID2
```

Figure 123. VGS Service Machine $SERVER$ NAMES Example

If more than one library exists in a configuration, VGS requires that a LIBCONFG LIST file be present on its A disk (see Figure 124).

```
* Configuration file last updated by Adrian 03/21/96
L12345       MARVIN
L54321       HANK
* end of configuration data
```

Figure 124. Sample VGS Service Machine LIBCONFG LIST

If the secondary inventory support machine is to handle requests from multiple VSE guests, a LIBRCMS SRVNAMES file must be present on its A disk (see Figure 125). The file identifies the name of the VSE and the name of its associated LIBRCMS server.

```
* LIBRCMS xref file last updated by Adrian 03/21/96
VSE1        LIBRC1
VSE2        LIBRC2
VSE3        LIBRC3
* end of cross reference file
```

Figure 125. Sample LIBRMCS SRVNAMES File

5.4.2 Librarian Server for CMS Users

To enable the use of the secondary inventory support machine by VSE guests, LIBRCMS is used to pass the results of a LBSERV inventory request from the library manager to the requesting VSE guest. On each VSE, a partition is required to run the librarian server. Dynamic partitions can be used, and at least 1 MB of virtual storage is required. Also, the JCL should include a SETPFIX command to fix a minimum of 50 KB to be used to communicate with the secondary inventory server. Figure 126 shows an example of the JCL that should be sent to each of the VSE guests that require inventory listing sent from the VGS inventory server.

```
* $$ JOB JNM=LIBRCMS,CLASS=C,LDEST=*,DISP=K
// JOB LIBRCMS Start VSE/ESA librarian server for CMS users
// LIBDEF *,SEARCH=(PRD2.COMM)
// SETPARM SRVNAME='LIBRC1'
// SETPFIX LIMIT=100K
// EXEC LIBRCMSV,SIZE=AUTO
/*
/&
* $$ EOJ
```

Figure 126. Sample LIBRCMS JCL

5.4.3 VGS Exits

The exits described below can be used to control the way in which VGS operates. All are optional except FSMRMVGC, the VGS customization exit.

5.4.3.1 VGS Customization Exit FSMRMVGC

VGS customization exit FSMRMVGC is used to define some locally named resources and give some control over the way in which VGS operates. The VGS options that you can change are listed below.

- VGS_RES_TYPE: The type of resource that the main FSMRMVGS EXEC is to manage, either LOCAL or PRIVATE. If neither of these values is specified, a LOCAL resource is the default. IUCV authorizations are required in the directory entry for the VGS machine as well, and for its communication partners when a LOCAL resource is managed. For a PRIVATE resource, authorization is handled with name files (authorized users must be added to the $SERVER$ NAMES file on VGS, and a UCOMDIR NAMES file entry must be added for the requesting machine). When the VSE guest communicates directly with VGS through the LBSERV macro interface, VGS_RES_TYPE must be LOCAL. The supplied default value is LOCAL.
- LOCAL_VGS_NAME: The name used by the VGS EXEC to identify itself as the manager of the resource. When the VSE guest communicates directly with VGS through the LBSERV macro interface, the LOCAL_VGS_NAME must be VGLIBSRV. The supplied default value is VGLIBSRV.
- TELL_USERID: The user ID (or user ID/node ID combination separated with /) to receive messages about unwholesome server events, if such notification is requested by means of further options. Until you modify this option, the messages are displayed at the server machine console on which the error occurs. To notify multiple users, use a name file on the server's A disk, and use a nickname to refer to the file.

- TELL_ON_ERROR: An indicator for requesting that TELL_USERID receives a message when a nonfatal error occurs. The supplied default is *N*(no).
- TELL_ON_FATAL: An indicator for requesting that the defined user ID receives a message when a fatal error occurs. The supplied default is *N* (no).
- RESULTS_MAX_AGE: A criterion for purging completed mount requests from the history file, VGSWTD RESULTS A. The numeric value represents the age in days before records are purged. The supplied default is 1 day.
- V_PACE_MAKER: The minimum number of seconds that must elapse between checkback calls to the RMS machine to see whether a mount has completed. Checkback calls sent too frequently add unnecessary overhead to the RMS machine. The supplied default is 10 seconds.
- SCRTCH_POOL: The name of the DFSMS/VM RMS scratch category to be accessed for mount requests when the SCRATCH designation is used in request syntax instead of SCRATCHx, where x is a designated pool ID. DFSMS/VM RMS provides 16 scratch categories, or pools, where x is 0-F. When VSE shares the library with VM/ESA, it may be desirable to ensure that VSE uses a different default scratch pool from that used by VM/ESA, as specified in the DFSMS/VM control file. The supplied default for VSE is SCRATCH0.
- MI_VALUE: The timeout value in seconds, after which the VGS machine will sever a request from a client, if a connection has been received but no request is sent. The supplied default value is 180 seconds (3 minutes).

The variables listed below require customization if you plan to exploit the query and manage inventory functions and have defined the secondary inventory support machine. If you do not have to define the secondary inventory support machine, change the HELPER_ID value as described below.

- HELPER_ID: The user ID of the inventory support machine that supports processing of manage inventory and query inventory requests. If an inventory support machine is not desired (that is, if there is no need to maintain inventory lists or send lists from the VSE guest), specify eight asterisks (********). The supplied default is VGINVHLP.
- INV_MAX_TIME: The maximum number of seconds VGS is to keep in-process query inventory and manage inventory requests active before responding to the requester with a timeout error. This is a precaution in the unlikely event that the secondary service machine goes down between the start and finish of processing a request. VGS will respond with a timeout error to VSE. The supplied default is 120 seconds (20 minutes).
- I_PACE_MAKER: The minimum number of seconds that must elapse between searches by the inventory support machine for new inventory requests. The objective is to moderate the pace of machine processing enough not to impact expected response time while allowing it to look for work often. The supplied default is 10 seconds.
- MASTER_NAME: The user ID of the DFSMS/VM RMS master machine. The Inventory machine verifies that files received as inventory reports are sent by user ID. The supplied default is RMSMASTR.
- VSE_Q_LIB: The name of the predefined VSE librarian library where query list members will be written. If the library is not defined, query inventory requests will fail. The supplied default is VGSINV.

- VSE_M_LIB: The name of the predefined VSE librarian library where manage list members are to be found. If the library is not defined, manage inventory requests will fail. The supplied default is VGSINV.
- VSE_Q_SLIB: The name of the predefined VSE librarian sublibrary where query list members will be written. If the sublibrary is not defined, query inventory requests will fail. A suggested convention is to use the library name *sublibrary.* The supplied default is ATL1.
- VSE_M_SLIB: The name of the predefined VSE librarian sublibrary where manage list members are to be found. If the sublibrary is not defined, manage inventory requests will fail. A suggested convention is to use the library name *sublibrary.* The supplied default is ATL1.
- REPORT_FNAME: The file name for the report files sent to the inventory machine reader from the RMS master machine. By convention, the file name is the value of the DFSMS/VM control file variable, GV_GLOBAL_RESOURCE_ID. This value is used during query inventory processing to validate reader files. The supplied default is DFSMS001, the control file default.

5.4.3.2 VGS Authorization Exit FSMRMVGA

VGS authorization exit FSMRMVGA enables you to control who is authorized to connect to VGS and who is allowed to issue the STOP_VGS command. As shipped, the exit authorizes all requests. Unauthorized attempts to connect to VGS result in a message sent to the log.

5.4.4 VSE Library Control Device Driver

The steps to customize the LCDD to match the requirements of your installation are:

1. Install network hardware and 3494 Token-Ring feature
2. Create the VTAM configuration
3. Add the ALT SYS command to the IPL procedure
4. Install LCDD code
5. Define LCDD options
6. Start LCDD

We have assumed that the LCDD code has been installed and in a native VSE/ESA environment, the network connection has been established between the host and the 3494. Detailed information about establishing the network connection and installing the LCDD code can be found in the *IBM 3494 User's Guide: Device Driver VSE/ESA*.

5.4.5 Add ALT SYS Command to the IPL Procedure

The SYS ATL IPL parameter (Figure 127) is used to define whether the VSE system will communicate with the IBM 3494 tape library through VGS or LCDD:

- VSE: communicate through LCDD
- VM: communicate through VGS

The 3495 is supported only through VGS.

```
SYS ATL={VM | VSE }
```

Figure 127. SYS ATL IPL Parameter

If VSE/ESA is running native, the default is VSE. If VSE/ESA is running as a guest, the default is VM.

5.4.6 Define LCDD Options

LCDD expects certain installation-specific information to be provided by control statements associated with the LCDD job. Those control statements are:

Local_VSE_ID An eight-character identifier for the VSE system

Library_ID An eight-character LU name for an attached library and identification on the LAN. This is both the APPC resource name and the name that is used in functional requests from users.

The network TP name is LIBMGRTP.

The SCRDEF keyword precedes the name of the default scratch pool for this host on this library. The default is SCRATCH00.

The INSERT keyword allows a target category to be specified for automatic insert processing of new volumes inserted in the library. The target must be either SCRATCHnn or PRIVATE. Without this parameter, automatic insert processing does not occur.

An optional INSMSG keyword allows the messages and mount queuing to be enabled or disabled for mounts that fail with a volume-not-found condition. The character Y (for yes) enables this capability. N (for no) disables it. If this parameter is omitted, messages are issued and mounts are queued (that is, the default is INSMSG=Y).

There is one Library_ID statement for each attached IBM 3494 tape library. The Library_ID in the first statement specified is the ID used if the user request does not specify which IBM 3494 tape library to use.

Device_List Defines the serial number of the IBM 3494 tape libraries attached and the addresses of the tape drives within that are to be used

Msg_Level Determines which messages are written to the system console

Query_Inv_List Designates the name for the predefined library in which query inventory (QI) member lists are to be created.

Manage_Inv_List Designates the name of the predefined library from which manage inventory (MI) member lists are to be read.

Figure 128 on page 201 shows an example of an LCDD options file.

```
LOCAL_VSE_ID VSEHOST1              * ID of this VSE system
LIBRARY_ID AUTLIBK1 LIBMGRTP SCRDEF=SCRATCH00 INSERT=SCRATCH00 INSMSG=Y
LIBRARY_ID AUTLIBK2 LIBMGRTP       * Second lib definition
DEVICE_LIST 12345678 461 462       * Drives for this host to use
DEVICE_LIST 87654321 482           * Drives for this host to use
MSG_LEVEL 1                        * Write maximum to console
QUERY_INV_LISTS LIB=LCAINV         * Master inventory files
MANAGE_INV_LISTS LIB=LCAWRK        * Working copies
```

Figure 128. Sample LCDD Options File

5.4.7 Starting LCDD

Figure 129 shows a sample JCL statement for starting the LCDD. The FSMLCITM phase is expected to reside in the program library established for LCDD code during product installation. In this example, LCDD runs in a dynamic partition. The LCDD control cards following the EXEC statement are described in the *IBM 3494 User's Guide: Media Library Device Driver for AS/400*.

```
* $$ JOB JNM=LCARUN,CLASS=C
* $$ LST CLASS=C
// JOB LCARUN
// ASSGN SYSLST,PRINTER
// LIBDEF *,SEARCH=(LCA.PROD.LCAINV.LIBMGRLU)
// EXEC PGM=FSMLCITM,SIZE=200K
MSG_LEVEL 1                             * Display max. level msg
LOCAL_VSE_ID VSE1LCA                    * ID of this VSE system
LIBRARY_ID LIBMGRLU LIBMGRTP SCRDEF=SCRATCH00 INSERT=SCRATCH00 INSMSG=Y
DEVICE_LIST 12345678 180 181            * Tape drives
DEVICE_LIST 87654321 1A0                * Tape drive
QUERY_INV_LISTS LIB=LCAINV              * Master inventory files
MANAGE_INV_LISTS LIB=LCAINV             * Manage from master file
/&
* $$ EOJ
```

Figure 129. Sample JCL to Start the LCDD

Ensure that VTAM is active before starting the LCDD job and that the IBM 3494 library manager is online. After the LCDD starts, it performs a set of initialization tasks before it becomes active and capable of accepting user requests. Part of initialization involves exchanging messages with the IBM 3494 library manager.

During initialization, the communication paths are verified, and the library manager sends configuration data for installed library hardware to the LCDD. The LCDD uses the configuration data to complete its in-storage control block structures required for conducting further communications with the library manager and servicing user requests for library functions.

After initialization is successfully completed, the following message is displayed on the console, and both the MSG command and the programming interfaces are enabled:

```
LCAxxx2307I LCDD is initialized and ready for service
```

If the LCDD cannot connect to the IBM 3494 library manager, or if the IBM 3494 library manager returns configuration information that does not match any data provided in the DEVICE_LIST control card, this message is displayed on the console and the LCDD goes into a wait state until the IBM 3494 library manager sends configuration data:

```
LCAxxx2315I Initialized processing awaits configuration data
```

If configuration data was sent by the library manager but does not match the DEVICE_LIST control card input, an additional message (LCAxxx2317W) indicates that no library drives are initialized. In this case, check the control card DEVICE_LIST. Make any needed corrections and then stop and restart the LCDD.

If the library manager is online and operational and the LCA2315I message is displayed without the LCA2317W message, or if neither the LCAxxx2307I nor the LCAxxx2315I message is written on the console during initialization, there is a possible error in the VTAM or library manager communications definitions. Cancel the LCDD job and restart it after the configuration problems are resolved.

5.4.8 Tape Management System Considerations

Tape management systems do not talk directly to the library manager. They either communicate through the LBSERV macro, possibly through the VSE guest server, or through CSL calls to RMS. It is the responsibility of the tape management system to manage data sets. The purpose of VGS and RMS is to provide a communication mechanism to the IBM 3494 tape library.

All tape management systems should provide a mechanism to synchronize the status of the volumes that are held in the IBM 3494 tape library. This synchronization is typically invoked through an operator command or as part of normal tape management housekeeping.

5.4.9 Library Manager Categories Used by VM/ESA and VSE/ESA

DFSMS/VM uses 16 library manager volume categories from 0080 (hex) through 008F as VM categories from SCRATCH0 through SCRATCH9 and SCRATCHA through SCRATCHF. VSE/ESA uses 32 library manager volume categories from 00A0 (hex) through 00BF as VSE categories from SCRATCH00 through SCRATCH32. See Appendix A, “Library Manager Volume Categories” on page 353 for details.

5.5 OS/400

IBM 3494 support for the AS/400 environment is supplied in the MLDD. This is the basic support to control an IBM 3494 from AS/400.

BRMS/400 uses the interfaces in the MLDD to service IBM 3494 operations for applications or end users. BRMS/400 is the recommended interface to the IBM 3494.

In this section we explain the basic considerations for sharing and partitioning an IBM 3494 tape library in an AS/400 environment using BRMS/400.

More information about the MLDD can be found in the *IBM 3494 User's Guide: Media Library Device Driver for AS/400*. Information about BRMS/400 can be found in *Backup Recovery and Media Services/400 V3R7*.

5.5.1 Basic Implementation

In this section we explain the basic implementation of the MLDD and BRMS/400.

5.5.1.1 Installation Tasks for MLDD

The installation tasks for the MLDD are:

1. Sign on to AS/400 as QSECOFR.
2. From the main menu, type RSTLICPGM and press PF4.
3. Fill in the menu choices as follows and then press Enter:
   - Product ==> 5798RZH
   - Language number ==> 2924 (for English upper or lower case)

   Two product libraries are created, QMLD and QUSRMLD. In addition to these, a subsystem called QMLDSBS is created.
4. Type the ADDMLD command and press PF4 to:
   - Set up the RS-232 or LAN port for IBM 3494 communications
   - Vary on the MLDD line
5. Type the INZMLD command and press PF4 to initialize the MLDD. This initialization command starts jobs QMLMAIN, QMLCOM, and QMLTRACE. You can use the ENDMLD command to terminate these jobs for problem analysis or error recovery.
6. Use the DSPSTSMLD command to display the IBM 3494 status:

- Total and available cells
- I/O station status
- Operational state

5.5.1.2 Installation Tasks for BRMS/400

The installation tasks for the BRMS/400 are:

1. Issue the RSTLICPGM command to:
   - Gather device information
   - Dynamically build classes, policies, and control groups
   - Set up default backup control groups for full backup of the entire system
2. Enroll the CST in the BRMS/400 media management inventory.
3. Review the BRMS/400 policies and change them to suit your needs.
4. Add further backup control groups for more granular backup.
5. Add archive control groups if needed.
6. Perform initial full system save to generate save history as a recovery starting point.

5.5.1.3 BRMS/400 Control Data Sets

The BRMS/400 uses its own media inventory for volume management. The media inventory contains the volser number, contents, location, container, and status of all volumes. Both active (private) and scratch volumes are carried in the media inventory.

5.6 AIX Support

In this section we describe the support of IBM 3494 tape libraries for applications running on AIX, on an RS/6000 or RS/6000 SP. Two environments are discussed: the library device driver environment and the ADSM application environment. The latter provides IBM 3494 tape library management functions in addition to backup and restore and archive and retrieve functions.

IBM′s Remote Tape API (RTAPI) provides a programmable interface to allow network AIX clients to access tape data from an IBM 3494 tape library attached to an AIX RTAPI tape server. RTAPI is not discussed in this section, but an IBM Storage Specialist can provide you with information about RTAPI.

In this section, we use the term *RS/6000* for both an RS/6000 and an RS/6000 SP node.

5.6.1 AIX Device Drivers

In this section we describe the device drivers used to support an IBM 3494 tape library in an RS/6000 environment. We also give an overview of how the device drivers are installed and configured.

Depending on the attachment method used, there are two different device driver implementations. Figure 130 shows the two device drivers that are used in a SCSI environment:

- Atape.driver, which provides the interface to the tape drive
- Atldd.driver, which provides the library manager control point (LMCP) daemon

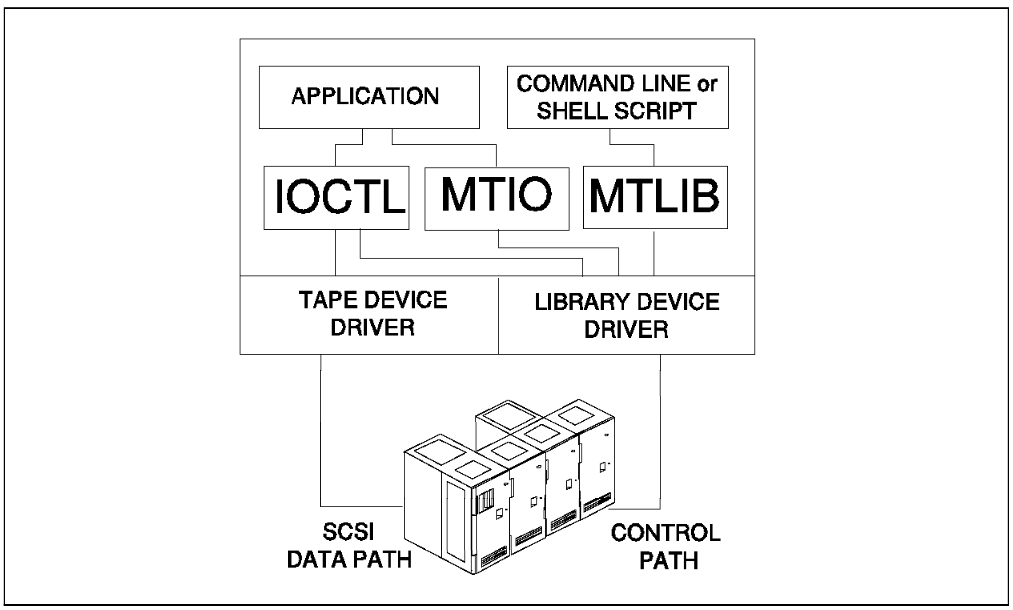


Figure 130. AIX SCSI Support for Tape Library

Figure 131 on page 205 shows an ESCON or parallel channel attachment. In this configuration, a single device driver provides the interface to both the tape drive and IBM 3494 tape library. There are two device drivers, depending on which type of channel is used:

- s370.driver, for parallel attachment

- s390.driver, for ESCON attachment

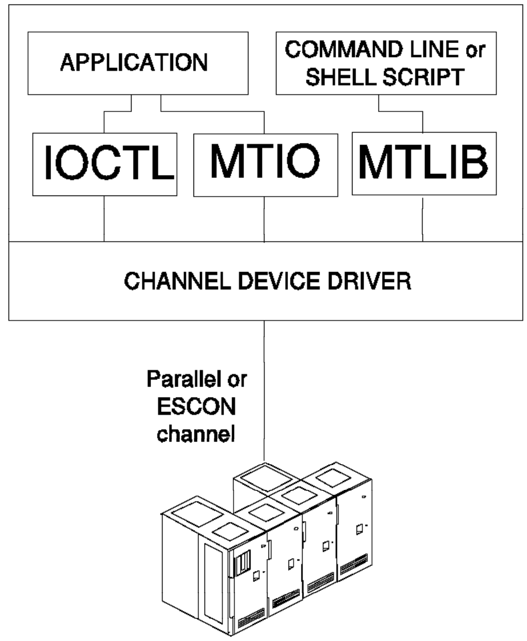


Figure 131. AIX Parallel or ECSON Support for Tape Library

In both environments, the drivers provide a programmable interface through system calls to the tape device and library manager and a command line interface to the library manager. The programming interface is provided through AIX special files: in the case of tape devices, through the /DEV/RMT*; and in the case of /DEV/LMCPx, through the library manager control point daemon. The programmable and command line interfaces provided with the device drivers are:

- IOCTL for tape devices and to open the library manager control point special file
- MTIO for library system calls
- MTLIB library command interface

As shipped with the AIX kernel, the IOCTL system calls have had additional functions added to provide support for the 3490, 3490E, and 3590 tape drives. The driver supplies the existing IOCTL functions to allow compatibility with existing applications. The programmable interface to control library operations is provided by the MTIO system calls. Before a call can be made, the library manager control point special file must first be opened by the use of IOCTL.

We do not describe the IOCTL or MTIO system calls further. Detailed information can be found in the *SCSI Device Drivers: Installation and User's Guide* in the *IBM AIX Parallel and ESCON Channel Tape Attachment/6000* .

5.6.2 MTLIB Command Line Interface

The MTLIB command can be issued from either the AIX prompt or within a shell script. The MTLIB command is easy to use and enables you to obtain status information about the library, drives, and cartridges. Using MTLIB, you can mount and demount cartridges, and perform insert and eject functions by changing the cartridge′s library manager category.

The structure of the MTLIB command is simplistic, so every action that the library must perform to complete a task must be coded. Appendix B, "MTLIB Command" on page 361 contains full details on the MTLIB command.

You can use the MTLIB command to quickly automate existing backup procedures if an application such as ADSM, RTAPI, or LibrarySmart was not used. Before you can mount a cartridge, you first have to change its library manager category to an AIX scratch or specific category. Native AIX can use any category, but care should be taken if you are sharing the library.

In the example in Figure 132, we assume that volume AIX001 was already in the library and we just inserted volume AIX002. After we made two TAR backups, we ejected AIX001 so that it could be kept in an offsite vault.

```
mtlib -l /dev/lmcp0 -C -VAIX001 -t1000
mtlib -l /dev/lmcp0 -m -f /dev/rmt0 -VAIX001
mtlib -l /dev/lmcp0 -m -f /dev/rmt1 -VAIX002
tar -cvf /dev/rmt0 ./
tar -cvf /dev/rmt1 ./
mtlib -l /dev/lmcp0 -d -f /dev/rmt0 -VAIX001
mtlib -l /dev/lmcp0 -d -f /dev/rmt1 -VAIX002
mtlib -l /dev/lmcp0 -C -VAIX001 -tFF10
mtlib -l /dev/lmcp0 -qL
mtlib -l /dev/lmcp0 -m -f /dev/rmt0 -VAIX002
tar -tvf /dev/rmt1
mtlib -l /dev/lmcp0 -d -f /dev/rmt0 -VAIX002
```

Figure 132. Using MTLIB to Automate TAR Backup

- mtlib -l /dev/lmcp0 -C -VAIX001 -t1000
  This command changes the cartridge AIX001 library manager category to x′1000′, which is not reserved by any other hosts or for any library manager function.
- mtlib -l /dev/lmcp0 -m -f /dev/rmt0 -VAIX001
  This command mounts cartridge AIX001 onto device rmt0.
- mtlib -l /dev/lmcp0 -m -f /dev/rmt0 -VAIX002
  This command mounts cartridge AIX002 onto device rmt1.
- tar -cvf /dev/rmt0 * tar -cvf /dev/rmt0
  This is the TAR command used to perform normal backup. It is normally used to back up the whole file system from which the MTLIB command is run.
- mtlib -l /dev/lmcp0 -d -f /dev/rmt0 -VAIX001
  This command demounts cartridge AIX001 from dev rmt0. If in a script, this command is not issued until the TAR command has completed.
- mtlib -l /dev/lmcp0 -d -f /dev/rmt1 -VAIX002

This command demounts cartridge AIX002 from dev rmt1. If in a script, this command is not issued until the TAR command has completed.

- mtlib -l /dev/lmcp0 -C -VAIX001 -tFF10
  This command changes the library manager category of cartridge AIX001 to FF10. Setting the library manager category instructs the library manager to eject the cartridge from the library through the convenience I/O station (see Table 47 on page 353 for a full list of library manager volume categories).
- mtlib -l /dev/lmcp0 -qL
  This command requests status information about the library from the library manager (see Figure 133 on page 208 for the response to this command).
- mtlib -l /dev/lmcp0 -m -f /dev/rmt0 -VAIX002
  This command remounts cartridge AIX002 to device rmt0.
- tar -tvf /dev/rmt0
  This is the TAR command to list the files on the cartridge. It could be used to ensure that all files have been backed up as needed.
- mtlib -l /dev/lmcp0 -d -f /dev/rmt0 -VAIX002
  This command demounts the cartridge from rmt0.

```
Performing Query Library Data using /dev/lmcp0
Library Data:
   state................Automated Operational State
                        Dual Write Disabled
   input stations.......1
   output stations......1
   input/output status..All input stations empty
                        All output stations empty
   machine type.........3494
   sequence number......12345
   number of cells......207
   available cells......0
   subsystems...........1
   convenience capacity.20
   accessor config......01
   accessor 0 status....Accessor available
                        Gripper 0 available
                        Gripper 0 vision operational
                        Gripper 1 not installed
                        Gripper 1 vision not operational
   accessor 1 status....00
   accessor 2 status....00
   accessor 3 status....00
   accessor 4 status....00
   accessor 5 status....00
   accessor 6 status....00
   accessor 7 status....00
   comp avail status....Primary library manager installed.
                        Primary library manager available.
                        Primary hard drive installed.
                        Primary hard drive available.
                        Secondary hard drive installed.
                        Secondary hard drive available.
                        Convenience input station installed.
                        Convenience input station available.
                        Convenience output station installed.
                        Convenience output station available.
```

Figure 133. Response to MTLIB Query Library Command

5.6.3 Device Driver Installation

The discussion that follows assumes that the hardware is installed and the data and command paths have been connected. See 4.8, “AIX Support” on page 106 for an overview of connecting the library manager to an RS/6000 through a LAN or directly through an ESCON or parallel channel.

There are a number of steps to install the device drivers. We give an overview of the steps required in a SCSI environment. For further information about ESCON or parallel attachment, see *IBM AIX Parallel and ESCON Channel Tape Attachment/6000*.

Device driver installation and configuration can be done through either the AIX Systems Management and Installation Tool (SMIT) or commands.

5.6.3.1 Installing the AIX Tape and Medium Changer Device Driver

The tape device drive is called the *AIX tape and medium changer device driver*. It supports the IBM 3490 Model C and F and the IBM Magstar 3590 Model B1A tape drives when they are installed in an IBM 3494.

Use the *installp* utility to install the AIX tape and medium changer device driver and the *smit, chdev, rmdev,* or *mkdev* commands for configuration.

You must have root authority to perform any of these operations.

Use the smit command, or to install from the command line, use the following command:

```
installp -ac -d /dev/rfd0 Atape.driver
```

If a previous version of Atape.driver is installed, use the -F flag with the installp command to force an installation. After the driver software is installed and a tape drive is connected to the adapter card, configure the device and make it available.

To make the hardware aware of the tape drive you can either:

- Enter the cfgmgr command with no parameters. This command automatically configures all devices, including the new IBM Magstar 3590 tape subsystem.
- Shut down the system and reboot by entering the

  ```
  shutdown -Fr
  ```

  command. This process automatically configures and makes available any new devices.

  Note: We recommend that the system be powered off if the SCSI cable has not been connected to the tape drive. A fuse in the terminator can trip if power is present when connecting the cable.

Follow the steps listed below to configure the tape drive to the operating system. Our example shows how a 3590 would be configured. As you can see from the length of the mkdev command, it would be much simpler to use smit:

1. Use the mkdev command. For example, on AIX Version 4:

   ```
   mkdev -s scsi -c tape -t 3590 -p scsi1 -w 4,0 -l rmt4 -a
   block_size=0
   ```

   This command defines a SCSI tape device, connected at target 4 and logical unit number (LUN) 0 and attached to the parent adapter, scsi1. It is type 3590 with a special file name of */dev/rmt4*.

2. Use the smit menu and enter the smit tape command.

   Figure 134 on page 210 shows the tape drive menu on the Add a Tape Drive screen.

```
                           Add a Tape Drive
Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                                      (Entry Fields)
  Tape Drive Type                                 3590
  Tape Drive Interface                            scsi
  Description                                     IBM 3590 Tape...
  Parent Adapter                                  scsi1
* CONNECTION address                             (10)           +
  Block Size (0=Variable Length)                 (0)            +#
  Use Hardware Compression on Tape               (yes)          +
  Use Device Buffers during Writes               (yes)          +
  Allow Device to Dominate SCSI Bus Cycles       (yes)          +
  Activate volume information logging            (yes)          +
  Maximum size of log file(in # of entries)      (5000)         +#







F1=Help          F2=Refresh          F3=Cancel          F4=List
F5=Reset         F6=Command          F7=Edit            F8=Image
F9=Shell         F10=Exit            Enter=Do
```

Figure 134. Defining the IBM 3590 Using the Smit Menu

Notes:

- For the CONNECTION address, the format is *TL* in AIX Version 3, and *T,L* in AIX Version 4, where *T* is the SCSI target address of the device and *L* is the SCSI LUN address for the corresponding target.
- The Block Size parameter determines whether the device driver will accept fixed- or variable-length blocks from an application or the device. If zero is specified, the driver will accept blocks of variable length. If a positive, nonzero value is specified, the driver will only accept blocks of that exact length.

  With block size set to zero, variable block mode, be sure the utility or application has the proper blocking characteristic set.
- For a 3590 we recommend that the transfer size of the SCSI bus be increased, so that applications can use the 2 MB block size that the drive supports. To increase the transfer size, enter:

  `/usr/lpp/Atape/instAtape -s 0x902000`

  Further information about the IBM Magstar 3590 tape subsystem can be found in *IBM Magstar 3590 Tape Subsystem: Multiplatform Implementation*. This redbook also provides further information on the operation and configuration of SCSI libraries.

To configure a defined tape drive use smit tape or issue this command:

`mkdev -l rmt4`

To check that the tape drive is available, issue this command:

`lsdev -Cc tape`

5.6.3.2 Installing the AIX Tape Library Device Driver

Ensure that the RS-232 or LAN cable for IBM 3494 communications is in place before you install the device driver. Install the AIX tape library device driver by following these steps:

1. Install the device driver software.
2. Configure the IBM 3494 serial port (the library control path can use either an RS-232 or a LAN connection).
3. Define the IBM 3494 to the daemon.
4. Configure the LMCP.
5. Load the daemon.

To load the daemon, follow these steps:

1. Install the AIX tape library device driver by using the installp utility, the smit command, or the following command:

   ```
   installp -acXd /dev/rfd0 all
   ```

   Before entering the above command, insert the diskette labeled "IBM Automated Tape Library Device Driver, AIX LAN/TTY" in the workstation diskette drive.

2. If you are using RS-232 for the control path, use the smit command to configure the serial port (the library manager control path). If you are using a LAN connection, proceed with configuring the LMCP. To configure the RS-232 connection, enter the following:

   ```
   smit tty
   ```

   - Select, from the TTY menu, *Add a tty device*.
   - From the Selection menu, select the appropriate parent adapter.
   - From the ADD TTY menu:
     - Enter the port number (use F4 to generate a list of possible values).
     - Set baud rate to 9600.
     - Set 8 data bits, 1 stop bit, no parity.
     - Set Enable program to off (use F4 to generate a list of possible values).
     - Set Enable LOGIN to disable (use tab key to toggle value).
   - Press Return to configure the tty device.

3. Define all library names to the daemon, using your favorite editor to edit the */etc/ibmatl.conf* file:

   ```
   painless   /dev/tty0   mercury
   ```

   This device-stanza entry defines a library *painless* connected to the workstation on */dev/tty0* through an RS-232 connection. The identifier that *painless* uses to identify this particular host is *mercury*:

   ```
   painless   9.115.32.12   mercury
   ```

   This device-stanza entry defines a library *painless* connected to a LAN, and the library manager IP address is *9.115.32.12*. The port address could also be added. Again, the identifier that *painless* uses to identify this particular host is *mercury*.

4. Configure the LMCP, using smit to update the Add a LMCP Logical Device menu. The library name you choose must be one of the library names that you defined in the */etc/ibmatl.conf* file.

5. You now have to make the LMCP available. On the smit Tape Drive Menu, select the *Configure a Defined Tape Drive* option, or issue this command:

   ```
   mkdev -l lmcp{x}
   ```

   where {x} is the number used when defining the control point.

6. Load the daemon with the following command:

   ```
   cfgmgr
   ```

   The /etc/inittab file is updated when you configure the LMCP. The daemon is started automatically during system initialization.

   To check that the daemon is running, issue this command:

   ```
   ps -ef | grep lmcp
   ```

Once the device drivers have been installed, we recommend that you complete the test procedure before installing or customizing application software.

Full descriptions of device driver installation can be found in the *SCSI Device Drivers: Installation and User's Guide* and in the *IBM AIX Parallel and ESCON Channel Tape Attachment/6000*.

5.6.4 Define Tape Library and Tape Drives to ADSM

For ADSM to use the IBM 3494 tape library, follow these steps:

1. Define the tape library.
2. Define the library-resident drives.
3. Define the storage pool device class.
4. Define the storage pool.
5. Define the tape volumes in the storage pool.
6. Check in the volumes to the storage pool.
7. Change the management class to use the new storage pool.

To define the library and type of library to ADSM, use the DEFINE LIBRARY command (Figure 135). We have used the abbreviated versions of the parameters.

```
DEF LIBR PAINLESS LIBT=349X SCRATCHCAT=301 PRIVATCAT=300 DEVI=/dev/lmcp0
```

Figure 135. ADSM DEFINE LIBRARY Command

PAINLESS is the library name; this name could also be the name used for the LMCP. The ADSM library manager categories are 012d and 012c for scratch and private volumes, respectively. In ADSM the category numbers are in decimal, and in the library manager they are in hex. The ADSM scratch and private default library manager categories can be changed in the DEFINE LIBRARY command (except to those reserved for the library manager). We have shown this in the example. When support for 3590 drives is enabled (by the ENABLE3590LIBRARY option in the server options file), ADSM automatically creates two scratch categories, one for 3490 scratch volumes and one for 3590 scratch volumes.

The 3490 scratch category is specified with the SCRATCHCAT parameter (default 012D), the 3590 scratch category is one number higher (default 012E).

We next define the devices that will be inside the library, using the DEFINE DRIVE command (Figure 136).

```
DEF DR PAINLESS ATLDR1 DEVI=/dev/rmt1
```

Figure 136. ADSM DEFINE DRIVE Command

In this example we define the tape drive that is accessed through the AIX special /dev/rmt1 to ADSM. The drive is known to ADSM as ATLDR1 and is resident in the library called PAINLESS.

Before defining the storage pool, you must define the type of devices within the storage pool, using the DEFINE DEVCLASS command. It is not possible to mix 3590 and 3490E drives in the same device class and therefore the same storage pool. Figure 137 shows the command to define a device class for the 3590 drives in our IBM 3494 tape library. For other parameters, we use the default values.

```
DEF DEV ATLDEVCL DEVT=3590 LIBR=PAINLESS
```

Figure 137. ADSM DEFINE DEVCLASS Command

Use the DEFINE STGPOOL command to define a storage pool that the IBM 3494 tape library uses (Figure 138).

```
DEF STG ATLPOOL ATLDEVCL
```

Figure 138. ADSM DEFINE STGPOOL Command

The storage pool is called ATLPOOL and the class of device with that pool is defined by the ATLDEVCL device class. For other parameters, we use the defaults.

Using the DEFINE VOLUME command (Figure 139), you can manually define the volumes ADSM will have in a storage pool. Alternatively, you could use the MAXSCRATCH parameter of STGPOOL to allow ADSM to get its own scratch volumes from the library manager ADSM scratch category.

```
DEF V ATLPOOL ADSM01 ACC=READW
```

Figure 139. ADSM DEFINE VOLUME Command

We have defined the cartridge with a volser number of ADSM01 and belonging to a storage pool called ATLPOOL.

Before the volumes can be used by ADSM, they must first be labeled. ADSM provides a program (DSMLABEL) to do this. DSMLABEL with the -search parameter labels all cartridges in the INSERT category, so care must be taken that only the cartridges to be used by ADSM are in this category. Figure 140 on page 214 shows an example of a DSMLABEL command. If the -keep parameter is not specified, the cartridge is placed in the convenience I/O station once it has been labeled.

```
dsmlabel -drive=/dev/rmt1 -drive=/dev/rmt2
         -library=/dev/lmcp0 -search -keep
```

Figure 140. ADSM DSMLABEL Command

Once the cartridges have been labeled, the library manager category can be assigned to them by issuing the CHECKIN LIBVOLUME command to eject volume from an IBM 3494 tape library. Figure 141 shows an example of a CHECKIN LIBVOLUME command. We assign cartridges with a volser number of ADSM01 to the ADSM library manager scratch category. By specifying CHECKL=NO, we tell ADSM that we do not want the label to be checked. If all volumes in the library manager insert category are to be in ADSM, we use the SEARCH=YES parameter and do not specify a volser number. Take special care when using this parameter if the IBM 3494 tape library is shared by other hosts.

```
CHECKI LIBV PAINLESS ADSM01 STAT=SCR CHECKL=NO DEVT=3590
```

Figure 141. ADSM CHECKIN LIBVOLUME Command

5.7 Sun OS

Sun can only attach to an IBM 3494 through a SCSI-2 data path and using either LAN or RS-232 for the library control path. As with AIX, two device drivers would be supplied, one for the tape drive and the other for the library. The AIX configuration in Figure 130 on page 204 is similar to the implementation used with Sun.

The library device driver provides a library manager control point daemon (LMCPD), which is accessed through three C object modules to interface with the library manager. The MTLIB command line interface is also available.

5.7.1 Installing the IBM Tape and Media Changer Device Driver for SunOS

Installation of the tape and media changer device driver is accomplished by using the standard Sun *package* facility. The IBM SCSI Tape and Medium Changer Device Driver for Solaris package is named *IBMtape*. Configuration of the device driver is handled through the standard convention of a *name.conf* configuration file having the same name as the driver and existing in the same directory as the device driver. The Differential SCSI-2 support must already exist on the machine before installing the IBM SCSI Tape and Medium Changer Device Driver for Solaris. If the Differential SCSI-2 adapter and the associated SCSI adapter device driver are not installed and configured, you must install and configure them before proceeding with the installation of the *IBMtape* package.

Note: You must have root authority to perform this procedure, and you will be required to reboot the system during the installation.

If your system has a diskette drive, insert the distribution diskette and enter the following commands:

```
/usr/bin/volcheck
/usr/sbin/pkgadd -d /vol/dev/aliases/floppy  IBMtape
/usr/bin/eject
cd /
```

Then shut down and reboot the system according to your normal procedures.

If your system does not have a diskette drive but is connected to the network, insert the distribution diskette in another workstation on the network and enter the following commands:

```
/usr/bin/volcheck
/usr/bin/dd if=/vol/dev/aliases/floppy  of=/tmp/image.pkg
/usr/bin/eject
```

Now enter the following commands on the target workstation:

```
/usr/sbin/pkgadd -d /tmp/image.pkg IBMtape
(tmp is directory on server)
 cd /
/usr/sbin/shutdown -y -g  -i6
```

Then shut down and reboot the system according to your normal procedures.

To verify that the installation was successful, enter:

```
pkginfo stdd
```

Refer to the Solaris manuals for more detailed information about installing a Sun package.

Detailed instructions for the installation, configuration, and verification of the IBM SCSI Tape and Medium Changer Device Driver for Sun OS as well as the Sun OS Tape Library Driver can be found in the *SCSI Device Drivers: Installation and User's Guide*, which is shipped with the device drivers.

5.7.2 Installing the IBM Tape Library Driver for Sun OS

Installation of the Tape Library device driver is accomplished by using the standard Sun *package* facility. The IBM Tape Library Driver for Solaris package is named *lmcpd*. The LAN or TTY support must exist on the machine before installing the IBM Library daemon for SunOS. Install and configure the LAN or TTY adapter and associated LAN or TTY adapter device driver before proceeding with the installation of the *lmcpd* package. You must have root authority to perform this installation.

The distribution diskette contains a file system comprising the *lmcpd* package with the library daemon and other associated files and utilities.

Ensure that the RS-232 or LAN cable for IBM 3494 communications is in place before you install the device driver. The library control path is established by either of the following methods:

- Using a standard 25-pin null modem D-shell RS-232 cable. The cable can be placed in a native serial port, or on an 8- or 16-port asynchronous adapter.
- Using a LAN connection (either Ethernet or token ring) with TCP/IP.

To install the IBM tape library daemon for SunOS follow these steps:

1. Install the IBM 3494 daemon, called *lmcpd*.
2. Configure the IBM 3494 serial port (the library control path can use an RS-232, or LAN connection).
3. Define the IBM 3494 to the *lmcpd* daemon.
4. Define the host port if using TCP/IP for the library control path.

Detailed instructions for the installation, configuration, and verification of the IBM SCSI Tape and Medium Changer Device Driver for Sun OS as well as the Sun OS Tape Library Driver can be found in the *SCSI Device Drivers: Installation and User's Guide*, which is shipped with the device drivers.

5.8 HP-UX

HP hosts attach to an IBM 3494 through a SCSI-2 data path and either Ethernet or Token Ring LAN for the library control path. The IBM SCSI Tape and Medium Changer Device Driver for HP-UX and the HP-UX Tape Library Device Driver must both be installed to use the IBM 3494 on an HP host. These device drivers for an HP host only support SCSI-attached 3590 tape drives in an IBM 3494 library.

The library device driver provides an LMCPD, which is accessed through a C object module to interface with the library manager. The MTLIB command line interface is also available.

5.8.1 Installing the Tape and Media Changer Device Driver for HP-UX

To install the IBM SCSI Tape and Medium Changer Device Driver for HP-UX (ATDD), follow these steps:

1. Copy the software from the distribution medium to the depot.
2. Check the README file and verify that your system is appropriately configured for installing the ATDD device driver.
3. Ensure that the tape drives to be managed by the ATDD driver are powered up.
4. Install and configure the software.

Detailed instructions for the installation, configuration and verification of the IBM SCSI Tape and Medium Changer Device Driver for HP-UX as well as the HP-UX Tape Library Driver can be found in the *SCSI Device Drivers: Installation and User's Guide*, which is shipped with the device drivers.

5.8.2 Installing the IBM Tape Library Driver for HP-UX

Installation of the Tape Library device driver for HP-UX is done with the standard *swinstall* facility. The IBM Tape Library Driver for HP-UX is named *lmcpd*. The LAN support must exist on the machine before the IBM Tape Library driver for HP-UX is installed. Install and configure the LAN support before proceeding with the installation of the *lmcpd* package. You must have root authority to perform this installation.

Use a LAN connection (either Ethernet or Token Ring) through TCP/IP. The connection must be in place before the software is installed to ensure proper initialization of the daemon. For each IBM 3494 connected through TCP/IP, ensure that your machine has access to its library manager. Use the ping utility to verify that you have network connectivity to the library manager.

The distribution diskette contains a *swinstall* process that includes the *lmcpd* daemon with other associated files and utilities.

To install the IBM Tape Library Device Driver for HP-UX for the IBM 3494 follow these steps:

1. Copy the software from the distribution medium to the depot.
2. Check the README file and verify that your system is appropriately configured for installing the *lmcpd* software.
3. Install and configure the software.

Detailed instructions for the installation, configuration and verification of the IBM SCSI Tape and Medium Changer Device Driver for HP-UX as well as the HP-UX Tape Library Driver can be found in the *SCSI Device Drivers: Installation and User's Guide*, which is shipped with the device drivers.

5.9 Non-IBM Open Systems Support

Detailed and up-to-date information about non-IBM hardware and software that will attach to IBM 3494s can be found on the Internet at:

```
http://www.storage.ibm.com/hardsoft/tapud/3494/mag3494.htm
http://w3.rmss.storage.ibm.com/rmssprods/Tape/3494_vts/Contable.htm
```

Chapter 6. Installation Verification

In this chapter we cover hardware and software verification. We also include a number of checklists and points you may want to consider when you plan testing.

After the hardware is installed, we recommend that you go through an extensive test schedule. This is the right time to test because:

- Testing will make you familiar with the tape library and related software.
- You can test in this phase without risk to the production environment.
- Testing will prepare you to know how to handle abnormal conditions when they occur in production.

Use the testing provided in this chapter as a base for your own planning. Certain tasks may not apply to your site, however, and others may have to be added, depending on your environment.

6.1 Hardware Installation Verification

These proposed tests concern the tape library hardware and the library manager. The tasks listed in Table 31 are usually performed by operations personnel; refer to the (*IBM 3494 Tape Library Dataserver Operator's Guide*) for more information.

Table 31 (Page 1 of 2). Hardware Testing

Task	**Comment**
Power on and off the library	See Operator's Guide
Perform mode switching (auto, manual, and pause mode)	See Operator Guide
Test operation in manual mode	See Operator Guide
Switch active library manager to standby (IBM 3494 with High Availability unit only)	See Operator Guide
Switch active accessor to standby (IBM 3494 with High Availability unit installed only)	See Operator Guide
Enter cartridge into convenience I/O station	See 9.8, "Inserting and Ejecting Cartridges" on page 298
Enter cartridge into an empty storage cell (IBM 3494 only)	See 9.8, "Inserting and Ejecting Cartridges" on page 298
Enter cartridge into high-capacity I/O facility	See 9.8, "Inserting and Ejecting Cartridges" on page 298
Enter cartridge without bar code into convenience I/O station (IBM 3494 only)	See Operator Guide
Enter cartridge in stand-alone mode (transient mount) into convenience I/O station (IBM 3494 only)	See 9.10, "Stand-Alone Dump and Restore" on page 303
Test remote library manager console	See Operator Guide

Table 31 (Page 2 of 2). Hardware Testing	
Task	**Comment**
Handle INTERVENTION REQUIRED situation; learn where to find the detailed information on the library manager panel	See Operator Guide
Retrieve cartridge from a tape drive	See Operator Guide
Retrieve lost cartridge inside the library	See Operator Guide
Retrieve cartridge from the gripper	See Operator Guide
Move the cartridge accessor manually	See Operator Guide
Test backup procedures for tape drive failure	See 9.12.2.1, “MVS Operator Commands” on page 322
Test backup procedures for accessor or accessor controller failure	See Operator Guide: Manual mode
Test backup procedures for IBM 3494 library manager failure	See Operator Guide. The library manager may or may not, depending on the nature of the failure, write one of the following messages to the host: • library manager CHECK-1 condition • library manager equipment check • library manager offline • library manager path check See 10.3.11, “Library Manager Database Recovery and Host Resynchronization” on page 351
Test backup procedures for library manager hard-disk failure	Disruptive action. Customer Engineer must replace library manager disk with its backup copy. See 10.3.11, “Library Manager Database Recovery and Host Resynchronization” on page 351.

6.2 OS/390 and System Managed Tape

In this section we cover the software areas you should consider testing as part of your library and system-managed tape implementation project. Table 32 s.lists the testing tasks.

Table 32 (Page 1 of 2). System-Managed Tape Testing	
Task	**Comment**
Allocate a standard SMS data set in the IBM 3494	
Allocate an SMS multivolume data set in the IBM 3494	
Allocate several SMS data sets as multifile (LABEL=...) in the IBM 3494	
Allocate an SMS data set and reuse it with DISP=MOD	
Allocate a non-SMS data set outside the library	

Table 32 (Page 2 of 2). System-Managed Tape Testing	
Task	**Comment**
Allocate non-SMS multivolume data sets outside the library	
Reuse with DISP=MOD one of the first data sets of a multifile tape	
Allocate non-SMS data sets in the IBM 3494	This should be impossible!
Allocate SMS data set outside IBM 3494	This should be impossible!
Allocate the same SMS data set from two systems simultaneously	
Reuse the same data set from two systems simultaneously	
Initialize cartridges at open time	See 7.2.5, "Tape Initialization" on page 229
Initialize cartridges, using IEHINITT, EDGINERS (DFSMSrmm), or a vendor tape management system equivalent	See 7.2.5, "Tape Initialization" on page 229
Reinitialize already initialized cartridges	
Test sharing of library and system-managed tape components in an SMSplex or among multiple systems	
Check impact of RESERVEs against the various system control data sets in case of access by multiple systems	
Transfer cartridges between systems	This may require adding VOLUMEENTRIES in the TCDB and updating the tape management system.

6.3 Basic Tape Library Support

Because migration to and from BTLS is similar to that in system-managed tape in many ways, we limit our comments mainly to what is different.

6.3.1 Testing

All testing tasks (Chapter 6, "Installation Verification" on page 219) apply to BTLS, although the results are slightly different in many cases:

- Insert processing is not be handled automatically. Use LIBRARY INVENTORY commands to define cartridges to BTLS once they are inserted.
- Eject processing is invoked by a LIBRARY SETCATEGORY EJECT/XEJECT command. No console or ISMF interface is available. Some tape management systems drive this command through the BTLS command interface exit (IDCLI04).
- Allocation is driven by BTLS, using either esoteric units or job names to select a library drive. You have to test the definitions and make sure you have the right data sets in the library.
- You can use IEHINITT to label tapes inside a library.
- The specifications of the SYS1.PARMLIB ALLOCnn member are applicable to BTLS.

6.4 VM/ESA and VSE/ESA

Table 33 lists the testing tasks to prove that the tape management system and the library are communicating and that you can successfully read and write data to library-resident drives. IBM does not provide a tape management system for VM or VSE, so we cannot give detailed information about how to carry out these tests. These tests should also be used to develop operational procedures, which should be complete before the library is used for production work.

Table 33. VM/ESA and VSE/ESA Testing Procedures

Task	**Comment**
Check that automatic insert processing is working as expected.	
Check that the library manager category and tape management system catalog synchronize correctly.	This is done either by command or by batch job.
Check the tape management system vaulting procedures. They should cause cartridges to be ejected from the library.	
Check that the tape management system operator commands to work as expected with the library.	Operator commands may not exist for your tape management system.
Allocate a standard data set in the IBM 3494.	
Allocate a multivolume data set in the IBM 3494.	
Allocate several data sets as multifiles in the IBM 3494.	
Modify a previously written data set.	
Read an 18-track data set in the IBM 3494 on a 3490E tape drive.	
Reuse the same data set from two systems simultaneously.	
Initialize cartridges if any new media is to be used.	
Reinitialize already initialized cartridges.	

6.5 AIX

After installing the device driver, use the MTLIB and TAPEUTIL commands (Table 34 on page 223) to test the installation and connectivity to the library. Complete these tests before continuing with any application software configuration or testing.

Table 34. AIX Test Procedure

Task	Comment	Suggested Resolution
Confirm the device driver version. Confirm that tape drives have been made available and the LMCP daemon is running.	• lslpp -l Atape.driver• • lslpp -l atldd.driver• • lslpp -l s370.driver• • lslpp -l s390.driver• • lsdev -Cc tape • ps -ef | grep lmcp	• To configure the drive, issue the **cfgmgr** command. • To make drive available, issue the **mkdev -l rmt{x}** command. • To make the LMCP available, enter the **mkdev -l lmcp{x}** command. • To start the LMCP daemon, issue the **cfgmgr** command.
Exercise 3494 control path by querying library.	• mtlib -l /dev/lmcp{x} -qI • mtlib -l /dev/lmcp{x} -v -a V(volser)	• Check that an RS-232 or LAN connection is enabled on the library manager system summary display to see whether the connection is active. • Check that the 3494 is in auto mode and the mount can be seen on the mount queue.
Exercise 3494 accessor by mounting and demounting a cartridge. Perform a read/write test and eject the cartridge through the convenience I/O station.	• mtlib -l /dev/lmcp{x} -m -f /dev/rmt{x} -V(volser) • tapeutil -f /dev/rmt{x} rwtest • tapeutil -f /dev/rmt{x} unload • mtlib -l /dev/lmcp{x} -d -f /dev/rmt{x} • mtlib -l /dev/lmcp{x} -v -C -tFF00 -V(volser)	• Check that the 3494 is in auto mode and the mount can be seen on the mount queue.

Note: •Present only in an SCSI environment •Present only in a Parallel environment •Present only in an ESCON environment

Chapter 7. Software Customization for OS/390

Once you have completed your software implementation and installation verification, consider doing some post installation tasks such as implementing procedures for your operations environment.

To show how the IBM 3494 works on an OS/390 system, we also step through what happens if you read or write to a tape, the way a device is selected, how scratch tapes are selected, and how cartridge entry and eject work.

7.1 OAM Customization

Through the CBRXLCS general use programming interface, an application program can:

- Change the use attribute of a cartridge (CUA)
- Eject a cartridge from the library (EJC)
- Query whether a cartridge is present in a library (QVR)
- Test a cartridge′s eligibility to be mounted (TVE)

There are also four installation wide exits that get control at various processing points:

- Change of use exit (CBRUXCUA)
- Cartridge entry exit (CBRUXENT)
- Cartridge eject exit (CBRUXEJC)
- Cartridge not in library exit (CBRUXVNL)

The installation wide exits are used to verify and promote changes. For example, if the CBRXLCS eject interface or an operator command was issued to eject a cartridge from a library, the CBRUXEJC exit would notify DFSMSrmm that the cartridge was being ejected from the library so that DFSMSrmm could update its location.

Most tape management systems provide their own code for some or all OAM exits. For DFSMSrmm they are installed during SMP/E installation time. If you use any other tape management system, contact your software vendor.

The cartridge not in library exit (CBRUXVNL) is optional. It can be used for situations where a cartridge has been requested but does not reside in the specified library.

7.2 DFSMSrmm Customization

System-managed tape and the library manager do not manage the contents of the cartridges. System-managed tape manages the physical characteristics of the cartridge and assigns appropriate drives and media at allocation time, and the library manager manages the physical location of the cartridge within the library. DFSMSrmm manages your installation′s tape volumes and the data sets on those volumes. DFSMSrmm is fully integrated into system-managed tape and uses the LCS macro, and the entry, eject, change-use-attributes, and volume-not-in-library exits.

Refer to informational APAR II08155 and II10888 for up-to-date information about new DFSMSrmm functions.

DFSMSrmm supplies four installation wide exits, CBRUXENT, CBRUXCUA, CBRUXVNL and CBRUXEJC, which provide fully integrated management of the IBM 3494 tape library. They are installed in SYS1.LINKLIB during SMP/E installation of DFSMS/MVS. DFSMSrmm can automatically carry out insert, scratch, and movement processing. Its partition support allows for easy control of cartridge entry where the library is partitioned between two or more systems. For a discussion of partitioning a tape library, refer to 7.6, “Partitioning Tape Libraries among Multiple Systems” on page 240.

The following steps are required to implement an IBM 3494 tape library with DFSMSrmm:

1. Define cartridge entry rules
2. Inform DFSMSrmm of library-resident cartridges
   - New cartridges
   - Existing DFSMSrmm-managed cartridges
3. Define procedures to eject cartridges
4. Define procedures to ensure database synchronization with the TCDB

7.2.1 Cartridge Entry Processing with DFSMSrmm

When cartridges are inserted into an IBM 3494 tape library, their bar codes are validated, and, if acceptable, the cartridge is placed into the insert category. The library manager then sends a message to all attached hosts. When OAM receives this message, it checks with DFSMSrmm through the entry exit (CBRUXENT) to see whether DFSMSrmm approves or disapproves. This process is controlled by REJECT statements in the EDGRMMxx member of PARMLIB. The REJECT parameter can be used to control entry into the library and whether or not the cartridge is to be used for input processing only. In the example in Figure 142, cartridges starting with DD3 will not be allowed in the library. Cartridges starting with CC12 will be used for input processing only. REJECT ANYUSE(*) is to prevent any cartridges not known to DFSMSrmm from being added to the TCDB. If both OUTPUT and ANYUSE are specified, ANYUSE overrides OUTPUT, so in the final example all tapes starting with PR (with the exception of those starting with PRD) will be available for input processing only. When a cartridge matches the REJECT ANYUSE statement, a return code of 12 is set in the CBRUXENT exit, which tells OAM to leave this cartridge to be processed by another host.

```
REJECT ANYUSE(DD3*)
REJECT OUTPUT(CC12*)
REJECT ANYUSE(*)
REJECT ANYUSE(PRD*),OUTPUT(PR*)
```

Figure 142. RMM REJECT Statements in EDGRMMxx

The CBRUXVNL exit (volume not in library) provides support so that a volume needed for processing to continue can be reentered into the library.

DFSMSrmm provides volume location and movement information that can be used to determine whether the volume can be entered into the library. If the volume is defined in the DFSMSrmm control data set, DFSMSrmm provides location, movement, and status information. Then DFSMSrmm uses the information to build a WTO message that includes the volume location and prompts the operator to enter the volume into the system-managed library. If the volume entering the library is marked as in transit to other than a system-managed library, ensure that the move for the volume is confirmed as completed. Otherwise the volume entry will be rejected.

DFSMSrmm EDGLCSUX gets called from CBRUXVNL when a volume not currently mounted on the system is to be allocated.

DFSMSrmm issues message EDG8197I for all volumes it knows nothing about. This could include offline DASD or nonmanaged tape. If this message is issued because a DASD volume was not mounted or has no unit control block (UCB), modify the CBRUXVNL exit so that DFSMSrmm is not called when processing the DASD volumes.

Before entering cartridges into the library, you must first establish your cartridge entry rules in the EDGRMMxx member of PARMLIB. If you are adding to the library new cartridges that DFSMSrmm does not yet know about and have not coded REJECT ANYUSE(*), DFSMSrmm will automatically add the volumes to its CDS during cartridge entry processing.

7.2.2 Define Cartridges

We recommend that you define your private volumes to DFSMSrmm before entering them in the IBM 3494 tape library by using the DFSMSrmm ADDVOLUME command. However, the location is automatically updated during insert processing. Cartridges that are already defined to DFSMSrmm will be accepted into the library, in accordance with the insert policies that you have defined, and their LOCATION will be updated in DFSMSrmm. If you want the home location of a cartridge to be in a library, use the CHANGEVOLUME command with the LOCATION subparameter. This can be done by issuing multiple commands or by using the DFSMSrmm CLIST function to build a list of the cartridges in the library using the DFSMSrmm SEARCHVOLUME command.

You can use the CHANGEVOLUME command to specify a storage group name for private volumes so that DFSMSrmm can provide the storage group name during cartridge entry processing. Although a blank storage group name is valid in system-managed tape environments, you should group your private volumes according to the policies specified in the ACS routines.

7.2.3 Eject Cartridges

The CHANGEVOLUME command, together with the FORCE operand, allows update of the CDS to show that a volume was ejected from an SMS library, even when the library and/or TCDB are not available. This situation could occur if manual processing has to be done to support a recovery at an alternate site with tapes that have been built in a library at the original site. RACF update access to the STGADMIN.EDG.FORCE facility class is required for the CHANGEVOLUME FORCE action to be performed.

If volumes are ejected from the library through the OS/390 LIBRARY command or the ISMF volume application, the eject exit, CBRUXEJC, is called to inform DFSMSrmm and update the storage location accordingly. An additional step or job to be added to the DFSMSrmm housekeeping run is to eject from the library cartridges that were assigned new destinations as part of vital record processing. This additional step or job uses the CHANGEVOLUME EJECT command. The cartridge can be sent to either the bulk output station or the convenience station. SEARCHVOLUME can be used to build a list of volumes to be ejected (Figure 143 on page 228).

```
//SEARCH   EXEC PGM=IKJEFT01
//SYSTSPRT DD  SYSOUT=*
//SYSTSIN  DD  *
 RMM SEARCHVOLUME VOLUME(*) OWNER(*) LOCATION(ATL) DESTINATION(*) -
     INTRANSIT(NO) LIMIT(*) -
     CLIST('RMM CV ',' EJECT')
 EX EXEC.RMM.CLIST
```

Figure 143. RMM EJECT Sample Step

Note: DFSMSrmm sets the INTRANSIT(YES) flag for ejected volumes as soon as EJECT has been performed. You must then issue the CONFIRMMOVE command just as you do without an IBM 3494 tape library.

Notice

If you use logical volumes in a VTS, it is still possible to use DFSMSrmm to eject a logical volume. DFSMSrmm simply turns over the EJECT request to OAM and assumes the task will be done.
However, if an EJECT is issued for a logical volume **not in the FAST READY or INSERT category,** this error message is returned to the host:
CBR3726I FUNCTION INCOMPATIBLE ERROR CODE 6 FROM LIBRARY lib-name FOR VOLUME volser
Thus DFSMSrmm could become out of synch with the TCDB if you try to eject a private volume. (The FAST READY attribute is only assigned to scratch categories and therefore implies that the volume is in a scratch category.)
Once a logical volume has been ejected from the library, data on the volume is deleted and cannot be recovered. Refer to 7.10.2.1, "Ejecting Logical Volumes from the Virtual Tape Server" on page 267 for details on ejecting logical volumes.

7.2.4 TCDB and DFSMSrmm Synchronization

You can use EDGUTIL to check the consistency of information in the control data set and the TCDB. EDGUTIL checks the volume status and the library where the volume resides. If any discrepancies are identified, an informational message is issued to the SYSPRINT file. You must then use DFSMSrmm CHANGEVOLUME and/or IDCAMS ALTER commands to put all repositories in synch. Figure 144 shows a sample job.

For a vendor tape management system, use the functions provided with system-managed tape support.

```
//UTIL     EXEC     PGM=EDGUTIL,PARM='VERIFY(VOLCAT)'
//SYSPRINT DD       utility message data set
//MASTER   DD       DISP=SHR,DSN=DFSMSrmm.MASTER.CDS
```

Figure 144. Sample DFSMSrmm VERIFY

7.2.5 Tape Initialization

For volumes in an automated tape library dataserver, you have the option of using DFSMSdfp OPEN processing as an alternative to using DFSMSrmm EDGINERS or IEHINITT to label scratch volumes.

Note: Initialization, for neither stacked or logical volumes, is not required with the VTS. Stacked and logical volumes are initialized transparently to the user and host at the time of first use.

If the automated tape library dataserver is fully functional (vision system working) and the VOL1 label for a scratch volume does not match the external label, DFSMSdfp rewrites the VOL1 label with the correct volser.

DFSMSrmm turns off the initialize action to defer the labeling to OPEN processing under DFSMSdfp control if you request the initialization before entering a scratch volume into the automated tape library dataserver. DFSMSrmm automatically replies to the messages issued at open time that are due to label changes allowed and supported by DFSMSrmm. DFSMSrmm automatically replies to label messages when a label change is allowed by DFSMSrmm, the volume is not being rejected by DFSMSrmm, and DFSMSrmm is not running in record mode. DFSMSrmm does not reply when the wrong volume is mounted, unless the volume is in a library and the mounted volume′s bar code does matches.

If you want to use DFSMSrmm instead of DFSMSdfp to initialize new tapes in a library, proceed with the following steps:

1. Either enter the undefined volumes into the IBM 3494 while DFSMSrmm is active or define the volumes as scratch to DFSMSrmm with LOCATION(atlname) and enter the volumes into the IBM 3494 with DFSMSrmm active.

2. Volumes should now be defined to DFSMSrmm with SCRATCH status and be known to be in the library.

3. Use the RMM CV volser INIT(Y) command to set the initialize action for each volume. RMM SV VOL(*) STATUS(SCRATCH) LOC(atlname) can be used to build the commands.

4. Run EDGINERS in automatic mode.

   In Figure 145 on page 230, an automatic run of EDGINERS is scheduled to find and initialize up to 99 volumes residing in an automated tape library dataserver called MYATL. All tape cartridges are labeled as appropriate for the drive type on which they are mounted, and for their current media characteristics.

5. DFSMSrmm temporarily sets the TCDB status to PRIVATE for the tapes to be initialized, because no specific mounts (as they are required for labeling a cartridge) are allowed for SCRATCH tapes inside a library.

Note: The automatic synchronization between DFSMSrmm and the TCDB works only if DFSMSrmm runs in PROTECT mode.

EDGINERS determines whether a volume in a system-managed tape library can be mounted on the current system. If the volume cannot be mounted, possibly because it is defined in a TCDB on another system, DFSMSrmm skips that volume.

The control statement description is as follows:

- Tape DD and SYSIN DD are not required for a system-managed tape environment.
- PARM values request initialization of 99 cartridges in library MYATL. No verification will be done. Verification will cause each cartridge to be mounted twice: once for initialization and once for verification.

DFSMSrmm ensures that volumes in a system-managed tape library to be initialized or erased are in the private category, because the automated tape library dataserver does not support specific mounts of scratch volumes. You must define a volume in a system-managed tape library to DFSMSrmm before you can initialize or erase it. Any volume not defined to DFSMSrmm will be requested to be mounted on the drive allocated by the TAPE DD statement in the JCL for EDGINERS as long as the drive is not in a system-managed library.

During demount processing, DFSMSrmm ensures that errors detected on volumes mounted in an automated tape library are reflected in the TCDB. For example, DFSMSrmm ensures that the TCDB contains information about write-protected, wrong volume, and wrong label type errors. DFSMSrmm skips the volume rather than having the operator correct the error.

```
//STEP1 EXEC PGM=EDGINERS,
//     PARM='COUNT(99),LOCATION(MYATL),INITIALIZE,NOVERIFY'
//SYSPRINT  DD  SYSOUT=A
```

Figure 145. Sample DFSMSrmm EDGINERS

7.3 Other Tape Management Systems

Unlike DFSMSrmm's support of the IBM 3494 tape library in a IBM 3494 tape library environment, some vendor tape management systems do not use all of the exits OAM provides. Therefore, care should be taken that all administrative duties (such as scratch and eject) are carried out from the tape management system and reflected properly in the TCDB.

Both scratch and eject processing typically use the CBRXLCS general use programming interface. An additional step or job would be added to issue the appropriate commands supplied by the vendor to scratch or eject cartridges. To drive the macro, a flat file produced by the tape management system's reporting programs is used, such as the picking list that operators use for vaulting cartridges. If the tape management system does not use the change-of-use (CBRUXCUA) or eject exit (CBRUXEJC), changes made at the OS/390 console through the LIBRARY command or through the ISMF volume application will not be forwarded to the tape management system, and cartridges may end up in unpredictable states.

Use of the installation wide exits is optional. However, if you are using a tape management system, you need the exits to invoke your tape management system. The tape management systems of some other vendors provide sample exits.

The following sample exit routines are provided in SYS1.SAMPLIB:

- **CBRUXENT**: The cartridge entry installation exit routine is called during cartridge entry processing to approve or disapprove entry of a cartridge into the library and to determine the TCDB volume record contents for each volume entered into the library. If you need to code this exit routine, you can use SYS1.SAMPLIB member CBRSPUXE as a model.

- **CBRUXCUA**: When you issue the CBRXLCS macro or the ISMF line operator ALTER to change a volume′s use attributes, the change-use-attribute installation exit routine is called before the TCDB volume record is updated. If you need to code this exit routine, you can use SYS1.SAMPLIB member CBRSPUXC as a model.
- **CBRUXEJC**: The cartridge eject installation exit routine is called to approve or disapprove ejecting a cartridge from a library, and to determine the TCDB volume disposition and contents for each volume to be ejected. If you need to code this exit routine, you can use SYS1.SAMPLIB member CBRSPUXJ as a model.
- **CBRUXVNL**: The volume-not-in-library installation exit routine is invoked when there is a request to process tape volumes that are not resident in a library but must be resident for processing to continue. This exit routine is invoked to give you the opportunity to insert a volume into an IBM 3494 tape library to prevent job failures. If you need to code this exit routine, you can use SYS1.SAMPLIB member CBRSPUXV as a model.

For detailed information about the exit routines, refer to *DFSMS/MVS OAM PISA for Tape Libraries*.

Note: It is possible (but not recommended) to run system-managed tape without a tape management system. You would have to use the exits described above and write code to drive them in order to guarantee data integrity and to handle private and scratch cartridges accordingly.

7.4 DFSMShsm Customization

The most significant change resulting from support of system-managed tape units and tape volumes is the transition of device selection capabilities. See *DFSMS/MVS DFSMShsm Implementing and Customizing* for detailed information about how to adapt DFSMShsm for system-managed tape.

Refer also to informational APAR II10972 for the most up to date information about new functions in DFSMShsm.

The following DFSMShsm functions can use tape library devices when writing output to tape:

- Migration
- Backup
- Spill
- Backup of the DFSMShsm CDSs and journal
- Recycle for migration and backup tapes
- Full volume dump
- ABARS
- Tape copy for migration and backup tapes
- Duplex tape for migration and backup tapes

7.4.1 Allocation

With system-managed tape DFSMShsm has no decisive role for unit allocation. If the ACS routines direct a DFSMShsm allocation request to a library, the DFSMShsm unit names have no effect on allocation. However, the names are passed to the ACS routines. See Table 35 for a complete list of all parameters that have unit options. If the tape is not system-managed, the unit name retains the controls.

Note: If you are using the &UNIT-variable in your ACS routines to select HSM data sets as candidates for the library, you will have to explicitly specify a *unitname* in the respective HSM parameters.

Table 35. DFSMShsm Unit Parameters

Command	Parameter
ABACKUP	UNIT(*tape-unitname*)
ADDVOL	UNIT(*tape-unitname*)
ARECOVER	UNIT(*tape-unitname*) TARGETUNIT(*tape-unitname*)
DEFINE	UNIT(*tape-unitname*)
SETSYS	ABARSUNITNAME(*tape-unitname*) ARECOVERML2UNIT(*tape-unitname*) ARECOVERUNITNAME(*tape-unitname*) BACKUP(TAPE(*tape-unitname*)) CDSVERSIONBACKUP(UNITNAME(*tape-unitname*)) MIGUNITNAME(*tape-unitname*) RECYCLEOUTPUT(BACKUP(*tape-unitname*) MIGRATION(*tape-unitname*)) SPILL(TAPE(*tape-unitname*)) TAPEMIGRATION (DIRECT(TAPE(*tape-unitname*)) - ML2TAPE(TAPE(*tape-unitname*)) - NONE(ROUTETOTAPE(*tape-unitname*))) TAPEUTILIZATION(UNITNAME(*tape-unitname*)) UNITNAME(*tape-unitname*)
TAPECOPY	ALTERNATEUNITNAME(*tape1-unitname*,*tape2-unitname*) ALTERNATE3590UNITNAME(*tape1-unitname*,*tape2-unitname*)
TAPEREPL	ALTERNATEUNITNAME(*tape-unitname*)

The data class MEDIA TYPE and RECORDING TECHNOLOGY parameters are honored and are used to select the allocation of a library device. They override parameter settings in the ARCCMDxx member of PARMLIB. TAPEHARDWARECOMPACT only relates to 3480 output and is superseded by the data class. If no data class is assigned to a DFSMShsm generated tape inside a library, compaction is the default.

When you want to implement DFSMShsm functions in a tape library, you must determine which functions should use it and set up the ACS routines to assign a storage class, a data class for IDRC and recording format, and a storage group for tape.

To define the tape environment (global scratch pool or DFSMShsm-specific scratch pool), make the required updates to the following DFSMShsm commands:

SETSYS SELECTVOLUME(SCRATCH) For performance reasons use a global scratch pool for a DFSMShsm function that is using the library. If a DFSMShsm specific scratch pool is being used, the scratch tape volumes to be used by DFSMShsm must be assigned a private category when they are added to the tape library.

SETSYS TAPEDELETION(SCRATCHTAPE) This option tells DFSMShsm that recycled migration and backup tapes, along with expired dump tapes, are to be returned to a global scratch pool.

SETSYS PARTIALTAPE(MARKFULL|REUSE) Migration and backup tapes that are partially filled during tape output processing are marked full if the MARKFULL option is specified. This enables a scratch tape to be selected the next time the same function begins. Marking tapes full enables full exploitation of the cartridge loaders in the IBM 3495 because the cartridge loaders can be filled with scratch tapes between tape processing windows. When the total tape-media use and low recycle overhead are more important (and for all IBM 3494s), PARTIALTAPE(REUSE) should be specified. In a REUSE environment, tapes are fully utilized and the amount of recycle processing is reduced.
PARTIALTAPE(MARKFULL) is recommended for VTS logical volumes. It enables the VTS to use ″fast ready″ allocation in the tape volume cache.

7.4.2 Data Set Names

Output device selection is based on the data set name given to the ACS routines. The data set name here is the name of the single-file data set on tape, and it is related to the DFSMShsm function that is performing the output (for example, MIGRATE or BACKUP). This data set name has no relation to the original DASD level 0 user′s data set name.
Here is a list of the data set names used for tape allocation with BACKUP, MIGRATION, DUMP, DUPLEX, and TAPECOPY:

- backup_prefix.BACKTAPE.DATASET (backup)
- migration_prefix.HMIGTAPE.DATASET (migration)
- backup_prefix.DMP.dclass.Vvolser.Dyyddd.Tssmmhh (dump)
- backup_prefix.COPY.BACKTAPE.DATASET (tapecopy, duplex of backup)
- migration_prefix.COPY.HMIGTAPE.DATASET (tapecopy, duplex of migration)

Here is a list of the data set names used for tape allocation with control data set backups:

- uid.BCDS.BACKUP.Vnnnnnnn (DATAMOVER=HSM)
- uid.MCDS.BACKUP.Vnnnnnnn (DATAMOVER=HSM)
- uid.OCDS.BACKUP.Vnnnnnnn (DATAMOVER=HSM)
- uid.JRNL.BACKUP.Vnnnnnnn (DATAMOVER=HSM)
- uid.BCDS.BACKUP.Dnnnnnnn (DATAMOVER=DSS)
- uid.MCDS.BACKUP.Dnnnnnnn (DATAMOVER=DSS)
- uid.OCDS.BACKUP.Dnnnnnnn (DATAMOVER=DSS)
- uid.JRNL.BACKUP.Dnnnnnnn (DATAMOVER=DSS)

Here is a list of the data set names used for tape allocation with ABARS:

- outputdatasetprefix.C.CccVnnnn (control file)
- outputdatasetprefix.D.CccVnnnn (data file)
- outputdatasetprefix.I.CccVnnnn (instruction file)
- outputdatasetprefix.O.CccVnnnn (internal data file)

Note: In releases earlier than DFSMShsm 1.3, you cannot use the data class routine to decide which DFSMShsm tapes should be SMS-managed and which should not. In these releases, DFSMShsm invokes the storage

class routine first and decides, based on whether a storage class is assigned, to proceed with the remaining ACS routines or to skip them. For this reason, the storage class routine needs to be coded such that only the data set name, unit type, and job name are used to make this determination for DFSMShsm tapes.
This limitation has been corrected with DFSMShsm 1.3 so you can do all the filtering in the data class routine.

If PARTIALTAPE(REUSE) is requested, the tape volume selected after allocation of a unit will be one that can be mounted on the allocated unit.
The use of the specific scratch pool with DFSMShsm is still supported with system-managed tape.

When input data sets are allocated for DFSMShsm, the situation is more strictly controlled. A tape unit within the proper library will always be selected for a library-resident volume. It is not possible to use a tape unit in one library for tapes that reside in another.

7.4.3 Library Parameters

These parameters and options are related to or are used with tape library operations:

- SETSYS TAPEUTILIZATION(LIBRARYBACKUP PERCENTFULL(pct))
- SETSYS TAPEUTILIZATION(LIBRARYMIGRATION PERCENTFULL(pct))
- SETSYS TAPESPANSIZE(nnn)
- SETSYS DUPLEX(BACKUP(Y|N))
- SETSYS DUPLEX(MIGRATION(Y|N))
- DEFINE ABARSTAPES(STACK|NOSTACK)
- DEFINE DUMPCLASS (dclass STACK(nn))
- BACKVOL SG(sgname)|VOLUMES(volser) DUMP(dclass STACK(10))

SETSYS TAPEUTILIZATION PERCENTFULL(pct) defines the TAPEUTILIZATION for backup or migration library tapes. The default PERCENTFULL of 97% applies when no other value has been specified.

The LIBRARYMIGRATION and LIBRARYBACKUP parameters apply to system-managed tape library tapes only.

If you are copying the contents of one tape to another with the TAPECOPY command or are using the concurrent creation option, DUPLEX, you need to be aware of minor inconsistencies that can exist in the length of cartridge-type tapes. Because the TAPECOPY command copies the entire contents of one tape to another, it is important that enough media is available to copy the entire source tape to its target. Therefore, when you are copying tapes with the TAPECOPY command, use the default options (the equivalent of specifying the TAPEUTILIZATION command with the PERCENTFULL option of 97%). DFSMShsm marks the end of volume when tapes are 97% full. When you use the DUPLEX option, we recommend that you use the 97% value to ensure that you can write the same amount of data to both tapes. During duplexing, the NOLIMIT parameter of TAPEUTILIZATION is converted to the default of 97%.

Note:

Special considerations have to be taken when emulated devices are used, such as logical VTS volumes or 3490E emulation on Magstar cartridges (see Table 36 on page 235).

Using <50% can speed up recall processing in a VTS, because having smaller logical volumes reduces the delay for the recall operation.

Table 36. DFSMShsm PERCENTFULL Parameters

Device Type	PERCENTFULL Value
3490 native	97
3490 CST emulated with VTS	97
3490 ECCST emulated with VTS used for migration	<50
3490 ECCST emulated with VTS used for backup	97
3490 emulated with 3590	1100
3590 native	97

SETSYS TAPESPANSIZE can be set to get a balance between the amount of tape that remains unused and the number of cases where a data set goes to two volumes. The value can be best described as *the smallest size data that you are willing to allow to span multiple tapes*. Knowing the statistical distribution of the data set sizes can help in setting this value.

A tape span size (default 500 MB, maximum 4000 MB) is used to decide whether a new data set can be allowed to go to the tape volume when the volume is nearly full (compared with the utilization defined with the PERCENTFULL parameter). If only Magstar tapes are used for backup and migration, we recommend using the maximum value (4000 MB) to avoid spanning.

DFSMShsm calculates the estimated size based on IDRC effect and gaps for 3490 and position information reported by the tape subsystem if 3590. If the data set is larger than SPANSIZE, it is written on the tape. Otherwise, DFSMShsm compares the data set size with the remaining media space; if the small data set is calculated to fit entirely on the current tape, DFSMShsm begins to write. If calculated not to fit, DFSMShsm issues an FEOV to change tapes.

The tape volumes created by DFSMShsm migration and backup functions can contain data sets that span from one tape volume to another. Each case of a data set spanning volumes in this way is said to create a *connected group*. Every succeeding connection from the second volume to a third one, and so on, extends the size of the connected volume group. An FEOV between data sets reduces the occurrence of data sets spanning tape volumes.

If SETSYS TAPEUTILIZATION(NOLIMIT) has been specified, no action is taken to reduce data set tape volume spanning. We recommend avoiding NOLIMIT for several reasons, many of which are related to recycle.

SETSYS DUPLEX This function can be used to create concurrent copies of either backup or migration tapes. The resulting structure and data set names will be exactly the same as if you had used TAPECOPY to copy the tape asynchronously. Using ACS routines, it is very simple to route duplicate output to a different library that will probably be located in an offsite location.

SETSYS ABARSTAPES(STACK|NOSTACK) If native Magstar is used with ABARS output tapes, use this parameter to force ABARS to use a single tape for its four types of output files created during ABACKUP.

DEFINE DUMPCLASS (dclass STACK(10)) or

BACKVOL SG(sgname)|VOLUMES(volser) DUMP(dclass STACK(10)) Using the STACK keyword with the AUTODUMP definitions allows DFSMShsm to use the capacity of Magstar 3590 cartridges. Multiple volume dumps are written to a single tape. The value of 10 causes DFSMShsm to write dump copies of 10 DASD volumes to a single Magstar cartridge, thus maximizing tape usage.
The value can be increased or decreased, depending on average disk capacity used and the number of tape drives available. If you had 50 source DASD, choosing STACK(50) would single-thread all dumps to a single tape drive. Using STACK(10) instead would allow 5 drives to dump 10 volumes each. Recovery would be faster in the second case as well, because you can only recover from one volume on a tape at a time.

7.4.4 Enhanced List Functions

When only a subset of DFSMShsm migration or backup tapes is to be in a library, it is important to know which tapes are connected to which tapes. All tapes connected to one another must be together in a single library. To help in this situation, the LIST TTOC command has several parameters:

- SELECT(CONNECTED)
- SELECT(NOTCONNECTED)
- SELECT(CONNECTED(volser))

The SELECT parameter can be used to indicate that all connected groups are listed or that all unconnected volumes are listed. It can also be used to request only a listing of the volumes that are connected to a known volume.

When a connected group is listed, the listing also indicates where inconsistencies exist – for example, if one of the volumes is within a library and others are outside it.

The LIST TTOC SELECT(LIB|NOLIB) command can be used to list only original backup or migration volumes that are in libraries or volumes that are outside all libraries. The LIST TTOC SELECT(LIB(ALT)|NOLIB(ALT)) command can be used to list information about original volumes whose alternate tape is or is not in a library.

The LIST TTOC SELECT(FULL|NOTFULL|EMPTY) command can list migration and backup tape volumes with full, partially full, or empty status.

The LIST TTOC SELECT(ALTERNATEVOLUME) command can list tape volumes that are marked full and have an alternate volume. This provides the capability to identify the full backup and migration tape volumes that have an alternate tape. LIST TTOC SELECT(NOALTERNATEVOLUME) lists all volumes that are full but have no alternate volume and thus need to be copied.

The library dependency parameter is also available when listing dump volumes.

7.4.5 Use Recycle to Move DFSMShsm Data

To move your DFSMShsm backup and ML2 data to a library, use the RECYCLE command. To direct the recycled data to a library, use the SETSYS RECYCLEOUTPUT command and direct future migrations and backups to the library.

Using RECYCLE SELECT (INCLUDE(RANGE(nnnnn:mmmmm))) or RECYCLE SELECT (EXCLUDE(RANGE(nnnnn:mmmmm))) for RECYCLE input can be helpful while selecting and migrating data to and from an IBM 3494 or a VTS. Its immediate purpose is to enable you to set up volume ranges for different media types and different emulation types, such as VTS logical volumes and 3490-emulated Magstar cartridges.

There are no special data set names for RECYCLEOUTPUT, although you must code your ACS routines, or BTLS options if using BTLS, to route RECYCLEOUTPUT to the library, using the &UNIT variable. See 7.4, “DFSMShsm Customization” on page 231 for a discussion on DFSMShsm and system-managed tape and 7.13, “Basic Tape Library Support” on page 269 for a discussion on DFSMShsm and BTLS.

You can direct the data to a 3590 tape subsystem by assigning a new data class that specifies a media type of MEDIA3, a recording technology of 128 tracks, and compaction YES. DFSMShsm will take full advantage of the capacity of the 3590 tape cartridge.

Recycling to a library containing high capacity cartridges entails moving more data per cartridge when using the same thresholds as for the previous cartridges. This may extend the RECYCLE time, even though fewer tape mounts will occur; thus, a single cartridge may take longer to become subject to recycling. If your recycling window is limited, review your recycle thresholds carefully.

RECYCLEINPUTDEALLOCFREQUENCY(BACKUP(bfreq) MIGRATION(mfreq)) is an optional parameter that you use to periodically deallocate an input unit during recycle processing, especially in a tape environment where contention for tape drives may be a consideration. This dynamically changeable parameter prevents DFSMShsm from possibly keeping an input unit allocated for hours.

BACKUP(bfreq) and MIGRATION(mfreq) specify that during recycle processing of backup or migration volumes, deallocation of an input unit will occur after the specified number of input connected sets representing single-file-format cartridges have been processed. Specifying 0 will retain the input unit until recycle processing has completed. For example, specify

```
SETSYS RECYCLEINPUTDEALLOCFREQUENCY(BACKUP(20))
```

to deallocate the input unit every 20 input backup connected sets. Using

```
SETSYS RECYCLEINPUTDEALLOCFREQUENCY(MIGRATION(1))
```

to deallocate the input unit after each input migration connected set has been processed. Always use a value of 1 if the command will process physically incompatible cartridges which say they are the same, such as true versus emulated 3490.

An alternative way of moving ML2 and user tape data to a new media or tape library is to use ABARS: *ABACKUP MOVE* in combination with *ARECOVER REPLACE* can be used to move data into an IBM 3494 tape library or a VTS. ABARS has the advantage that you can specify data set name patterns that will be moved into a device.

7.4.6 Insert Existing DFSMShsm-Owned Volumes into the Library

As DFSMShsm CDSs keep only volser information about owned volumes, they do not care whether or not the volumes are in the library. Thus you can move existing owned volumes into the library. However, some DFSMShsm-owned volumes are multivolume data sets, and all the volumes of a set have to reside in the same library and in the same storage group. To identify connected volumes, use the LIST command shown in Figure 146. A sample result is shown in Figure 147.

```
        LIST TTOC SELECT(CONNECTED(A05002)) ODS(LIST)
```

Figure 146. DFSMShsm LIST Command

```
---- DFHSM CONTROL DATASET - TAPE VOLUME TTOC - LISTING - AT 08:32:12 ON 92/01/2

VOLSER    UNIT    VOL    TOTAL  VALID  PCT    VOL    RACF  PREV    SUCC    NUM
          NAME    TYPE   BLKS   BLKS   VALID  STATUS       VOL     VOL     REC
A05001    3480    D(01)  00005  00005  002    FULL    NO   *NONE*  A05002  001
A05002    3480    D(01)  00005  00005  002    FULL    NO   A05001  A05003  001
A05003    3480    D(01)  00005  00005  002    FULL    NO   A05002  *NONE*  001
***END OF CONNECTED TAPE VOLUME SET ***
----- END OF - TAPE VOLUME TTOC   - LISTING -----
```

Figure 147. DFSMShsm LIST Command Output

When you enter the selected DFSMShsm-owned tape volumes, assign them the use attribute of PRIVATE and storage groups.

Consider using SETSYS TAPESPANSIZE and SETSYS TAPEUTILIZATION to reduce the number of connected volumes. TAPESPANSIZE determines whether a data set is small or large. A data set smaller than the value specified has to fit on the tape being processed. If DFSMShsm calculates that the data set will span to another tape, it issues an FEOV and starts writing the whole data set to a new tape. A large data set is allowed to span volumes. Do not specify TAPEUTILIZATION(NOLIMIT) because that will prevent TAPESPANSIZE from taking effect. SETSYS TAPEUTILIZATION(PERCENTFULL(97)) would be a good value.

7.5 JES3 Miscellaneous

In this section we consider some restrictions and limitations of JES3 and IBM 3494 tape library support. We discuss various JES3 functions and how they are affected by the library tape units.

7.5.1 Tape Media and Integrated Cartridge Loader

CST(MEDIA1), ECCST (MEDIA2), and 3590 Magstar (MEDIA3) can be used on the IBM 3494 tape library. New scratch data set allocations requiring MEDIA3 are allocated to 3590; allocations requiring MEDIA2 are allocated to 3490Es; and allocations requiring MEDIA1 may be allocated to either 3490s or 3490Es.

OS/390 allocation randomizes the eligible lists of units to avoid allocation to the same device. JES3 MDS unit selection does not support this randomizing and generic preference ordering.

7.5.2 Storage Group States

Storage group states are not supported as they are for DASD. They do not influence JES3 system select because they are not used to determine the JES3 main mask. Therefore, storage group states cannot be used to force jobs to be eligible for specific processors.

Because JES3 allocates IBM 3494 tape library drives before job execution and OS/390 allocation determines eligible devices using the storage group state at execution time, changes to a storage group between C/I processing and job execution could invalidate the device selected by JES3. Even though JES3 selects the IBM 3494 tape library device, it must be the device eligible for OS/390 allocation at execution time, otherwise the job fails OS/390 allocation. Therefore, to prevent job failures, define them as *ENABLE* to all IBM 3494 tape library connected systems and do not change the state while IBM 3494 tape library eligible jobs are queued for main. The IBM 3494 tape library drives must remain offline to ineligible systems.

7.5.3 Device Online/Offline Status

JES3 supports the VARY SMS,LIBRARY command introduced by DFSMS/MVS for the IBM 3494 tape library online/offline status change.

If the device is defined to JES3, a JES3 *VARY device command is generated as if the operator had entered the command. JES3 does VARY devices online and offline to OS/390 as is done today. The assumption is that OAM varies the devices off or on for library reasons after all devices have been varied off or before the devices have been varied on by JES3.

The traditional practice of setting the tape units offline in the initialization stream and then using commands to set units online can be used with IBM 3494 tape library drives just as it is used for nonlibrary drives.

The IBM 3494 tape library drives must be kept offline to ineligible mains to prevent JES3 from scheduling to them because the storage group status specification does not work for JES3.

7.5.4 IPL Considerations

Some operator action may be needed to recover tape volumes within the IBM 3494 tape library whenever jobs that use tape drives inside the library. are executing on a system that fails. Under normal operating conditions, volumes are dismounted at CLOSE, step, or job termination. Because these events may not occur with a system failure or IPL, a ″volume in use″ error may occur when the volumes are reused, causing a job failure.

The error occurs only when an attempt is made to mount a volume on an IBM 3494 tape library drive other than the drive previously used and the previously used drive is unavailable to the target system at the time of reuse.

Because this scenario may not be predictable, use the following procedure to avoid the problem:

1. Vary all systems offline to JES3 to prevent volume reuse until a dismount can be performed.
2. Use either IPL on the failed system or JES3 to restart the jobs on the failed system.
3. Issue an OS/390 UNLOAD command for each drive that was in use on the failed system. You can issue the command from any system in the complex that has access to the tape drive.
4. VARY all systems online to JES3.

7.5.5 Inoperable Devices

IBM 3494 tape library devices that are inoperable at IPL can be brought online with an HCD activate followed by a JES3 vary. Failure to comply with this sequence may result in jobs failing allocation because JES3 setup selects IBM 3494 tape library devices that are not available to OS/390 allocation.

7.6 Partitioning Tape Libraries among Multiple Systems

Partitioning a tape library involves dividing the library resources— tape drives and tape volumes — among multiple systems or sysplexes, or both, for their exclusive use. The set of tape drives and tape volumes that belong to one or more systems or sysplexes, or both, may not be used by a nonsharing system or sysplex without manual intervention. Each attached partition can be either an MVS platform or a non-MVS platform. A single MVS platform can consist of one or more systems or sysplexes, or both, connected to a shared TCDB; this group of sharing systems or sysplexes, or both, is referred to as a TCDBplex. Each TCDBs can contain configuration information about the library and some subset of the volumes in the library. Partitioning may thus be viewed as dividing a physical library into multiple logical libraries, with each logical library (TCDBplex) represented by one TCDB.

To partition a library among multiple TCDBplexes requires separation of the scratch pools; that is, each TCDBplex must have a separate library manager category for each scratch media type (CST, ECCST , high performance cartridge tape, and extended high performance cartridge tape). For logical completeness, the error and private volume categories should also be unique to each TCDBplex. To change the default category assignments, you can specify the categories in PARMLIB member DEVSUPxx. DEVSUPxx eliminates the need of a user modification used in earlier releases of DFSMSdfp to assign volume categories. The category specification parameters enable the installation to change the default category assignments associated with a system or sysplex, or both. It is the responsibility of the installation to ensure that all systems or sysplexes, or both, associated with the same TCDB (TCDBplex) use the same category assignments. For a discussion of the partitioning related DEVSUPxx parameters, refer to 5.1.2.5, “DEVSUPxx Member of SYS1.PARMLIB” on page 131.

7.6.1 Setting Volume Categories

In a partitioned library, it is recommended that the installation use DEVSUPxx to change the default categories associated with each TCDBplex. Therefore no TCDBplex uses the default categories, so there are no volumes in those categories. If the DEVSUPxx parameters are inadvertently removed from one system, scratch mount requests are directed to the empty default categories, and the mount requests fail. If there is a TCDBplex that is using the default categories, volumes can be mounted by the system where the DEVSUPxx parameters were removed. If a scratch volume from a default category, is mounted on the system where the parameters were removed, it is not used because there is no tape volume record in the TCDB. The volume is assigned to the error category, with resultant disruption in library operations in the TCDBplex that owns the default categories.

DFSMSrmm offers two facilities (the REJECT ANYUSE command in PARMLIB member EDGRMMxx and the USE operand value on the RMM ADDVOLUME or CHANGEVOLUME subcommands) that allow an installation to specify those volume serial numbers that are not to be used in this TCDBplex. When you enter a volume into a system-managed tape library, if the volume is defined to DFSMSrmm and you have specified the USE operand without MVS, or the volume matches a specified REJECT ANYUSE(prefix), EDGLCSUX sets a return code of 12 to pass to OAM. OAM passes the return code to the library manager and the volume is left in the INSERT category in the library manager database. It does not create a volume entry in the TCDB. The volume is then available for another sharing system to process the insert request. The sharing system could be another MVS, VM, or UNIX system. Refer also to 7.2.1, “Cartridge Entry Processing with DFSMSrmm” on page 226.

If you have another tape management system and you need to partition your tape library, ask your vendor for the exit code of module CBRUXENT to approve or disapprove entry of cartridges into the TCDB.

Assume that you have two TCBplexes, PLEX1 and PLEX2. PLEX1 includes systems SYS1A and SYS1B; PLEX2 includes systems SYS2A, SYS2B, and SYS2C. All five systems are attached to the same IBM 3494 tape libraries (see Figure 148 on page 242).

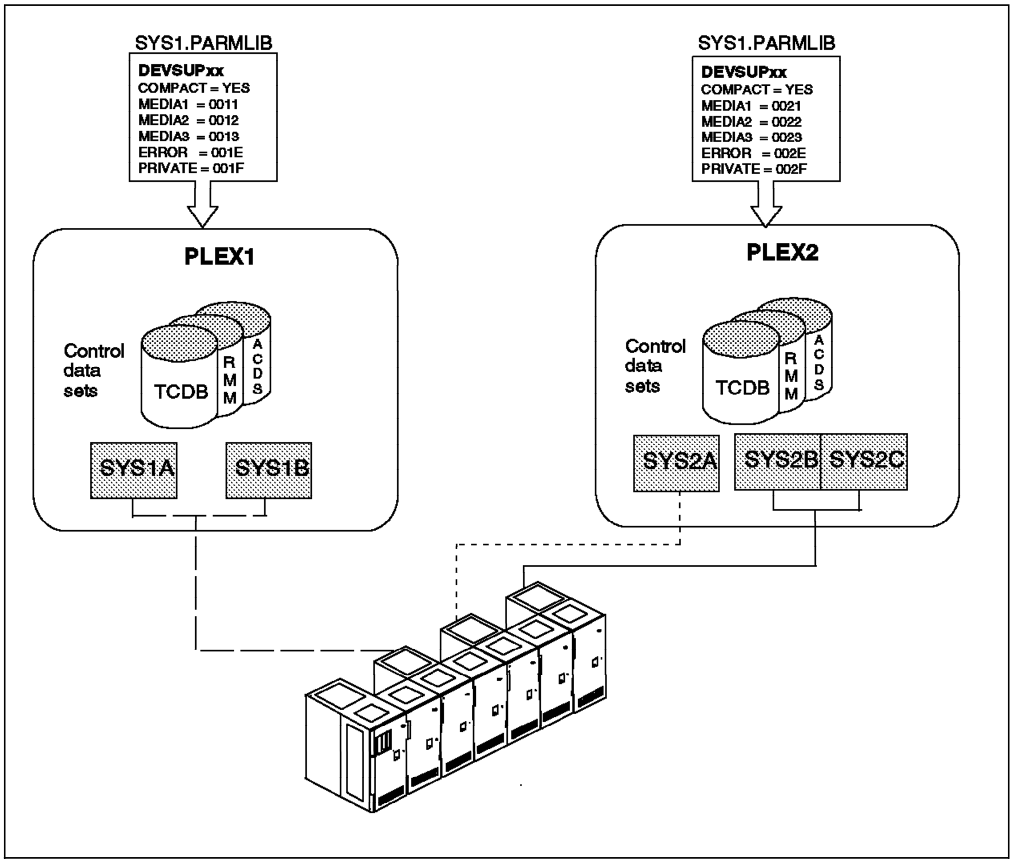


Figure 148. Partitioning and Volume Categories

- Scratch mounts from systems in PLEX1 get volumes from library manager categories X′0011′, X′0012′, or X′0013′ assigned as specified in the DEVSUPxx members of SYS1.PARMLIB, depending on the requested media type in the data class.
- Scratch mounts from systems in PLEX2 get volumes from library manager categories X′0021′, X′0022′, or X′0023′ assigned as specified in the DEVSUPxx members of SYS1.PARMLIB, depending on the requested media type in the data class.

The setting for the private category is optional, because specific mount requests use the TCDB volume entry information. The library manager private category is not used for specific mount requests. To reflect the host category assignment on the library manager, we recommend always specifying a category for private volumes on all hosts.

For details regarding partitioning and sharing, refer to the *Guide to Sharing and Partitioning IBM Tape Library Dataservers.*

7.7 Allocation Criteria

With DFSMS/MVS support for tape libraries, there are two or three databases or catalogs that contain information about tape volumes and the data sets on the volumes. The OS/390 system catalog retains its role as the data set catalog. It is not mandatory that tape data sets be cataloged in the OS/390 catalog.

To see how the information in these separate databases is used when a job reads or writes a data set on a tape volume, we look at the three most common cases:

- Reading an old cataloged data set
- Reading an old uncataloged data set
- Writing a new data set and cataloging it

Additionally we explain the process of tape device selection and how the library manager manages the order for scratch volumes from the host.

7.7.1 Reading a Data Set

Here is the procedure that OS/390 allocation uses to locate and read a data set (refer to Figure 149 on page 244):

1. Find the volser:

   - If a data set is cataloged, the data set name is found in the OS/390 data set catalog. The volser is extracted from the catalog entry. (**1**)

   - When the data set is not cataloged, its volser must be indicated through JCL or parameters in a dynamic allocation request. Searching the OS/390 data set catalog is bypassed.

2. The TCDB is searched to find the volume entry for the volume. If the volume entry is found, and it indicates that the volume is within a library (and not in SHELF), the library name, storage group, and device type are extracted from the entry. They are used in allocating a tape unit for reading the data set. (**2**)

   Note: If a volume entry is found in the TCDB and the LOCATION indicates LIBRARY, allocation always goes inside a tape library. When a foreign tape comes to your system with a volser that already is in a tape library, there are two ways of reading it on a tape device outside the library:

   - Use BLP in your JCL.

   - Remove the existing volume entry from the TCDB. After you have read the foreign tape, you must add the volume entry to the TCDB, using IDCAMS commands.

3. If the volume entry is not found in the TCDB, and the volume not in library installation exit (CBRUXVNL) does not prompt the operator to enter the volume into the library, allocation will be directed to a device that is outside the library. (**3**)

4. Allocation or OPEN requests that the volume be mounted on the selected unit. (**4**) For a discussion of device selection refer to 7.7.3, "Device and Library Selection in a 3494 Environment" on page 245. In the case of a library, this request is transformed into a channel command, which requests the library manager to mount the volume.

5. The library manager searches its database to find the storage cell ID where the cartridge is stored. The library manager constantly keeps its database up to date and records the fact that the volume has been moved to the tape unit. (**5**)

6. When the data set is being opened, the correctness of the tape volume selection is verified with information from the volume and data set labels on the tape. Next, the user's right to access the tape volume and the data set is

verified with RACF through SAF. The fact that the volume and the data set have been used is reflected in the TCDB and DFSMSrmm's database by updating the relevant records there. (**6**)

7. When the data set is closed after it has been used, and the volume is demounted, the library manager is requested to move the volume from the tape unit to a storage cell in a library. (**7**)

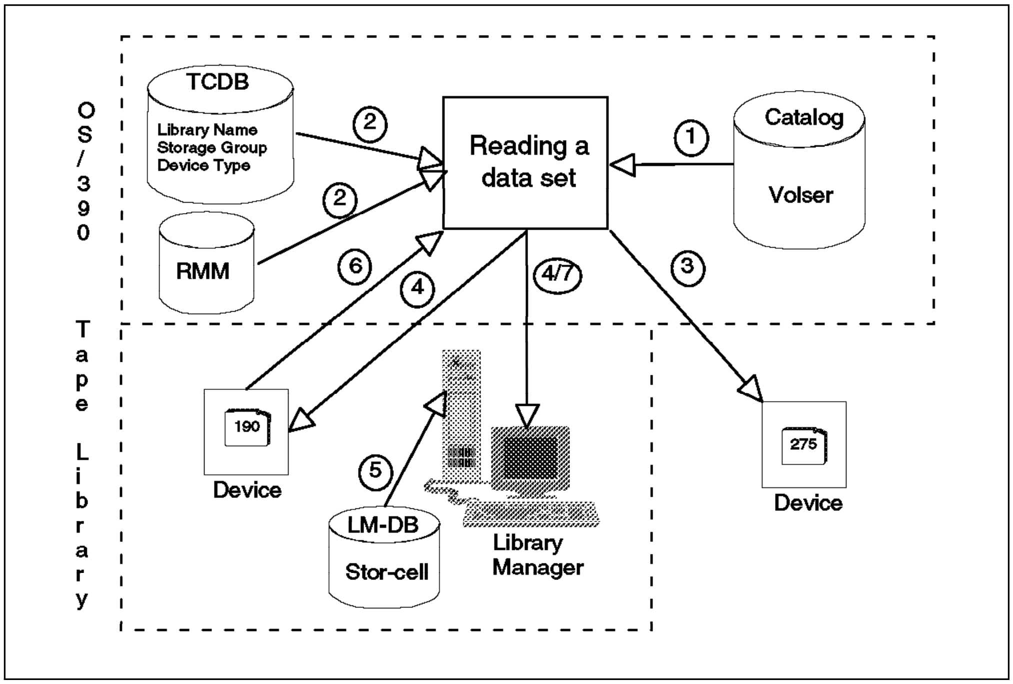


Figure 149. Process Flow to Read a Data Set

7.7.2 Writing a New Data Set

Here is the procedure to write a new data set (see Figure 150 on page 245):

1. From the data set name and other information given in JCL or a dynamic allocation request and the data class, the SMS ACS routines derive a storage class and a storage group for the data set. These determine the allocation to a suitable unit in a tape library. (**1**)

2. Allocation determines on which device the scratch volume will be mounted. (**2**) For a discussion of device selection refer to 7.7.3, "Device and Library Selection in a 3494 Environment" on page 245.

3. OPEN requests that the library manager mount a scratch volume. (**3**)

4. The library manager selects a volume from the scratch category and mounts it on the tape unit. (**4**)

5. If no storage class is derived from SMS, the data set will be written on a device outside the tape library. (**5**)

6. The data set is opened. Again, the user's right to access the volume is checked, based on the volume serial number, which now becomes known to OS/390. (**6**)

7. The TCDB, RACF database, and DFSMSrmm's CDS are accessed to verify authorization. The volume must be known to DFSMSrmm, and it must be a scratch volume. The CDS is updated to indicate the new data set on the tape

volume, to record the SMS classes assigned, and to indicate the changed status (scratch or private). The update to the TCDB also indicates which storage group has been selected for the volume and the changed status. (**7**)

8. The library manager database is updated to indicate the changed category of the volume (from scratch to private). (**8**)

9. If cataloging is requested for the data set, it is performed at disposition time. The OS/390 data set catalog is updated to indicate the data set name and its volume serial. (**9**)

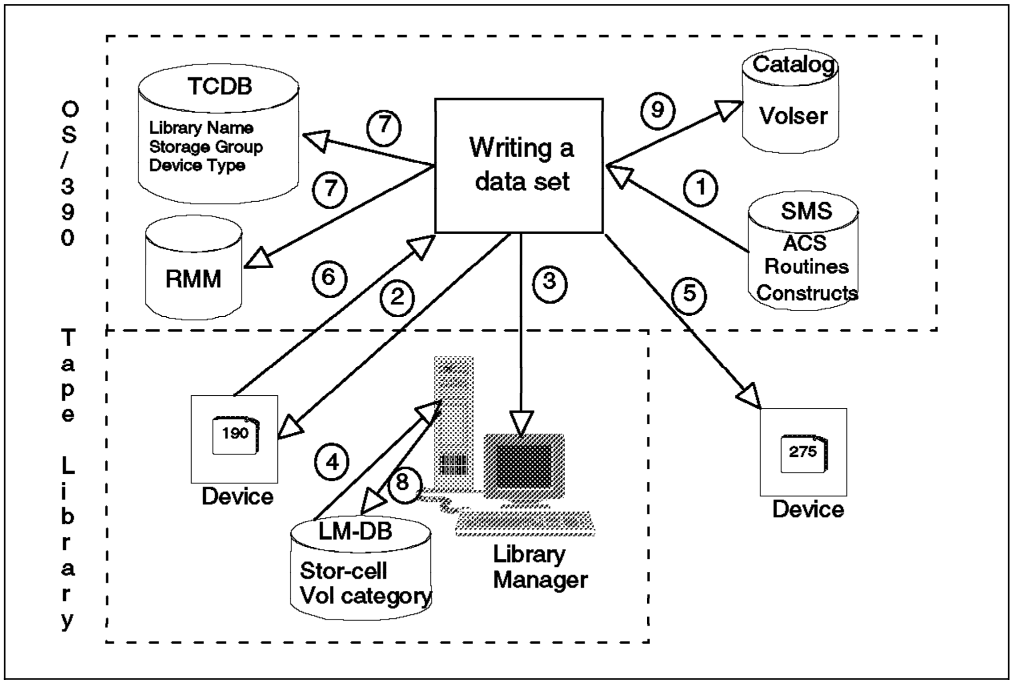


Figure 150. Process Flow to Write a Data Set

7.7.3 Device and Library Selection in a 3494 Environment

Device selection within a library or across libraries in the same storage group is determined by weighing how well each device meets the needs of the request being processed and then selecting the device that best meets those needs. For specific mount requests the device selection is limited to the drives in the library where the volume resides. Each device is looked at from various viewpoints. Below is a list of the viewpoints in priority order. The higher the viewpoint in the priority list, the higher the assigned weight for the device will be. The weights given for each viewpoint are added together. The device with the highest sum is selected for allocation.

1. **Online/pending offline/offline**

   Devices in this category are ranked in the following order:

   - Online - best fit
   - Pending offline
   - Offline - worst fit (will not be considered unless no online or pending offline device will work)

2. **Volume mounted status**

Devices in this category are ranked in the following order:

- Specific volume request, and the required volume is mounted on this device
- Nonspecific volume request or specific volume request and the required volume is not mounted on this device

3. **Media type**

   This category will match for virtual drives in a VTS because they emulate a 3490 with a cartridge loader installed

   All three volume requests below have the same weight assigned. The devices are ranked within a request in the order listed.

   Example:

   If the device has an inactive ACL with the same media type, a request for a specific volume gets the same weight as a request for a nonspecific volume.

   - For specific volume requests
     - Device has an inactive ACL with the same media type
     - Device has an inactive ACL with the wrong media type
     - Device has an active ACL with the same media type
     - Device has an active ACL with the wrong media type
   - For nonspecific volume requests when a specific media type was requested
     - Device has an active ACL with the same media type
     - Device has an inactive ACL with the same media type
     - Device has an inactive ACL with the wrong media type
     - Device has an active ACL with the wrong media type
   - For nonspecific volume requests when no media type is specified
     - Device has an active ACL with CST or DM3 media
     - Device has an active ACL with ECST or DM4 media
     - Device has an inactive ACL with CST or DM3 media
     - Device has an inactive ACL with ECST or DM4 media

4. **Library preference**

   For nonspecific volume requests, an attempt is made to balance loads across libraries. All libraries are assigned a random number. Additionally a scratch factor is assigned to those libraries that exceed the scratch threshold.

   Devices in this category are ranked in the following order:

   - Devices in libraries that are above scratch threshold
   - Devices in libraries that are below scratch threshold

5. **Generic preference**

   Each device is assigned a relative generic preference number. The highest generic in the custom-defined preference order or indicated in the preferred device pool list is given the highest weight, the next a lower weight, down to the lowest generic device in the list.

6. **Device pool preference**

   For requests where the device pools have been prioritized by the library manager, the first device pool gets the highest weight, the second in the device pool gets a lower weight, and so on.

   The drive priority list that the library manager will send to the host is discussed in 3.2.2, "Performance with Dual Active Accessor Feature" on page 76.

7. **Autoswitchable preference**

   Non-autoswitchable devices are preferred over autoswitchable.

8. **Device preference**

   Because individual devices are never ordered for any reason, a random preference value is generated for each device, to prevent using the same device all the time.

Note: The following considerations are not taken into account for device selection:

- Number of available drives
- Busy condition of control unit or library accessor

7.7.4 Library Manager Scratch Selection

In the IBM ATL architecture, true scratch mount orders from the host are nonspecific and identify only the drive and the library manager category from which to choose the volume (mount from category). When the library manager receives a mount from category order, it selects the volume to be mounted. This applies to real volumes as well as virtual volumes in the VTS.

Normally this selection is done in a first in first out (FIFO) order, so that the most recently inserted or expired volume is placed at the bottom of the list and the oldest volume in the list is the chosen next.

There are two exceptions to this FIFO selection:

- The selection of the next scratch volume in a VTS logical library

  The library manager first checks the virtual drives to see whether there are more even or odd volsers currently mounted and chooses the next volser, such that the best even-odd balance is maintained. The reason for this is to balance the number of active (mounted) volumes in the file systems of the VTS tape volume cache (TVC). The TVC is divided into two file systems, one with even volsers, and one with odd. Any volsers passed over by this selection are not eligible to be selected again until the selection has wrapped through the stack.

- When the Dual Active Accessor feature is enabled

  The library manager attempts to provide cartridge-drive affinity for true scratch mounts by choosing the next volser that is in the same zone as the drive chosen by the host, so that the accessor servicing this drive does not have to cross the zone boundary to pick the cartridge. Any volsers passed over by this selection are not eligible to be selected again until the selection has wrapped through the stack. Even if only one accessor in a Dual Active Accessor IBM 3494 is active, perhaps because of maintenance, the library manager still uses the cartridge drive affinity to select the next volume for a scratch mount.

These exceptions to the FIFO selection normally used may affect the age of scratch volumes in the scratch categories. These exceptions may be observed by operators as inconsistent, random, or unpredictable.

Figure 151 through Figure 154 on page 251 illustrate the library manager scratch selection process:

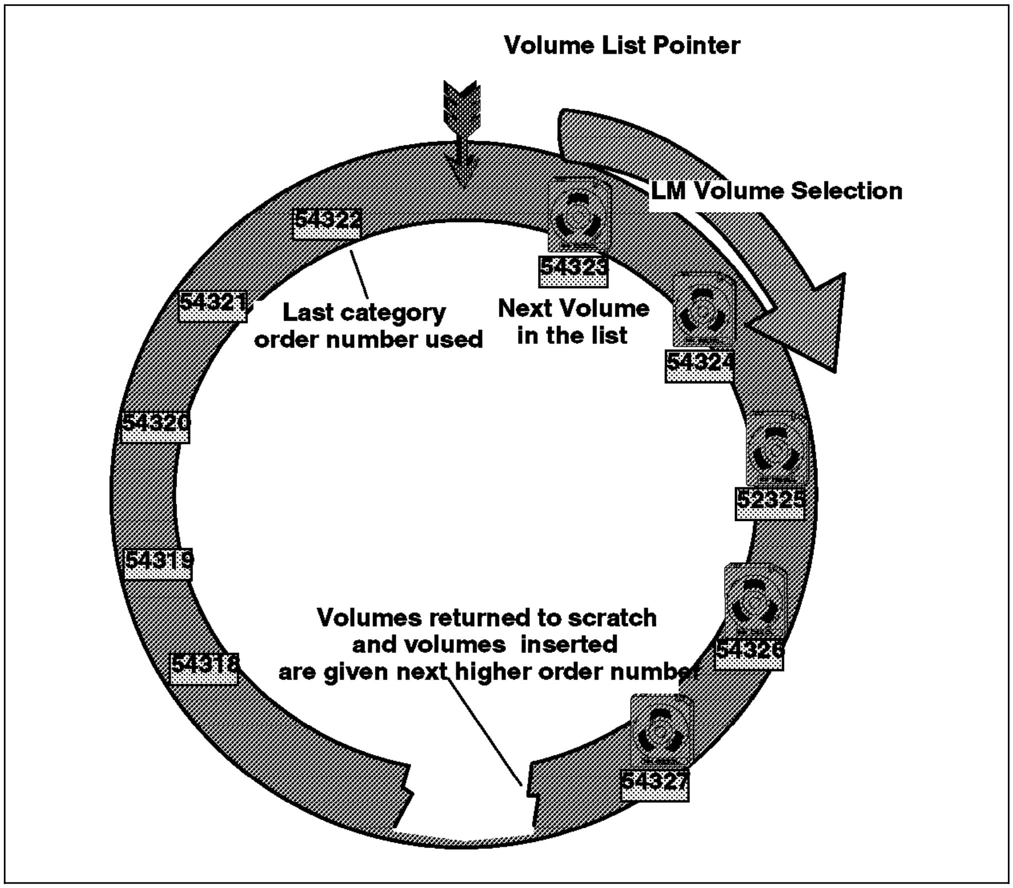


Figure 151. Library Manager Scratch Selection without Skipping

Note that Figure 151 represents one scratch category, but there may be many such categories in a single library. The five-digit numbers represent category order numbers, not volume serial numbers.

- Volumes are arranged in sequence of category order number, not by volser
- The pointer to the next volume moves in ascending sequence.
- Volumes returned to scratch (reassigned to this category) are given a new, higher category order number.
- Volumes inserted into the library (and assigned to this category) are given a new, higher category order number.
- Category order numbers are virtually infinite.

Figure 152 on page 249 shows how volumes might be skipped by the library manager scratch selection process:

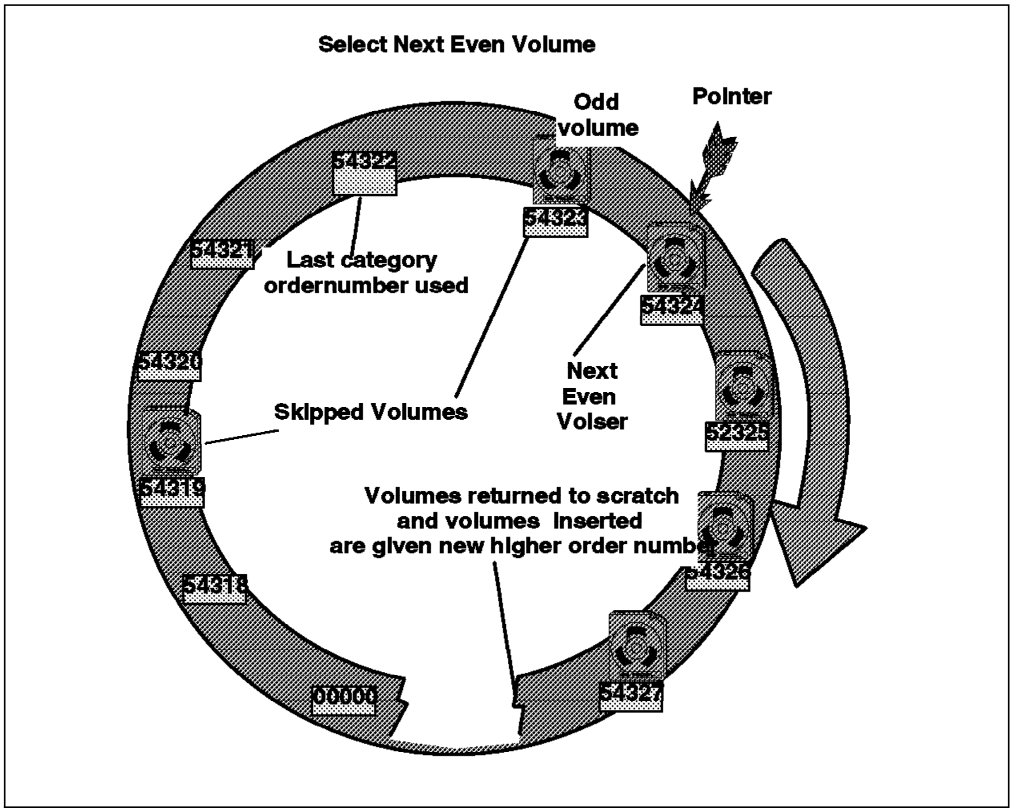


Figure 152. Library Manager Scratch Selection with Skipping

- Volumes are skipped in the VTS scratch categories to maintain an even-odd balance of volumes currently mounted on virtual drives.
- Volumes are skipped in a Dual Active Accessorlibrary to facilitate drive and zone affinity to the selected volume.
- Skipped volumes must wait for the pointer to come around again. The pointer will begin again at 0 after it passes the highest category order number.
- If volumes are assigned to this category, by insertion or return-to-scratch, faster than they are selected for use, the pointer will not start over at the bottom of the order numbers.
- Category order numbers are never reused. A volume returned to this category will be given a new (higher) number.

Figure 153 on page 250 shows that there is no fixed relationship between volsers and category order numbers:

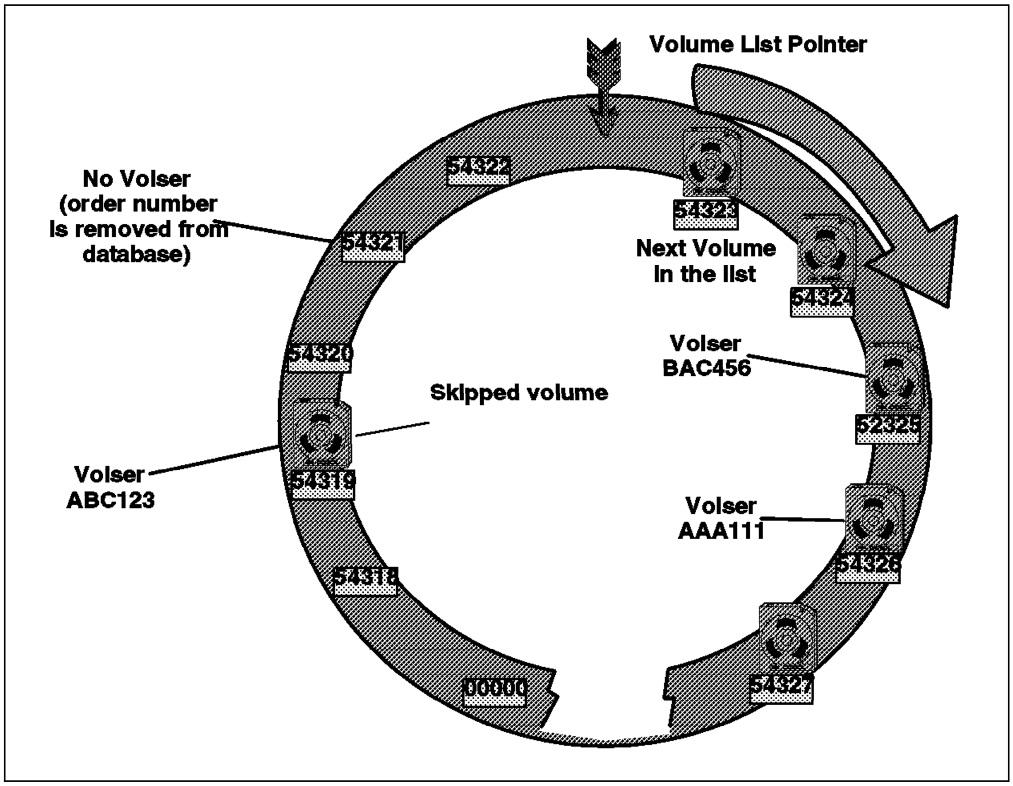


Figure 153. Relationship between Volser and Category Order Number

The volumes are placed in the category in the order in which they are received, and they are assigned the next higher category order number. The category numbers that have been used (not skipped) are removed from the database and never reused.

Figure 154 on page 251 shows that if the selection catches up with insert or scratch processing,the pointer will start back at the lowest order number in the database and pick up the skipped volumes.

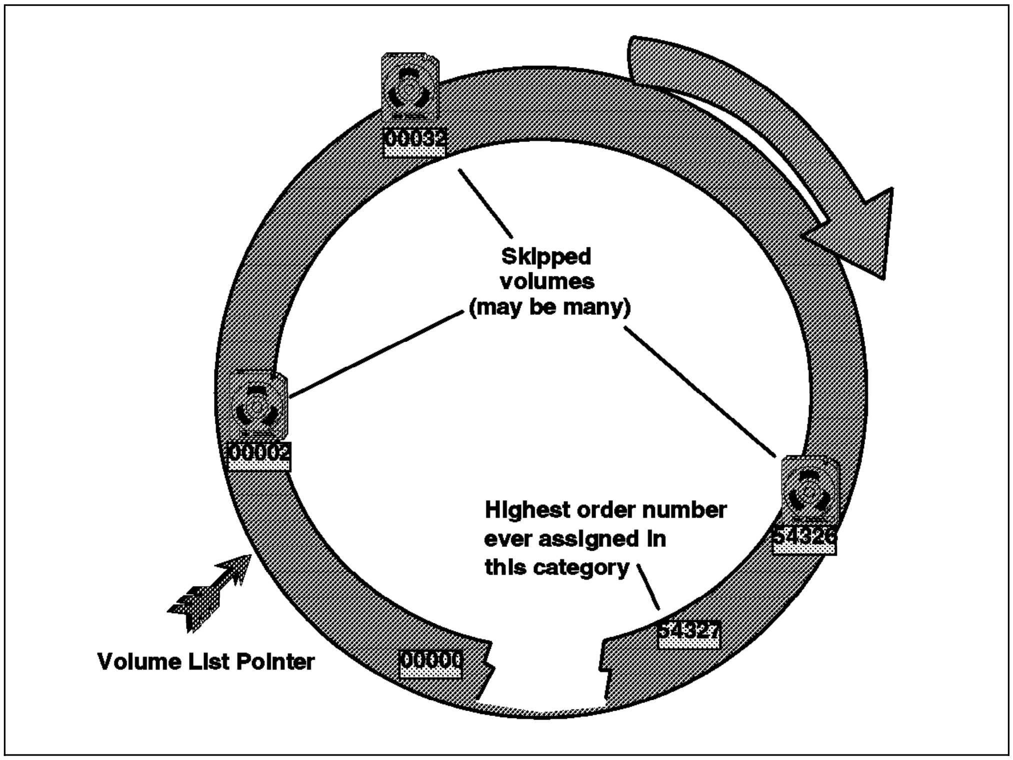


Figure 154. Selection End-of-List Processing

7.8 TCDB Considerations

Your 3494 tape library installation depends heavily on the availability of your TCDB. An extended outage of a TCDB can be extremely disruptive because tape date stored in the IBM 3494 cannot be retrieved without access to the TCDB. Table 37 gives an overview of the most important TCDB handling tasks and shows functions to detect and correct out-of-synch conditions.

Table 37 (Page 1 of 2). TCDB Tasks

Task	**Comment**
Schedule job to save TCDB	See 7.8.1, "TCDB Backup" on page 252 for details.
Restore or rebuild TCDB after destruction	Use standard ICFCATALOG recovery procedures such as the IBM integrated catalog facility recovery utility (ICFRU. See 7.8.2, "Planning for TCDB Recovery" on page 252 for details.
Move TCDB to a different volume	See 7.8.3, "Moving a TCDB to a Different Volume" on page 254 for details.
List information in the TCDB	See 7.8.4, "Listing Information in the TCDB" on page 256 for details.
Verify consistency among TCDB and tape management system	See 7.2.4, "TCDB and DFSMSrmm Synchronization" on page 228 for details
Verify the location of the tape volumes in your tape libraries	See 7.8.5, "Library Manager Database and TCDB Synchronization" on page 257 for details.

Table 37 (Page 2 of 2). TCDB Tasks	
Task	**Comment**
Perform manual updates against the TCDB	See 7.8.6, “TCDB Manual Update” on page 260 for details.

7.8.1 TCDB Backup

The most important task is to make sure that the TCDB is included in the backup job or job stream for catalogs. We suggest that you run IDCAMS EXPORT for the back up. You may use other programs such as DFSMShsm or DFDSS to back up your TCDB. However, if you want to use ICFRU as your recover too, then IDCAMS is the backup program to use.

7.8.2 Planning for TCDB Recovery

For TCDB recovery, you can use CFRU or a similar product that uses SMF records to perform forward recovery against a point-in-time backup copy.

Note: There is a new catalog record type for the TCDB. APAR GA14666 provides ICFRU support for the new catalog record type.

ICFRU relies on the fact that catalog management routines log each catalog change to SMF. These SMF records contain images of catalog records that can be combined with the catalog records from an IDCAMS EXPORT copy of a catalog. The combined catalog records are reloaded through IDCAMS IMPORT, so the catalog is recovered to the point of failure. ICFRU requires that all SMF type 61, 65, and 66 records be recorded. You should ensure that SMF parameters specify recording for these record types for all jobs. Check SMFPRMxx member in SYS1.PARMLIB.

The principal steps for a full TCDB recovery follows. The procedure, shown in Figure 155 on page 254 is similar to a normal ICF catalog recovery:

1. Deny access to the TCDB from all systems except the system to be used for recovery.
2. Stop tape activity and vary the tape library offline.
3. Save a copy of the damaged TCDB for future use (e.g., for diagnostics).
4. Cause the TCDB to be closed in the recovery system.
5. Record the date and time when it has been confirmed that the TCDB is closed on all systems. This is the stop date and time needed as input parameter to the ICFRRSV program.
6. Switch and dump the SMF data set on all systems that had access to the TCDB. The SMF records for the TCDB will be needed for forward recovery of the TCDB.
7. Identify an EXPORT backup copy of the TCDB. This will be the EXPIN data set for ICFRRAP.
8. Establish a start date and time for forward recovery which is needed as input parameter to the ICFRRSV program. You can obtain the date and time from message IDC0594I in the export job creating your backup copy of the TCDB.
9. Identify the SMF data needed for forward recovery. The concatenation of all SMF data sets is the SMFIN DD statement for ICFRRSV.

10. Execute the ICFRRSV program, using start and stop times and dates determined above. ICFRRSV collects all SMF TCDB records and writes them to an output file.
11. Using DFSORT or a similar facility, sort the SMF output from ICFRRSV.
12. Execute the ICFRRAP program, using the output from the sort as input and the EXPORT copy identified.
13. Use IDCAMS to delete the TCDB for RECOVERY.
14. Import the EXPORT copy produced by ICFRRAP.
15. Back up the TCDB to start a new recovery cycle.
16. Vary the tape library online.

For a complete description of a TCDB recovery refer to the *Integrated Catalog Forward Recovery Utility/Operations Manual.*

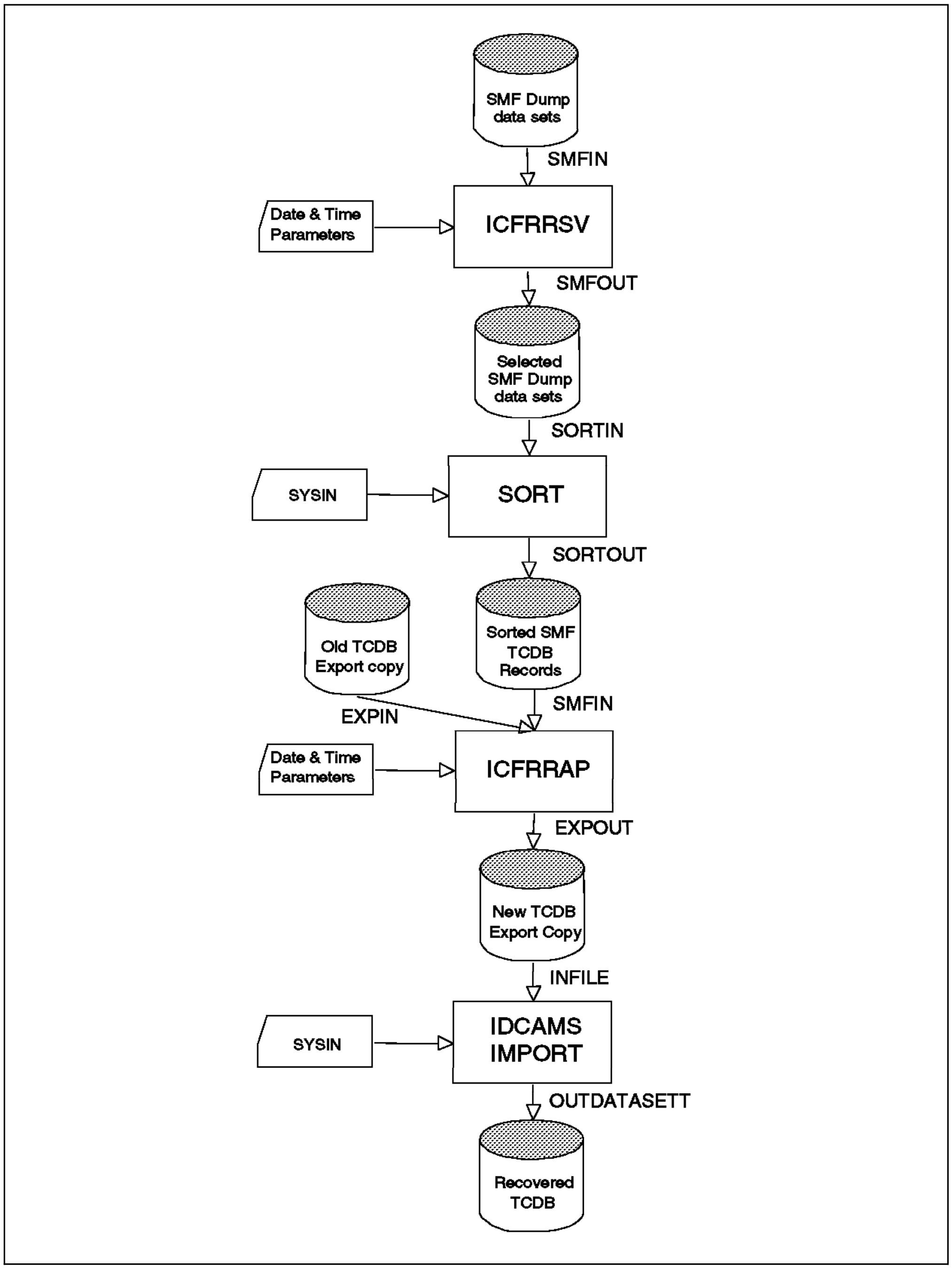


Figure 155. Using ICFRU to recover a TCDB

7.8.3 Moving a TCDB to a Different Volume

Follow these steps to move a TCDB (SYS1.VOLCAT.VGENERAL) to a different volume:

1. Stop all tape activity and vary the IBM 3494 tape library offline using the command in Figure 156:

```
V SMS,LIB(libname),OFFLINE
```

Figure 156. Vary the Library Offline

2. You should restrict access to a catalog when you are performing maintenance procedures that involve redefining the catalog (Figure 157 on page 255). If you do not restrict access to the catalog, by locking it, terminating user sessions, or another method, users might be able to update the catalog during maintenance and create a data integrity exposure.

```
//LOCKCAT EXEC PGM=IDCAMS
//SYSPRINT DD SYSOUT=A
//SYSIN    DD *
  ALTER SYS1.VOLCAT.VGENERAL LOCK
/*
```

Figure 157. Lock the TCDB

3. Export the TCDB with the EXPORT command (Figure 158):

```
//EXPORT  EXEC PGM=IDCAMS
//SYSPRINT DD SYSOUT=A
//CATBACK  DD DSN=OBI.CATBACK.VOLCAT,DISP=(,CATLG),
//            UNIT=SYSDA,VOL=SER=volser,
//            SPACE=(CYL,(5,5))
//SYSIN    DD *
  EXPORT SYS1.VOLCAT.VGENERAL -
         OUTFILE(CATBACK) -
         TEMPORARY
/*
```

Figure 158. Export the TCDB

4. Delete the TCDB (Figure 159):

```
//DELCAT  EXEC PGM=IDCAMS
//SYSPRINT DD SYSOUT=A
//SYSIN    DD *
  DELETE SYS1.VOLCAT.VGENERAL -
         RECOVERY -
         UCAT
/*
```

Figure 159. Delete the TCDB

5. Import the TCDB to the different volume (Figure 160 on page 256). If you want the attributes of the catalog to change, define the catalog with the desired attributes on the newvol, and import the original catalog into the newly defined catalog. Specify INTOEMPTY on the IMPORT command.

```
//IMPORT  EXEC PGM=IDCAMS
//SYSPRINT DD SYSOUT=A
//SYSIN    DD *
  IMPORT INDATASET(OBI.CATBACK.VOLCAT) -
         OUTDATASET(SYS1.VOLCAT.VGENERAL) -
         OBJECTS((SYS1.VOLCAT.VGENERAL -
                  VOLUMES(newvol))) -
                  UNLOCK
/*
```

Figure 160. Import the TCDB

6. Vary the IBM 3494 tape library online (Figure 161):

```
V SMS,LIB(libname),ONLINE
```

Figure 161. Vary the Library Online

7.8.4 Listing Information in the TCDB

In addition to browsing through ISMF panels, you can list the information in the TCDB, using the LISTC command. To see the library entry only, use the LIBRARYENTRIES parameter. When you want to see volume entries, specify the VOLUMEENTRIES parameter as shown in Figure 162. This example lists all tape volume entries whose names begin with the letters *VA* in the ATLLIB1 tape library. (The screen has been edited to fit the page size.)

```
 -------------------------  TSO COMMAND PROCESSOR  ---------------------
 ENTER TSO COMMAND, CLIST, OR REXX EXEC BELOW:

 ===> tso listcat volumeentries(va*) library(atllib1) all




                         LISTING FROM CATALOG -- SYS1.VOLCAT.VGENERAL

VOLUME-ENTRY-----------VAL0001
    DATA-VOLUME
      LIBRARY----------ATLLIB1     LOCATION-----------LIBRARY
      RECORDING--------UNKNOWN     MEDIATYPE-----------MEDIA2
      STORAGE-GROUP---*SCRTCH*     USE-ATTRIBUTE------SCRATCH
      CHECKPOINT-------------Y     ERROR-STATUS-------NOERROR
      SHELF-LOCATION------------(NULL)
      OWNER---------------(NULL)

    CREATION-DATE---1991-01-01   ENT-EJ-DATE---1990-01-01
    COMPACTION------------NONE   SPEC-ATTRIBUTE -----NONE
    EXPIRATION------2000-12-31   LAST-MOUNTED--1991-01-01
    WRITE-PROTECTED----------N   LAST-WRITTEN--1991-01-01
```

Figure 162. LISTC Command for Library Entry

7.8.5 Library Manager Database and TCDB Synchronization

Because system-managed tape uses three repositories (library manager database, TCDB, tape management system database), out-of-synch conditions are possible.

The manual way of searching for single misplaced volumes in the library is to check and verify storage cell addresses from the library manager′s "Search Database for Volume." However, you should use the AUDIT command to search for misplaced volumes without stopping AUTO mode.

The AUDIT command helps you verify the physical location of tape volumes within the library. It verifies whether or not a library volume resides in the location listed for that volume in the library manager inventory. The library manager maintains the library location of the cartridges in its inventory. The volume records in the TCDB identify the libraries where the volumes reside. If the TCDB records do not match the library manager inventory when an audit is performed, the TCDB records, the inventory, or both, must be corrected. The AUDIT function does not perform any corrective actions; messages are issued and the volume error status field in each tape volume record is updated, but the purpose of the audit is verification only. The AUDIT command requires storage administrator authority.

AUDIT provides three levels of auditing:

- Single volume audit (invoked by the AUDIT line operator)
- Volume list audit (invoked by the AUDIT command)
- Library audit (invoked by the AUDIT line operator)

AUDIT can be invoked as an ISMF line operator on the MOUNTABLE TAPE VOLUME LIST panel (single volume audit) or from the TAPE LIBRARY LIST panel (library audit).

AUDIT can also be invoked as an ISMF command to audit all eligible volumes on the MOUNTABLE TAPE VOLUME LIST panel (volume list audit). ISMF is an important part of the audit scheme because it allows you to start with an entire tape volume list. Then, using sorting and filtering capabilities, you reduce that list to a subset of volumes – for example, all volumes in a single storage group. At that point, you can use the AUDIT command to request an audit of all volumes in that subset list.

You may want to use the following criteria when filtering a volume list:

- Fully or partially qualified volser
- Fully or partially qualified storage group name
- Fully or partially qualified library name
- Other criteria using ISMF VIEW, SORT, and HIDE

Before scheduling an audit request for a library, ensure that the following criteria are met:

- The library must be defined in the SMS configuration.
- The library must be online, operational, and not pending offline.
- The library must not be in manual mode, and the vision system must be operative.

Enter the AUDIT line operator next to the row of the suspect volser on the MOUNTABLE TAPE VOLUME LIST panel as shown in Figure 163 on page 258.

```
  Panel  List  Utilities  Scroll  Help
------------------------------------------------------------------------------
                           MOUNTABLE TAPE VOLUME LIST
Command ===>                                                   SCROLL ===> PAGE
                                                          Entries 1-11 of 11
Enter Line Operators Below:                               Data Columns 3-7 of 20

    LINE       VOLUME  USE      VOLUME              CHECKPT  LIBRARY  STORAGE
    OPERATOR   SERIAL  ATTR     ERROR STATUS        VOLUME   NAME     GRP NAME
   ---(1)----  -(2)--  --(3)--  -------(4)--------  --(5)--  --(6)--- --(7)---
               VOL01   PRIVATE  I/O ERROR           NO       SHELF    TAPE1
               VOL02   SCRATCH  UNEXPIRED SCRATCH   ---      SHELF    *SCRTCH*
               VOL101  SCRATCH  NO ERROR            NO       SHELF    *SCRTCH*
               VOL102  SCRATCH  PASSWORD CONFLICT   NO       LIB1     *SCRTCH*
               VOL103  SCRATCH  SECURITY CONFLICT   NO       LIB2     *SCRTCH*
               VOL104  PRIVATE  SCRATCH IN USE      ---      LIB2     TAPE1
               VOL105  PRIVATE  VOLSER MISMATCH     NO       LIB1     TAPE1
               VOL106  SCRATCH  CHCKPOINT CONFLICT  YES      LIB2     *SCRTCH*
               VOL107  SCRATCH  WRITE CONFLICT      YES      LIB1     *SCRTCH*
   AUDIT       VOL108  PRIVATE  VOLUME MISPLACED    NO       LIB1     TAPE1
               VOL109  PRIVATE  NO ERROR            NO       LIB1     TAPE1
   ----------  ------  -----------  BOTTOM  OF  DATA  -----  ----     -------
```

Figure 163. Audit Line Operator Command from ISMF

The library vision system on a library verifies the external label on the volume at the physical location specified in the library manager database. The cartridge is neither mounted nor read, only the external label is verified. The following actions are performed when an audit is requested against volumes in a library:

- The system verifies that the tape volume has an entry in the library manager.
- The visual system verifies that the tape volume is in its assigned location in the library.
- The vision system verifies that the external cartridge label of the tape volume is present and readable.
- The system verifies that the tape is accessible in the library.

To perform a volume list audit from the MOUNTABLE TAPE VOLUME LIST panel, use the AUDIT command on the command line of the ISMF panel.

To perform a library audit from the TAPE LIBRARY LIST panel, use the AUDIT line operator next to the tape library name. When you specify a library audit, all volsers assigned to that library by the host are audited.

Because a library audit and a volume list audit may take a long time to complete, a confirmation panel is displayed whenever these audits are requested. This panel gives you the opportunity to confirm or cancel the audit request. To confirm, type in *Y* then press Enter. See Figure 164 on page 259 for the CONFIRM AUDIT REQUEST panel.

Note: In an environment with multiple systems at different DFSMS/MVS software levels but sharing a common TCDB, library audits should be performed on the system with the highest software level of DFSMS/MVS. A library audit on a lower DFSMS/MVS software level does not include higher release level volumes if they are media types unknown to the lower level software.

```
  Panel  Utilities  Help
 ------------------------------------------------------------------------------
                              CONFIRM AUDIT REQUEST

 Command ===>

   Number of Volumes to be Audited:  5



 Specify the Following:
    Enter "/" to select option   _ Perform Audit



    Note:  If audit is performed, audit requests will be interspersed with other
           requests, with the audit request having low priority.





 Use ENTER to Perform Operation;
 Use HELP Command for Help; Use END Command to Exit.
```

Figure 164. Confirm Audit Request Panel

Note: The audit operation can be a lengthy process. During AUDIT execution, other activity in the library is not quiesced, and AUDIT requests are given a lower priority than other requested functions. It may take several hours for you to receive notification that a full library audit or an extensive volume list audit has completed. Therefore, when scheduling an audit, take workload and time factors into consideration.

When the AUDIT is complete, a message indicating its success or failure is sent to your user ID. REFRESH the list and check the VOLUME ERROR STATUS column for the following errors:

- EXTERNAL LABEL ERR
- INACCESSIBLE
- NOT IN LIBRARY
- NOT IN SLOT

Refer to the help index for explanations of volume error states.

During the audit process, if the vision system detects an unexpected volume in the specified cell address, it searches the library manager's database. If there is an entry in the database for the unexpected volser, the database is updated to reflect its current cell location. If the unexpected volume is identified as a misplaced volume, all hosts are notified, and the TCDB is updated. If the vision system detects an empty cell, you may have to run the inventory process.

7.8.6 TCDB Manual Update

If any discrepancies are identified between the TCDB and the tape management system or library manager database, there may be a need to fix those VOLUMEENTRIES in the TCDB by using IDCAMS commands. Also keep in mind that you can change the contents of the tape management system database to synchronize the tape repositories.

LIBRARYENTRIES can be changed as well to recover from catalog errors. The LIBRARYENTRY record entry is also contained in the SMS control data set. Thus use ISMF panels for normal tape library alter functions.

The following IDCAMS commands are available for tape library support:

ALTER LIBRARYENTRY Alters all tape library entry fields except the library name

ALTER VOLUMEENTRY Alters all tape volume entry fields except the tape volser.

CREATE LIBRARYENTRY Creates a tape library entry

CREATE VOLUMEENTRY Creates a tape volume entry

DELETE Deletes tape library and tape volume entries

This example alters the LIBRARYNAME of the tape library volume entry with volser GRKB01.

```
//ALTERVOL JOB  ...
//STEP1    EXEC PGM=IDCAMS
//SYSPRINT DD   SYSOUT=A
//SYSIN    DD   *
     ALTER VGRKB01 -
           VOLUMEENTRY -
           LIBRARYNAME(ATL01)
/*
```

Refer to *DFSMS/MVS Access Method Services for ICF* for the syntax of the IDCAMS command.

7.9 ISMF ALTER Command

ISMF enables you to alter the use attribute, storage group, shelf location, and owner information of a single tape volume or a volume list through the use of the ALTER line operator or the ISMF ALTER command. These commands are used from the MOUNTABLE TAPE VOLUME LIST panel (see Figure 163 on page 258).

ISMF is an important part of the altering scheme when used in conjunction with the ALTER command because it allows you to start with an entire tape volume list. Then by using sorting and filtering capabilities, you can reduce that list to a subset of volumes – for example, all the volumes in a single storage group. Use the ALTER command against the subset list to change information volumes on the list at once. You can also use the ALTER command to take the volume out of the error category in the library manager inventory.

When you invoke the ALTER command on the MOUNTABLE TAPE VOLUME LIST panel,the use attribute, storage group, shelf location, and owner information values will be altered for all volumes in the list (see Figure 165 on page 261).

```
  Panel  Utilities  Help
 ------------------------------------------------------------------------------
                   MOUNTABLE TAPE VOLUME ALTER ENTRY PANEL
 Command ===>


 Number of Volumes to be Altered:  10

 Specify New Values for the Following Fields (Blank means no change):

   Use Attribute  . .      (P - Private, S - Scratch, or blank)

   Storage Group  . .

   Shelf Location . .

   Owner Information
     ===>




 Use ENTER to Perform ALTER;
 Use HELP Command for Help; Use END Command to Exit.
```

Figure 165. ALTER from the MOUNTABLE TAPE VOLUME ALTER ENTRY PANEL

When the ALTER line operator is entered from the MOUNTABLE TAPE VOLUME LIST panel, the Next MOUNTABLE TAPE VOLUME ALTER ENTRY PANEL (see Figure 166) is displayed to enable you to enter the new values for the specific volume requested. The four screen examples that follow (Figure 166, Figure 167 on page 262, Figure 168 on page 263, and Figure 169 on page 263) provide more information regarding the ALTER function for a specific tape volume.

```
  Panel  Utilities  Help
 ------------------------------------------------------------------------------
                   MOUNTABLE TAPE VOLUME ALTER ENTRY PANEL
 Command ===>

 Tape Volume : VOL101

 Specify New Values for the Following Fields:        (leave as-is if no change)

 Use Attribute:  Old Value   : SCRATCH
                 New Value . . P          (P - Private or S - Scratch)

 Storage Group:  Old Value   :
                 New Value . .

 Shelf Location: Old Value   :
                 New Value . .

 Owner Information:
     Old Value:
 New Value  . .

 Use ENTER to Perform ALTER;
 Use HELP Command for Help; Use END Command to Exit.
```

Figure 166. Next Mountable Tape Volume Alter Entry Panel

If, when the volume was entered into the library, no values were specified for storage group name, shelf location, or owner information, the Old Value fields on this panel are blank, and the tape volume record reflects blanks in these fields in the TCDB. You then add the values for owner information, storage group, and shelf location into the New Value fields and press Enter. The fields are updated in the TCDB, and the next time the volume is displayed, the new information appears in the Old Value fields. The New Value fields are primed with the same information (see Figure 167).

```
  Panel  Utilities  Help
------------------------------------------------------------------------------
                   MOUNTABLE TAPE VOLUME ALTER ENTRY PANEL
Command ===>

Tape Volume: VOL101

Specify New Values for the Following fields:      (leave as-is if no change)

Use Attribute:  Old Value   : PRIVATE
                New Value . . P       (P - Private or S - Scratch)

Storage Group:  Old Value   : SGTAPLCL
                New Value . . SGTAPLCL

Shelf Location: Old Value   : BASEMENT1
                New Value . . BASEMENT1

Owner Information:
    Old Value: CENTER
New Value  . . CENTER

Use ENTER to Perform ALTER;
Use HELP Command for Help; Use END Command to Exit.
```

Figure 167. Both Old Value and New Value Assigned to the Volume

If you type blanks over the New Value for storage group, shelf location, or owner information, the corresponding field in the tape volume record is set to blank, and the New Value fields show as blank the next time the record is displayed. See Figure 168 on page 263.

```
  Panel  Utilities  Help
------------------------------------------------------------------------------
                   MOUNTABLE TAPE VOLUME ALTER ENTRY PANEL
Command ===>

Tape Volume: VOL101

Specify New Values for the Following Fields:       (leave as-is if no change)

Use Attribute:  Old Value   : PRIVATE
                New Value . . P        (P - Private or S - Scratch)

Storage Group:  Old Value   :
                New Value . .

Shelf Location: Old Value   : BASEMENT1
                New Value . . BASEMENT1

Owner Information:
    Old Value: CENTER
New Value  . . CENTER

Use ENTER to Perform ALTER;
Use HELP Command for Help; Use END Command to Exit.
```

Figure 168. New Value Blanked out for Storage Group

Note that both the Old Value and the New Value fields for storage group are now blank. To add a storage group again, indicate the new value for storage group in the New Value field and press Enter (see Figure 169).

```
  Panel  Utilities  Help
------------------------------------------------------------------------------
                   MOUNTABLE TAPE VOLUME ALTER ENTRY PANEL
Command ===>

Tape Volume: VOL101

Specify New Values for the Following Fields:        (leave as-is if no change)

Use Attribute:  Old Value   : PRIVATE
                New Value . .          (P - Private or S - Scratch)

Storage Group:  Old Value   :
                New Value . . SGTAPRMT

Shelf Location: Old Value   : BASEMENT1
                New Value . . BASEMENT1

Owner Information:
    Old Value: CENTER
New Value  . . CENTER

Use ENTER to Perform ALTER;
Use HELP Command for Help; Use END Command to Exit.
```

Figure 169. New Storage Group Assigned to Blank Storage Group

ISMF validates the New Value input for the use attribute to allow only P or S. The New Value input for storage group is validated on the same selection entry panel; however, blanks are acceptable in this field.

ISMF does not validate the existence of the storage group in the active configuration. However, if the tape volume is library-resident, OAM provides the validation to ensure the following:

- The volume's storage group is defined in the current ACDS as a tape storage group.
- The volume's library is defined in the specified storage group.
- The volume's library is defined in the current ACDS as a valid tape library.

Note: If the tape volume is shelf-resident, only the first check is made.

If OAM detects an error in any of the above conditions, neither the use attribute nor the storage group is changed. However, shelf location and owner information can be altered even though a storage error is detected.

When an error occurs during the ALTER function, a message is stored in the message history for the entry. You can issue the message line operator to obtain the error information.

When you press Enter to perform the alter operation, the CONFIRM ALTER REQUEST panel (Figure 170) showing the number of volumes to be altered is displayed. Confirm the alter request by changing N to Y and pressing Enter.

```
  Panel  Utilities  Help
-------------------------------------------------------------------------------
                             CONFIRM ALTER REQUEST
Command ===>


Number of Volumes to be Altered: 10



   Enter "/" to select option   Y Perform Alter











Use ENTER to Perform Operation;
Use HELP Command for Help; Use END Command to Exit.
```

Figure 170. CONFIRM ALTER REQUEST Panel

7.9.1 Changing the Use Attribute from Private to Scratch

If you use the ALTER command to specify a NEW VALUE of scratch for the use attribute and any of the volumes on the list are private with an expiration date that has not yet passed, the PRIVATE TO SCRATCH CONFIRMATION PANEL (Figure 171 on page 265) is displayed for *each* volume whose expiration date has not yet passed.

Note:

- When DFSMSrmm is installed, any attempt to alter the use attribute from private to scratch is rejected unless DFSMSrmm already shows the volume as scratch.
- The change-of-use attribute installation exit (CBRUXCUA) is invoked whenever there is an attempt to change the use attribute for a tape volume. It may override the request or change the values. Refer to 7.3, "Other Tape Management Systems" on page 230 for more information about this installation wide exit. If your tape management system does not support CBRUXCUA, we recommend that you not use ISMF to change the status of library-resident volumes.

```
  Panel  Utilities  Help
 ------------------------------------------------------------------------------
                    PRIVATE TO SCRATCH CONFIRMATION PANEL
 Command ===>


                      Confirm Alter of Volume:  VOL101

        Currently this Volume is Private and
        Its Expiration Data has not yet Passed.

 Enter "/" to select option   _  Do you still want to change it to scratch?

        You may specify that all private volumes on
        the list should be changed to scratch whether
        or not their expiration dates have passed.
        If you do, the volumes will be changed without
        redisplaying this confirmation panel.

 Enter "/" to select option   _  Allow All Private Volumes to be
                                 Changed to Scratch?

 Use ENTER to Perform Operation;
 Use HELP Command for Help; Use END Command to Exit.
```

Figure 171. Private to Scratch Confirmation Panel

If the response is "**/**" on either confirmation panel, OAM changes the following items:

- The use attribute is changed to *S* in the TCDB.
- The storage group name is set to **SCRTCH** in the TCDB.
- The expiration date in the TCDB is blanked out.
- The volume error status is reset to *NO ERROR* in the TCDB.
- The library manager category of the cartridge is changed from private to scratch.

7.9.2 Changing the Use Attribute from Scratch to Private

When the ALTER line operator or the ALTER command is used to change the use attribute for tape volumes to private, the following fields in the TCDB are updated:

- The use attribute is changed to *P* in the TCDB.
- The volume error status is reset to *NO ERROR* in the TCDB.
- The category of the cartridge or cartridges is changed from scratch to private.

The changes to the TCDB volume record are performed immediately. When the line operator or command is complete, you are returned to the MOUNTABLE TAPE VOLUME LIST panel with the appropriate success or failure message. If the volume or volumes are successfully changed, use the ISMF REFRESH command to display the new values in the tape volume record.

Note: When DFSMSrmm is installed, its CDS is updated to reflect these changes.

7.10 Insert and Eject Processing

During normal operations, the tape library is online. Whenever a cartridge is inserted into the library through the I/O station, an attention message is sent to all attached hosts, indicating that a cartridge has been added to the Insert category.

For a detailed description of the manual tasks and library manager logic related to insertion, see 9.8, “Inserting and Ejecting Cartridges” on page 298.

7.10.1 Entry Processing Logic

Cartridges are physically entered through either the high capacity I/O facility or convenience I/O station. The library holds the cartridges in INSERT category while a series of checks are run against each one:

1. Check uniqueness of volser.

   The first step is to ensure that the external volser is unique. If it is not unique, the volume is left in the input station and the volume category is set to eject.

2. Access TCDB record.

   If the volser is unique, the volume record is retrieved from the TCDB. Possible dispositions are:

   - Volume record is not present in the TCDB (newly entered cartridge).
   - Volume record indicates that the volume is in another library (error, the cartridge is ejected).
   - Volume record indicates that the volume is in this library (reentry of a manually removed cartridge).
   - Volume record indicates volume is shelf resident (normal cartridge reentry).

3. Before the TCDB volume record is created or updated, the cartridge entry installation exit (CBRUXENT) is called to set the values for many of the fields in the record. The current contents of the volume record are passed to the exit as input. For a new volume, the volume serial and the default use attribute are passed. With this information, the exit has the following options:

   - Make no changes to the input fields.
   - Override more than one of the input fields.
   - Reject cartridge entry.
   - Request the exit not be invoked again.

   The exit or a tape management system can supply relevant information such as recording technology and whether the cartridge is scratch or private.

7.10.2 Ejection of Cartridges

There are several ways the host can request cartridges to be ejected:

- By an OS/390 operator command – for example, LIBRARY EJECT,VOL123
- From an ISMF panel using the EJECT line operator in the Mountable Tape Volume Application panel
- Through a tape management system
- Through an assembler program, using the CBRXLCS FUNC=EJECT programming interface

If just a few cartridges are to be ejected, use the convenience I/O facility as this does not stop the automatic running of the library. The size of the convenience I/O facility varies according to the type of library you have installed. If the number of cartridges is considerably more than the convenience I/O facility can accommodate, use the high capacity I/O facility and the respective LIBRARY EJECT,BULK or ISMF EJECT B command. The library must be put into pause mode before the operator can enter the enclosure to remove the cartridges.

Completion of the eject request is communicated to the host asynchronously.

If an eject operation is in progress and the convenience output station door is open, the library manager sends an attention message (CBR37E5E INPUT/OUTPUT DOOR OPEN) to all attached hosts requesting that an operator close the door. If an eject operation is in progress and the convenience output station is full, the library manager also sends a message (CBR3753E ALL CONVENIENCE OUTPUT STATIONS ARE FULL) requesting an operator action.

7.10.2.1 Ejecting Logical Volumes from the Virtual Tape Server

Logical volumes are not physical entities that can be individually removed from the library. They reside on stacked volumes with many other logical volumes. If you issue an EJECT for a logical volume all data on that volume will be lost.

Note: There is no way to recover the data on the logical volume once the EJECT command is processed.

Because of the permanent nature of the EJECT, the Virtual Tape Server subsystem only allows you to EJECT a logical volume, that is in either the INSERT or SCRATCH (defined with fast- ready attribute) category. If a logical volume is in any other status, the EJECT will fail. Tapes that are in INSERT status can be ejected by the setting of the return code by the CBRUXENT exit. This exit is usually provided by your tape management system vendor.

Once the tape is in SCRATCH status follow the procedure for EJECT processing based on whether your environment is system-managed tape or BTLS. You will also need to follow the procedure specified by your tape management system vendor. For DFSMSrmm issue the RMM CHANGEVOLUME volser EJECT command. If your tape management system vendor does not specify how to do this, you can use one of the following commands:

1. OS/390 command LIBRARY EJECT,volser
2. IDCAMS command LIBRARY EJECT,volser (for BTLS)
3. ISMF EJECT line operator for the tape volume

If the eject process fails because the tape is in another status, you will get errors. For libraries managed under DFSMS/MVS system-managed tape, system command `LIBRARY EJECT,volser` issued to a logical volume in PRIVATE status fails with this message:

```
CBR3726I Function incompatible error code 6 from library <library-name>
         for volume <volser>.
```

Note: In a DFSMS/MVS system-managed tape environment, if you try to eject a logical volume and get this error, OAM notifies the tape management system through the OAM eject exit, CBRUXEJC, before the eject request is sent to the tape library. The library manager will eventually fail the eject, but the tape management system has already marked the volume as ejected. There is no notification back that the eject has failed.

If your tape management system is DFSMSrmm, you can use the following commands to clean up the RMM CDS for failed logical volume ejects and to resynchronize the tape configuration database and RMM CDS:

```
RMM SEARCHVOLUME VOL(*) OWN(*) LIM(*) INTRANSIT(Y) LOCATION(vts) -
    CLIST('RMM CHANGEVOLUME ',' LOC(vts)')

EXEC EXEC.RMM
```

The first RMM command asks for a list of volumes that RMM thinks it has ejected and writes a record for each in a sequential data set called ′prefix.EXEC.RMM.CLIST′. The CLIST then checks whether the volume is still resident in the VTS library, and it is, it corrects the RMM CDS.

7.11 Scratch Pooling

DFSMS/MVS system-managed tape does not support multiple scratch pools of a single media type in its current release. The libraries may contain different types of scratch cartridges:

- MEDIA1 (CST 3490 cartridges)
- MEDIA2 (ECCST 3490E cartridges)
- MEDIA3 (Magstar 3590 cartridges)

The scratch cartridges will be selected according to DATACLAS definitions during nonspecific allocations. If you have two or more systems attached to a library and do not want to have a common pool for scratch volumes, you have to partition the library as discussed in 7.6, “Partitioning Tape Libraries among Multiple Systems” on page 240. For detailed coverage of sharing and partitioning, see the *Guide to Sharing and Partitioning IBM Tape Library Dataservers.*

BTLS allows you to specify up to eight different scratch categories (SCRTCH1 through SCRTCH8). (You can load a specific category into a given drive′s ICL, using the IDCAMS LIBRARY SETACL command.) BTLS picks the correct type of scratch tape if your tape management system supplies the correct scratch pool name (SCRTCH1-8) through the IGXMSGEX Message Display exit. See 5.2.3.2, “Message Display” on page 184. Although BTLS implements multiple scratch pool selection, it does not include the overall level of function that system-managed tape delivers to simplify the management, operation, and automation of your customer′s tape data.

7.12 Duplicate Volume Serial Numbers

For system-managed tape, all volsers in the same SMSplex must be unique across tape, DASD, and optical environments.

BTLS has limited support for duplicate tape volsers and does not care about DASD or optical duplicate names. The BTLS EXPDT98000 option allows a duplicate of a BTLS library volume to be mounted on a drive outside the library. When the EXPDT98000 option is used, and a DD statement includes EXPDT=98000, BTLS will not validate or interfere with the allocation.

DFSMSrmm does not support duplicate volsers and cannot manage volumes not defined to it. DFSMSrmm IGNORE support must be used to process duplicate tapes.

Within the IBM 3494 all volumes, including native, stacked, and logical, must be unique. You have to use distinct volume serial number ranges for the three volume types.

7.13 Basic Tape Library Support

Because migration to and from BTLS is similar to that in system-managed tape in many ways, we limit our comments mainly to what is different.

7.13.1 Backup and Synchronization

The repositories of BTLS are the system master catalog and the BTLS user catalog. As with system-managed tape, protect the catalogs, using standard ICFCATALOG backup and recovery procedures such as ICFRU.

If you have a catalog recovery tool at hand, you can use it to recover the catalog from a backup and cumulated SMF records.

If the BTLS user catalog fails, you can obtain the list of the volumes by using the LIBRARY INVENTORY command and then define the volumes to the new BTLS user catalog by using the LIBRARY DEFINE command. In this way, you can recover the BTLS user catalog definitions of volumes in the library. To detect anomalies and to generate reports, BTLS provides the following functions:

LIBRARY AUDIT Use the robotic system to verify that volumes are physically present in the library.

LIBRARY COUNTS Obtain a count of all volumes in each category in a library.

LIBRARY INVENTORY Obtain a list of volsers for all of the volumes by category.

When you use the LIBRARY INVENTORY command to obtain the list of volumes, the library manager returns a complete list of its inventory in response to this request. BTLS assigns its PRIVATE volumes to library manager volume category X′FFFF′. DFSMS/VM and VSE/ESA also use the same library manager volume category. In addition, AIX/6000 and the Control Path Server can use the user-specified library manager volume category. After you obtain the list of the PRIVATE category volumes, you must be careful to select BTLS volumes. Therefore we recommend that you use a different range of volume serial numbers for each system.

LIBRARY LISTVOL List the volumes that are cataloged for a library.

LIBRARY REPORT Create a report of all devices defined for a library.

Most of the above commands use data sets as either input or output, so you can easily reuse them if you need to go through an entire set of commands to achieve a certain result.

To update or correct BTLS information, use these commands:

LIBRARY DEFINE Define either volume or library record.

LIBRARY DELETE Delete either volume or library records.

LIBRARY SETCATEGORY Assign a volume to the category specified.

LIBRARY SETDEVICE Associate a scratch category with a device.

Automation considerations are different from system-managed tape. Because neither OAM nor SMS is used, CBR* or IGD* library messages are not issued at the OS/390 console. Refer to the *BTLS V1R1 User's Guide and Reference* for a complete update on all BTLS messages.

HCD is optional for BTLS. You might as well use MVSCP definitions if your current MVS/ESA release supports MVSCP.

7.13.2 DFSMShsm and BTLS

Because DFSMShsm runs as a started task, you have to specify DFSMShsm procedure names in the LIBRARY JOBNAMES command when you want to use the library in BTLS with OPTIONS(Jxx). When you use ABARS in BTLS, you also have to specify the ABARS procedure name.

As BTLS also honors esoteric names, you can control the DFSMShsm function level granularity to exploit the library, if the esoteric option is specified.

Table 35 on page 232 lists all tape output controls.

Because the SETSYS LIBRARYMIGRATION and LIBRARYBACKUP parameters are valid only for system-managed tape libraries, DFSMShsm uses the same characteristics as for nonlibrary tapes. However, a tape drive within the proper library is always selected for a library-resident volume. The DFSMShsm unit name affects device allocation. Read compatibility works automatically on input device allocations of DFSMShsm-owned volumes. The unit name could be a generic or esoteric name.

Note: If you use a generic device name in the SETSYS unittype statements and do not have 3490E devices installed, you must be aware of the following: When you vary the 3490E library devices online, all HSM input allocations are directed to the new 3490E units because OS/390 device preferencing tries to use non-ICL devices in preference to ICL-capable devices for specific mounts.

DFHSM forces data compaction (IDRC or IBMLZ1) for the 3490E and 3590 when it is used as the output device. SETSYS TAPEHWC or SETSYS NOTAPEHWC effectively controls IDRC only for the 3490 base models. The DFHSM default for the 3490 base models is NOTAPEHWC.

The TAPECOPY command provides a way of copying migration level 2 and backup single-file tape volumes. When you use 3480, 3480X, 3490, and 3590 generic unit names for input volumes for TAPECOPY, you must consider device compatibility. The original volumes and the alternate volumes that will be created must use the same recording technology and media type. DFHSM verifies device compatibility automatically.

During TAPECOPY processing, if MEDIA1 is mounted when MEDIA2 is needed, or vice versa, the process will fail. To avoid this situation, the SETSYS TAPEOUTPUTPROMPT(TAPECOPY(YES)) command forces a message to the operator indicating which media type should be mounted. By defining two scratch media categories with the LIBRARY SETCATEGORY command, SCRTCH for MEDIA1 and SCRTCH2 for MEDIA2, the OS/390 operator can mount the correct media type for the request.

Chapter 8. Data Migration

In this chapter we describe data migration for each of the platforms discussed in the previous chapters.

8.1 OS/390 and System-Managed Tape

In this section we focus on the data migration tasks and considerations for system-managed tape. OS/390 and DFSMS/MVS provide the most sophisticated storage management functions of any platform and are designed to handle terabytes of data. Dealing with such large amounts of data requires a well-thought-out concept and good planning. Most of the information in this section therefore applies to the system-managed tape environment.

Planning includes the following tasks:

1. Categorize your tape data. In general, you can assign tape data sets to one of the following categories:
   - DASD backup tapes, which are ideal candidates for migration to an automated library using high capacity tapes because of large-scale data transfers.
   - Process tapes that are created during periodic execution of an installation′s application program. These can be very good candidates for VTS.
   - Archive tapes that contain records held for historical, legal, regulator, or disaster-recovery purposes. For these tapes, consider merging existing cartridges onto fewer ECCST or Magstar 3590 tape cartridges.
   - Journal tapes that contain transactions recorded against another data set. These data sets are usually written with using the write-validity-check option. Consider using DASD logging and migrating the data written to DASD to tape later, using TMM or manual procedures.
   - Interchange tapes that are prepared for use in other locations. These tapes require the receiving location to be able to process the cartridge delivered. These data sets might be candidates to remain on CST or ECCST cartridges.
2. Plan the management of all tape formats and recording technologies involved.
3. Develop a data migration sequence. Determine the order in which to migrate your tape data sets. Typically, you start with DFSMShsm or DASD backup tapes.
4. Develop a data migration strategy.
5. Plan ways to verify that data has migrated successfully.

8.1.1 Tape Data Analysis

Use the SMS Volume Mount Analyzer (VMA) included in DFSMS/MVS to help you determine the number of storage cells and the number and type of drive units. You also must know how many tape cartridges you need, whether they are to be CST, ECCST, or 3590 or put into a VTS, and which applications should be using those media types. Use VMA for the analysis.

VMA consists of two programs:

GFTAXTR needs SMF record types 14, 15, 21, and 30 from all systems that use the library. It generates a summary file for all subsequent reporting activities. This summary file is only about 5% the size of the SMF data.

GFTAVMA is the keyword-driven reporting program. It creates reports based on the output of GFTAXTR. JCL examples for both programs can be found in SYS1.SAMPLIB with the names of GFTAVMAP and GFTAXTRP. Refer to *DFSMS/MVS Using the Volume Mount Analyzer* on how to use VMA. Use the statements listed in Figure 172 for the first run.

```
//VMACNTL  DD *
REP(EST,GB,USE,IDRC,TOP(PGM,HLQ,JOB,PCT(95)))
UNIT(EXC(3420))
TAPEDEV(3490E)
TAPELEN(2)
LARGE(600)
```

Figure 172. Sample SMSVMA Control Statements

The reports you get let you identify job names, programs, and high level qualifiers used with the cartridges. You see the average size of data sets created for each of the above and detailed information about the time of day these activities occur (see Figure 173 on page 275). Programs ADARUN and ARCCTL seem to be good candidates for large-capacity tape cartridges, having an average size (AVG SIZE) of 1337.9 MB and 1257.1 MB, respectively. Program IDCAMS does not use enough of the cartridge, as it shows an average size of 0.2 MB per cartridge! That is when the VTS comes into play. See the *IBM Magstar Virtual Tape Server: Implementation Guide* for tools and recommendations for selecting VTS data.

GFTASRT3 -- REPORT TOP PROGRAM NAMES

RANK	PROGRAM	# DSNS	% TOT	CUM DSN	% TOT	> LARGE	AVG SIZE
1	ADARUN	592	37.2	592	37.2	372	1337.9
2	ARCCTL	67	4.2	659	41.4	41	1257.1
3	ADRDSSU	303	19.1	962	60.5	0	159.7
4	IEBGENER	145	9.1	1107	69.6	0	1.8
5	SARSTC	2	0.1	1109	69.7	0	0.1
6	P74YT1	147	9.2	1256	79.0	0	7.7
7	IDCAMS	22	1.4	1278	80.4	0	0.2
8	NAT55BAK	50	3.1	1328	83.5	0	40.5
9	SORT	49	3.1	1377	86.6	0	3.7
10	TITS567	46	2.9	1423	89.5	0	4.0

Figure 173. Sample VMA Report Output

This report is a good starting point for identifying the native potential for larger capacity tapes and helps in the initial coding of your ACS routines or BTLS options.

8.1.2 Testing ACS Logic with NaviQuest

You can generate and execute test cases, using ISMF Option 7.4, the ACS TEST SELECTION panel (Figure 174 on page 276). The test cases input are saved in a data set. (For an example, see Figure 177 on page 278).

```
                              ACS TEST SELECTION
COMMAND ===>

SELECT ONE OF THE FOLLOWING OPTIONS ===>

  1  DEFINE          - Define an ACS Test Case
  2  ALTER           - Alter an ACS Test Case
  3  TEST            - Test ACS Routines


IF OPTION 1 OR 2 CHOSEN ABOVE, SPECIFY:

  ACS TEST LIBRARY ===> 'DFRES1.TCASE1.CNTL'
  ACS TEST MEMBER  ===> TAPE1






USE ENTER TO PERFORM SELECTION;
USE HELP COMMAND FOR HELP; USE END COMMAND TO EXIT.
```

Figure 174. ACS Test Selection panel

In addition to those basic ISMF functions, NaviQuest provides a multitude of functions to ease and automate the creation and comparison of test cases for the entire SMS environment. One special function NaviQuest delivers is the setup of test cases based on VMA data taken from your site. Because this function is closely related to the implementation of a library, we discuss it briefly here. For more information see the *NaviQuest Demonstration and Hands-On Usage Guide.*

To access NaviQuest, if it is installed in your environment, select Option 11 from the ISMF Primary Menu, which gets you to the NaviQuest PRIMARY OPTION MENU (Figure 175 on page 277).

```
                     NaviQuest PRIMARY OPTION MENU

ENTER SELECTION OR COMMAND ===>

SELECT ONE OF THE FOLLOWING:

  1  GENERATE TEST CASES      - Generate test cases from saved lists/records
  2  ACS COMPARISON TEST      - Compare the BASE and NEW ACS listings
  3  GENERATE ACS XREF        - Enhanced XREF ACS test listing
  4  UPDATE TEST CASE RESULTS - Update test cases with expected results
  5  GENERATE SMS REPORTS     - Create reports from ISMF lists or DCOLLECT
  6  GENERATE MODEL COMMANDS  - Generate model commands from ISMF or DCOLLECT







USE HELP COMMAND FOR HELP; USE END COMMAND TO EXIT.
```

Figure 175. NaviQuest Primary Option Menu Panel

After you select Option 1, you are presented with a menu to select the type of test case data for NaviQuest to use. To build test cases from VMA data, select Option 4.

The panel shown in Figure 176 on page 278 appears, where you can choose the following:

- Number of test cases to create
- Member name prefix for the resulting members
- Selection filter to be applied against the input data

Note: The input to this process is not raw SMF data but VMA-extracted SMF data. See *DFSMS/MVS Using the Volume Mount Analyzer* on how to run data extraction.

```
              BULK GENERATION OF TEST CASES FROM VMA EXTRACT FILE
COMMAND ===>

TO GENERATE TEST CASE LIBRARY, SPECIFY:
  DATA SET NAME CONTAINING VMAXTRT DATA
    ===> 'NAVIQ1.GFTAXTR.DATA'

  NUMBER OF TEST CASES      ===> 10      (1 to 9999, blank)
  MEMBER NAME PREFIX        ===> HSM     (1 to 4 alphabets)
  PROGRAM NAME TO FILTER ON ===> ARCCTL

  TEST CASE PDS      ===> 'DFRES1.TCASE1.CNTL'
    REPLACE EXISTING PREFIX ===> Y (Y or N)


Note:  Before running this function you must have run GFTAXTR from
       your saved SMF type 14,15,21, and type 30 records.




USE ENTER TO PERFORM GENERATION;
USE HELP COMMAND FOR HELP; USE END COMMAND TO EXIT.
```

Figure 176. Test Case Generation from VMA

The output written to the specified data set has the same format as without NaviQuest. However, NaviQuest generates more detailed information and enables you to test with real-life data instead of a randomly generated subset of examples. We show two test cases: one for DFSMShsm data (Figure 177), and one for DFSMSdss data (Figure 178 on page 279).

```
DESCRIPTION1:
From VMA EXTRACT file 'NAVIQ1.GFTAXTR.DATA' on 08/03/96 at 7:08pm
DSN: HSM.COPY.BACKTAPE.DATASET
DSTYPE: PERM
DSORG: PS
ACSENVIR: ALLOC
SIZE: 179328
EXPDT: 1999365
VOL: 01
100017
JOB: HSM
DD: SYS0512
PGM: ARCCTL
UNIT: 348X
```

Figure 177. NaviQuest-Generated Test Case: DFSMShsm

```
DESCRIPTION1:
From VMA EXTRACT file 'NAVIQ1.GFTAXTR.DATA' on 08/03/96 at 7:08pm
DSN: GSMVSE.DATA.SAVDAY
DSTYPE: GDS
DSORG: PS
ACSENVIR: ALLOC
SIZE: 0
EXPDT: 1995033
VOL: 01
100369
JOB: SAVTS001
DD: OUTDD1
PGM: ADRDSSU
UNIT: 348X
```

Figure 178. NaviQuest-Generated Test Case: DFSMSdss

The result of checking the specified input against the SCDS you are about to test looks somewhat like the screen shown in Figure 179.

DSS0017 and HSM0001 are the members shown in Figure 177 on page 278 and Figure 178, respectively.

You see the classes that would be assigned to the data set names specified and can check whether this is what you intended.

```
                              ACS TESTING RESULTS

CDS NAME         : SMS.SCDS0
ACS ROUTINE TYPES: DC SC MC SG
ACS TEST LIBRARY : SMS.TESTCASES.DATA

  ACS TEST
  MEMBER       EXIT CODE   RESULTS
  ---------    ----------  -----------------------------------
                        0  SG = SGTAPLCL

  DSS0017               0  DC = DCTAPLR
                        0  SC = SCTAPLCL
                        0  MC = MCTAPE
                        0  SG = SGTAPLCL

  HSM0000               0  DC = DCTAPLR
                        0  SC = SCTAPLCL
                        0  MC = MCTAPE
                        0  SG = SGTAPLCL

  HSM0001               0  DC = DCTAPLR
                        0  SC = SCTAPRMT
                        0  MC = MCTAPE
                        0  SG = SGTAPRMT
```

Figure 179. ACS Testing Results Panel

However, you cannot see the data set names and other input criteria on the list. That is why you go back to NaviQuest and select Option 3 (GENERATE ACS XREF) to generate the ACS CROSS REFERENCE REPORT (Figure 180 on page 280).

```
                          ACS CROSS REFERENCE REPORT
COMMAND ===>

TO GENERATE REPORT, SPECIFY:
  ISMF TEST CASE LISTING
    ===> 'DFRES1.LISTING'

  DSN FOR CROSS REFERENCE LISTING
    ===> 'DFRES1.XREF.LISTING'
    REPLACE CONTENTS IF DSN EXISTS ===> Y (Y or N)

  VARIABLES TO INCLUDE IN REPORT:        (Y or N)
    DSN   ===> Y        UNIT    ===> N       SIZE    ===> N
    EXPDT ===> N        JOBNAME ===> Y       PROGRAM ===> N






USE ENTER TO PERFORM GENERATION;
USE HELP COMMAND FOR HELP; USE END COMMAND TO EXIT.
```

Figure 180. NaviQuest-Generated ACS CROSS REFERENCE REPORT

The input is the ACS test output listing data set, and the output is a new listing data set as shown in Figure 181. You can specify which columns you want NaviQuest to add. If you are not using the program name in your ACS routines to make decisions, you probably do not need it on the output listing.

```
                               ACS TESTING RESULTS

CDS NAME         : SMS.SCDS0
ACS ROUTINE TYPES: DC SC MC SG
ACS TEST LIBRARY : SMS.TESTCASES.DATA

ACS TEST
MEMBER    EXIT CODE   RESULTS        DSNAME                     PROGRAM
--------- ----------  -----------    -------------------        -------

DSS0017            0  DC = DCTAPLR   GSMVSE.DATA.SAVDAY         ADRDSSU
                   0  SC = SCTAPLCL
                   0  MC = MCTAPE
                   0  SG = SGTAPLCL

HSM0000            0  DC = DCTAPLR   HSM.BACKTAPE.DATASET       ARCCTL
                   0  SC = SCTAPLCL
                   0  MC = MCTAPE
                   0  SG = SGTAPLCL

HSM0001            0  DC = DCTAPLR   HSM.COPY.BACKTAPE.DATASET  ARCCTL
                   0  SC = SCTAPRMT
                   0  MC = MCTAPE
                   0  SG = SGTAPRMT
```

Figure 181. ACS Testing Results Panel

The obvious results are these:

- HSM and DSS data sets are assigned data class DCTAPLR, which comprises 36-track, MEDIA2 cartridges (refer to Table 21 on page 154 through Table 24 on page 154 for SMS construct definitions used in the samples).
- DSS save and HSM backup data sets are directed to storage group SGTAPLCL, which is the local tape library.
- HSM TAPECOPY data sets are directed to storage group SGTAPRMT, which is the remote tape library.

8.1.3 Data Migration Methods

Several methods are available to migrate tape data sets to the library. To migrate your tape environment, you are likely to use a mixture of the three methods described below.

8.1.3.1 Fill with Scratch Volumes Only

This method basically inserts only scratch tapes in the library. The default volume attribute can be set to SCRATCH and does not have to be updated. We recommend this method if you are starting to use a new, larger media type in the library. It is the best way to ensure that you do not move inactive and half-empty tapes into the library.

New tape allocations are directed to the library by the ACS routines, starting smoothly with one or two jobs or data sets. After three to four months, most of the active tape data sets will reside inside the library. After that, you can consider moving the remaining tapes into the library by using another approach – copying them, for example. Before you do so, however, verify the contents of those tapes. Often, you find that they probably will never be reused and can safely stay on the shelf.

8.1.3.2 Move Existing Volumes

Physically moving existing cartridges into the library requires careful examination of every single cartridge to ensure that each is processed inside the library.

The biggest concern when moving existing cartridges is to separate active from inactive cartridges. Tape data analysis (see 8.1.1, “Tape Data Analysis” on page 274) can help you select active cartridges.

The existing volumes must be entered as PRIVATE volumes. To read uncataloged data sets in them, you must specify the volser. When migrating by application, be sure that all dependencies on other applications are resolved.

Examine your tape environment regarding the cartridge system tape requirements for the library. Criteria to check include:

- All volumes must have a supported external bar code label readable by the IBM 3494 vision system.
- All volume serial numbers in the SMSplex must be unique across tape, DASD, and optical environments.
- All volumes of a multivolume data set must reside in the same library and belong to the same storage group.

- If you are migrating from a 3480-type environment and are planning to read existing 3480 tapes on the IBM 3490E devices, you must consider the following:

  The IBM 3490E can read IBM 3480 and IBM 3490 written tapes. However, the IBM 3490E is a different device type from the IBM 3480 and IBM 3490, so either catalog entries or JCL UNIT-statements for such data will have to be changed to allow for IBM 3490E allocation. A program is available to change the catalog entries of all tape data sets from IBM 3480 to IBM 3490 to enable an IBM 3490E to read those data sets. The program is TPCATCVT and can be found in MKTTOOLS as TAPEMIG PACKAGE. You can also use the special SYS3480R and SYS348X esoterics to override catalog entries where appropriate for read-only activity. Neither copying nor recataloging is required with this technique. For the handling of write data (scratch mounts) use the DEVSERV VOLNSNS=YES parameter (see 5.1.2, “Update SYS1.PARMLIB” on page 129).

8.1.3.3 Copy Tape Data Sets

You may want to consider using a product designed to copy data from one media to another. These products are designed to do much of the work for you. Table 38 lists the tape copy product of which we are aware. You can choose one of these products, or perhaps you have your own that performs a similar function. Certainly you do not need a tape copy product, but using one facilitates moving many tapes into the IBM 3494.

You have to take your environment into consideration when evaluating these products. Some of the options to consider when evaluating a tape copy product are:

- Interaction with your tape management system
- How automated the process is
- How fast and efficient the copy operation is
- Flexibility in using the product for other functions such as duplicate tape creation
- Ease of use
- Ability to create a pull list for any manual tape mounts
- Ability to handle multivolume data sets
- Ability to handle volume size changes whether from smaller to larger or larger to smaller
- Functionality to review the list of data sets before submission
- Audit trail of data sets already copied
- Flexibility in being able to filter the data sets by wildcards or other criteria such as expiration or creation date
- How well it handles failures, such as input volume media failures, during the copy operation

Table 38. Tape Copy Products		
Product Name	**Vendor Name**	**Web Address for More Information**
Beta55	Beta Systems Software AG	*http://www.betasystems.com*
CA-1/TLMS Copycat	Computer Associates International, Inc.	*http://www.cai.com/products/dsm/asm.htm*
CARTS-TS or CARTS-MC	Technologic Software Concepts, Inc.	*http://www.technologic.com/carts/cartsts.html*
FATAR	Innovation Data Processing	*http://www.innovationdp.com/*
Info-Pac - TapeSaver	Mobius Management Systems Inc.	*http://www.mobius-inc.com/products/tapesaver.htm*
Tape/Copy	OpenTech Systems, Inc.	*http://www.opentechsystems.com/copy.htm*
Zela	Software Engineering of America	*http://www.seasoft.com/zela.html*

8.1.4 Data Entry Methods

The entry default use attribute on the ISMF TAPE LIBRARY DEFINE panel can be set to either PRIVATE or SCRATCH (see Figure 68 on page 144). For the initial loading of cartridges into the library, the recommended setting depends on your migration approach. If you are moving already existing volumes into the library, set the default insert category to PRIVATE to avoid accidental overriding of recorded data in the volume.

If you are inserting scratch cartridges only, set the default insert category to SCRATCH.

8.1.4.1 Manually Populating the Storage Cells

This is the fastest way of initially loading a large number of cartridges into the library. First, the library manager has to be set in PAUSE or MANUAL mode. An operator can then enter the library enclosure to insert cartridges directly into the storage cells in the enclosure walls.

Once the cartridges are in the library and the library manager has been set back to AUTO mode, an inventory operation is invoked from the library manager's console to create the volume information in the library manager's database.

8.1.4.2 Using the High Capacity I/O Facility

The high capacity I/O facility is defined during the teach process, providing from 10 to 260 storage cells (depending on model and setup; see 2.2.11, "High-Capacity Facilities" on page 32) for bulk insert and eject. Bulk input is also used when the library is operated in MANUAL mode to temporarily store the cartridges that the operator has removed from the drives. Redefining the high capacity I/O facility requires a partial teach process and inventory process for the storage frames, which may require several hours.

Using the high capacity I/O facility to insert the cartridges, the operator must set the library manager in PAUSE mode. Then the operator can enter the library and insert the cartridges in the storage cells dedicated to input that are in the frame next to the operator access door. Do not put any cartridges in any place other than the high capacity I/O facility during bulk input, because the library manager will not know they exist.

After the operator has left the library enclosure and reset the library manager to AUTO mode, he or she must request the high capacity input operation from the library manager console. The cartridge entry process is then started (see 9.8, “Inserting and Ejecting Cartridges” on page 298).

8.1.4.3 Using the Convenience I/O Station

The convenience I/O station allows the operator to enter 10 to 30 cartridges at one time. The library manager automatically recognizes that there are cartridges in the input station and sends the cartridge accessor to the input station to perform the cartridge entry process. The use of the convenience I/O station does not interrupt library operation. No special preparation is required to use this station.

Any outstanding mount or demount requests are satisfied first before the convenience I/O station is serviced.

Although migration to a library does not necessarily require JCL or application changes, review your JCL and applications regarding the following changes:

- Devices requested through unit affinity, such as UNIT=AFF=ddname, are honored only if the volumes reside in the same library. Resolve these dependencies when moving volumes into the library or be aware that more drives could be allocated in parallel.
- If programs invoke FEOV based on cartridge capacity thresholds, review these thresholds and the use of MEDIA1, MEDIA2, and MEDIA3.

8.1.5 MEDIA Considerations

The Magstar 3590 tape cartridge introduces new dimensions for cartridge capacity. Figure 182 on page 285 shows the number of IBM 3480 cartridges (also known as MEDIA1 or CST) and the number of IBM 3490 cartridges (also known as MEDIA2 or ECCST) that are required to store the same amount of uncompacted data as a single 3590 Magstar (MEDIA 3) tape cartridge.

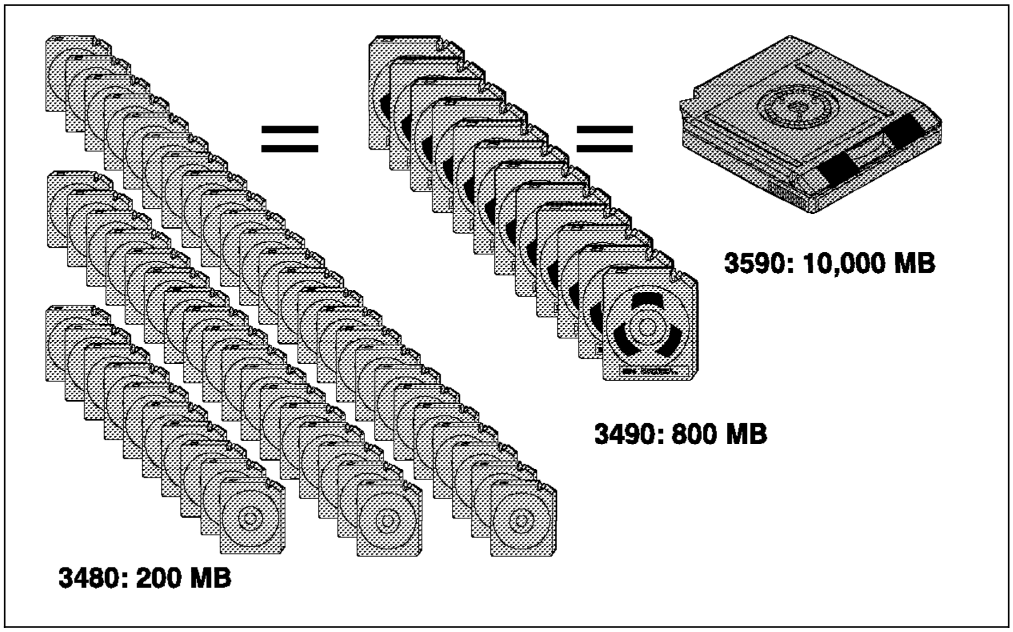


Figure 182. IBM 3480, 3490, and 3590 Cartridge Capacity

It depends largely on the applications that use tape and on the size and structure of the data written to tape how efficiently you can use the large capacity of the MEDIA3 (Magstar) cartridges.

Good candidates for using the high-capacity tapes effectively are:

- DFSMShsm
- DFSMSdss or similar product
- Database backup tools
- OAM object tape support
- ADSM on all platforms
- BRMS/400
- R/DARS

To simplify managing multiple media types in your tape environment, we highly recommend that you use a unique volser range for every media type. This approach facilitates proper identification of the media type by the tape operator, the tape management system, and the host software that manages operation of a library.

Remember that the 3590 tape cartridge cannot be mounted on a non-IBM 3590 tape drive, even though its outer shape is the same as the shape of the cartridges used with IBM 3480 and 3490 tape subsystems. For details on the external bar code label, see 9.9, “Cartridge Labels and Bar Codes” on page 300.

The ESCON-attached IBM 3590 does not support Read Backward CCW (command code X′0C′). Instead, it supports a new Read Previous CCW that allows processing of a 3590 tape cartridge in the backward direction without the performance penalties that exist with the Read Backward CCW. IBM 3480 and 3490 devices have to reread the physical block from the medium for each request of a logical block. The Magstar 3590 tape drive retains the physical block in the device buffer, similar to the way in which Read Forward CCW operates. The Read Previous CCW transfers data to the host in the same order in which it was written, rather than in reverse order as with the Read Backward CCW.

8.1.6 Capacity Enablement

Over the years, several methods have been developed to close the ever-increasing gap between the capacity available on magnetic cartridges and the amount used thereof. All methods involve implementation effort and some of them inherit other disadvantages. Only with the appearance of the methods of a VTS, such as the IBM Magstar 3494 VTS, did an automated way to optimize tape usage become available. Figure 183 shows an overview of capacity enablement methods.

	VTS	TMM	User JCL stacking	pre-alloc stacking sw	post-alloc stacking sw
Cartridge 100% used	✓	✓	✓	✓	✓
No JCL changes	✓	✓	✗	✓	✓
Media awareness	✓	✓	✗	✓	✓
No extra management.	✓	✗	✗	✗	✗
No additional sw	✓	✓	✓	✗	✗
No additional DASD	✓	✗	✓	✓	✓
No additional mounts	✓	✓	✓	✓	✗

Figure 183. Capacity Enablement Methods

TMM still makes perfect sense for many customers and applications. It will help you to:

- Eliminate excessive tape mounts
- Increase the utilization of cartridge capacity
- Reduce the size of the tape library

TMM is transparent to users and applications and requires no JCL changes.

With TMM you use your ACS routines to route small tape data set allocations to a separate DASD pool called the DASD buffer (figref refid=tmm). Every hour DFSMShsm checks the occupancy of this DASD buffer, an SMS storage group, and moves eligible files to tape. If data sets are accessed by the application or user, DFSMShsm automatically recalls them. Data set movement through the storage hierarchy is based on the management class you assign to the data set. There are two different types of data sets:

Active data is data that will be reused. If the usage pattern shows reuse after a few days, you can profitably migrate this type of data from the DASD buffer to ML1 storage.

Backup data is data that is rarely reused. Most of the all-tape data sets fall into this category. Move these files from the DASD buffer directly to ML2 tape.

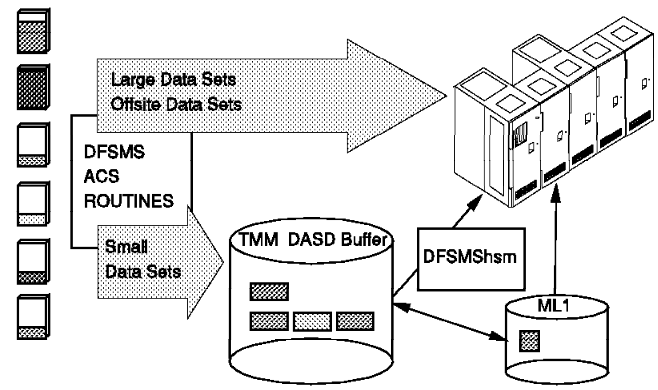


Figure 184. Tape Mount Management Overview

DASD serves as a temporary repository for small data sets, including those generated for backup and recovery. Management of the DASD buffer pool decreases both tape mount activity and library size by implementing the following strategies:

- The data set can be maintained in the DASD buffer until it expires. The storage administrator controls this residence with the assignment of proper management classes to control buffer residence duration for a data set as a function of its usage, size, and the relative cost of DASD and tape storage after applying labor and management costs. The costs of mounts and cartridge use can be eliminated for data sets whose life cycle is shorter than the specified residence period.
- Data migration operations to tape can service multiple data sets through automatic data set stacking by DFSMShsm or an equivalent product, thus using the entire storage capacity of a cartridge. Compression and compaction further optimize cartridge capacity. This implementation minimizes mount activity and reduces media and library management costs as fewer cartridges are required. If data set residence control is effective, data set recall is minimized, with most remaining mount requests addressed by the cartridge loader.

Implementing the DASD buffer has several advantages when compared to having the data sets reside on tape:

- Data sets residing in the DASD buffer are accessed directly with DASD performance. Multiple data set tapes have an inherent delay because they must be positioned to the desired data set.
- Tape storage subsystems must dedicate one transport per open data set per task. A DASD storage unit can have multiple data sets allocated concurrently.
- DASD has no wait time pending operator, cartridge loader, or robot mount; DASD storage provides immediate allocation.
- Tape data sets can be accessed by only one task at a time. Jobs requiring access to a data set allocated to tape must be executed serially. DASD data sets can be read by multiple tasks concurrently, allowing multiple jobs to be run in parallel.

8.1.7 DFSMSdss and Database Utilities

If you decide to manage DFSMSdss data such as backups and dumps, database image copies, or any other data created by a backup utility in a library using system-managed tape, you have several options:

- Code the program name or jobname of the jobs in the ACS routines and assign DATACLAS, STORCLAS, and STORGROUP as appropriate. Leave the JCL unchanged.
- Change the UNIT=XXXX JCL parameter to a value you have defined as an esoteric name in your I/O definition and in the ACS routines, as outlined in Figure 185.
- Add a data class (DATACLAS=xxxxxxxx) or storage class to the JCL, as shown in Figure 186.

```
//STEP1    EXEC PGM=ADRDSSU
//SYSPRINT DD   SYSOUT=*
//DASD1    DD   UNIT=SYSDA,VOL=SER=SMS002,DISP=SHR
//TAPE     DD   DISP=(,KEEP),DSNAME=MWER.SMSMIG.DATA,UNIT=LIBLCL,
//         VOL=SER=SMSMIG,LABEL=(1,SL)
//SYSIN    DD  *
   DUMP INDDNAME(DASD1) -
   OUTDDNAME(TAPE) -
   DATASET(INCLUDE(MWER.SMSTOOL.**)) TOL(ENQF)
//
```

Figure 185. Sample DFSMSdss JCL Using Esoteric Name

```
//STEP1    EXEC PGM=ADRDSSU
//SYSPRINT DD   SYSOUT=*
//DASD1    DD   UNIT=SYSDA,VOL=SER=SMS002,DISP=SHR
//TAPE     DD   DISP=(,KEEP),DSNAME=MWER.SMSMIG.DATA,UNIT=3480,        .,
//         VOL=SER=SMSMIG,LABEL=(1,SL),
//    DATACLAS=DCTAPLCL
//SYSIN    DD  *
   DUMP INDDNAME(DASD1) -
   OUTDDNAME(TAPE) -
   DATASET(INCLUDE(MWER.SMSTOOL.**)) TOL(ENQF)
//
```

Figure 186. Sample DFSMSdss JCL with Added Data Class

You can stack multiple full-volume dumps on a single volume because the stand-alone dump program accepts a file number to be restored. To copy multiple physical full-volume dumps to a single cartridge, use the DFSMSdss COPYDUMP command.

To move other data sets to a library, you can use the following software products and their utilities:

- DFSMS/MVS utility IEBGENER

  You can use IEBGENER to copy sequential data sets. IEBGENER also makes it possible to copy user labels.

You can also use IEBGENER when moving generation data sets (GDSs) without creating an additional generation in the generation data group. Follow the order in which the DD statements are listed in Figure 187 on page 289, so that the UNCATLG comes first.

```
      //*       * 1. STEP : ALLOC A GENERATION DATA GROUP DATA SET
      //*       **************************************************
    2 //STEP01   EXEC PGM=IEBGENER
    3 //SYSPRINT DD   SYSOUT=*
    4 //SYSIN    DD   DUMMY
    5 //SYSUT1   DD   DSN=CART.TESTGDG.G0009V00,DISP=(OLD,UNCATLG)
    6 //SYSUT2   DD   DSN=CART.TESTGDG.G0009V00,
      //         DISP=(,CATLG,DELETE),
      //         UNIT=3590-1,
      //         DCB=(GDG,RECFM=F,LRECL=80,BLKSIZE=80)

IEF236I ALLOC. FOR GENER.TESTG STEP01
IEF237I J21E ALLOCATED TO SYSPRINT
IEF237I DMY  ALLOCATED TO SYSIN
IEF237I 04C1 ALLOCATED TO SYSUT1
IGD100I 04C0 ALLOCATED TO DDNAME SYSUT2   DATACLAS (        )
IEF142I GENER.TESTG STEP01 - STEP WAS EXECUTED - COND CODE 0000
IEF285I   USER1.GENER.TESTG.JOB15200.D0000101.?       SYSOUT
IEF285I   CART.TESTGDG.G0009V00                        UNCATALOGED
IEF285I   VOL SER NOS= SC1417.
IEF285I   CART.TESTGDG.G0009V00                        CATALOGED
IEF285I   VOL SER NOS= SC1505.
```

Figure 187. Sample IEBGENER Job

- DFSORT utility ICEGENER

  If you have DFSORT installed, you can achieve more efficient processing for jobs set up to use the IEBGENER utility by using the ICEGENER facility of DFSORT. Qualifying IEBGENER jobs are processed by the equivalent, but more efficient, DFSORT copy function. If, for any reason, the DFSORT copy function cannot be used (for example, when IEBGENER control statements are specified), control is automatically transferred to the IEBGENER utility. The ICEGENER utility can be used for either selected IEBGENER jobs or, automatically, all IEBGENER jobs.

  To use ICEGENER to copy data sets, substitute the name ICEGENER (or the alias SORTGENR) for the name IEBGENER in any jobs you choose.

8.2 VM/ESA and VSE/ESA

In VM/ESA and VSE/ESM environments, tape allocation is controlled through the tape management system. The details of a migration project will therefore differ, depending on which tape management system you have installed. When migrating to a library, a number of common migration considerations must be taken into account:

- Which categories of tape data are involved?
- Are there cartridges which are not managed by the tape management system?

- Does the data have to be read by a different tape technology at another location?
- Is managing multiple tape formats and recording technologies involved?
- What is the data migration sequence?
- How do you plan to verify that data has been successfully migrated?
- How do you plan to manage the library resource if it is shared with another platform? See the *Guide to Sharing and Partitioning IBM Tape Library Dataservers*.

8.3 AIX

We do not discuss data migration in an AIX environment in any detail, as the details depend on the application you are using and the current hardware that you have installed.

In planning your data migration or implementing a new application that may be using a library, we recommend that you conduct thorough tests and migrate data in a carefully controlled manner. When migrating or moving data to a library, take the following into consideration:

- Which categories of tape data are involved?
- Are there cartridges that are not managed by the tape management system?
- Does the data have to be read by a different tape technology at another location?
- Is managing multiple tape formats and recording technologies involved?
- What is the data migration sequence?
- How do you plan to verify that data has been successfully migrated?
- How do you plan to manage the library resource if it is shared with another platform? See the *Guide to Sharing and Partitioning IBM Automated Tape Library Dataservers*.

Chapter 9. Operational Considerations

In this chapter we describe the operation of the IBM 3494. We include information about generic tape library operating procedures and operations in a specific operating system or application environment.

We do not include detailed information about the operation of the tape drives, as the library performs all cartridge mount and demount operations. Operational knowledge of the tape drive is required only for error recovery (see Chapter 10, “Error Handling and Recovery” on page 339) or manual mode operation (see 9.11.2, “Manual Mode Operation” on page 305).

During normal library operation, there is no need for any operator involvement, with the exception of adding or removing cartridges from the library enclosure. The library attempts to recover from errors without operator intervention; it requires operator intervention only if it is unable to recover. The cleaning of the tape drives is carried out automatically, on the basis of the rules you defined through the library manager.

The library manager application has detailed help, which you can access by pressing the PF1 key or using the Help pull-down. For ease of use, we recommend that you use the operator panel on the IBM 3494 (rather than the library manager) to change the operational mode and power status.

The library manager application provides two menus: the operator menu and the service menu. The service menu provides some additional menu pull-downs below the operator pull-downs, including the service menu the IBM Service Representative would use to maintain and repair the library. The service menu can be password protected if that option is chosen during the library teach process.

You can make selections from the action bar of the operator or service menu, with choices from the pull-down menus, or using active radio buttons, check boxes, and push buttons. Although you can use either the keyboard or the pointing device to make your choices, the pointing device is the preferred method for ease of use.

Further operating information can be found in the *Magstar 3494 Tape Library Operator's Guide*.

9.1 Operational Modes and States

At any point in time the current operational status of the tape library is defined by a combination of:

- An operational mode
- An operational state
- One or more informational states

Operational modes describe accessor movement, operational states describe the status of the library manager or library power, and informational states describe any error or abnormal library condition.

In the sections that follow we provide detailed information about operational modes, operational states, and informational states.

9.2 Operational Modes

The IBM 3494 can be in any of three operational modes, but only one at a time. The library must complete mode transition before the mode can be changed again. The three operational modes are:

- AUTO
- PAUSE
- MANUAL

The operational mode of the library is changed through the Mode pull-down on the library manager, or the AUTO and PAUSE buttons on the IBM 3494 operator panel.

9.2.1 AUTO Mode

In AUTO mode, the library is under the control of the library manager. The accessor moves under the control of the library manager to carry out mount, demount, and cartridge movement requests. To be in AUTO mode, all safety circuits must be complete. From AUTO mode, you can go to PAUSE or MANUAL mode. If you select MANUAL mode, the library will go into PAUSE mode before entering MANUAL mode.

9.2.2 PAUSE Mode

PAUSE mode is intended to allow the operator to access the interior of the IBM 3494. While the library is in PAUSE mode, mount and demount commands that require accessor movement are queued until the library returns to AUTO mode. The library manager responds to host requests for status information. From PAUSE mode you can change the library operational mode to either AUTO or MANUAL.

9.2.3 MANUAL Mode

MANUAL mode is intended to allow 100% library availability. It enables the library to be operated manually under the control of the library manager in the event of an accessor failure or during preventive maintenance. From MANUAL mode you can go to PAUSE or AUTO mode. If you select AUTO mode, the library goes into PAUSE mode before entering AUTO mode. During MANUAL mode operation, the library manager receives requests from the attached host and displays the action (mount or demount), volser, storage cell location, and drive address on the library manager console and tape drive message panels.

9.3 Operational States

The operational states are:

- Library manager initialization
- Initialization complete
- Offline
- Online
- Shutdown pending

- Library manager switchover in progress (only the IBM 3494 with Model HA1 installed)
- Accessor switchover in progress (only the IBM 3494 with Model HA1 installed)
- Dual Active Accessor enabled/disabled (only the IBM 3494 with Dual Active Accessor feature)
- Dual Active Accessor transitioning (only the IBM 3494 with Dual Active Accessor feature)

9.3.1 Library Manager Initialization

During library manager initialization, the library manager application is loaded, the interfaces to the tape subsystems and hosts are powered on and tested, and the library manager database is verified.

9.3.2 Initialization Complete

Once the library manager has successfully completed initialization, the library will become operational. The operational mode and state (online or offline) can be set through the library manager upon initialization complete. If they are not set, a timeout occurs and the library enters the default mode and state. If any library components are not available upon initialization complete, the operation mode and state are set to match the current component availability. The library does not exit initialization complete if it has not been taught or inventoried.

9.3.3 Offline

The library manager is offline and will not respond to any host requests, although commands entered through the library manager are accepted.

9.3.4 Online

The library manager is online and accepting commands from host requests. This is the normal operational state of the library manager.

9.3.5 Shutdown Pending

The library manager is in the process of terminating the library manager application, once power is removed from the library. Once shutdown is complete, you can initialize the library manager application by pressing cntl-alt-delete on the library manager keyboard. If you press the power off button on the IBM 3494 operator panel, the library manager enters shutdown pending before the power is removed. When you select shutdown by using the Mode pull-down menu, the library manager enters into this state.

9.3.6 Library Manager Switchover in Progress

This operational state is available only on an IBM 3494 with the High Availability unit installed. In the dual library manager configuration, this state occurs when the active and standby library managers switch roles on a failure or on request by the operator. The library manager is in this state until the switchover completes. The switchover can take several minutes to complete.

9.3.7 Accessor Switchover in Progress

This operational state is available only on an IBM 3494 with the High Availability unit installed. In the dual accessor environment this state occurs when the active and standby accessors switch roles on a failure or on request by the operator. This switchover can take several minutes to complete.

9.3.8 Dual Active Accessor Enabled/Disabled

These operational states are possible only on an IBM 3494 with the High Availability unit and Dual Active Accessor feature installed. The Dual Active Accessor environment may be enabled by the operator and disabled by a failure of one accessor or on request by the operator.

9.3.9 Dual Active Accessor Transitioning

This operational state is possible only on an IBM 3494 with the High Availability unit and Dual Active Accessor feature installed. In the dual accessor environment this state is initiated by a failure of one accessor or on request by the operator. Transitioning can take several minutes to complete.

9.4 Informational States

The informational states are:

- Degraded operation
- Safety enclosure interlock open
- Bar code reader or vision system nonoperational
- Intervention required
- Library manager Check 1 condition
- All storage cells full
- Out of cleaner volumes
- Dual write disabled
- Dual library manager status (only the IBM 3494 with Model HA1 installed)
- Accessor status (only the IBM 3494 with Model HA1 installed)

9.4.1 Degraded Operation

The library is degraded when any component (with the exception of tape subsystems) has failed and been made unavailable. Some level of library operation will be available even in the degraded state. To resolve the degraded state, the failing component would have to be repaired and made available by an IBM Service Representative.

With the IBM 3494 the following components can be marked unavailable and the library will continue operation but indicate to the hosts that it is in a degraded mode:

- One gripper in a dual gripper, single accessor configuration
- Up to three grippers in a dual gripper, dual accessor configuration (when the High Availability unit is installed)
- Second disk drive in a dual disk drive configuration
- Bar code scanner
- One accessor in a dual accessor configuration (when the High Availability unit is installed)
- Components of the dual library manager configuration (when the High Availability unit is installed)

- Convenience I/O station

9.4.2 Safety Enclosure Interlock Open

This state indicates that one or more of the door interlocks is open. If all doors are fully closed, it is likely that a component within the safety circuit has failed. The library will not enter AUTO mode while in this state.

This state does not apply to an IBM 3494 when a service bay door of the High Availability unit is open in service mode.

9.4.3 Bar Code Reader or Vision System Nonoperational

On the IBM 3494 this state is entered if the bar code reader has failed. During this time, the library continues to operate, but cartridges cannot be entered or removed from the library.

9.4.4 Intervention Required

This state is entered when the library requires an operator to take action. On the IBM 3494, the attention light on the operator panel blinks to signal the operator. Once the operator has cleared the intervention and if required confirms that he or she has done so, this state ends.

9.4.5 Library Manager Check 1 Condition

The library enters this state if it is unable to continue because of an unrecoverable error. In this state, all host commands and requests are lost. The library manager attempts to restart the library manager after a Check 1 condition. However, this restart does not occur if the number of Check 1′s exceeds three in 10 minutes.

9.4.6 All Storage Cells Full

This state is entered when cartridges are present in the convenience I/O station and no empty storage cells are available in the library.

9.4.7 Out of Cleaner Volumes

This state indicates that cleaner volumes are not present in the library and a clean operation has been requested by the library manager. In a mixed tape drive system (3490E/3590) either type of cleaner cartridge could be missing.

9.4.8 Dual Write Disabled

This state indicates that a secondary copy of the library manager database is not available. Either the dual write option was not selected or the second library manager hard disk has failed (or was not installed) in an IBM 3494.

9.4.9 Dual Library Manager Status

This informational state is available only on an IBM 3494 with the High Availability unit installed. It includes the status of the connection links between the two library managers, the state of the secondary database, and whether the standby library manager is capable of taking control.

9.4.10 Accessor Status

This informational state is available only on an IBM 3494 with the High Availability unit installed. In a dual accessor environment, this state indicates the status of the accessors, which accessor is active, and whether the standby accessor is capable of taking control.

9.5 Library Manager Startup

The library manager is automatically started when the library is powered on by way of the operator panel on the IBM 3494. While the library manager is starting, it is in library manager initialization status. At this time, the library manager database is initialized, and a validity check is carried out on the primary and backup databases. If any errors are found with the secondary database, library manager initialization continues, and the library enters the dual-write-disabled informational state. If errors exist with the primary database, the Check 1 informational state is entered.

On an IBM 3494 with the High Availability unit installed, the two library managers must decide which of four possible databases to choose as the primary database and which as the secondary database. Many combinations are possible; each depends on the status of the library managers, the databases, and the communication links between the library managers. Comparison of the databases is performed by the library managers. Under normal conditions (library managers, communication links, and databases all available after a normal termination of both library managers), one library manager will be the active library manager. Its primary disk will contain the primary database. The second library manager will be the standby library manager, and its primary disk will contain the secondary database.

Other conditions (such as library managers unable to communicate, desynchronized databases, library manager failure) are handled so that one library manager starts up with the right database. If this is not possible, the library enters the Check 1 state.

9.5.1 Monitoring Accessor Mounts per Hour

IBM 3494 accumulates a count of mounts over a period of 1 hour, for each accessor. This count is displayed by the library manager on the Accessor Mounts per Hour window, for a rolling 24 hours.

9.6 SMF Record Type 94

IBM 3494s accumulate statistics over a period of 1 hour. These statistics represent the activity of the tape library that results from responding to all hosts attached to the library. At the end of the hour, the library manager sends the statistics to all attached hosts. MVS/ESA system-managed tape and BTLS provide the support for these statistics, and an SMF type 94 record is reporting the activity of all devices in the tape library written.

The information in the SMF type 94 record represents current information and a summary of the last hour. Current information represents the value of the statistics at the point the record is written. The summary of the last hour information represents statistics over the most recent hour for which composite statistics have been calculated.

The SMF type 94 record also supports statistics related to the VTS. For details on monitoring the VTS see the *IBM Magstar Virtual Tape Server: Implementation Guide*.

9.7 Library Inventory

An inventory of the library is carried out during the installation of the IBM 3494. Once the IBM 3494 is installed, you can choose to reinventory the library. The IBM 3494 also has the option to inventory only parts of the library.

9.7.1 Installation Inventory

When the library is first installed, an inventory of the library is carried out after the teach process has completed. At this time, the library manager database is initialized, and, if volumes are present in the library, records are added to the library manager database. This initial inventory is started by selecting **Inventory new storage** from the library manager Commands pull-down menu. Until the inventory is complete, the library manager will be offline, and all attached hosts will be unable to use the library.

The IBM 3494 takes approximately 4 minutes to inventory one frame. Once the inventory of the hardware is complete, the library manager can be put online. Before any host can use the library, the host and library manager databases must be synchronized. At this point, all cartridges within the library are in the library manager INSERT category (see Appendix A, “Library Manager Volume Categories” on page 353). This synchronization (referred to as *insert processing*) causes the library manager database to be updated to match the host tape management system database. Each volume has a volume category assigned, indicating which host owns the volume and whether the volume is a specific or nonspecific cartridge. Insert processing varies among the different platforms. See Chapter 5, “Implementing Software” on page 119 for more detailed information.

9.7.2 Reinventory Complete System

By selecting **Reinventory storage** from the library manager Commands pull-down menu, it is possible to reinventory the contents of the library. To select this option, you need the administrator password if password protection is enabled. The reinventory processes cause the existing library manager volume database to be deleted, a new database initialized, and records added for all the cartridges within the library. All cartridges are placed in the library manager INSERT category (see Appendix A, “Library Manager Volume Categories” on page 353), so the library manager database must be resynchronized with the host tape library databases. Insert processing differs among the different platforms. See Chapter 5, “Implementing Software” on page 119 for more detailed information.

We do not recommend that a library be reinventoried on a regular basis. Reinventorying should be done only if problems exist with the library manager database that cannot be rectified by host software commands.

9.7.3 IBM 3494 Inventory Update

Inventory update is available on the IBM 3494 only. It is enabled from the library manager Commands pull-down menu. If enabled, the IBM 3494 will inventory a single frame or adjacent frames after the door has been opened[1]. The choice of single frame or adjacent frames is selected as part of the teach process. Inventory update has two main purposes. If a cartridge is lost within the library, doing an inventory update identifies where the cartridge is and updates the library manager database to reflect its new location. If large numbers of cartridges are to be inserted into the library, they can be placed in empty storage cells throughout the library. When the doors are closed and the library is placed in AUTO mode, the library manager database is updated with new cartridges. These new cartridges are now in the library manager INSERT category, and the library manager and host databases must be synchronized to ensure that the cartridge is placed in the correct library manager category.

If, after an inventory update, the IBM 3494 finds that cartridges have been removed from the library since the last update, it places those cartridges in a category called “Manually Ejected” (X“FFFA”). The host system can upload that category and use the “Purge Volume” category (X“FFFB”) to delete the database entries in the library manager.

During an inventory update, some operations are held until the update has completed. Operations that are held are:

- Audit
- Eject
- Mounts involving volumes in the rack(s) to be inventoried

See Appendix A, “Library Manager Volume Categories” on page 353 for more information about the library manager categories.

9.8 Inserting and Ejecting Cartridges

In the sections that follow, we describe some ways of inserting cartridges into and ejecting cartridges from the library.

9.8.1 Inserting Cartridges

In this section we describe two ways of inserting cartridges into the library:

- Convenience I/O station insert
- High capacity I/O facility insert

For additional insert procedures specific to the IBM 3494, see also 9.11.10, “Empty Cell Insert” on page 317 and 9.11.11, “Insert Virtual Tape Server Logical Volumes” on page 317.

When the cartridges are inserted into the library, if the bar code is readable and the volser is unique, a record of the volume is added to the library manager database, and the cartridge is placed in the library manager INSERT category. All attached hosts are notified.

[1] With the High Availability unit, the IBM 3494 will not inventory a service bay frame when the door of a service bay is opened in service mode.

In the IBM 3494, a volser range function is used to help determine a volser′s media type when the cartridge is inserted into the tape library. For more information about the volser range, refer to 9.11.9, "Volser Range for Media Types" on page 316.

When a cartridge is placed in the convenience I/O station, high capacity I/O facility, or an empty cell within the IBM 3494, and the volser already exists within the library manager database, the cell that the volume currently occupies within the library is checked. If the cell is empty, the new cartridge is placed in the cell. If the cartridge is placed in an empty cell within an IBM 3494, the database record is updated. If a cartridge with the same volser is in the cell, the new cartridge is left in the input station and an operator intervention is flagged. If the cartridge is placed in an empty 3494 cell, it is then placed in the convenience I/O station and an operator intervention is flagged.

9.8.2 Convenience I/O Station Insert

A cartridge is placed in the convenience I/O station for insertion into the IBM 3494. When the door is closed, the library manager senses the presence of a cartridge and locks the door. The library manager then instructs the accessor to remove a cartridge from the convenience I/O station and place it in a storage cell. At this time, the bar code is read, and the volser and media type are checked. If the bar code is unreadable or a cartridge with a duplicate volser is in the library, the cartridge is returned to the convenience I/O station and an operator intervention is flagged.

If the bar code is readable and the volser is unique, a record of the volume is added to the library manager database, and the cartridge is placed in the library manager INSERT category. All attached hosts are notified.

If the IBM 3494 unlabeled tape facility is used to enter unlabeled cartridges into the tape library through the convenience I/O station, it is not possible to verify the volser or media type. If a duplicate volser is specified, the cartridge is left in the convenience I/O station and a operator intervention is flagged. For more information about unlabeled tape support, refer to 9.11.14, "Unlabeled Tape Operation" on page 318.

9.8.3 High Capacity I/O Facility Insert

To insert a large number of cartridges into the IBM 3494, you can use the high capacity I/O facility, which must have been predefined in the teach operation. The volser and media type are verified. If a problem exists with the bar code, the cartridge is left in the high capacity I/O facility cells or external high capacity I/O station, and an operator intervention is flagged.

9.8.4 Cartridge Placement on Initial Load

For performance reasons, cluster cartridges near the tape subsystems that will be using them, in particular:

- During load of the library
- When using inventory update to add cartridges
- When the library has the Dual Active Accessor feature

9.8.5 Ejecting Cartridges

To eject cartridges from the IBM 3494, enter the appropriate eject commands from the host system that owns the cartridges. You can eject a specified cartridge to either the convenience I/O station or the high capacity I/O facility.

Only two types of cartridges can be ejected through the library manager console: a cleaning cartridge, and a VTS stacked volume in an IBM 3494 (see 9.11.12, “Eject a Virtual Tape Server Stacked Volume” on page 317).

For more information about the host system, refer to 9.12, “OS/390 with System-Managed Tape” on page 321, and 9.13, “MVS/ESA with Basic Tape Library Support Operation” on page 333.

9.9 Cartridge Labels and Bar Codes

The tape library uses the external label to identify cartridges in the tape library during the inventory process. It uses the media type label to determine the type of the cartridge. Any cartridges without a media type label are added to the library manager database as the default media type that is specified in the teach process.

An IBM 3480 drive cannot read from, or write to, an ECCST cartridge. Similarly, Magstar 3590 cartridges cannot be used on IBM 3480 or 3490 drives. IBM tape cartridges have been designed with different cartridge casing color schemes to avoid the situation where an operator might mount an incompatible cartridge in an IBM tape drive.

To ensure that the operator can identify the correct tape volume and mount it on an IBM tape drive, a human-readable label is used. You must label all cartridges with a six-character volser on the external label. A volser can be from one to six characters, with blanks padded on the right for a volser with fewer than six characters. The character set supported for the external labels is:

- Upper- case alphabet; A - Z
- Numerics; 0 - 9
- Blank (or space), trailing only

If you automate your tape operations, the same considerations apply, but now the library must ensure that:

- The correct type of cartridge is mounted on a compatible IBM tape drive.
- The correct type of cleaning cartridge is mounted in the drive when a cleaning operation is needed.
- The correct tape volume is mounted when requested.

Therefore a machine-readable label, a bar code, is required in addition to the human-readable external volume identification label.

To enable the IBM 3494 to recognize the different cartridge types, an additional, single-character, media-type label is used. When a cartridge is inserted in a tape library, its media type is recorded from the label. This ensures that the correct cartridge types are mounted on compatible IBM tape drives within the library. Also, when using IBM system-managed tape, scratch thresholds can be set according to media type.

Figure 188 on page 301 shows the three types of IBM tape cartridges.

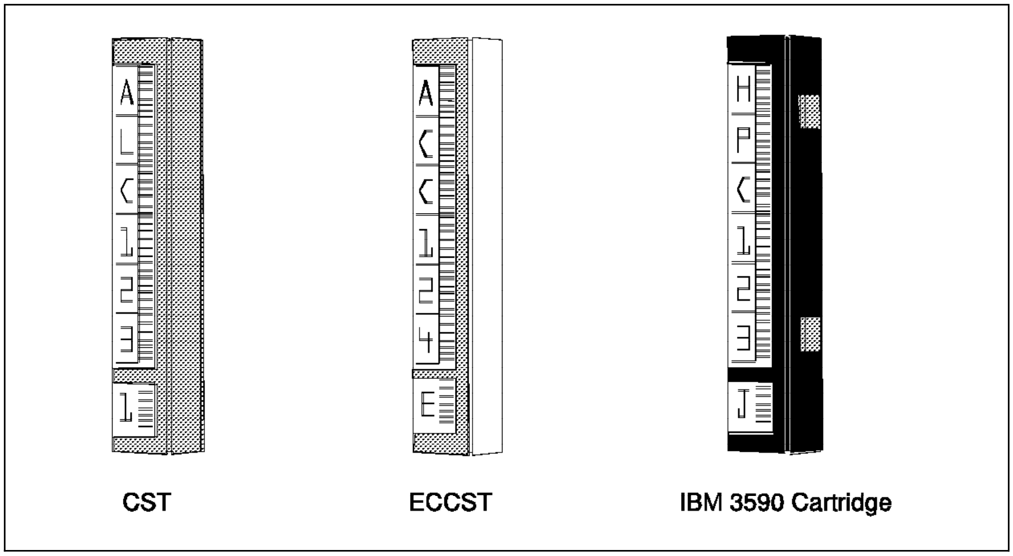


Figure 188. Cartridge Identification and Media-type Labels

- The CST cartridge has a monotone grey casing.
- The ECCST cartridge has a two-tone grey and white casing.
- The Magstar 3590 tape cartridge has a monotone black casing with blue inserts and a blue leader block. The Magstar 3590 cleaner tape has white inserts and a white leader block assembly.

Figure 188 also shows the six-character human- and machine-readable volser labels and the following single-character media-type labels:

1 A cartridge having this label is treated by the library as a CST cartridge.

E A cartridge having this label is treated by the library as an ECCST cartridge. This label is required when the cartridge is used in an IBM 3494.

J A cartridge having this label is treated by the tape library as a Magstar 3590 tape cartridge. This label is mandatory, because the IBM 3494 uses this character as the sole means of identifying a Magstar 3590 tape cartridge.

With the exception of CSTs, we strongly recommend that media-type E and J labels be placed on all cartridges within the IBM 3494 library. This recommendation applies to all environments and all platforms. Such labeling will minimize the possibility of mounting incompatible cartridge types in the tape drives.

Currently, bar code labels supplied by two label manufacturers conform to the common standard of IBM tape libraries and STK Silos:

- Engineered Data Products (EDP) Tri-Optic
- Wright Line Tri-Code

The bar code used by the external labels is *Automation Identification Manufacturers Uniform Symbol Description Version 3*, otherwise known as Code 39. The bar code area contains the same characters as the human-readable area surrounded by start and stop characters. The start and stop characters of the external labels are:

- Wright Line Tri-Code uses an asterisk (*).
- EDP Tri-Optic uses a dollar sign ($).

If an external label contains the * or the $ character as part of the volser, the bar code reader may or may not recognize it correctly, resulting in a potentially incorrectly read number.

An RPQ for the vision system is available upon request to handle other bar code labels such as Comparex or GRAU.

We recommend ordering new, initialized cartridges with the specified bar code labels attached. Most suppliers will deliver them to your specifications within about six weeks, but you must confirm when the supplier can deliver them before ordering. You can intermix these labels (and cartridges) in your tape library.

We do not recommend that you print your own labels, because it is unlikely that you could achieve the same quality as the labels available for purchase.

9.9.1 Service Volume Label Definition

Service volumes (CE cartridges) are shipped with the tape library. Service volumes have a unique external volser label that distinguishes them from any other type of volumes. The pattern of a CE cartridge volser is:

Character Position	***Description***
1-2	Must be CE
3	Must be a blank
4-6	A three-digit number

For example, “CE_001” is a valid volser for a service volume.

Normally, an embedded blank in a volser is illegal and results in the volume being flagged as having an unreadable external label. The blank is used for the service volume labels to ensure that they are unique and do not conflict with other customer volume labels. Service volumes are restricted to certain reserved storage cell locations, which are predetermined.

9.9.2 Cleaner Volume

The tape drives need to be cleaned on a regular basis, and cleaning requires special cleaning cartridges. To ensure that the operator can identify a cleaning cartridge, external labels are placed on these cartridges by the manufacturer. The IBM 3480 and 3490 models use a single type of cleaning cartridge. However, the Magstar 3590 requires a Magstar 3590 cleaning cartridge.

Within a library, cleaning cartridges are identified by a particular set of volume serial masks, typically CLN***. Magstar 3590 cleaning cartridges must be further identified by the media type label (J after the volser), otherwise, in response to a cleaning request, they could get mounted in an IBM 3490 drive.

The cleaner volumes in the tape library also need an external label. One or more masks identifying which volsers identify cleaning volumes must be defined from the library manager console. The cleaner volume masks can be defined whenever one of the following selections is made from the library manager console:

- ***Inventory New Storage***, and none of the components in the tape library configuration have been inventoried
- ***Reinventory Complete System***
- ***Cleaner Masks***

A dialog box is displayed on the library manager console with 10 cleaner masks. When the masks are presented for the first time, the first mask is set to a default value of CLN***, and the other nine masks are set to blanks. The asterisk (*) character can be used in the mask and is interpreted as a wildcard character. Once the cleaner volume masks are set, any volser labels that match any of the masks are considered to represent cleaner volumes.

Cleaner volumes can be ejected using a library manager command (refer to 9.8.5, “Ejecting Cartridges” on page 300). This action causes the use count to be reset to zero. If the cartridges have not been completely used, the statistics on the cleaner cart will be inaccurate when the cleaner cartridges are put back in.

9.10 Stand-Alone Dump and Restore

In the sections that follow we describe stand-alone dump and restore procedures using the tape devices within an IBM 3494.

9.10.1 MVS Stand-Alone Dump to IBM 3494

To carry out a stand-alone dump to an IBM 3494, use the IBM 3494 stand-alone device support, so that normal library operation will not be affected. To carry out a stand-alone dump to an IBM 3494 resident drive, follow these steps:

1. Vary the drive to be used for the stand-alone-dump offline to all attached hosts.
2. Set up the stand-alone device support through the library manager Commands pull-down menu, selecting the drive varied offline in Step 1, and enter the first of the preformatted stand-alone dump tapes in the convenience I/O station.
3. Start the stand-alone dump procedure on the failed MVS system, using the device address of the drive varied offline in Step 1.
4. If further tapes are requested, use the stand-alone device panel to mount and demount new tapes.
5. Once the stand-alone dump is complete, exit the stand-alone device support and vary the drive back online to attached hosts.

9.10.2 MVS Stand-Alone Restore from a Tape Library

The Stand-Alone Services program is available with DFDSS V2.5 and DFSMSdss. The Stand-Alone Services RESTORE command is supported by tape devices within the IBM 3494. The RESTORE command enables you to restore your dump tapes by using tape devices inside the tape library.

The Stand-Alone Services program runs independently of a system environment either as a true stand-alone system or under a VM system. The program operates in extended control (EC) mode and requires 2 MB of real storage. It supports the tape library in XA or ESA mode only. The drives to be used for Stand-Alone Services must remain offline to other systems.

To restore from the dump tapes, the Stand-Alone Services program uses only tapes inside the tape library and the TAPEVOLSER parameter of the RESTORE command to mount specified dump tape volumes by means of the cartridge accessor. In Figure 189, device address FDD is a tape drive in an IBM 3494, and the tape volumes with volsers BCD101 and BCD102 contain the dump data set to be restored. Volume BCD101 is the first volume in the sequence, and BCD102 is the second. Device address 791 is a DASD. The NOVERIFY parameter of the RESTORE command prompts the operator for permission to write on the device at address 791. Refer to *DFDSS V2R5 and DFSMSdss Stand-Alone Services Overview* for more detailed information.

```
RESTORE FRMDV(TAPE) FRMADR(FDD) TOADR(791) -
NOVERIFY TAPEVOL((BCD101) (BCD102))
```

Figure 189. Sample RESTORE Command

The following devices can be used to IPL the Stand-Alone Services program:

- DASD
  - IBM RAMAC DASD Family
  - IBM 9345 Storage Subsystem
  - IBM 3390 or 3380
- Tape
  - IBM 3590, 3490E, 3490 (including VTS emulated drives), and 3480 tape subsystems
  - IBM 3430, 3424, 3422, 3420 (Models 3, 4, 5, 6, 7, and 8)
- Tape libraries
  - IBM 3494
  - IBM Magstar Virtual Tape Server
- Card readers
  - IBM 3525
  - IBM 3505
  - Virtual card reader under VM

Refer to Chapter 4, "Stand-Alone Services Hardware Requirements" in *DFDSS V2R5 and DFSMSdss Stand-Alone Services Overview* for more information.

9.11 Operational Procedures

In the sections that follow, we describe operational procedures for the IBM 3494. For more detailed information about these procedures refer to the *Magstar 3494 Tape Library Operator's Guide.*

9.11.1 Tape Device Cleaning

The accessor performs all drive cleaning operations under the control of the library manager. Drive cleaning is scheduled by either time or drive mount. These options are mutually exclusive and are selected through the Cleaning Schedule option of the library manager Commands pull-down menu. We recommend that drive cleaning be based on drive request. Use time-based cleaning only if drive usage is very low. For 3590 Magstar drives, use a value of 999 mounts to perform cleaning based on drive request rather than library initiated.

The library manager keeps a count of the number of times the cleaner cartridges are used. When a cartridge reaches its usage count as set on the cleaning schedule menu, it is ejected from the library through the convenience I/O station. On the IBM 3494, if a convenience I/O station is not installed, the cartridge is placed in the single I/O cell. When the cleaning cartridge is ejected, it should be replaced with a new cleaning cartridge. The bar code label can be reused from the old cartridge if the label can be removed without damaging it.

9.11.2 Manual Mode Operation

If the cartridge accessor is not available, library operation can continue, with the operator taking the place of the cartridge accessor. With an IBM 3494 with the High Availability unit installed, this condition occurs only when both cartridge accessors are unavailable.

To enter MANUAL mode, select the Mode pull-down menu from the library manager menu, then select the Manual mode item. The library manager attempts to move the cartridge accessor to its parking position. If a cartridge accessor cannot be moved out of the way automatically, the operator or the IBM Service Representative may be required to move the failed cartridge accessor into its parking position. When the tape library enters MANUAL mode, the commands for the operator to perform are displayed on the library manager console (Figure 190).

```
                                   Action List

 Select an action. Press Enter to confirm action completion (except Mounts).

     Action     VOLSER    From                To
     Mount      WCC007    Rack   12 B 11      Device 3F1
     Mount      WSB392    Rack    7 C  5      Device 3F0
     Mount      SCR023    Rack   12 E  6      Device 3F1
     Mount      WR0112    Rack    3 J 13      Device 201
     Mount      FGG641    Rack   11 C 10      Device 200
     Eject      ERV399    Rack   13 F 11








 Press the Refresh key (F9) to update the list.
 F1=Help  F3=HideScreen  F4=Error  F5=Insert  F6=Review  F9=Review  F10=Locate
```

Figure 190. IBM 3494 Manual Mode Terminal Action List

The library manager console provides information about the type of command, volser, the cell number of the volume located, and tape drive addresses. The mount commands are also displayed on the tape drive message display.

When the operator opens the frame doors to start performing manual operations, the first task is to remove any cartridge from the gripper and place it in the convenience I/O station.

When volumes are used in MANUAL mode, their library manager database indicator is set to "Manual Mode." This indicator is also used to direct error recovery when the tape library is returned to the AUTO mode.

The main operations processed by the operator in MANUAL mode are mount and demount. To execute a mount operation, the operator reads the information provided on the library manager console, locates the volume, and loads it into the specified tape drive. To assist the operator, the volser to be mounted and its location are displayed on the message display of the appropriate tape drive. Thus, the operator can perform the mount operation without the library manager console. If a mount operation is successful, a confirmation is provided by the tape subsystem.

No explicit operator response is required. Unless the operator has a problem in performing the mount operation, loading the volume in the tape drive completes the operation. If the operator has a problem during the mount, he or she should specify the action, using cursor keys on the library manager console, and then press the PF4=Error key. Pressing that key displays the Error Processing screen on the library manager console (Figure 191).

```
                              Error Processing

Select the error description that best fits the error situation and press
the Enter key.


    Action     VOLSER    From            To
    Mount      SSG332    Rack    2 D  22    Device 3F5



    Error Description . . .
                              Rack Cell Empty
                              Rack Cell In Use
                              Wrong VOLSER
                              Device In Use
                              No Cartridge In Device
                              Cartridge Not Found
                              Other Error


F1=Help  F3=HideScreen  F12=Cancel
```

Figure 191. IBM 3494 Library Manager Manual Mode Error Processing Screen

On the console, the operator selects the error description to report the error.

If a cartridge is loaded into a tape drive that has not requested the mount, the cartridge is unloaded. No host attention indication is presented for the mistaken mount.

To execute a demount operation, the tape drive automatically rewinds and unloads the cartridge volume. The operator then removes the cartridge from that drive. The cartridges demounted from the drives are either placed in the high capacity output cells or removed from the tape library to a customer-provided cart.

An Audit operation is not allowed in MANUAL mode. Any queued audit operations fail as they are fetched from the operations queue. Any audit commands received after the tape library has entered MANUAL mode fail immediately.

9.11.3 Safety Operations

The tape library uses a safety interlock circuit, which controls the aisle power to the cartridge accessor, to separate motion and electrical hazards in the tape library from operator and service personnel. The circuit is also used to minimize the damage to a cartridge accessor should its position control system fail.

There are also nonelectrical elements of the safety system. For example, the safety labels are placed inside and outside the tape library to caution operator and service personnel.

9.11.4 Response to Intervention-Required Condition

Certain conditions in the tape library require short-term operator intervention to resolve. These conditions do not stop the library manager from accepting commands, but they may delay the execution of certain queued operations. When one or more intervention-required conditions exist, the tape library is in the intervention required state. Each intervention-required condition is reported to the attached hosts by an unsolicited attention message, with an associated unsolicited unit check.

The library manager keeps track of the outstanding intervention-required conditions. These conditions can be displayed on the library manager console, and an operator can indicate which conditions have been resolved.

Follow these steps to resolve each condition:

1. Use the Commands pull-down menu and select **Operator intervention** on the library manager console.

   The Operator Intervention window (Figure 192 on page 308) with a list of the intervention-required conditions is displayed on the library manager console. If there are no intervention-required conditions, the window is blank.

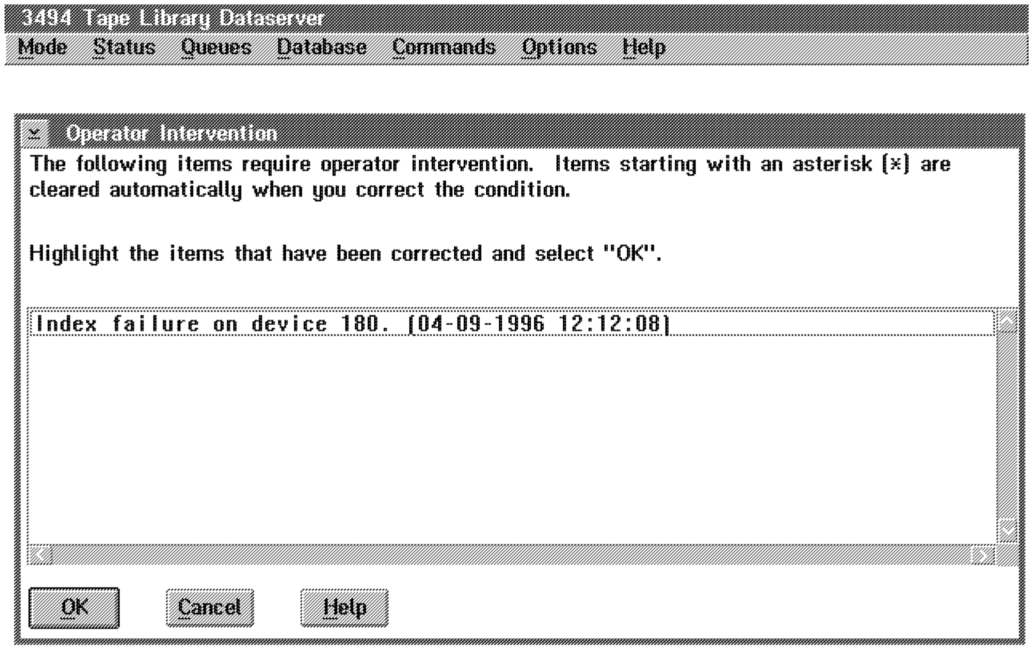


Figure 192. IBM 3494 Library Manager Operator Intervention Window

2. Resolve the intervention-required condition.

   Determine which condition to resolve, perform the necessary action, and then reply that the condition was resolved by highlighting the condition and clicking on the **OK** button. Some conditions (for example, convenience I/O station full) are automatically cleared after you resolve them, but they cannot be cleared until you resolve the condition. You can use the **Help** button to display the operator actions for the intervention-required conditions.

3. Repeat Step 2 until all conditions are resolved.

   When you reply that all outstanding conditions are resolved, the window closes. You can close the window and resolve some conditions later by clicking on the **Cancel** button.

9.11.5 Search the Library Manager Database for Volumes

You can use the library manager database to search the cartridges in the tape library and obtain the volume category, storage cell location, exception condition, and other cartridge information. Select the Database pull-down menu from the library manager console to view selected volumes in the tape library. On the Search Database for Volumes pop-up window (Figure 172) you can search the volume database for specific volumes, on the basis of search criteria. The more search criteria used, the more restrictive the search.

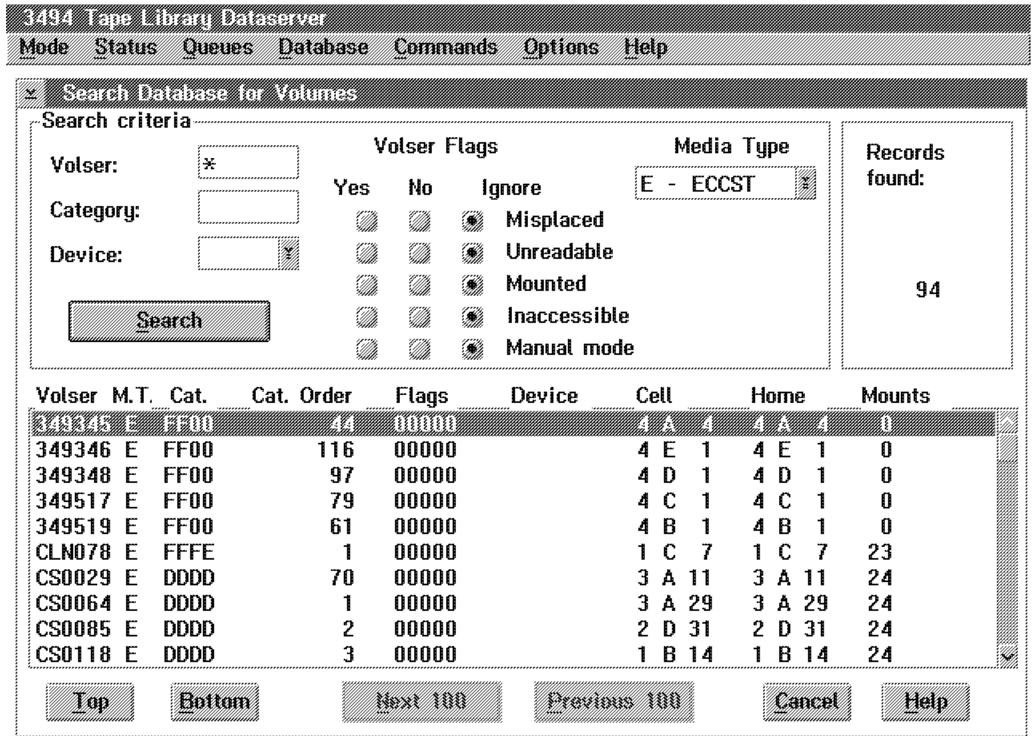


Figure 193. IBM 3494 Library Manager Search Database for Volume Window

The following choices can be included in the search criteria:

VOLSER Enter the volser used in the search. The identifier consists of one to six alphanumeric characters that match the external label. You can include a wildcard character, where "?" or "_" indicates one character and "*" or "%" indicates multiple characters.

Category Enter the category used in the search. A category is a logical grouping of volumes for specific use. The categories are 0000 to FFFF. They must contain four hexadecimal characters and cannot contain wildcard characters. All categories beginning with ′FF′ are predefined for use or reserved for library manager use. See Appendix A, "Library Manager Volume Categories" on page 353 for a comprehensive list of library manager volume categories.

Device Either enter or select the tape drive address used in the search to see whether the volume is mounted or being mounted on the drive. A valid tape drive address can be obtained by clicking on the down-pointing arrow. Single-and multiple-character wildcards are valid.

Media Type Select the correct media types for the type of tape drives installed in the tape library:

- **1** CST
- **E** ECCST
- **J** Magstar 3590 tape cartridge
- **K** Magstar 3590 Enhanced Capacity tape cartridge
- **?** Unknown

Flags The following flag selections can be included in the search criteria:

Misplaced The cartridge location is unknown. A volume serial number specified in a library request is not in the tape library where expected.

Unreadable The vision system cannot read the bar code of the external cartridge label.

Mounted The cartridge is mounted or being mounted on a tape drive.

Inaccessible The cartridge accessor cannot access the cartridge. A requested volser is in the tape library but cannot be accessed by the cartridge accessor because of a problem with either the cartridge or the cell that contains the cartridge.

Manual mode An operator handles the cartridge during MANUAL mode processing.

These flags are used for problem determination procedures that determine whether the tape library contains volumes for which some action must be taken.

The following are possible values for each flag:

Yes Search for volumes to which this flag applies.

No Search for volumes to which this flag does not apply.

Ignore Search for volumes without regard for this flag.

The search results are displayed in a list. The list can contain up to 100 records at one time. If more than 100 records are found, use the **Next 100** and **Prev 100** push button to display the additional records. Each record contains the following information:

Volser The volume serial number of the cartridge

M.T. The media type of the cartridge

Cat. The category represented by four hexadecimal characters that identify the group of volumes or a predefined category

Cat. Order The position of the cartridge in the category

Flags The status of the flags

Device The tape drive address if the cartridge is mounted

Cell The storage cell that contains the cartridge

Home The cartridge home cell location

Mounts The total number of times the cartridge was mounted

9.11.6 Home Cell Mode

The tape library operates in either fixed or floating home cell mode. The home cell mode selection is made during the teach process as follows:

Fixed home cell — This mode assigns each volume a fixed storage cell location when it enters the tape library. The volume is always returned to the same location after it is used.

Floating home cell — In this mode, a volume is put into the most convenient storage cell location to minimize cartridge accessor movement and optimize performance. For more information about performance, refer to 3.2, “Performance” on page 74.

In an IBM 3494, floating home cell mode is available only if the optional dual gripper (feature code 5215) is installed or if DAA is installed and activated (feature code 5050). The dual gripper reduces the number of storage cartridge cells by approximately 10%. For more information about the dual gripper, refer to 2.2.8, “Cartridge Accessor” on page 28.

9.11.7 Remote Library Manager Console

The remote library manager console allows you to control or monitor the operations and status of the tape library from a remote location. The remote terminal can be located anywhere on the LAN. The remote terminal can control—or monitor the status of—up to eight library managers. You can monitor multiple library managers, but you can control only one at a time.

Connection to the library manager is password-controlled. The remote console logon password can be changed only from the library manager.

The remote library manager console feature includes the software that is needed to control or monitor any library manager that is attached to the LAN. The tape library must have one of the LAN attachment features: Token Ring or Ethernet. The remote library manager console and the host system attachment can use the same LAN attachment feature of the tape library.

If the High Availability unit is installed in the IBM 3494, only one feature code 5226 is required for both library managers. The software provided will be loaded on both library managers.

The customer is responsible for supplying the remote terminal hardware and software. See the *IBM 3494 Tape Library Dataserver Introduction and Planning Guide* for more detailed information.

The remote library manager console provides the following functions:

- Switching keystrokes mode

  The keystrokes mode determines whether the remote console′s input and pointing device movements affect the remote console or one of the connected library managers. There are two keystrokes modes: keystrokes remote mode and keystrokes local mode. In the keystrokes remote mode, all of the keyboard input on the remote console affects the library manager, except the remote console operating-system hot keys. The operating-system hot keys are Ctrl+Esc to display its task list, Alt+Esc to show the windows and full screens in an ordered rotation, and the Alt+Tab to show the system menus for the windows and the full screen in an ordered rotation. In the keystrokes local mode, all of the keyboard input on the remote console affects the remote console only.

- Changing session state

  The session state is the current state of the session between the remote console and the library manager. It can be changed from both consoles. If both users try to change the state at the same time, the library manager takes precedence. The session can be changed between the following states:

- Active — The remote consoles control the library manager. The library manager keyboard and pointing device are not processed. The library manager can regain control by pressing a hot-key combination to change the session state.
- Monitor — The remote console monitors the library manager console, but the library manager user is in control of the keyboard and pointing device input.
- Suspend — The remote console session is stopped temporarily.
- Terminate — The remote console session is terminating.

• Transferring files

The file-transfer utility allows files to be transferred from the library manager to the remote console. Transferring files to the library manager is not allowed. Only the remote library manager console can initiate a file transfer.

9.11.8 Simple Network Management Protocol

The library manager contains limited SNMP support. SNMP is a standard TCP/IP protocol that sends alerts (called SNMP traps) over a TCP/IP LAN network to one or more SNMP monitoring stations. These monitoring stations can be used to alert operations staff of problems or operator interventions that occur at the library. Monitoring is independent of the host system that is controlling the 3494 and of the location of the 3494.

The library manager code offers the ability to monitor the following library manager events:

- **OPINT** - Operator Interventions
- **UNSOL** - Unsolicited Attention Messages
- **SERVC** - Service Request Messages
- **CHCK1** - Library Manager Check 1 Conditions
- **TESTM** - Test SNMP Trap Message

For a detailed description of these events, see the *Magstar 3494 Tape Library Operator's Guide*.

9.11.8.1 Selecting SNMP Trap Types

To select the types of library manager trap events to be monitored:

1. Select **Commands** from the main menu.
2. Select **SNMP Options** from the pull-down menu.
3. Select **Select SNMP Trap Types** from the sub-menu.
4. Select the trap types to be monitored from the dialog box with all library manager trap types (see Figure 194 on page 313).
5. Select **OK**.

Figure 194. Select SNMP Trap Types Window

9.11.8.2 Configuring SNMP Trap Destinations

When the library manager trap types have been selected, you have to configure the library manager to send SNMP traps to the correct monitoring stations:

1. Select **Commands** from the main menu.
2. Select **SNMP Options** from the pull-down menu.
3. Select **Change SNMP trap Destinations** from the submenu.

The library manager can be configured to send SNMP traps to a maximum of five different trap destinations. The procedure for configuring the SNMP trap destinations depends on the version of OS/2 (2.11 or 4.0) running on the library manager. To determine which version of OS/2 you have, choose **About** from the **Help** menu. The configuration procedures for both versions of OS/2 are shown below.

OS/2 Version 2.11: Figure 195 shows the OS/2 2.11 version of the change SNMP trap destinations pop-up window.

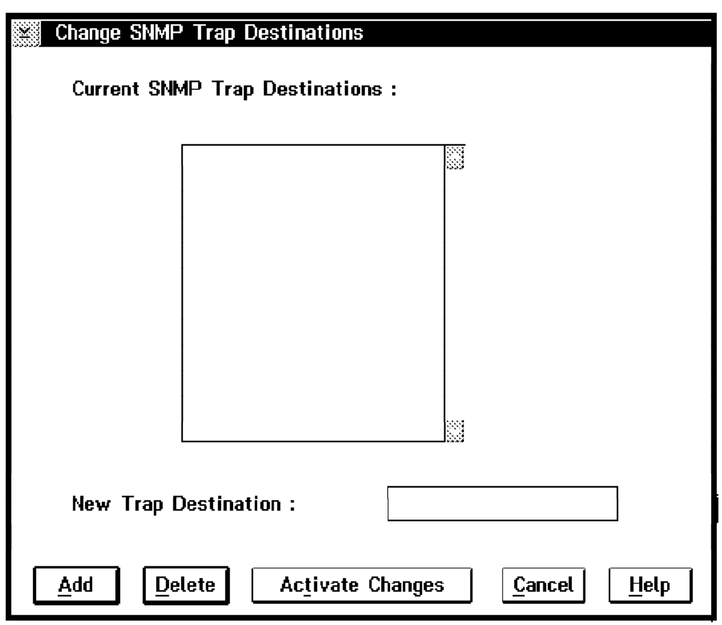


Figure 195. Change SNMP Trap Destinations Window: OS/2 VERSION 2.11

To add a destination:

1. Add the SNMP trap destination in the New Trap Destination field.
2. Select the **Add** push button.

To delete a destination:

1. Highlight the SNMP trap destination that you want to delete in the list box.
2. Select the **Delete** push button.

The changes are activated when you select the **Activate Changes** button. If the SNMP daemon is running when you select **Activate Changes**, the library manager will kill it and restart it with the new changes.

OS/2 Version 4.0: For OS/2 Version 4.0, the SNMP HRMCNFIG program is used to configure SNMP trap destinations. Selecting the **Change SNMP Trap Destinations** menu item from the **SNMP options** menu starts this program.

Figure 196 shows the SNMP configuration window.

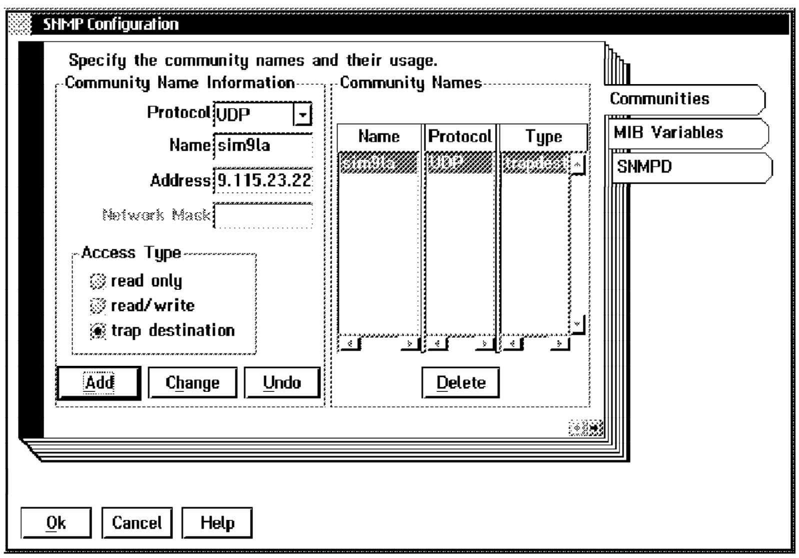


Figure 196. SNMP Configuration Window: OS/2 Versin 4.0

To add a destination:

1. Select the **trap destination** radio button.
2. Select **UDP** in the protocol field.
3. Enter the monitor station name and IP address in the appropriate fields.
4. Select the **Add** push button.
5. Select the **OK** push button.

To delete a destination:

1. Highlight the SNMP trap destination that you want to delete in the list box.
2. Select the **Delete** push button.
3. Select the **OK** push button.

Note: HRMCNFIG is an external process to the library manager. Therefore you must wait until that process has completed before library manager SNMP support is enabled. Wait until the Change SNMP Trap Destinations field becomes selectable again (ungrayed). Once it has become selectable, all SNMP features can be used.

9.11.8.3 Starting SNMP

After trap types have been selected and trap destinations have been configured, library manager SNMP support can be enabled:

1. Select **Commands** from the main menu.
2. Select **SNMP Options** from the pull-down menu.
3. Select **Start SNMP** from the submenu.

These actions start the SNMP daemon. To ensure that the daemon is running, use Ctrl + Esc to bring up a window list, and make sure that SNMPD is listed.

9.11.8.4 Stopping SNMP

To stop SNMP:

1. Select **Commands** from the main menu.
2. Select **SNMP Options** from pull-down menu.
3. Select **Stop SNMP** from the submenu.

Library manager SNMP traps will not be generated if the SNMP daemon is not running.

9.11.8.5 Sending TESTM Messages

Once SNMP has been configured, you can send a test SNMP trap to ensure that SNMP is configured correctly. The TESTM trap allows a test message to be sent to the SNMP monitor stations. To send a TESTM message:

1. Select **Commands** from the main menu.
2. Select **SNMP Options** from the pull-down menu.
3. Select **Send TESTM Trap** from the submenu.
4. Enter the test message text in the dialog box.
5. Select the **Send** push button on the dialog box. (see Figure 197)

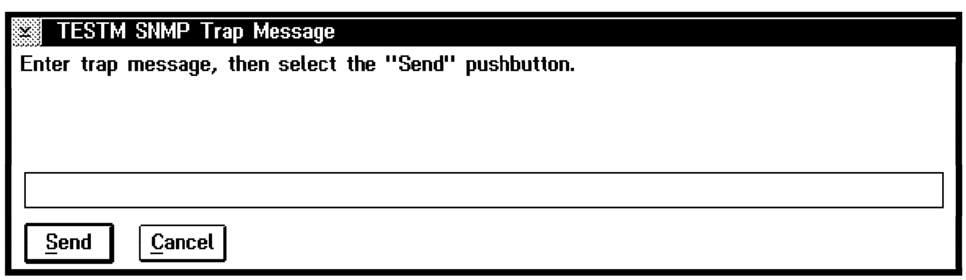


Figure 197. TESTM SNMP Test Message Window

9.11.8.6 SNMP Requirements

To use SNMP on the IBM 3494 the following are required:

- Either LAN attachment feature code 5219 or 5220 must be installed on the 3494 to be able to connect it to the customer's LAN.
- SNMP alert monitoring software must be running on a workstation on the LAN to which the 3494 is connected.
- The SNMP alert monitoring software must be customized to handle the SNMP traps sent by the 3494 library manager.

9.11.8.7 SNMP Troubleshooting

Most problems encountered will be related to site network configuration. To ensure that SNMP is working correctly:

1. Make sure that the SNMPD process is running.
2. Make sure that the monitor station can be pinged from a service window. If the monitor station cannot be pinged, there is a network configuration problem that must be corrected.
3. Generate a TESTM trap message and check the SNMPD window to see whether it was sent. Use Ctrl + Esc to bring up the window list. Highlight the SNMPD process. You should see the TESTM trap message in the window. If there are any errors, the daemon is not being started correctly.

9.11.9 Volser Range for Media Types

The volser range for media types function allows the entry of up to 50 volser ranges and associated media types on the library manager. It is used to help determine a volser′s media type when it is inserted into the tape library.

Volser ranges are used only for physical volumes. The available media types are CST, ECCST, Magstar 3590 (HPCT), and Magstar 3590 for use by the VTS (VTS HPCT).

The volser entry fields can contain up to six alphanumeric characters. The two volsers must be entered in the same format. Corresponding characters in each volser must both be either alphabetic or numeric. For example, AAA998 and AAB004 are of the same form, whereas AA9998 and AAB004 are not. The volsers that fall within a range are determined as follows: The volser′s range is incremented where alphabetic characters are incremented alphabetically and numeric characters are incremented numerically. For example, volser range ABC000 through ABD999 would result in a range of 2000 volsers (ABC000 - ABC999 and ABD000 - ABD999).

When a range is added or modified, the library manager automatically combines overlapping ranges with the same media type and checks for range conflicts.

When you modify a volser range, the media type for existing volumes in the tape library is not changed. Volumes inserted subsequently will reflect the new set of ranges and associated media type.

The media type of the inserted volume is determined by using the following rules:

1. The media type label read by the vision system is used.
2. The volser ranges are used to determine a media type if the vision system cannot read the media type label. If the volser being inserted appears within one of the volser ranges, the range′s associated media type is used.
3. The library manager uses the default media type defined during the teach process to determine the media type if the inserted volser does not fall into one of the volser ranges.
4. The volser is ejected if there is no default media type.

9.11.10 Empty Cell Insert

The inventory update function enables large numbers of cartridges to be inserted into the library. Inserting cartridges in this way is disruptive to library operations, so it is usually carried out at the same time as a high capacity output operation.

To insert the cartridges, inventory update should be enabled, the library placed in PAUSE mode, and one or more doors opened. The cartridges should be placed in any empty storage cell, the doors closed, and the library put into AUTO mode. When the High Availability unit is installed, a cartridge must not be placed in the cells of the service bays.

The library manager then performs an inventory update; the accessor scans all storage cells in the frames, and in selected adjacent frames, wherever the doors were opened. Any new cartridges have their bar codes validated. Unlabeled cartridges cannot be added to the library in this way. If the volser and media type are valid, the library manager database is updated, and the cartridge is placed in the INSERT category. The inventory of each frame takes a maximum of 4 minutes. For more detailed information about inventory update, see 9.7.3, “IBM 3494 Inventory Update” on page 298.

9.11.11 Insert Virtual Tape Server Logical Volumes

This pop-up window allows the insertion of logical volumes into a VTS. Up to a total of 150,000 virtual volumes can be inserted. Volsers must be unique within a physical library. A logical volume′s volser cannot match another logical or physical volume′s volser.

For more information, see the *IBM Magstar Virtual Tape Server: Implementation Guide*.

9.11.12 Eject a Virtual Tape Server Stacked Volume

This pop-up window allows a stacked volume to be ejected from the library. When a stacked volume eject is initiated, the Virtual Tape Server copies any active data off the stacked volume onto other stacked volumes. When all data has been removed, the Virtual Tape Server initiates the eject of the now empty stacked volume. This process can take a long time.

For more information, see the *IBM Magstar Virtual Tape Server: Implementation Guide*.

9.11.13 Set Virtual Tape Server Management Policies

This pop-up window allows the Inhibit Reclaim Schedule and the Free Storage Threshold to be set. The Inhibit Reclaim Schedule defines when the VTS should not perform reclaim operations. The Free Storage Threshold percentage is used to provide a warning when a VTS is running out of available free storage. The reclaim threshold controls the percentage of active data that remains on the stacked volumes before they become eligible for reclaim processing. The default setting is 10%. We recommend that changes to this value be executed with caution in an established VTS, because raising the threshold can cause intense reclaim activity to occur. Use the library manager display, Active Data Distribution, can be used to predict the results of a change in this value.

9.11.14 Unlabeled Tape Operation

Each cartridge in the tape library must have proper external labels. The vision system identifies the volser and type of cartridge during an inventory operation by reading the external labels. The IBM 3494 provides an unlabeled tape facility to allow occasional insertion of cartridges through the convenience I/O station without proper external labels. Once inserted through the unlabeled tape facility, the cartridges can be used in the same manner as regular, properly labeled cartridges are used, except for any operations that require the external label to be read:

- If the cartridges are moved during MANUAL mode operations to another location, these unlabeled cartridges will be ejected because they were not found in their proper locations.
- If the tape library is reinventoried, these cartridges will be ejected because the library manager database was deleted and their external labels could not be read during reinventory.
- If two unlabeled cartridges are swapped during MANUAL or PAUSE mode, the tape library will not be aware of the post-inventory exchange. Inventory update is automatically performed after MANUAL or PAUSE mode, but it verifies only that all unlabeled cartridges are in cells that previously contained unlabeled cartridges. Therefore, when asked to mount one of the exchanged cartridges, the tape library will mount the wrong one.

We strongly recommend that unlabeled cartridges be left in the tape library for as short a time as necessary to satisfy their requirements.

If you want to use unlabeled tapes, you must have the convenience I/O station.

To insert unlabeled cartridges, follow these steps:

1. Ensure that the convenience I/O station is empty.
2. Enter the volsers and the cartridge type of all cartridges to be inserted in the spaces on the Insert Unlabeled Cartridges pop-up window (see Figure 198 on page 319).

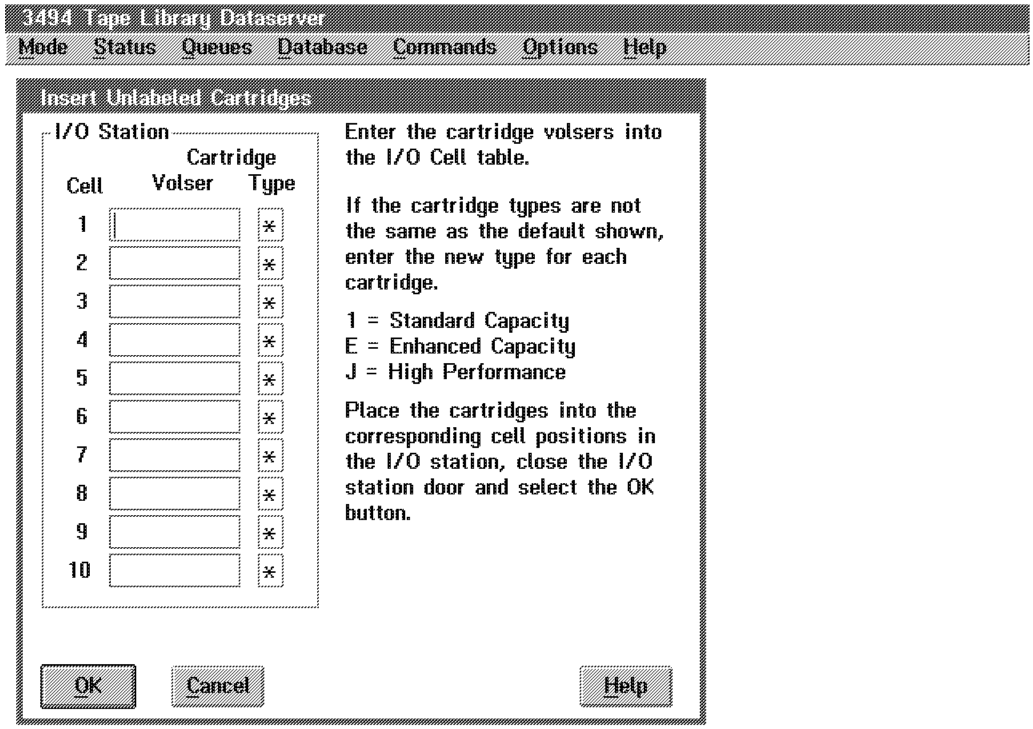


Figure 198. IBM 3494 Library Manager Insert Unlabeled Cartridges Window

3. Place the cartridges in the convenience I/O station in the same sequence as represented on the pop-up window and close the convenience I/O station door.

4. Select the **OK** button.

9.11.15 Stand-Alone Device Setup

You can perform stand-alone operations to a tape device inside an IBM 3494 if you use the Setup Stand-alone Device pop-up window (Figure 199 on page 320). This will allow you to mount or demount cartridges with specific volsers in the library manager database.

You can also mount cartridges in the convenience I/O station. This is known as the *transient mount* or the *mount from input station* function. Its purpose is to allow you to mount cartridges that are not resident in the IBM 3494 and have no proper external labels. These cartridges are picked directly from the convenience I/O station, loaded into the tape drive by the cartridge accessor, and then returned to the convenience I/O station. The convenience I/O station feature must be installed to take advantage of this function.

You can also mount the cartridge of a predefined sequential set of a specified category. This is known as the *automatic cartridge loader mode*. Although the tape drives in the IBM 3494 do not have automated cartridge loaders, the IBM 3494 allows for automatic mounting of the next cartridge of a predefined sequential set, in a specified tape drive in the tape library. The IBM 3494 supports the assignment of cartridges to a special category, the assignment of a specified drive for restricted use with the special category, and the ending of the restricted usage of a tape drive.

The setup stand-alone device function of the IBM 3494 works only when you are running stand-alone utilities or IPL your stand-alone program. For example, in MVS environments, all of the above functions are useful only when the MVS operating system is unavailable. Therefore, you cannot use the stand-alone device for by MVS jobs.

To use the setup stand-alone device function, select **Setup Stand-Alone Device** from the library manager Commands pull-down menu.

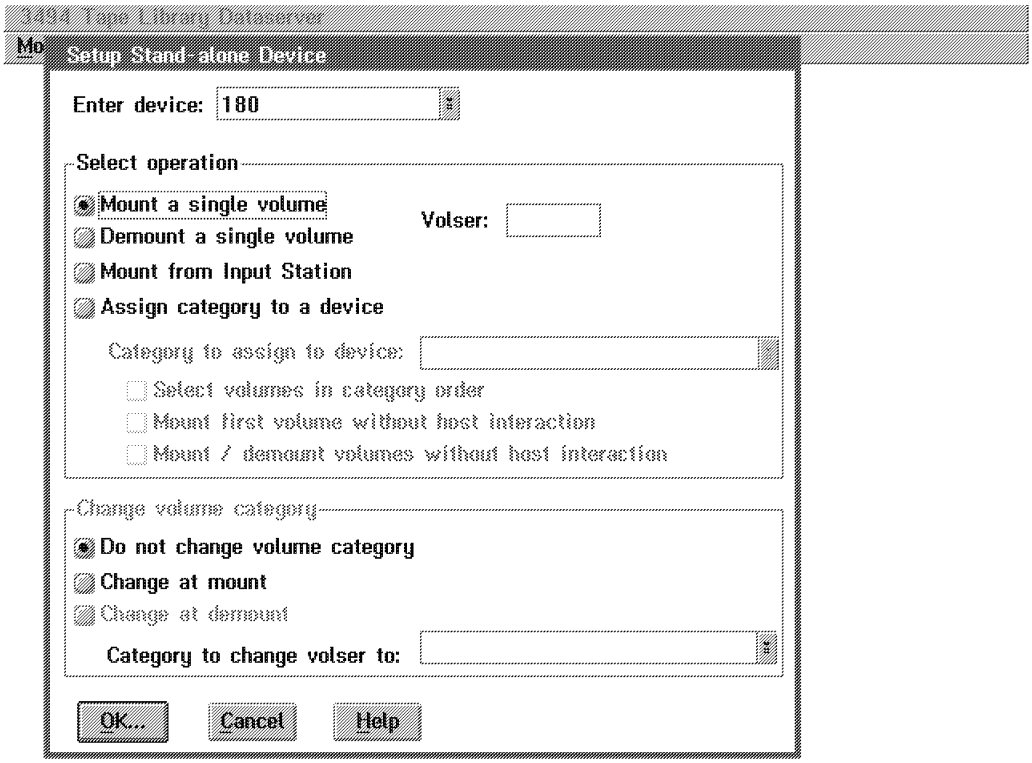


Figure 199. IBM 3494 Library Manager Setup Stand-Alone Device Window

To set up a stand-alone device, follow these steps:

1. Enter a device address in the Enter device field to specify the tape device in the IBM 3494.
2. Enter a volser in the Volser field to identify the tape volume that should be mounted.
3. Select **Mount a single volume** to mount a specified volume onto the requested device.

   When you select this operation, you must also select either **Do not change volume category** or **Change at mount**.

To set up a stand-alone device with transient mount, follow these steps:

1. Enter a device address in the Enter device field to specify the tape device in the IBM 3494.
2. Enter a volser into the Volser field to identify the tape volume that should be mounted.

3. Select **Mount from Input Station** to mount transient cartridges located in the convenience I/O station directly onto the requested device and then return them to the convenience I/O station after unloading.

To set up a stand-alone device with automatic cartridge loader mode, follow these steps:

1. Enter a device address in the Enter device field to specify the tape device in the IBM 3494.
2. Enter a volser in the Volser field to identify the tape volume that should be mounted.
3. Select **Assign category to a device** to assign a category to a tape device.

   When you select this operation, you must select one of the three Change volume category options.
4. Enter a category to assign to a device in the Category to assign to device field.
5. Select **Select volumes in category order** to mount volumes in their category order.

See the *IBM 3494 Tape Library Dataserver Operator's Guide* for more detailed information.

9.12 OS/390 with System-Managed Tape

In this section we describe the operational aspects of operating a tape library in an OS/390 and system-managed tape environment. This section is not intended to replace the full description of operational procedures in the product documentation.

9.12.1 Operational Interfaces

The operational interfaces to system-managed tape are provided by:

- The ISMF library and volume applications
- The MVS LIBRARY command
- The DFSMS DISPLAY and VARY commands

These three interfaces in conjunction with the installation tape management system provide for the full operation of the library.

9.12.2 Operator Interfaces

The tape library has some operator interfaces that are different from those of other stand-alone tape devices:

- **Two levels of tape unit offline**

  When the tape unit is part of a tape library, the tape unit online or offline state depends on the library manager.

  The tape units of a library can individually be taken offline and online. The command to VARY units ONLINE or OFFLINE is the same in a DFSMS and non-DFSMS tape environment, as long as the library itself is online. Varying a tape unit online may be ineffective if the library is not online.
- **Mount and demount messages**

The mount and demount messages no longer appear on the operator console. However, they are issued internally and logged in the hard-copy log.

If there is an error situation where the operator decides to operate the tape library in MANUAL mode, the mount and demount messages are displayed on the library manager and on the drive displays.

The mount message also indicates the requested media, displaying MEDIA1, MEDIA2, or MEDIA3 accordingly.

- **Automated DDR swap**

  The DDR swap process, an error retry that is rather complicated, has been automated. If the error is such that the tape unit can unload the cartridge, the robot moves the cartridge to another tape unit within the same library, if one is available. The system selects the unit, and the operator cannot change the selection.

9.12.2.1 MVS Operator Commands

The following MVS operator commands support the tape library:

- **LIBRARY EJECT,volser{,PURGE|KEEP|LOCATION}{,BULK}**

  This command is used to request the ejection of a volume from a tape library. The variations available in this command are:

  - Eject to the convenience I/O station (no additional specification).
  - Eject to the bulk output station (BULK or B).
  - Remove the volume record from the TCDB (PURGE or P).
  - Keep the volume record in the TCDB and update it to indicate that the cartridge has been ejected (KEEP or K). If the record contains information in the SHELF location field, it is not changed. If the SHELF location field is empty, the operator must enter information about the new location as a reply to WTOR. The reply can be up to 32 characters long.
  - Keep the volume record in the TCDB and update it, including updating the SHELF location even if there is some information in this field (LOCATION or L). The operator has to enter the new information as a reply to WTOR.

  If none of the variations (PURGE, KEEP, or LOCATION) has been indicated in the command, a default decides whether the record is kept or purged. This default can be set separately for each library by way of the ISMF Library Definition panel.

  This command is available for the operator to eject single cartridges. Mass ejection of cartridges is usually performed through program interfaces such as ISMF, a tape management system, or batch job.

- **LIBRARY SETCL, device-number, media-type**

  This command allows the setting of the media type of the scratch volume that is to be loaded into the ICL of the specified tape drive. The command must be issued on the system on which the drive is online. The other hosts are notified when the drive is varied online on the system.

  If the media assignment by this command is different from the current assignment, the ICL is emptied, and proper cartridges are loaded.

- **VARY SMS,LIBRARY(libname),OFFLINE**

This command acts on the full library; that is, it stops tape library actions and gradually makes all of the tape units within this library unavailable. The units are varied offline “for library reasons,” which means that they are not accessible because the whole library is offline.

This simple form is a single-system form. The status of the library remains unaffected in other MVS systems.

Note: The VARY unit command is completely separate from the library manager action.

- **VARY SMS,LIBRARY(libname),ONLINE**

  This command is required to bring the library back to operation after it has been offline.

  The library does not necessarily go offline as a result of an error in some component of the library. Thus, some message explanations for error situations request the operator to first vary the library offline and then back online. This usually clears all error indications and returns the library back to operation. Of course, this is only the MVS part of error recovery. The hardware, software, or operational error within the library itself must be cleared before the library is brought back to cooperation with MVS.

- **VARY SMS,LIBRARY(libname,sysname,...),ON/OFF** and

  VARY SMS,LIBRARY(libname,ALL),ON/OFF

  These extended forms of the VARY command can affect more than one system. The first form affects one or more named MVS systems. The second form performs the VARY action on all systems within the SMSplex.

  The VARY SMS command allows the short forms ON and OFF as abbreviations for ONLINE and OFFLINE, respectively.

- **DISPLAY SMS,OAM**

  This command gives a single line of information about all tape libraries (if present), their tape units, storage cells, and scratch cartridges.

  This is the view of the single system where the command was executed. The number of unallocated, online drives is also given under the heading AVL DRV (available drives).

  If both optical libraries and tape libraries are defined in the SMS configuration, two multiline WTOs are displayed. The first multiline display produced by the LCS is the display of optical library information. The second multiline display is a display containing tape library information.

- **DISPLAY SMS,LIBRARY(libname|ALL),STATUS**

  The library status display shows the SMS view of either one library or all libraries. The result contains one line of information for each library. This is a multihost view, which basically indicates whether the library is online, offline, or pending offline.

  STATUS is the default parameter.

- **DISPLAY SMS,LIBRARY(ALL),DETAIL**

  The DETAIL display, although a single-system view, gives slightly more information. The display is similar to the result of DISPLAY SMS,OAM, but each library gets its own line of information.

- **DISPLAY SMS,LIBRARY(libname),DETAIL**

This command gives the details of the status of a single library. It is the only command that displays the library state (AUTO, PAUSE, or MANUAL mode). Reasons for the mode and indications of inoperative parts of the library are given on additional status lines. Examples of special situations are:

– Safety enclosure interlock open
– Vision system not operational
– Convenience output station full
– Out of cleaner volumes

- **DISPLAY SMS,STORGRP(grpname|ALL)**

  There are no new parameters in the storage group display command because the optical library request formats are adequate here.

  This display command is a general form of a request and gives the total SMS multihost view of the situation. The result is a display of the status of either all storage groups (DASD, optical, and tape) or a single storage group. There is no format to display one category only.

- **DISPLAY SMS,STORGRP(grpname|ALL),DETAIL**

  The DETAIL display is not much more detailed than the general display; only the library names of this storage group are indicated. This display is, in fact, more restricted than the general display. It gives the view of only one system, that is, the view of its OAM, as the header line indicates.

  The LISTVOL parameter of DISPLAY SMS,STORGRP is not used for tape storage groups. Although a volume list can be viewed through ISMF, a similar listing on the console would be too long to be meaningful.

- **DISPLAY SMS,VOLUME(volser)**

  This command displays all information that is stored about the volume in the TCDB (the VOLCAT), as well as some nonpermanent state information, such as “volume mounted on library-resident drive.”

- **DS QT,devnum,1,RDC**

  This command displays identification, status, and diagnostic information about tape devices. You can use the command to display the LIBRARY-ID and the LIBPORT-ID that is stored for a device in an IBM 3494.

  Here is the sample output of a DS QT system command:

```
DS QT,1699,1,RDC
IEE459I 12.30.05 DEVSERV QTAPE 970
UNIT DTYPE  DSTATUS CUTYPE  DEVTYPE  CU-SERIAL  DEV-SERIAL ACL LIBID
1699 3490L  ON-NRD  3490A20 3490B40  0177-10619 0177-10619 I   10007
  READ DEVICE CHARACTERISTIC
3490203490400000 1FF8808000000000 0000000000000000 0000000000000000
0100070100000000 4281000000000000 0000000000000000 0000000000000000
------
    | --
    | |------->            4. Byte = LIBPORT-ID
    |
    |---------------->  1.-3. Byte = LIBRARY-ID (omit first half byte)
LIBRARY-ID=10007
LIBPORT-ID=01
```

- **VARY unit,ONLINE/OFFLINE**

The VARY unit command in itself is no different from what it used to be. However, new situations will be seen when the affected unit is attached to a library.

When the library is offline, the tape units cannot be used. This is internally indicated in a new status, “offline for library reasons,” which is separate from the normal “unit offline” status. A unit can be offline for both library and single-unit reasons.

A unit that is offline for library reasons only cannot be taken online with VARY unit,ONLINE. Only VARY SMS,LIBRARY(...),ONLINE will help.

A unit that has been individually varied offline and is also offline for library reasons can be brought back online only by varying it online individually and varying its library online. The order of these activities is immaterial, but both are necessary.

Currently no display directly gives the reason the unit is offline, nor is there a display that would give the name of the library to which this unit belongs.

- **DISPLAY U**

  The DISPLAY U command displays the status of the requested unit. If the unit is part of a tape library (either manual or automated), device type 348X is replaced by 348L, an IBM 3490E will be shown as 349L, and a Magstar 3590 as 359L.

  For a manual tape library, this may create a situation where it is no longer possible to see from the console response whether a particular tape unit supports IDRC or not, because this information is overlaid by the L indicating that the unit belongs to a library.

  The output of DEVSERV is not changed in this way.

- **MOUNT**

  The MOUNT and UNLOAD commands are still available. The processing of MOUNT has been modified to accommodate automated tape libraries and the requirement to verify that the correct volume has been mounted.

9.12.3 System-Managed Tape Automation Considerations

In this section we summarize all messages related to library operations. They should be handled automatically or at least not go unnoticed. For a detailed reference see *OS/390 V2R4.0 MVS System Messages, Vol 1-5* . We do not include messages that result from a manual interaction such as insert or eject processing or issuing a command. Examples would be:

- CBR1055I Command rejected. Operand invalid.
- CBR3601I Entry of volume into library rejected. Duplicate in library.
- CBR3700I Eject canceled for volume. Library is unavailable.

All of the above messages are either a direct response to a manual interaction or are accompanied by other error messages in the lists below.

Note: The message text is not always shown exactly as it is displayed on the console. If you want to use text patterns to drive automation decisions, refer to the message manuals for your current release.

To perform a live check of the OAM-started task, proceed as follows:

Check OAM to ensure that it is up. If it is not up, a highlighted message can be issued to operations to investigate, or OAM can be automatically restarted for a limited number of retries.

9.12.3.1 MVS Library Messages

Table 39 shows the MVS library messages that can be generated.

Table 39. MVS Library Messages

	Text	Automation Action or Comment
IEF111I	ALLOCATION FAILED – DEVICE IS NOT IN LIBRARY lib	
IEF113I	ALLOCATION FAILED – A LIBRARY REQUEST SPECIFIED A NONLIBRARY DEVICE	
IEF115I	ALLOCATION FAILED – NNN UNITS REQUIRED, BUT NO LIBRARY HAS ENOUGH UNITS	
IEF116I	MOUNT OF VOLUME ON DEVICE FAILED	
IEF118I	MOUNT OF VOLUME ON DEVICE FAILED	
IEF120I	ALLOCATION FAILED – A NONLIBRARY REQUEST SPECIFIED A LIBRARY DEVICE	
IEF150I	ALLOCATION FAILED – UNABLE TO OBTAIN VOLUME RECORD FOR VOLUME	
IGF516I	SWAP IN PROGRESS IN LIBRARY lib, NO ONLINE DEVICES CAN BE FOUND	
IGF512I	SWAP FROM DDD TERMINATED – FAILURE DURING LIBRARY PROCESSING	
IEC503I	AUTOMATED TAPE LIBRARY ERROR	
IGD21001I	TAPE VOLUME volser USE ATTRIBUTE IS ALREADY PRIVATE. TAPE VOLUME RECORD IS UPDATED FOR VOLUME volser	
IGD21002I	UNABLE TO CHANGE THE VOLUME USE ATTRIBUTE FOR TAPE VOLUME volser DUE TO CBRUXCUA INSTALLATION EXIT.	

9.12.3.2 General OAM Messages

Table 40 shows the OAM messages that can be generated.

Table 40 (Page 1 of 2). General OAM Messages

	Text	Automation Action or Comment
CBR0002I	OAM INITIALIZATION COMPLETED	
CBR0097I	OAM RESTART COMPLETED	

Table 40 (Page 2 of 2). General OAM Messages		
	Text	**Automation Action or Comment**
CBR0099I	OAM TERMINATION COMPLETE	
CBR0119I	ENTRY DEFAULT DATA CLASS FOR LIBRARY lib NOT AVAILABLE	
CBR0130I	INVALID CONSOLE NAME console ASSOCIATED WITH LIBRARY lib	
CBR1000I	OAM VERB COMMAND EXECUTION SCHEDULED	
CBR1910I	VERB REJECTED. OAM ADDRESS SPACE NOT STARTED OR OAM1 SUBSYSTEM NOT INITIALIZED	
CBR1950I	INSTALLATION EXIT exitname HAS BEEN REACTIVATED	
CBR3006I	LIBRARY lib WITH LIBRARY ID libid UNKNOWN IN I/O CONFIGURATION	
CBR3911I	THERE IS NO ONLINE AND OPERATIONAL TAPE LIBRARY	
CBR4195I	LACS RETRY POSSIBLE FOR JOB jobname	
CBR4196D	JOB jobname, DRIVE ddd, ERROR CODE code. REPLY ′R′ TO RETRY OR ′C′ TO CANCEL	Issue RETRY command
CBR8007I	NO DB2 SUBSYSTEM OR THE DB2 SSID VALUE OF ″NONE″ HAS BEEN SPECIFIED. SUBSYSTEM CANNOT SUCCESSFULLY INITIALIZE.	

9.12.3.3 General Library Messages

Table 41 shows the general library messages that can be generated.

Table 41 (Page 1 of 3). General Library Messages		
	Text	**Automation Action or Comment**
CBR3002E	LIBRARY lib NO LONGER USABLE	See 10.2.1, “HA1 Recovery Scenarios” on page 342 and 10.2.2, “DAA Recovery Scenarios” on page 347.
CBR3003I	LIBRARY lib NOW OFFLINE	Needs action
CBR3004I	LIBRARY lib NOW ONLINE	
CBR3604I	UNABLE TO UPDATE SCRATCH VOLUME OR EMPTY SLOT COUNT FOR LIBRARY lib	
CBR3617I	UNABLE TO OBTAIN THE NUMBER OF SCRATCH VOLUMES OR EMPTY SLOTS IN LIBRARY lib	
CBR3660A	ENTER MEDIA1/MEDIA2 SCRATCH VOLUMES INTO LIBRARY lib	Needs action
CBR3710I	LIBSERV FAILURE OCCURRED FOR LIBRARY lib RC = rc RSN = rsn	

Table 41 (Page 2 of 3). General Library Messages		
	Text	**Automation Action or Comment**
CBR3711I	UNEXPECTED ERA CODE era FROM LIBRARY lib	Needs action
CBR3712I	UNEXPECTED COMPLETION CODE CC=code, FROM LIBRARY lib	Needs action
CBR3713I	PERMANENT I/O ERROR IN LIBRARY lib, FOR VOLUME volser. SENSE NOT AVAILABLE.	
CBR3715I	REQUEST FOR LIBRARY lib FAILED. NO PATHS AVAILABLE	
CBR3722I	LIBRARY lib EQUIPMENT CHECK	Needs action or manual intervention
CBR3723I	LIBRARY lib VISION SYSTEM NOT OPERATIONAL	Needs manual intervention
CBR3726I	FUNCTION INCOMPATIBLE ERROR CODE code FROM LIBRARY lib FOR VOLUME volser	
CBR3727I	CONTROL UNIT AND LIBRARY MANAGER INCOMPATIBLE IN LIBRARY lib, ERROR CODE code	
CBR3729I	LIBRARY MANAGER FOR LIBRARY lib OFFLINE	Needs action or manual intervention. See 10.2.2, “DAA Recovery Scenarios” on page 347.
CBR3750I	MESSAGE FROM LIBRARY lib: message	
CBR3751I	DEVICE ddd IN LIBRARY lib IS UNAVAILABLE	
CBR3752I	DEVICE ddd IN LIBRARY lib IS NOW AVAILABLE	
CBR3753E	ALL CONVENIENCE OUTPUT STATIONS IN LIBRARY lib ARE FULL	Needs action or manual intervention
CBR3754E	HIGH CAPACITY OUTPUT STATION IN LIBRARY lib IS FULL	Needs action or manual intervention
CBR3755E	INPUT/OUTPUT DOOR OPEN IN LIBRARY lib	Needs action or manual intervention
CBR3757E	LIBRARY lib IN PAUSED/MANUAL MODE OPERATIONAL STATE	See Chapter 9, “Operational Considerations” on page 291.
CBR3758E	LIBRARY lib OPERATION DEGRADED	Needs action or manual intervention. See 10.2.1, “HA1 Recovery Scenarios” on page 342 and 10.2.2, “DAA Recovery Scenarios” on page 347.
CBR3759E	LIBRARY lib SAFETY ENCLOSURE INTERLOCK OPEN	Needs action or manual intervention. See Chapter 9, “Operational Considerations” on page 291.
CBR3760E	LIBRARY lib VISION SYSTEM NOT OPERATIONAL	Needs action or manual intervention

Table 41 (Page 3 of 3). General Library Messages		
	Text	**Automation Action or Comment**
CBR3761E	LIBRARY lib LIBRARY MANAGER OFFLINE	Needs action or manual intervention
CBR3762E	LIBRARY lib INTERVENTION REQUIRED	Needs action or manual intervention. See Chapter 9, "Operational Considerations" on page 291 and 10.2.1, "HA1 Recovery Scenarios" on page 342.
CBR3763E	LIBRARY lib LIBRARY MANAGER CHECK 1 CONDITION	Needs action or manual intervention. See Chapter 9, "Operational Considerations" on page 291 and 10.2.2, "DAA Recovery Scenarios" on page 347.
CBR3764E	LIBRARY lib ALL STORAGE CELLS ARE FULL	
CBR3765E	NO CLEANER VOLUMES AVAILABLE IN LIBRARY lib	
CBR3766E	DUAL WRITE DISABLED IN LIBRARY lib	Needs action or manual intervention. See Chapter 9, "Operational Considerations" on page 291.
CBR3767E	LIBRARY lib ENVIRONMENTAL ALERT	Needs action or manual intervention
CBR3781I	NO MEDIA1|MEDIA2 SCRATCH VOLUMES AVAILABLE in LIBRARY lib	Needs action
CBR7032I	CBRXLIB (CREATE|RETRIEVE|UPDATE) ERROR FOR LIBRARY lib RETURN CODE = rc	Check for preceding IDC3009I messages

9.12.3.4 Volume-Specific Library Messages

Table 42 shows the general volume-specific library messages that can be generated.

Table 42 (Page 1 of 2). Volume-Specific Library Messages		
	Text	**Automation Action or Comment**
CBR3714I	REQUEST FOR VOLUME volser IN LIBRARY lib LOST	Needs action
CBR3724I	VOLUME volser DOES NOT EXIST IN LIBRARY lib	
CBR3725I	LIBRARY lib COMMAND REJECT FOR VOLUME volser. ERROR CODE code	
CBR3728I	VOLUME volser IN USE IN LIBRARY lib.	
CBR3769I	MISPLACED VOLUME volser FOUND IN LIBRARY LIBRARY lib	

Table 42 (Page 2 of 2). Volume-Specific Library Messages		
	Text	**Automation Action or Comment**
CBR3770I	VOLUME volser MISPLACED IN LIBRARY lib	
CBR3771I	DUPLICATE VOLUME volser EJECTED FROM LIBRARY lib	
CBR3772I	DUPLICATE VOLUME volser LEFT IN INPUT STATION in LIBRARY lib	
CBR3773I	CARTRIDGE WITH UNREADABLE OR INVALID EXTERNAL LABEL LEFT IN INPUT STATION IN LIBRARY lib	Needs action. Possibly damaged external label
CBR3774I	UNEXPECTED VOLUME volser EJECTED FROM LIBRARY lib	Needs action. Possibly damaged external label
CBR3776I	VOLUME volser INACCESSIBLE IN LIBRARY lib	Needs action or manual intervention
CBR3777I	VOLUME volser NOW ACCESSIBLE IN LIBRARY lib	
CBR3778I	CLEANER VOLUME EJECTED FROM LIBRARY lib	See Chapter 9, “Operational Considerations” on page 291.
CBR3779I	DAMAGED VOLUME volser EJECTED FROM LIBRARY lib	
CBR3782I	VOLUME volser IN LIBRARY lib EXTERNAL LABEL MISSING OR UNREADABLE	Needs action. See Chapter 9, “Operational Considerations” on page 291.
CBR7031I	CBRXVOL (CREATE|RETRIEVE|UPDATE| REPLACE|DELETE|OPENVOL|GETVOL| CLOSEVOL) ERROR FOR VOLUME volser. RETURN CODE = rc	Check for preceding IDC3009I message

9.12.3.5 Insert and Eject Messages

Table 43 shows the insert and eject messages that can be generated.

Table 43 (Page 1 of 2). Insert and Eject Messages		
	Text	**Automation Action or Comment**
CBR3010I	VOLUME volser EJECTED FROM LIBRARY lib. PLACE IN SHELF LOCATION	
CBR3601I	ENTRY OF VOLUME volser INTO LIBRARY lib REJECTED. DUPLICATE IN LIBRARY lib	
CBR3603I	ENTRY OF VOLUME volser INTO LIBRARY lib REJECTED. DUPLICATE DASD OR OPTICAL VOLUME EXISTS	
CBR3605I	ENTRY OF VOLUME volser INTO LIBRARY lib REJECTED. STORAGE GROUP storgroup INVALID	

Table 43 (Page 2 of 2). Insert and Eject Messages		
	Text	**Automation Action or Comment**
CBR3610I	VOLUME ENTRY PROCESSING. THE FOLLOWING VOLUMES WERE ENTERED INTO LIBRARY lib: volser1 volser2 volser3 ...	
CBR3618I	TAPE ENTRY PROCESSING IN LIBRARY lib SUSPENDED	Needs action. Preceding message indicates reason of failure
CBR3620I	ENTRY OF VOLUME volser INTO LIBRARY lib FAILED.	See 9.8, "Inserting and Ejecting Cartridges" on page 298. Message indicating reason of failure follows.
CBR3650I	EJECT OF VOLUME volser FROM LIBRARY lib FAILED	See 9.8, "Inserting and Ejecting Cartridges" on page 298. Message indicating reason of failure follows.

9.12.3.6 Exit Messages

Table 44 shows the exit messages that can be generated.

Table 44. Exit Messages		
	Text	**Automation Action or Comment**
CBR3602I	ENTER REQUEST REJECTED BY CBRUXENT	See 9.8, "Inserting and Ejecting Cartridges" on page 298.
CBR3615E	TAPE ENTRY PROCESSING DISCONTINUED (CBRUXENT)	Determine the cause of failure, link-edit a new version of the exit, and issue LIBRARY RESET,CBRUXENT.
CBR3621I	ENTER REQUEST IGNORED BY THE CARTRIDGE ENTRY EXIT (CBRUXENT)	The volume is probably owned by another system.
CBR3645E	VOLUME NOT IN LIBRARY INSTALLATION EXIT (CBRUXVNL) DISABLED DUE TO AN INSTALLATION EXIT FAILURE	Determine the cause of failure, link-edit a new version of the exit, and issue LIBRARY RESET,CBRUXENT.
CBR3655E	TAPE EJECT PROCESSING DISCONTINUED (CBRUXEJC)	Determine the cause of failure, link-edit a new version of the exit, and issue LIBRARY RESET,CBRUXENT.
CBR3656I	EJECT REQUEST REJECTED BY CBRUXEJC	
CBR4225E	CHANGE USE ATTRIBUTE PROCESSING DISCONTINUED (CBRUXCUA)	Determine the cause of failure, link-edit a new version of the exit, and issue LIBRARY RESET,CBRUXENT.

9.12.4 Return to Scratch

Cartridges are returned to scratch status in the library by having their library manager category changed from specific (000F) to one of the scratch media categories (0001, 0002, and 0003 are the defaults for MEDIA1, MEDIA2, and MEDIA3, respectively, for system-managed tape). The category is changed by the OAM macro CBRUXLCS or the ISMF mountable-tape volume list ALTER command. The installation wide change-use-attribute exit, CBRUXCUA, is called to approve or disapprove the change requested.

DFSMSrmm uses the change-use-attribute exit. Therefore, if a volume is changed through ISMF and the change is approved by the DFSMSrmm database, DFSMSrmm is updated to reflect the change in the TCDB. Not all tape management systems use the change-of-use exit, so care must be taken as to the unit from which updates are controlled. We do not recommend using ISMF for anything other than displaying information in any installation where the tape management system does not make use of all the OAM exits.

9.12.5 Cartridge Insert Processing

When cartridges are entered into the tape library, the volume serial number and media type are checked by the library manager. If the bar code is readable and the volser is unique, a record is added to the library manager database and the cartridge is placed in the INSERT category. A message is sent to all hosts informing them that a cartridge is in the INSERT category. The LCS component of OAM builds the TCDB record with some information that is verified by the tape management system by way of the cartridge entry exit, CBRUXENT. The return code of CBRUXENT controls whether or not the cartridge is to be accepted into the library ejected from the library, or left for another host to process (see Table 45). If the exit sets a return code of zero, the cartridge is accepted in the library, and the TCDB and library manager records are updated.

Table 45. CBRUXENT Return Codes

Return Code	Meaning
0	Perform entry as requested, with no changes to the variables.
4	Perform entry as requested, but note changes to the variables.
8	Do not allow cartridge to be entered; OAM will schedule an EJECT.
12	Ignore entry request; leave for other host. Cartridge remains in INSERT category.
16	Perform cartridge entry, using variables as passed to the exit, then disable exit. •

Notes:

- Once CBRUXENT has been disabled, cartridge entry processing by that system ceases. To enable the exit, restart OAM or issue the LIBRARY RESET,CBRUXENT command.

The cartridge entry exit has two main purposes: (1) to verify and change information on cartridges as they are inserted into the library (see Table 46 on page 333), and (2) in an environment where a library is shared among multiple hosts, to ensure that the current host has access to its cartridges only.

If more than one SMSplex and tape management system are sharing a library, the entry exit must be common across members of an SMSplex and, if practical, the same exit should be used across all members of all SMSplexes. The entry exit should be coded in such a way that the return code set causes a tape to be accepted into or ejected from the library. If any non-SMS hosts use the library, their volumes should be ignored. If a cartridge remains unclaimed by the attached hosts, it will remain in the library manager INSERT category. If there is no TCDB entry for a cartridge, it cannot be ejected from the library through ISMF, the LIBRARY command, or the CBRXLCS macro.

Table 46. CBRUXENT Variables

Variable	Use
Volume serial number	Input only
Volume use attribute	Output/verified
Storage group name	Output/verified
Write protect status	Output/verified
Checkpoint volume indicator	Output/verified
Volume location code	Input only
Shelf location	Output
Volume owner information	Output
Volume record creation date	Input only
Last entry or eject date	Input only
Last mounted date	Output/verified
Last written date	Output/verified
Volume expiration date	Output/verified
Tape device selection information	Output/verified

9.12.6 Cartridge Eject Processing

Cartridges are ejected from the library when the library manager changes the category to an EJECT category. There are two EJECT categories: FF10 for the convenience I/O station and FF11 for the high capacity output facility. When the cartridge is ejected from the library, the cartridge record in the TCDB can be kept or purged. This is controlled by the EJECT DEFAULT on the ISMF Library Define panel or on the parameter used when ejecting the volume.

Installationwide exit CBRUXEJC approves or disapproves of a cartridge being ejected from the library.

9.13 MVS/ESA with Basic Tape Library Support Operation

In this section we describe the major operational aspects of operating a tape library in an MVS/ESA with BTLS environment. This section is not intended to be used as a replacement for full operational procedures.

9.13.1 Operational Interfaces

The operational interface to BTLS is provided by the IDCAMS LIBRARY command. The LIBRARY command is used to perform operations needed to manage tape volumes that reside in a tape library.

The IDCAMS LIBRARY command can be executed as either a TSO command or with JCL. Refer to the *BTLS V1 User's Guide and Reference* for more information about the IDCAMS LIBRARY command.

9.13.2 Return to Scratch Processing

In a BTLS environment, when the volume resident in the tape library is used by host tape processing, the library manager category of the volume is automatically updated to the private category. For a scratch mount request, the library manager selects only the volume assigned to the scratch category. Therefore, when the data on the private category volume is no longer usable, the library manager volume category must be updated to the scratch category to recycle the volume to be used by a scratch mount request.

The only way to return the volume category to scratch in a BTLS environment is through the LIBRARY SETCATEGORY command. The command assigns a volume to the category specified by the CATEGORY parameter with the appropriate BTLS scratch category name. Figure 200 shows sample JCL to assign volumes to the scratch category.

```
//LIBJOB   JOB ...
//STEP1   EXEC PGM=IDCAMS
//SYSPRINT  DD SYSOUT=*
//LIBIN     DD DSN=ASSIGN.VOLUMES.TO.SCRTCH,DISP=SHR
//SYSIN     DD *
  LIBRARY SETCATEGORY UNIT(xxx) CATEGORY(SCRTCH)
/*
```

Figure 200. Sample JCL to Assign Volumes to Scratch Category

In this example, all of the volumes listed in the LIBIN data set are assigned to category SCRTCH.

Note: UNIT(*xxx*) specifies one of the tape drive addresses installed in the tape library.

BTLS has no function to manage the retention of the tape data set residing in the BTLS-managed volumes. Therefore, you have to develop a procedure or use the tape management system to manage the tape data set retention period.

9.13.3 Cartridge Insert Processing

When the cartridges are inserted into the tape library, the library manager creates the volume records for each cartridge, assigns INSERT category as the volume category, and sends the volume information to all connected host systems.

BTLS has no functional interface to receive the volume information from the library manager and automatically set up the volume status. You must carry out the following steps, using the LIBRARY command:

1. Obtain a list of the volumes in the INSERT category. Use the LIBRARY INVENTORY command with the CATEGORY(INSERT) parameter to obtain the list.

2. Assign volumes to the SCRATCH or PRIVATE category. Use the LIBRARY SETCATEGORY command and the volume list obtained in Step 1 to assign an appropriate volume category to the volume records in the library manager.

3. Create BTLS volume catalog records. Use the LIBRARY DEFINE command and the volume list from Step 1 to create BTLS volume catalog records in the BTLS user catalog. For specific volume requests, BTLS uses the volume catalog records to control allocation.

Figure 201 shows sample JCL for INSERT processing.

```
//LIBJOB   JOB ...
//STEP1   EXEC PGM=IDCAMS
//SYSPRINT  DD SYSOUT=*
//LIBOUT    DD DSN=INSERT.VOLUMES.LIST,DISP=(NEW,CATLG),
//         UNIT=SYSALLDA,DCB=(RECFM=FB,LRECL=80),SPACE=(CYL,(1,1))
//LIBIN     DD DSN=INSERT.VOLUMES.LIST,DISP=SHR
//SYSIN     DD *
  LIBRARY INVENTORY   UNIT(xxx) CATEGORY(INSERT)
  LIBRARY SETCATEGORY UNIT(xxx) CATEGORY(SCRTCH)
  LIBRARY DEFINE
/*
```

Figure 201. Sample JCL for INSERT Processing

In this example, an inventory list is to be obtained for all volumes in the INSERT category through the LIBRARY INVENTORY command. The volume serial number list is created in data set INSERT.VOLUMES.LIST. The LIBRARY SETCATEGORY command causes the volumes to be placed in the scratch category in the library manager. The LIBRARY DEFINE command causes the volumes to be defined in the BTLS user catalog as residing in LIB1.

Note: UNIT(*xxx*) specifies one of the tape drive addresses installed in the tape library.

9.13.4 Cartridge Eject Processing

The library manager ejects the volumes in the EJECT categories from inside the tape library to the convenience I/O station or the high capacity output cells. The EJECT categories are the convenience eject category and the bulk eject category. The volume in the convenience eject category is ejected to the convenience I/O station, and the volume in the bulk eject category is ejected to the high capacity output cell.

You can only use the library manager to eject cleaning cartridges without the host eject command. The data cartridges cannot be ejected through library manager console commands. Host interaction is needed.

In a BTLS environment, you can use the LIBRARY SETCATEGORY command to assign the eject category to the volume that you want to eject from the tape library (see Figure 202):

```
//LIBJOB   JOB ...
//STEP1   EXEC PGM=IDCAMS
//SYSPRINT  DD SYSOUT=*
//LIBIN     DD DSN=EJECT.VOLUMES.LIST,DISP=SHR
//SYSIN     DD *
  LIBRARY SETCATEGORY UNIT(xxx) CATEGORY(XEJECT)
/*
```

Figure 202. Sample JCL to Eject a Volume

In Figure 202 all of the volumes listed in the LIBIN data set are assigned to the convenience eject category. The BTLS volume catalog records for the volumes should also be deleted.

Note: UNIT(*xxx*) specifies one of the tape drive addresses installed in the tape library.

9.13.5 Media Selection

For a scratch mount request, BTLS volume selection is based on the scratch category assigned to the allocated tape drive. It is not based on the volume media type. To select by media type, assign a different scratch category to each media-type volume.

The system default scratch category name is SCRTCH1 (alias name for SCRTCH). BTLS supports eight scratch categories, SCRTCH1 through SCRTCH8. The system default can be changed by specifying a scratch category name in SYS1.PARMLIB member BTLSPRMxx. For example, if you specify SCRTCH2 in BTLSPRMxx, SCRTCH2 becomes the system default scratch category.

Use the IDCAMS LIBRARY SETDEVICE command to indicate that a tape drive should use a scratch category name other than the system default.

The category used to satisfy a scratch mount request issued to a particular tape drive is determined as follows:

1. If the LIBRARY SETDEVICE command was used to associate a category name with the tape drive, the category name specified in the SETDEVICE command is used.
2. If the LIBRARY RESETDEVICE command is used to restore the default state of the device (or the SETDEVICE command has never been issued to the device), the system default category name is used.

9.14 VM/ESA and VSE/ESA

In this section we cover the aspects of operating a tape library in a VM/ESA or VSE/ESA environment.

9.14.1 Operational Interfaces

There are no IBM-supplied operator commands for tape library management. Vendor tape library management software provides operator commands. Tape library management retrieves its information from the library manager by use of the RMS component of VM/ESA using CSL calls, or through the LBSERV macro in VSE/ESA.

9.14.2 Return to Scratch

The library manager category indicates whether a cartridge is private or scratch. The library manager automatically updates a cartridge to a private category when it is used. It is the responsibility of the tape management system to instruct the library manager to change a cartridge category back to scratch. This would normally be carried out as part of the tape management system return-to-scratch processing, which would be invoked with either an operator command or batch job.

9.14.3 Cartridge Insert Processing

If you have VM/ESA and have implemented bulk insert processing, cartridges entered into the library have their library manager categories set automatically. To complete insert processing, run the tape management system procedure to synchronize its database with the library manager database. If you are in a native VSE/ESA environment, it is the responsibility of the tape management system to complete insert processing once new cartridges have been entered into the library.

9.14.4 Cartridge Eject Processing

Ejecting cartridges is the responsibility of the tape management system. The tape management system vendor provides a mechanism, usually included as part of existing vaulting procedures, to send the appropriate commands to the library manager to move cartridges from storage cells to the I/O stations.

9.15 AIX

In this section we cover the operation of a tape library in an AIX environment.

9.15.1 Operational Interfaces

The MTLIB command is supplied with the tape library device driver. For information about the command, see 5.6.2, “MTLIB Command Line Interface” on page 206 and Appendix B, “MTLIB Command” on page 361.

9.15.2 Return to Scratch

Use the MTLIB command to change cartridges in the library manager category back to a scratch category:

```
mtlib -l /dev/lmcp0 -C -VAIX001 -txxxx
```

where xxxx is the scratch category you have chosen.

Applications can have insert processing support added to them— for example, ADSM′s CHECKIN processing changes the library manager category of a cartridge from INSERT to ADSM′s scratch category.

9.15.3 Cartridge Insert Processing

Once cartridges have been entered into the tape library, use the MTLIB command to change the library manager category from INSERT to your chosen AIX scratch and private categories:

```
mtlib -l /dev/lmcp0 -C -VAIX001 -t0090
```

where 0090 is the library manager category you chose for your AIX scratch cartridges.

ADSM′s CHECKIN processing will change the library manager category from INSERT to an ADSM category.

9.15.4 Cartridge Eject Processing

Use the MTLIB command to change a cartridge's library manager category to an I/O station category:

```
mtlib -l /dev/lmcp0 -C -VAIX001 -tFF10
```

where FF10 is the library manager category for the convenience I/O station.

Applications can have eject processing support added to them; for example, ADSM's CHECKOUT processing changes the library manager category of a cartridge to an I/O station's library manager category.

9.16 Sun Solaris

The Sun Solaris operational interfaces and return-to-scratch, insert, and eject processing are similar to those of AIX. See 9.15, "AIX" on page 337.

Chapter 10. Error Handling and Recovery

The library manager, in conjunction with the built-in hardware error recovery routines, attempts to recover from all library component failures. If the recovery is successful, the operation continues. If the recovery fails, the library manager sets the appropriate operational mode, operational status, and information states that reflect the impact of the failure. Hosts are informed of failures only if a host-requested operation has failed or a library component has become unavailable. How this notification is implemented depends on the way the host is connected to the library. If the host supports a single data and command path, the error condition is flagged through the channel. If the host requires a second connection to pass library commands (RS-232 or LAN), the error conditions are flagged to the attached host through that connection. The way in which the errors are presented to the operator at the host varies. These messages are accompanied by the operator intervention window on the library manager.

The library manager logs all errors in an error log. This log can be accessed through the library manager Service pull-down menu and be analyzed by the IBM Service Representative.

In the sections that follow, we discuss some library hardware failures and suggest some recovery actions. For additional information about error recovery, see the *IBM 3494 Tape Library Dataserver Operator's Guide* .

10.1 System Summary Window

The System Summary Window (figref refid=a6cr228.), which appears when the library manager is powered on, provides an overview of important information relating to library manager status and component availability or failure.

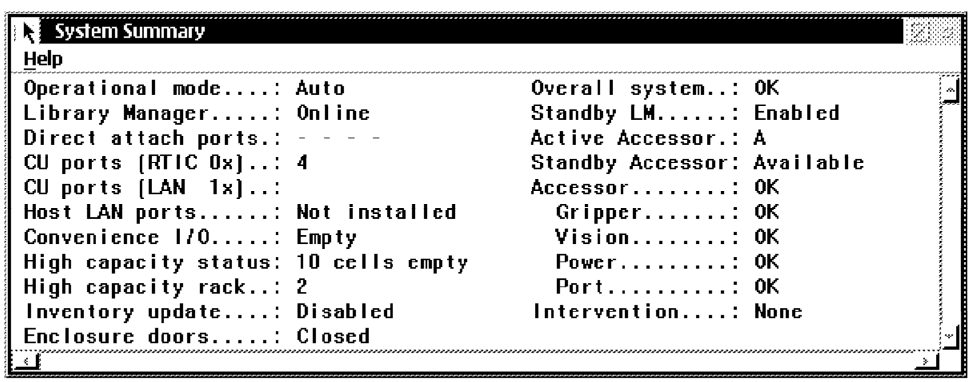


Figure 203. System Summary Window

The fields on the System Summary window can have the following values:

- The Library Manager field shows whether the library manager is **Online Pending**, *Online*, *Offline Pending*, or *Offline* to the attached tape control units.
- The Standby LM field shows the status of the standby library manager (LM).
  - *Enabled* indicates that the standby LM is functional.

- *Disabled* indicates that the standby LM is not functional and causes the overall system to report *Degraded*.
- *Degraded* indicates that the standby LM has lost one of its communication links with the active library manager.
- *Not Taught* indicates that the accessor has not completed a successful teach, thus making it unusable.

- The Active Accessor field shows which accessor is the active accessor.
  - An *A* indicates that accessor A is active.
  - A *B* indicates that accessor B is active.
  - *Both* indicates that the Dual Active Accessor feature is installed. See 2.2.14, "Dual Active Accessors" on page 38 for more information about the Dual Active Accessor.
  - *None* indicates that there is currently not an active accessor (both are unavailable).

- The Standby Accessor field shows the status of the standby accessor.
  - *Available* indicates that the standby accessor can be used if an accessor switch occurs.
  - *Service Mode* indicates that the accessor is unavailable while it is being serviced.
  - *Not Available* indicates that the accessor has components marked unavailable that currently make it unusable.
  - *Not installed* indicates that the second accessor is not installed.

10.2 Operating and Monitoring the High Availability Unit

When the High Availability unit (HA1) is installed, the IBM 3494 configuration has two library managers and two cartridge accessors. Each library manager controls a cartridge accessor. The addition of the second library manager and accessor in the 3494 subsystem improves the subsystem's availability and a customer's ability to access its data. In the event of a cartridge accessor or library manager failure, the IBM 3494 can continue operations after a short interruption.

The system can continue to operate as the failed component is being serviced. This feature also minimizes library downtime for installing library manager code patches.

Figure 204 on page 341 shows a schematic diagram of the HA1 components.

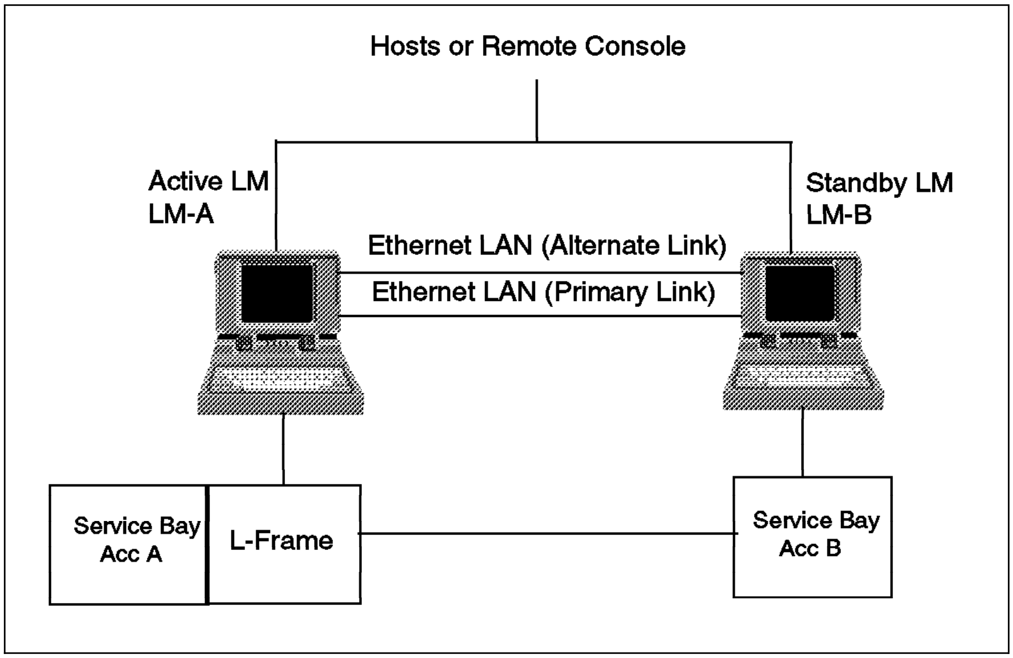


Figure 204. HA1 Components

Under normal operation, that is, no elements have failed or are degraded, the active library manager is library manager A (LM-A) and the standby library manager is running on library manager B (LM-B). The active accessor is accessor A and is controlled from LM-A. LM-A receives host commands over the serial interfaces (RS-422) from direct attached hosts and serially attached control units. LM-A controls the operator panel and convenience I/O station. The accessor manager on LM-A knows that the standby accessor, accessor B, is safely parked in its service bay. The accessor manager in LM-A performs move operations using accessor A. The active database on LM-A is continually backed up onto LM-B across the primary link.

The Dual Active Accessor (DAA) feature is a performance enhancement follow-on to the HA1 feature. With DAA installed and enabled, both accessor A and accessor B are active, and typically LM-A is the active library manager and LM-B is the standby library manager. The accessor manager in LM-A performs move operations using accessor A and passes move operation commands for accessor B to LM-B across the primary link.

The IBM 3494 is deemed to operate in degraded mode when any one of its components has failed.

If a switchover to the standby library manager has occurred because of a failure, there is no technical reason to switch back to the original library manager. However, this should be dictated by the customer's policies and needs. We recommend that you periodically switch between library managers to verify that the standby library manager is functional.

10.2.1 HA1 Recovery Scenarios

In this section we describe the failures that the HA1 will recover and the operational impact of the failure and recovery.

Two conditions cause a library manager switchover:

- Library manager failure due to a catastrophic failure or unrecoverable code detected error
- Switchover on demand

Note: A complete failure of a library manager causes its accessor to become unavailable.

10.2.1.1 Standby Library Manager Failure

in this section we discuss a Standby library manager failure due to a catastrophic failure such as loss of power or an unrecoverable code detected error (library manager Check 1 condition).

When a standby library manager fails, the attached hosts are sent an operational state change message (see Figure 205).

```
CBR3758E Library library-name operation degraded.
```

Figure 205. Standby Library Manager Failure Error Message

The status of some fields of the System Summary Window for the active library manager changes:

Overall system	Degraded
Standby LM	Disabled
Standby Accessor	Not Available

When the failure on the standby library manager is resolved, and the standby library manager is powered on, the standby accessor becomes *Available* as soon as the base library manager code is loaded.

After the standby library manager is initialized, the library manager database is initialized, and the database is copied from the active library manager. You can monitor the progress of the database copy on the active library manager by selecting the **Operational Status** pop-up window from the **Status** pull-down menu. The Database Dualwrite field displays *Copying to remote nn%*. When the database copy has completed successfully, the standby library manager is *Enabled* and the overall system field changes to *OK*.

Refer to 10.2.3, "Library Manager Switchover Times" on page 349 for information about the duration of the library manager switchover and database copy.

10.2.1.2 Active Library Manager Failure

In this section we discuss Active library manager failure due to a catastrophic failure or an unrecoverable code detected error.

When the active library manager fails, the attached hosts receives an operational state change message (see Figure 206 on page 343).

```
CBR3002E Library library-name no longer usable.
```

Figure 206. Active Library Manager Failure Error Message

The impacts of an active library manager failure are:

- Jobs that have their tapes mounted will continue to run. Jobs that have requested tape mounts that have not completed will fail. If all the tapes needed to complete the job are mounted, the job will run to completion. At the end of the job, the tapes will rewind and unload. Any demount commands will fail with an initial status indicating that LM-A is offline.
- The active library manager maintains the only copy of the command queue, and during a switchover the command queue is lost.
- If a new mount request arrives during switchover, it will fail with an initial status indicating that the library manager is offline.

During normal operations the Standby Library Manager pop-up window (Figure 207) is displayed:

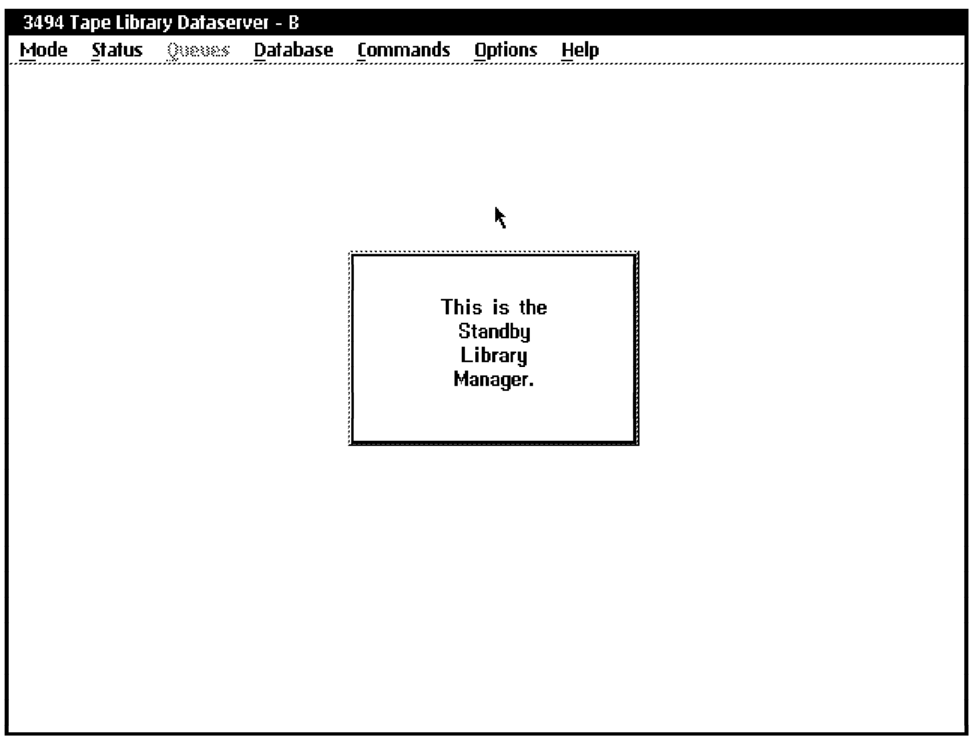


Figure 207. Standby Library Manager Pop-up Window

During library manager switchover, the window in Figure 207 is replaced by the Library Manager Switching pop-up window (Figure 208 on page 344).

Figure 208. Library Manager Switching Pop-up Window

When the standby library manager becomes active, the pop-up Window in Figure 208 is no longer displayed, and the System Summary window is displayed indicating transition to AUTO mode. The accessor is also switched because it becomes unavailable when the library manager to which it is attached fails.

During library manager switchover there is no host interaction. Switchover can take several minutes, and we suggest that the operator monitor the switchover process on the library manager

When the switchover has completed, the System Summary window shows:

Overall System	Degraded
Standby LM	Disabled
Standby Accessor	Not Available

The attached hosts receive an operational state change message (see Figure 205 on page 342).

In this scenario this message is an indication to the host operator that the library is available.

The operator should vary the library online and restart any jobs that have failed. When the failure on the standby library manager (LM-A) is resolved and it is powered on, the standby accessor (Accessor-A) becomes **Available** as soon as the base library manager code is loaded.

After LM-A is initialized, the library manager database on LM-A is initialized, and the database is copied from the active library manager (LM-B) to the standby library manager (LM-A). The progress of the database copy can be monitored as described in 10.2.1.1, “ Standby Library Manager Failure” on page 342. The database copy can take a long time depending on how big the database is and how busy the library is during the copy process. The database copy also uses a lot of the library manager resources. Therefore we suggest that you not attempt any other library manager actions during this process.

Refer to 10.2.3, “Library Manager Switchover Times” on page 349 for information about the duration of the library manager switchover and library manager database copy.

Note: With the VTS advanced functions installed from a host perspective, the library remains online and operational during the switchover.
When an LM switchover occurs, an operational state change bit is sent to the host (LM switchover in progress), causing a highlighted message:
CBR3783E Library manager switchover in library <library-name> in

progress. After the switchover completes, we delete this message and issue this message: *CBR3784I Library manager switchover in library <library-name> is now complete.* The check 1 bit that caused the library to go offline and issue CBR3002E is no longer being set.

10.2.1.3 Manual Library Manager Switchover

Library manager switchover on demand is an operator - initiated function that causes the active library manager to become the standby library manager and the standby library manager to become the active library manager.

This process, which is less disruptive than a library manager switchover due to library manager failure, involves the following operator actions:

- The library must be placed in a paused offline state. All drives in the library must be taken offline, and the library must be quiesced.
- The switchover is initiated by the operator selecting **Switch Active Library to Standby** from the **Mode** pull-down menu.
- When the switchover is complete, the active library manager is in paused and offline mode. The operator must vary the library manager to *auto* and *online* from the **Mode** pull-down menu.

When library manager switchover is done manually, no library manager database copy is done because the library manager keeps the two copies of the database in synch and knows that they are identical. Refer to 10.2.3, “Library Manager Switchover Times” on page 349 for information about the duration of a library manager switchover.

10.2.1.4 Standby Accessor Failure

When the standby accessor fails, the System Summary window shows:

Overall System	Degraded
Standby LM	Enabled
Standby Accessor	Not Available

and the attached hosts receive an operational state change message (see Figure 205 on page 342). The library continues to function but in degraded mode.

10.2.1.5 Active Accessor Failure

When the active accessor fails, the System Summary window shows:

Overall System	Degraded
Standby LM	Enabled
Standby Accessor	Not Available

and the attached hosts receive an operational state change message, which could be accompanied by one or more messages indicating that operator intervention is required (such as removing a cartridge from the gripper of the failed accessor). See Figure 209 on page 346 for examples of these messages

```
CBR3758E Library library-name operation degraded.
CBR3762E Library library-name intervention required.
CBR3776I Volume volser inaccessible in library library-name.
```

Figure 209. Active Accessor Failure Error Messages

Accessor switchover takes about 2 minutes. During this time:

- The library automatically goes into a temporary Pause mode.
- The standby accessor (accessor B), which now becomes the active accessor, comes out of its service bay and pushes the failed accessor (accessor A) into accessor A's service bay.

When accessor switchover is completed, the library automatically goes into Auto Online mode, and normal operations resume.

10.2.1.6 Manual Accessor Switchover

Accessor switchover on demand is an operator-initiated function that causes the active accessor to become the standby accessor and the standby accessor to become the active accessor. Accessor switchover is initiated by selecting **Switch Accessor to Standby** on the **Mode** pull-down menu.

Accessor switchover takes approximately 2 minutes. During this time:

- The library automatically goes into temporary **Pause** mode.
- The active accessor (assume accessor B) goes to its service bay.
- Accessor A comes out of its service bay and calibrates itself on both ends of the library.
- If a volume was in the gripper of accessor A the volume is placed in the recovery cell.
- The volume is scanned and its home cell is checked.
- If this volume's home cell is empty, the volume is taken from the recovery cell and placed in it's home cell.

When accessor switchover is completed, the library automatically goes into Auto Online mode, and normal operations resume.

We recommend that you periodically switch between accessors to verify that the standby accessor is functional.

10.2.1.7 HA1 and Gripper Failure

If you lose one gripper in a dual gripper accessor, the library manager sends an operational state change message to all attached hosts, informing the hosts that the 3494 subsystem is now operating in degraded mode. (See Figure 205 on page 342 for an example of an operational state change message.) The accessor will not switch to the standby accessor. The accessor can be switched by the operator from the library manager menu. If the accessor is switched, the 3494 subsystem is still considered to be operating in degraded mode until the failing gripper on the standby accessor is repaired.

If the accessor does not have the dual gripper feature installed, and the gripper experiences a failure, the active library manager sends an operational state change message to all attached hosts, informing the hosts that the 3494 is operating in degraded mode. The active library manager then parks the disabled accessor in its service bay and sends commands to the standby library manager over internal links. The standby library manager then executes the commands, using its accessor. Control of the 3494 does not switch to the standby library manager.

10.2.1.8 HA1 and Secondary Library Manager Disk Drive

A non-HA1 library manager comes standard with one primary hard disk and the option to specify a secondary hard disk. The primary hard disk contains the operating system and library database. The purpose of the secondary hard disk is to maintain a copy of the database that is on the primary hard disk. The secondary disk does not have a copy of the operating system. When the library manager has the secondary hard drive feature installed and the primary disk experiences an error, the secondary disk preserves only the database from the primary disk; it does not allow continued running. The primary disk must be repaired before operation can resume. The secondary disk is used to restore the database to the primary disk if required.

With the HA1, both library managers have the operating system and the database on their primary disks. Both primary disks are kept in synchronization over the internal LAN. The secondary disks are not used if both library managers are functional. With the HA1 installed, a failure of the primary hard drive causes a switchover to the standby library manager, and normal operations will continue.

In an HA1 configuration, both library managers must have the secondary hard disk feature installed. The secondary disks are not used if both library managers are functional. If one of the library managers experiences a problem, the active library manager uses both of its own disks. The active library manager′s primary hard disk contains the operating system and database, and the secondary hard disk becomes the backup disk.

10.2.2 DAA Recovery Scenarios

In this section we describe failure scenarios with the DAA feature installed and enabled and the operational impacts of the failure and recovery.

The conditions that cause a library manager switchover are discussed in 10.2.1, “HA1 Recovery Scenarios” on page 342.

10.2.2.1 Standby Library Manager Failure with the DAA Feature

A standby library manager failure with the DAA feature installed does not cause any host messages to be issued unless the failure is severe enough to cause the failure of the accessor “owned” by it. See 10.2.2.4, “ Accessor Failure with DAA Feature” on page 348 for details on accessor failure.

The System Summary window shows:

Overall System	Degraded
Standby LM	Disabled
Standby Accessor	Available/Not Available

When the failure on the standby library manager is resolved, and the standby library manager is restarted, the library manager database is initialized, and the database is copied from the active library manager.

When the database copy has completed successfully, the standby library manager is *Enabled* and the Overall system field changes to *OK*

10.2.2.2 Active Library Manager Failure with DAA

When the active library manager fails, the standby library manager switches from standby to active. There could be a time delay before the attached hosts receive any operational state change messages (see Figure 210).

```
CBR3002E Library library-name no longer usable.
CBR3729I Library Manager for library library-name offline.
CBR3763E Library library-name library manager check 1 condition.
```

Figure 210. Active Library Manager Failure with DAA Feature: Error Messages

On an OS/390 host, the D SMS,LIB(library-name),DETAIL command can be issued. The resulting display shows that the library is *Offline*, and *Degraded* and has a *Check1* condition and indicates whether one of the accessors has been placed offline.

The System Summary window shows:

Overall System	Degraded
Standby LM	Disabled
Standby Accessor	Available/Not Available

The impact of the active library manager failing is described in 10.2.1.2, " Active Library Manager Failure" on page 342.

When the library manager switchover has completed, you should put the library in **Auto Online** mode and vary the library online to the attached hosts.

After the failed library manager has been repaired and powered on, the library manager database is initialized, and the database is copied from the active library manager (LM-B) to the standby library manager (LM-A). The progress of the database copy can be monitored as described in 10.2.1.1, " Standby Library Manager Failure" on page 342. The database copy can take a long time, depending on how big the database is and how busy the library is during the copy process. The database copy also uses a lot of the library manager resources. Therefore we suggest that you not attempt any other library manager actions during this process.

Refer to 10.2.3, "Library Manager Switchover Times" on page 349 for information about the duration of the library manager switchover and database copy.

10.2.2.3 Manual Library Manager Switchover with DAA Feature

See 10.2.1.3, " Manual Library Manager Switchover" on page 345 for details.

10.2.2.4 Accessor Failure with DAA Feature

When an accessor fails with the DAA feature installed and enabled, the System Summary window shows:

Overall System	Degraded
Standby LM	Enabled
Standby Accessor	Not Available
Active Accessor	A/B

and the attached hosts receive an operational state change message and one or more informational messages (see Figure 211 on page 349).

```
CBR3758E Library library-name operation degraded.
CBR1110I Operation degraded due to unavailable hardware resource.
```

Figure 211. Accessor Failure with DAA Feature: Error Messages

The library automatically goes into a temporary **Pause** mode, and the active accessor pushes the failed accessor into its service bay. Then the library automatically switches to **Auto Online** mode and normal operations resume.

After the failed accessor has been repaired, following these steps to recover the accessor and enable the DAA Feature:

- From the **Service** pull-down menu, select **Activate DAA**.
- On the pop-up window ensure that the accessor to be recovered is selected.
- Select **OK**.

The active accessor will go to its service bay. The recovered accessor will calibrate on both ends of the library. Normal operations will resume with both accessors active.

10.2.3 Library Manager Switchover Times

Library manger switchover times were measured in an IBM 3494 that had two VTS Model B18s installed. When a complete failure of the active library manager occurred, it took 25 minutes for library manager switchover to complete. When a Check 1 condition was experienced on the active library manager, it took 15 minutes for library manager switchover to complete. At this point in time, the library is available and can be used for host processing.

Asynchronously, the library manager database is synchronized between the two library managers: It takes anywhere from 1 to 10 hours to copy the database, depending on the job load during the database copy and depending on the amount of volumes defined in the library. With a VTS being part of a library, the synchronization time will be in the range of 1 hour per 10,000 logical volumes.

10.3 Failure Scenarios without HA1

In this section we describe the operational impact of failures when the HA1 feature is not installed, the recovery actions initiated by the library manager and the recovery actions the operator must take.

10.3.1 Library Manager Failure

In a single library manager configuration, if the library manager fails, all library operation stops. As long as the library manager is unavailable, it is not possible to operate the library in Manual mode.

10.3.2 Accessor Failure

If an accessor fails in a single-accessor configuration, the library goes into Pause mode, and all attached hosts are notified of the error. In the IBM 3494, all mount and demount operations are queued. The library can be run in Manual mode while the IBM Service Representative is repairing the accessor. If the accessor inhibits access to any part of the library, operational procedures exist to move it. The accessor can be gently pushed to the end of the library.

10.3.3 Gripper Failure

If the gripper in a single accessor single gripper configuration fails, the library enters Pause mode, and all attached hosts are notified of the error. During the repair action, the library can be run in Manual mode. If one gripper fails in a dual-gripper, single- accessor configuration, the 3494 continues to function in a *Degraded* state. In this case, if the library had been operating in Floating Home Cell mode, it will operate in Fixed Home Cell mode, and, when the failure has been corrected, it automatically returns to operating in Floating Home Cell mode. An IBM 3494 can have up to four grippers installed when the High Availability unit and the dual gripper feature are installed. If all grippers of the active accessor fail, a switchover to the standby accessor is initiated. The repair action of a gripper on the standby accessor is not disruptive.

10.3.4 Bar Code Reader or Vision System Failure

The IBM 3494 has a single bar code reader. If the reader fails, all attached hosts are informed. Library operation continues, but all insert, eject, audit, and inventory operations are suspended. If the High Availability unit is installed, there are two bar code readers, one on each accessor. The IBM 3494 continues to run in *Degraded* mode, no automatic accessor switchover takes place. Switchover can be done manually by the operator to enable insert, eject, audit, and inventory operations.

10.3.5 Convenience I/O Failure

In an IBM 3494, if the convenience I/O station fails, eject operations are redirected to the high capacity output facility. If the high capacity output facility is not defined in the configuration, the eject operations remain queued until the convenience I/O station becomes available.

Insert operations can use any empty cell.

10.3.6 Library Manager Secondary Hard Disk Failure

If the library manager secondary hard disk fails, normal library operation continues, but all hosts are informed that the library is in *Degraded* mode. Once the secondary hard disk is repaired, database dual write can be re-enabled, and the secondary copy of the library manager database can be built.

10.3.7 RS-232 or LAN Host Connection Failure

If an RS-232 or LAN path between the library and a host fails, the host cannot use the library until the path is reestablished.

10.3.8 Tape Subsystem Communication Failure

If the communication path between a tape subsystem and the library manager fails, the tape subsystem is unavailable.

10.3.9 Tape Control Unit Failure

If a tape control unit fails, the drives supported by that controller are no longer accessible down that path. All hosts are informed of the error. Normal library operation continues while there is at least one available control unit, assuming that the hosts still have access to the tape drives.

10.3.10 Primary Library Manager Hard Disk Failure

Failure of the primary library manager hard disk in an IBM 3494 configuration without the High Availability (HA1) unit feature, but with the dual disk drive feature, causes all library operations to cease, and the library becomes unusable. The IBM Service Representative must replace the failed hard disk and load the operating system as well as the library manager code on it. Then the database can be copied from the secondary disk, and normal operations can resume. In an IBM 3494 configuration without the HA1 and the dual disk drive feature, all library operations cease, and the library is unusable. After the failed hard disk is replaced, the IBM Service Representative must carry out a library teach operation. The IBM 3494 must be inventoried, and the library manager database must be synchronized with the host tape databases. See 10.3.11, “Library Manager Database Recovery and Host Resynchronization.” Because an extended outage is possible, we recommend installing at least the dual disk drive feature.

10.3.11 Library Manager Database Recovery and Host Resynchronization

If the library manager database cannot be recovered from a secondary copy, perform the following steps before restarting automated operations:

1. Carry out the library teach process.
2. Carry out the library inventory process.
3. Resynchronize the library manager database with all attached hosts.

10.3.11.1 Library Teach Process

This step recovers information about the tape library system such as the tape library configuration, default media type, and device cleaning schedule.

10.3.11.2 Library Inventory Process

This step recovers information about volumes, such as volser, media type, volume location, and storage cell status. This step does not recover volume category information or information about the nonexternal label volumes that were inserted by means of the unlabeled tape facility. During the inventory process, the library manager ejects the nonexternal label volumes. Therefore, to recover the information about these volumes, use the unlabeled tape facility to insert them again.

After the library inventory, the volume category of each volume in the library manager database is assigned to the INSERT category, and the library manager sends the volume information to all attached hosts.

10.3.11.3 Resynchronize the Library Manager Database

This step recovers the volume category information. There is no general procedure to recover the volume category information. The recovery procedure depends on the software platform, as described below:

- MVS/ESA with system-manage tape

  In a system-managed tape environment, the TCDB and DFSMSrmm control data set (if DFSMSrmm is installed) contain the volume category information. It is always synchronized with the library manager database. When the library is varied online from a host system, the system receives information about the volumes in the INSERT category. Then OAM automatically sends commands to the library manager to assign the volume category according to the TCDB and DFSMSrmm control data set.

- MVS/ESA with BTLS

  In a BTLS environment, BTLS has no volume category information. It records only which volume resides in which tape library.

  If you have a procedure or a tape management system to manage tape data set and volume retention, you can obtain the volume category information as to PRIVATE or SCRATCH. Then use the IDCAMS LIBRARY SETCATEGORY command to assign the library manager volume category. Alternatively, your tape management system may support the IDCAMS LIBRARY SETCEXIT, which automatically resynchronizes the tape management system and the library manager database by way of the IDCLI04 exit.

  BTLS supports eight scratch categories. If you use a multiple scratch volume pools, you must also develop a procedure to manage the scratch categories.

- VM/ESA and VSE/ESA

  In a VM/ESA or VSE/ESA environment, it is the responsibility of the tape management system to resynchronize its database with the library manager database. Typically operational procedures are followed to issue the command or start the job provided by the tape management system to synchronize the two databases. The information in the tape management system database is never changed; only the library manager database is updated.

- AIX

  It is the responsibility of the tape management system to update the library manager database for the volumes it controls. If you are using ADSM, use the ADSM volume history file, and CHECKIN the volumes, using the appropriate volume category.

  If you have cartridges inside the IBM 3494 tape library that you have automated through the MTLIB command, set their library manager category by using this MTLIB command:

  ```
  mtlib -l /dev/lmcp0 -C -VAIX001 -txxxx
  ```

  where xxxx is the library manager category you are using.

Appendix A. Library Manager Volume Categories

Table 47 lists all library manager volume categories, and the platforms on which they are used, and their definition.

Table 47 (Page 1 of 8). Library Manager Volume Categories

Category (in hex)	Used by	Definition
0000	Null Category	This pseudo category is used in certain library commands to specify that the category which is already associated with the volume is to be used by default or that no category is specified. Use of the null category does not affect the volume′s order within the category to which it is assigned. No volumes are associated with this category.
0001	DFSMS/MVS	Indicates scratch MEDIA1. MEDIA1 is a standard-capacity cartridge system tape.
0002	DFSMS/MVS	Indicates scratch MEDIA2. MEDIA2 is an enhanced-capacity cartridge system tape.
0003	DFSMS/MVS	Indicates scratch MEDIA3. MEDIA3 is the IBM 3590 High Performance Tape Cartridge.
0004 to 000D	DFSMS/MVS	Reserved
000E	DFSMS/MVS	Indicates an error volume. Volumes in this category are scratch volumes for which the software detected an error during processing.
000F	DFSMS/MVS	Indicates a private volume. Volumes in this category contain user data or are assigned to a user.
0010 to 007F	DFSMS/MVS	Reserved. These volume categories can be used for library partitioning. Refer to 5.1.2.5, "DEVSUPxx Member of SYS1.PARMLIB" on page 131 for implementation details.
0080	DFSMS/VM including VSE Guest	Indicates that the volume belongs to the VM category SCRATCH0
0081	DFSMS/VM including VSE Guest	Indicates that the volume belongs to the VM category SCRATCH1
0082	DFSMS/VM including VSE Guest	Indicates that the volume belongs to the VM category SCRATCH2
0083	DFSMS/VM including VSE Guest	Indicates that the volume belongs to the VM category SCRATCH3
0084	DFSMS/VM including VSE Guest	Indicates that the volume belongs to the VM category SCRATCH4
0085	DFSMS/VM including VSE Guest	Indicates that the volume belongs to the VM category SCRATCH5
0086	DFSMS/VM including VSE Guest	Indicates that the volume belongs to the VM category SCRATCH6
0087	DFSMS/VM including VSE Guest	Indicates that the volume belongs to the VM category SCRATCH7

Table 47 (Page 2 of 8). Library Manager Volume Categories

Category (in hex)	Used by	Definition
0088	DFSMS/VM including VSE Guest	Indicates that the volume belongs to the VM category SCRATCH8
0089	DFSMS/VM including VSE Guest	Indicates that the volume belongs to the VM category SCRATCH9
008A	DFSMS/VM including VSE Guest	Indicates that the volume belongs to the VM category SCRATCHA
008B	DFSMS/VM including VSE Guest	Indicates that the volume belongs to the VM category SCRATCHB
008C	DFSMS/VM including VSE Guest	Indicates that the volume belongs to the VM category SCRATCHC
008D	DFSMS/VM including VSE Guest	Indicates that the volume belongs to the VM category SCRATCHD
008E	DFSMS/VM including VSE Guest	Indicates that the volume belongs to the VM category SCRATCHE
008F	DFSMS/VM including VSE Guest	Indicates that the volume belongs to the VM category SCRATCHF
0090 to 009F	-	Currently not assigned
00A0	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH00
00A1	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH01
00A2	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH02
00A3	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH03
00A4	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH04
00A5	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH05
00A6	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH06
00A7	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH07
00A8	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH08
00A9	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH09
00AA	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH10
00AB	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH11
00AC	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH12
00AD	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH13

Table 47 (Page 3 of 8). Library Manager Volume Categories		
Category (in hex)	**Used by**	**Definition**
00AE	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH14
00AF	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH15
00B0	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH16
00B1	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH17
00B2	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH18
00B3	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH19
00B4	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH20
00B5	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH21
00B6	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH22
00B7	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH23
00B8	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH24
00B9	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH25
00BA	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH26
00BB	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH27
00BC	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH28
00BD	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH29
00BE	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH30
00BF	Native VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH31
00C0 to 00FF	-	Currently not used
0100	OS/400 (MLDD)	Indicates that the volume has been assigned to category *SHARE400. Volumes in this category can be shared with all attached AS/400 systems.
0101	OS/400 (MLDD)	Indicates that the volume has been assigned to category *NOSHARE. Volumes in this category can be accessed only by the OS/400 system that assigned it to the category.

Category (in hex)	Used by	Definition
0102 to 012B	-	No assignment to a specific host system. These categories can be dynamically assigned by the library manager on request of a host.
012C	ADSM for AIX	Indicates a private volume. Volumes in this category are managed by ADSM.
012D	ADSM for AIX	Indicates an IBM 3490 scratch volume. Volumes in this category are managed by ADSM.
012E	ADSM for AIX	Indicates an IBM 3590 scratch volume. Volumes in this category are managed by ADSM.
012F to 0FF1	-	No assignment to a specific host system. These categories can be dynamically assigned by the library manager on request of a host.
0FF2	BTLS	Indicates a scratch volume. Volumes in this category belong to the optional scratch pool SCRTCH2.
0FF3	BTLS	Indicates a scratch volume. Volumes in this category belong to the optional scratch pool SCRTCH3.
0FF4	BTLS	Indicates a scratch volume. Volumes in this category belong to the optional scratch pool SCRTCH4.
0FF5	BTLS	Indicates a scratch volume. Volumes in this category belong to the optional scratch pool SCRTCH5.
0FF6	BTLS	Indicates a scratch volume. Volumes in this category belong to the optional scratch pool SCRTCH6.
0FF7	BTLS	Indicates a scratch volume. Volumes in this category belong to the optional scratch pool SCRTCH7.
0FF8	BTLS	Indicates a scratch volume. Volumes in this category belong to the optional scratch pool SCRTCH8.
0FF9 to 0FFE	-	No assignment to a specific host system. These categories can be dynamically assigned by the library manager on request of a host.
0FFF	BTLS	Indicates a scratch volume. Volumes in this category belong to the default scratch pool used by BTLS. **Note:** If you are planning to migrate to DFSMS/MVS, you should use this default scratch category only.
1000 to F00D	-	No assignment to a specific host system. These categories can be dynamically assigned by the library manager on request of a host.

Table 47 (Page 4 of 8). Library Manager Volume Categories

Category (in hex)	Used by	Definition
F00E	BTLS	Indicates a volume in error. Volumes are assigned to the error category during demount if the volume serial specified for demount does not match the external label of the volume being demounted.
F00F to FEFF	-	No assignment to a specific host system. These categories can be dynamically assigned by the library manager on request of a host.
FF00	All	Insert category. Set when a tape volume is added to the inventory. Used for both native volumes and virtual volumes. In case of a physical volume, the vision system reads the external label on the volume. The library manager creates an inventory entry for the volume and assigns it to this category. The attached hosts are notified when one or more volumes are assigned to this category.
FF01	Virtual Tape Server	Stacked Volume Insert category for Virtual Tape Server subsystem. A volume is set to this category when its volume ID is in the range specified for stacked volumes for any VTS subsystem library partition.
FF02	Virtual Tape Server	Stacked Volume Scratch category 0 for Virtual Tape Server subsystem. m. This category is currently unused.
FF03	Virtual Tape Server	Stacked Volume Scratch category 1 for Virtual Tape Server subsystem. This category is used by any VTS subsystem partition for its scratch stacked volumes.
FF04	Virtual Tape Server	Stacked Volume Private category for Virtual Tape Server subsystem. This category is used by any VTS subsystem partition for its private stacked volumes.
FF05	Virtual Tape Server	Stacked Volume Disaster Recovery category for Virtual Tape Server subsystem. A volume is set to this category when its volume ID is in range specified for stacked volumes for any VTS subsystem library partition and the Library Manager is in Disaster Recovery Mode.
FF06	Library manager	Used by the VTS for it′s backup volumes.
FF07	Library manager	Used by the VTS for it′s transaction log volumes.
FF08 to FF0F	-	Reserved for future hardware functions

Table 47 (Page 5 of 8). Library Manager Volume Categories

Category (in hex)	Used by	Definition
FF10	Library Manager	Eject category. Set when the library manager accepts an eject request. The volume becomes eject pending and is queued to be moved to the convenience output station. When the cartridge accessor delivers the volume to the output station, it is deleted from the library manager′s inventory.
FF11	Library Manager	Bulk Eject category. Set when the library manager accepts an eject request. The volume becomes eject pending and is queued to be moved to the high capacity output station. When the cartridge accessor delivers the volume to the output rack, it is deleted from the library manager′s inventory.
FF12	Virtual Tape Server	Export Pending category. A logical volume to be exported is assigned to this category at the beginning of a Virtual Tape Server export operation. Logical volumes in this category are considered in use. Any attempt by a host to mount, audit, or change the category of a volume fails. The original category of the volume is restored if the export operation is terminated or canceled before the volume is exported.
FF13	Virtual Tape Server	Exported category. Set when the Virtual Tape Server has exported the logical volume. The attached hosts are notified when volumes are assigned to this category. Any attempt by a host to mount, audit, or change the category of a volume, other than to purge the volume from the library manager inventory, fails.
FF14	Virtual Tape Server	Import category. Set for exported stacked volumes which are inserted in the library in preparation for an import operation. The import operation only processes stacked volumes in this category.
FF15	Virtual Tape Server	Import Pending category. Logical volumes to be imported from a stacked volume are added to the library manager inventory and assigned to this category when the Virtual Tape Server starts importing them. At completion, successfully imported volumes are assigned to the insert category (FF00), and unsuccessfully imported volumes are purged from the library manager inventory. The attached hosts are then notified of volumes assigned to the insert category.
FF16	Virtual Tape Server	Unassigned Category. Physical Volumes are assigned to this category when the Virtual Tape Server detects cartridges in the convenience I/O station. Manual interaction is required to assign the cartridges to the proper category. For exported stacked volumes, this would be the insert category (FF14).

Table 47 (Page 6 of 8). Library Manager Volume Categories

Table 47 (Page 7 of 8). Library Manager Volume Categories		
Category (in hex)	**Used by**	**Definition**
FF17	Virtual Tape Server	Export Hold category. Physical Volumes are assigned to this category after export function completes.
FF18 to FFF5	-	Reserved for future hardware functions
FFF6	Library manager	Set when the Library manager detects that a 3590 volume has a unique service volser. Volsers that fit the mask CE xxx (where xxx represents any valid volser characters) are service volumes. The embedded blank makes these labels unique from customer volumes. Normally service cartridges have volsers with the prefix CE (for example, CE 099). The specific cell location is predefined. The host does not have a record of a volume in the service category. The volumes in that category are not reported in inventory data in response to a request from the host.
FFF7	Library manager	Volumes to be used in a mount from the input station operation are placed in this category during the operation.
FFF8	-	Reserved
FFF9	Library manager	Indicates Service Volume. Set when the library manager detects that a 3490E volume has a unique service cartridge volser. Volsers that fit in the mask CE xxx (where xxx represents any valid volume serial characters) are service cartridges. Specific cell locations (defined during the teaching process) are reserved for service cartridges. The hosts do not have a record of volumes in the service volume category. Volumes in this category are not reported in inventory data in response to a request from the host.
FFFA	Library Manager	Indicates manually ejected. Volumes are assigned to this category when they have been removed from the library under the control of an operator, not the host. Volumes in this category are no longer available for any other operations except Purge Volume category assignment. The library manager does not currently support operator initiated ejects.
FFFB	Library Manager	Indicates Purge Volume. Used only with the 3494. When it notices during an inventory update that volumes have been removed since its last update, it places such volumes in the manually ejected category. Hosts can list such volumes and assign them (temporarily) to this purge-volume category. This action deletes their database entries in the Library Manager.
FFFC	Library Manager	Indicates Unexpected Volume. Reserved for future use

Table 47 (Page 8 of 8). Library Manager Volume Categories		
Category (in hex)	**Used by**	**Definition**
FFFD	Library Manager	Indicates a cleaner cartridge for the 3590 tape drive. Assigned to this category when the cleaner volumes are identified by the library manager. Cleaner volumes are recognized when their volume serial matches a mask set up by the operator through the library manager console. Cleaner volumes with the character *J* on the seventh position of the external volume label are assigned to this category. The hosts do not have a record of volumes in the cleaner volume category. Volumes in this category are not reported in inventory data in response to a request from the host.
FFFE	Library Manager	Indicates a cleaner cartridge for IBM 3490 drives. Assigned to this category when the cleaner volumes are identified by the library manager. Cleaner volumes are recognized when their volume serial matches a mask set up by the operator through the library manager console. Cleaner volumes without the character *J* on the seventh position of the external volume label are assigned to this category. The hosts do not have a record of volumes in the cleaner volume category. Volumes in this category are not reported in inventory data in response to a request from the host.
FFFF	All except DFSMS/MVS	Indicates a private volume. Set by the control program. Any tape mount request to this category must be for a specific volume serial, not based on the category only.

Appendix B. MTLIB Command

The following is the full syntax of the MTLIB command:

```
                            ┌─-D─────────────────────────────────────────────────────────┐
                            ├─-m──┬─-f filename─┬──┬─-V volser───┬──┬──────────────┬──┬────┬┤
                            │     └─-x number───┘  └─-s category─┘  └─-t category──┘  └─-n─┘│
►►──mtlib──┬─-l filename────┼─-d──┬─-f filename─┬──┬───────────┬──┬──────────────┬──┬────┬─┼──┬────┬──┬──────────►◄
           │                │     └─-x number───┘  └─-V volser─┘  └─-t category──┘  └─-n─┘ │  └─-v─┘  │
           │                ├─-qV──-V volser─────────────────────────────────────────────┤          │
           │                ├─-qL────────────────────────────────────────────────────────┤          │
           │                ├─-qS────────────────────────────────────────────────────────┤          │
           │                ├─-qI────────────────────────────────────────────────────────┤          │
           │                ├─-qC──-s category───────────────────────────────────────────┤          │
           │                ├─-qD──┬─-f filename─┬───────────────────────────────────────┤          │
           │                │      └─-x number───┘                                       │          │
           │                ├─-qE──-V volser─────────────────────────────────────────────┤          │
           │                ├─-qK──-s category───────────────────────────────────────────┤          │
           │                ├─-qR──┬─────────────┬───────────────────────────────────────┤          │
           │                │      └─-h hostid───┘                                       │          │
           │                ├─-qA──┬─────────────┬───────────────────────────────────────┤          │
           │                │      └─-h hostid───┘                                       │          │
           │                ├─-a──┬─-V volser─┬──────────────────────────────────────────┤          │
           │                │     └─-L list───┘                                          │          │
           │                ├─-c──┬─ filename──┬─────────────────────────────────────────┤          │
           │                │     └─ requestid─┘                                         │          │
           │                ├─-i requestid───────────────────────────────────────────────┤          │
           │                ├─-C──┬─-V volser─┬──┬─────────────┬──-t category──┬────┬────┤          │
           │                │     └─-L list───┘  └─-s category─┘               └─-n─┘    │          │
           │                ├─-k──┬─O───┬──-f filename──-s category──────────────────────┤          │
           │                │     ├─G───┤                                                │          │
           │                │     ├─A───┤                                                │          │
           │                │     ├─OG──┤                                                │          │
           │                │     ├─OA──┤                                                │          │
           │                │     ├─GA──┤                                                │          │
           │                │     ├─OGA─┤                                                │          │
           │                │     ├─C───┤                                                │          │
           │                │     └─X───┘                                                │          │
           │                ├─-r──┬─-s category────────┬──-h hostid──────────────────────┤          │
           │                │     └─-# num_categories──┘                                 │          │
           │                ├─-R -s category──┬─────────────┬────────────────────────────┤          │
           │                │                 └─-h hostid───┘                            │          │
           │                └─-S──-s category──-N name───────────────────────────────────┘          │
           └─-?─────────────────────────────────────────────────────────────────────────────────────┘
```

The *mtlib* program has the following flags:

Flag	Description
-f[*filename*]	Device special file name, for example, */dev/rmt0*
-x[*number*]	Device number, that is, 518350
-l[*filename*]	Library special file name, for example, */dev/lmcp0*
-q[*type*]	Query the library information option:

Type	Description
V	Volume data
L	Library data
S	Statistical data
I	Inventory data
C	Category inventory data
D	Device data
E	Expanded volume data
K	Inventory volume count data
R	Reserved category list
A	Category attribute list

Flag	Description
-D	Return an array of devices configured in the specified library
-m	Mount option
-d	Demount option
-c[*requestid*]	Cancel the pending request option
-n	No wait mode
-i[*requestid*]	Query the request ID status option
-C	Change the category of a volume
-a	Audit the specified volume
-k[*flags*]	Assign a category (with one of the following flags) to a device in the library:

Type	Description
O	Enable the category order
C	Clear the cartridge loader
G	Generate the first mount
A	Enable the auto mount
X	Remove the device category assignment

Flag	Description
-r	Reserve the category
-R	Release the category
-S	Set the category attribute

Note: The categories must be reserved before using this option.

Flag	Description
-s[*category*]	Source or starting category
-t[*category*]	Target category
-V[*volser*]	Volume serial number
-L[*list*]	List of the volume serial numbers
-N[*name*]	Category name to assign to the category
-h[*hostid*]	Host ID for the reserve or release category or the R/A option for the query command
-v	Verbose
-#[*seqno*]	Category or inventory sequence number to reserve
-?	Help text

Note: The *-l* argument is required.

The report in Table 48 was produced by:

```
mtlib -l /dev/lmcp0 -qV -VCS2000 (for AIX products)
mtlib -l libmgrc7 -qV -VCS2000   (for Sun products)
```

Table 48. Volume Query

```
Performing Query Volume Data using /dev/lmcp0
Volume Data:
   state................00
   class................00
   volser...............CS2000
   category.............FE00
   subsystem affinity...01 00 00 00 00 00 00 00
                        00 00 00 00 00 00 00 00
                        00 00 00 00 00 00 00 00
                        00 00 00 00 00 00 00 00
```

The report in Table 49 was produced by:

```
mtlib -l /dev/lmcp0 -f /dev/rmt5 -qD (for AIX products)
mtlib -l libmgrc7 -f /dev/rmt5 -qD   (for Sun products)
```

Table 49. Device Query

```
Performing Query Device Data on /dev/rmt5 using /dev/lmcp0
Device Data:
   mounted volser.......none.
   device category......0000
   device state.........Device installed in Library.
                        Device available to Library.
                        ACL is installed.
                        Undefined device state. - 0x01
   device class.........3490 Model B20/B40
```

The report in Table 50 was produced by:

```
mtlib -l /dev/lmcp0 -qE -VCS2000 (for AIX products)
mtlib -l libmgrc7 -qE -VCS2000   (for Sun products)
```

Table 50. Expanded Volume Data

```
Performing Query Extended Volume Data using /dev/lmcp0
Expanded Volume Data:
   volume status........0000
   volume attribute.....00
   volser...............CS2000
   device category......FE00
```

The report in Table 51 was produced by:

```
mtlib -l /dev/lmcp0 -qK (for AIX products)
mtlib -l libmgrc7 -qK   (for Sun products)
```

Table 51. Inventory Count Data

```
Performing Query Inventory Volume Count Data using /dev/lmcp0
Inventory Volume Count Data:
   sequence number......12345
   number of volumes....207
   category.............0000
```

The report in Table 52 was produced by:

```
mtlib -l /dev/lmcp0 -qL (for AIX products)
mtlib -l libmgrc7 -qL   (for Sun products)
```

Table 52. Library Data

```
Performing Query Library Data using /dev/lmcp0
Library Data:
   state................Automated Operational State
                        Dual Write Disabled
   input stations.......1
   output stations......1
   input/output status..All input stations empty
                        All output stations empty
   machine type.........3494
   sequence number......12345
   number of cells......207
   available cells......0
   subsystems...........1
   convenience capacity.20
   accessor config......01
   accessor 0 status....Accessor available
                        Gripper 0 available
                        Gripper 0 vision operational
                        Gripper 1 not installed
                        Gripper 1 vision not operational
   accessor 1 status....00
   accessor 2 status....00
   accessor 3 status....00
   accessor 4 status....00
   accessor 5 status....00
   accessor 6 status....00
   accessor 7 status....00
   comp avail status....Primary library manager installed.
                        Primary library manager available.
                        Primary hard drive installed.
                        Primary hard drive available.
                        Secondary hard drive installed.
                        Secondary hard drive available.
                        Convenience input station installed.
                        Convenience input station available.
                        Convenience output station installed.
                        Convenience output station available.
```

The report in Table 53 was produced by:

```
mtlib -l /dev/lmcp0 -qS (for AIX products)
mtlib -l libmgrc7 -qS   (for Sun products)
```

Table 53. Statistical Data

```
Performing Query Statistical Data using /dev/lmcp0
Statistical Data:
   hour index...........9
   drives...............2
   mounted drives.......1
   max mounted drives...2
   min mounted drives...1
   avg mounted drives...1
   max mounted time.....22
   min mounted time.....16
   avg mounted time.....19
   pending mounts.......0
   max pending mounts...2
   min pending mounts...0
   avg pending mounts...0
   mounts/hour..........18
   index mounts/hour....0
   pre-mounts/hour......0
   max mount time.......27
   min mount time.......16
   avg mount time.......19
   pending demounts.....0
   max pending demounts.2
   min pending demounts.0
   avg pending demounts.0
   demounts/hour........16
   index demounts/hour..0
   post-demounts/hour...0
   max demount time.....28
   min demount time.....19
   avg demount time.....24
   pending ejects.......0
   max pending ejects...0
   min pending ejects...0
   avg pending ejects...0
   ejects/hour..........0
   max eject time.......0
   min eject time.......0
   avg eject time.......0
   pending audits.......0
   max pending audits...0
   min pending audits...0
   avg pending audits...0
   audits/hour..........0
   max audit time.......0
   min audit time.......0
   avg audit time.......0
   input stores/hour....0
```

The report in Table 54 was produced by:

```
mtlib -l /dev/lmcp0 -qI (for AIX products)
mtlib -l libmgrc7 -qI   (for Sun products)
```

Table 54. Inventory Query

```
Performing Query Inventory Data using /dev/lmcp0
Inventory Data:
   sequence number......12345
   number of volumes....207
   inventory records
        record   0......category value......FE00
                        volser..............CS2000
                        volume attribute....00
                        volume class........00
                        volume type.........00
        record   1......category value......FE00
                        volser..............CS2001
                        volume attribute....00
                        volume class........00
                        volume type.........00
        record   2......category value......FF00
                        volser..............CS2002
                        volume attribute....00
                        volume class........00
                        volume type.........00
        record   3......category value......FF00
                        volser..............CS2003
                        volume attribute....00
                        volume class........00
                        volume type.........00
                        •
                        •
                        •
        record  97......category value......FF00
                        volser..............CS2100
                        volume attribute....00
                        volume class........00
                        volume type.........00
        record  98......category value......FF00
                        volser..............CS2101
                        volume attribute....00
                        volume class........00
                        volume type.........00
        record  99......category value......FF00
                        volser..............CS2102
                        volume attribute....00
                        volume class........00
                        volume type.........00

Note:  All available records are produced as output per request.
       Fewer records are shown here for the sake of brevity.
```

The report in Table 55 was produced by:

```
mtlib -l /dev/lmcp0 -qC -sFF00 (for AIX products)
mtlib -l libmgrc7 -qC -sFF00   (for Sun products)
```

Table 55. Category Inventory Query

```
Performing Query Category Inventory Data using /dev/lmcp0
Inventory by Category Data:
   sequence number......12345
   number of volumes....205
   category.............FF00
   inventory records
        record   0......category value......FF00
                        volser..............CS2017
                        volume attribute....00
                        volume class........00
                        volume type.........00
        record   1......category value......FF00
                        volser..............CS2016
                        volume attribute....00
                        volume class........00
                        volume type.........00
        record   2......category value......FF00
                        volser..............CS2015
                        volume attribute....00
                        volume class........00
                        volume type.........00
        record   3......category value......FF00
                        volser..............CS2014
                        volume attribute....00
                        volume class........00
                        volume type.........00
                        •
                        •
                        •
        record  97......category value......FF00
                        volser..............CS2098
                        volume attribute....00
                        volume class........00
                        volume type.........00
        record  98......category value......FF00
                        volser..............CS2097
                        volume attribute....00
                        volume class........00
                        volume type.........00
        record  99......category value......FF00
                        volser..............CS2096
                        volume attribute....00
                        volume class........00
                        volume type.........00

Note:  All available records are produced as output per request.
       Fewer records are shown here for the sake of brevity.
```

The report in Table 56 was produced by:

```
mtlib -l /dev/lmcp0 -r -#2 (for AIX products)
mtlib -l libmgrc7 -r -#2   (for Sun products)
```

Table 56. Reserve Category Command

```
Performing Reserve Category Inventory Data using /dev/lmcp0
Reserved Category List:
   sequence number............CA008
   system token...............9732019
   total number reserved......0002
                        category value......0105
                        category value......0106
```

The report in Table 57 was produced by:

```
mtlib -l /dev/lmcp2 -qR (for AIX products)
mtlib -l libmgrc7 -qR   (for Sun products)
```

Table 57. Reserve Category List

```
Performing Reserve Category List Data using /dev/lmcp2
Reserved Category List:
   sequence number............CA008
   system token...............9732019
   total number reserved......0002
                        category value......0105
                        category value......0106
```

The report in Table 58 was produced by:

```
mtlib -l /dev/lmcp0 -S -s105 -NSCRATCH (for AIX products)
mtlib -l /dev/lmcp0 -S -s106 -NWORKING (for AIX products)
mtlib -l /dev/lmcp0 -qA                (for AIX products)

mtlib -l libmgrc7 -S -s105 -NSCRATCH   (for Sun products)
mtlib -l libmgrc7 -S -s106 -NWORKING   (for Sun products)
mtlib -l libmgrc7 -qA                  (for Sun products)
```

Table 58. Category Attribute List

```
Category Attribute List:
   sequence number............CA008
   system token...............9732019
                        category value......0105, name.....SCRATCH
                        category value......0106, name.....WORKING
```

B.1 MTEVENT Program

The *mtevent* program is a command-line interface to the MTIOCLEW command. See the manual page on MTEVENT for more information.

The *mtevent* program has the following flags:

Flag	Description
-*l*[*filename*]	Library special file name, for example, */dev/lmcp0*
-*t*[*timeout*]	Number of seconds to wait for the event to occur (0 = no timeout)

Notes:

1. The *-l* flag is required.
2. If the *-t* flag is not supplied, timeout is not performed.

Appendix C. Special Notices

This publication is intended to help customer, Business Partner, and IBM storage system technical professionals implement the IBM Magstar 3494 Tape Libraries. The information in this publication is not intended as the specification of any programming interfaces that are provided by the IBM Tape Libraries. See the PUBLICATIONS section for more information about what publications are considered to be product documentation.

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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 International Technical Support Organization Publications

For information on ordering these ITSO publications see "How to Get ITSO Redbooks" on page 375.

- *Enhanced IBM Magstar Virtual Tape Server: Implementation Guide*, SG24-2229
- *IBM Magstar 3590 Tape Subsystem: Multiplatform Implementation*, SG24-2594
- *Guide to Sharing and Partitioning IBM Tape Library Dataservers*, SG24-4409
- *DFSMShsm Primer*, SG24-5272
- *Converting to Removable Media Manager: A Practical Guide*, SG24-4998
- *ADSM for MVS: Using Tapes and Tape Libraries*, SG24-4538
- *Lights Out! Advanced Tape Automation Using VM/ESA,* GG24-4347
- *NaviQuest Demonstration and Hands-On Usage Guide,* SG24-4720

D.2 Redbooks on CD-ROMs

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CD-ROM Title	Subscription Number	Collection Kit Number
System/390 Redbooks Collection	SBOF-7201	SK2T-2177
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RS/6000 Redbooks Collection (PDF Format)	SBOF-8700	SK2T-8043
Application Development Redbooks Collection	SBOF-7290	SK2T-8037

D.3 Other Publications

These publications are relevant as further information sources:

- *OS/390 MVS System Messages, Vols. 1-5,* , GC28-1784/85/86/87/88
- *OS/390 MVS Initialization and Tuning Reference,* SC28-1752
- *OS/390 JES3 Initialization and Tuning Reference,* SC28-1803
- *DFSMS/MVS DFSMSdfp Storage Administration Reference,* SC26-4920
- *DFSMS/MVS OAM PISA for Tape Libraries,* SC26-3051
- *DFSMS/MVS Implementing System Managed Storage*, SC26-3123
- *DFSMS/MVS DFSMShsm Implementing and Customizing*, SH21-1078

- *DFSMS/MVS DFSMSrmm Guide and Reference*, SC26-4931
- *DFSMS/MVS DFSMSrmm Implementation and Customization Guide*, SC26-4932
- *DFDSS V2R5 and DFSMSdss Stand-Alone Services Overview,* SC26-0185
- *ICFRU Program Description/Operations Manual,* SH20-6952
- *DFSMS/MVS V1R2 Using the Volume Mount Analyzer,* SC26-4925
- *BTLS V1R1 User's Guide and Reference*, SC26-7016
- *IBM 3494 User's Guide: Device Driver VSE/ESA,* GC35-0176
- *DFSMS/VM FL 221 Removable Media Services User's Guide and Ref.,* SC35-0141
- *IBM Magstar 3590 Tape Subsystem Introduction and Planning,* GA32-0329
- *IBM Magstar 3590 Tape Subsystem Operator's Guide,* GA32-0330
- *IBM 3590 Hardware Reference,* GA32-0331
- *3590 Silo-Compatible Frame Model C12 & C14 Intro., Plan., & User's Guide,* GA32-0366
- *IBM 3494 Tape Library Dataserver Introduction and Planning Guide,* GA32-0279
- *IBM 3494 Tape Library Dataserver Operator's Guide,* GA32-0280
- *IBM 3494 User's Guide: Media Library Device Driver for AS/400,* GC35-0153
- *SCSI Device Drivers: Installation and User's Guide,* GC35-0154
- *IBM AIX Parallel and ESCON Channel Tape Attachment/6000,* GA32-0311
- *Automated Tape Library Planning V3R7,* SC41-3309
- *Backup Recovery and Media Services/400 V3R2,* SC41-3345
- *Backup Recovery and Media Services V3R7,* SC41-4345
- *R/DARS for OS/400 V3R1 Installation and User's Guide,* SC26-7073

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This section explains how both customers and IBM employees can find out about ITSO redbooks, CD-ROMs, workshops, and residencies. A form for ordering books and CD-ROMs is also provided.

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  ```

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  ```
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  TOOLS SENDTO USDIST MKTTOOLS MKTTOOLS GET LISTSERV PACKAGE
  ```

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- **Redbooks Web Site on the World Wide Web**

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- **IBM Direct Publications Catalog on the World Wide Web**

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