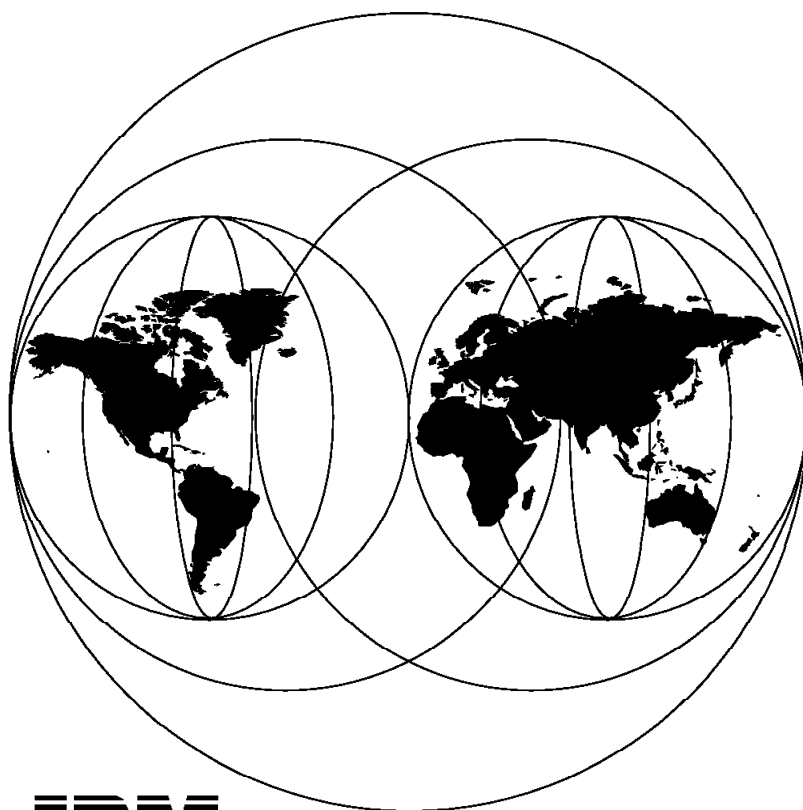# Magstar and IBM 3590 High Performance Tape Subsystem: Multiplatform Implementation

February 1997

IBM

International Technical Support Organization

San Jose Center

International Technical Support Organization

Magstar and IBM 3590 High Performance Tape Subsystem: Multiplatform Implementation

February 1997

> **Take Note!**
>
> Before using this information and the product it supports, be sure to read the general information in Appendix M, "Special Notices" on page 333.

1 **Fourth Edition (February 1997)**

This edition applies to the IBM 3590 High Performance Tape Subsystem, IBM 3591 tape control unit, IBM Magstar Virtual Tape Server, IBM 3494 enhancements, and IBM 3590-C12.

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Preface

This document is intended to help customers and IBM technical professionals implement the IBM 3590 High Performance Tape Subsystem on various platforms such as AIX/6000, OS/400, MVS/ESA, VM/ESA, and Sun systems. The IBM 3590 tape subsystem can also coexist with the current IBM 3490E tape subsystem in the IBM 3494 and 3495 Automated Tape Library Dataservers.

In addition to this, this second edition has been added information about IBM 3591 tape subsystem than can be used on OS/390, MVS/ESA, VM/ESA, and VSE/ESA platforms through an ESCON channel interface. The IBM 3591 tape subsystem uses IBM 3590 Magstar tape drives and 3590 high performance tape cartridges but it is looked as IBM 3490E tape subsystem from a software point of view. The third edition has been updated for IBM 3590-A00 ESCON tape controller and has been added information about IBM Magstar Virtual Tape Server and IBM 3590 Silo-Compatible tape subsystem.

This redbook describes the product overview, hardware and software implementation, migration, and operational considerations in various operating environments such as MVS/ESA, VM/ESA, AIX/6000, OS/400, and Sun systems. This information can be used to help customers plan and prepare their IBM 3590 and IBM 3591 tape subsystems implementation.

This document is written for storage administrators, systems programmers, and other technical professionals involved with and interested in storage subsystems.

How This Redbook Is Organized

This redbook contains 354 pages. It is organized as follows:

- Part 1, "Magstar and IBM 3590 High Performance Tape Subsystem"

  Part 1 provides information about Magstar and the IBM 3590 High Performance Tape Subsystem. It is organized as follows:

  - Chapter 1, "Introduction"

    This chapter gives an overview on the new Magstar and IBM 3590 High Performance Tape Subsystem hardware, including its attachment options, and the software support that is provided on different platforms.

  - Chapter 2, "Planning for Magstar"

    In this chapter, we explain which basic considerations have to be taken into account when implementing IBM 3590 High Performance Tape Subsystems especially when they are to be installed in an IBM 3494 or 3495 Automated Tape Library Dataserver.

  - Chapter 3, "Hardware Implementation"

    This chapter provides information to assist with the hardware implementation of the IBM 3590 High Performance Tape Subsystem, such as the environmental requirements for the IBM 3590 High Performance Tape Cartridge and the IBM 3590 tape subsystem, the components of the IBM 3590 tape subsystem, and their integration into IBM 3494 and 3495 Automated Tape Library Dataservers. Considerations affecting

platform-specific hardware implementations and multiplatform attachment options are discussed.

– Chapter 4, "Software Implementation"

In this chapter, we guide you through the software implementation steps in all environments that currently support the IBM 3590 High Performance Tape Subsystem. In each section, we first describe how to implement one or more stand-alone Magstar tape drives. Next, we explain additional implementation steps to be performed when using IBM 3590 tape subsystems inside an IBM 3494 or 3495 Automated Tape Library Dataserver.

– Chapter 5, "Migration in an MVS/ESA Environment"

In this chapter, we discuss migration considerations related to implementing an IBM 3590 tape subsystem in an MVS/ESA environment. Before we discuss the actual implementation, we describe the changes that have been introduced with the IBM 3590 tape subsystem and the latest versions of the MVS software regarding tape and tape management. We then discuss which data and applications can make the best use of the superior capacity and performance of the IBM 3590 High Performance Tape Subsystem and how to identify those in your environment as well as how to migrate them.

– Chapter 6, "Migration in Non-MVS Environments"

In this chapter we discuss migration considerations related to implementing IBM 3590 tape subsystems in VM/ESA, AIX/6000 and OS/400 environments. We do not cover VSE/ESA migration because VSE/ESA support is not available at time of writing.

– Chapter 7, "Operational Considerations for IBM 3590"

The IBM 3590 tape subsystem introduces new media and drives into the operational environment. In this chapter, we explain the new operational considerations associated with this tape subsystem. We discuss, in detail, operating the IBM 3590 tape subsystem, handling the new media, and problem recovery procedures.

• Part 2, "IBM 3490E Emulation Provided by IBM 3591 ESCON Tape Control Unit"

Part 2 provides information about the IBM 3591 ESCON Tape Control Unit. It is organized as follows:

– Chapter 8, "IBM 3591 Tape Subsystem Overview"

In this chapter we provide an overview of the IBM 3591 ESCON Tape Control Unit.

– Chapter 9, "IBM 3490E Emulation"

From a software point of view, the IBM 3591 provides 3490E emulation even though IBM 3590 tape drives are used. In this chapter we describe the difference in 3490E emulation provided by the IBM 3591, the native 3490E, and the IBM 3590.

– Chapter 10, "IBM 3591 Hardware Implementation"

In this chapter we provide information to assist with hardware implementation of the IBM 3591.

– Chapter 11, "IBM 3591 Software Implementation"

In this chapter we explain how to implement software in MVS/ESA, VM/ESA, and VSE/ESA environments.

  – Chapter 12, "Migration from IBM 3591 to IBM 3590"

  In this chapter we discuss the considerations for migrating from the IBM 3591 tape subsystem to a native IBM 3590 tape subsystem environment.

  – Chapter 13, "Operational Considerations for IBM 3591"

  In this chapter we describe operational considerations related to the IBM 3591 tape subsystem.

• Appendix A, "Enterprise Systems Connection (ESCON) Tutorial"

Enterprise Systems Connection (ESCON) is the most significant change to the I/O area of data processing since the original parallel Original Equipment Manufacturer Interface (OEMI) was introduced nearly 30 years ago. In this chapter, we describe ESCON terminology, fiber optic technology, ESCON architecture, and standards.

• Appendix B, "Small Computer Systems Interface Tutorial"

Small Computer Systems Interface (SCSI) is fully documented in ANSI standard X3.131-1986. This appendix provides you with basic knowledge of SCSI to understand this redbook more easily.

• Appendix C, "Enhancements to IBM 3494 Automated Tape Library Dataserver"

This appendix describes three enhancements to the IBM 3494:

  – Dual gripper

  – Additional options for the high-capacity output facility

  – Enhanced capacity convenience I/O station.

• Appendix D, "Library Manager Volume Categories"

This appendix lists all library manager volume categories, indicates the platforms on which they are used, and explains their meaning.

• Appendix E, "IBM 3590, 3494 and 3495 Special Feature Codes"

This appendix provides special-feature codes for the IBM 3590 High Performance Tape Subsystem and IBM 3494 and 3495 Automated Tape Library Dataservers.

• Appendix F, "SCSI Cabling for Magstar and IBM 3590 Tape Subsystem"

This appendix provides supplementary information of cabling the IBM 3590 tape subsystem in the SCSI attached environment.

• Appendix G, "IBM 3591 Tape Subsystem Presentation"

This appendix provides additional materials for you to use when presenting the IBM 3591 tape subsystem.

• Appendix H, "Read Characteristic and Read Buffered Log CCWs"

This appendix provides additional CCW descriptions that are provided by the IBM 3591 for 3490E emulation.

• Appendix I, "Tape Subsystem Comparison Chart"

This appendix provides a table that describes the major differences among the IBM 3480, 3490E, 3591, and 3590 tape subsystems.

- Appendix J, "QTAPE Option of the DEVSERV MVS Operator Command"

  The QTAPE option of the DEVSERV operator command has been designed to assist system operators, system programmers, configuration administrators, and customer service personnel in acquiring physical identification, status, and diagnostic information about tape devices in large, complex MVS/ESA configurations. This appendix provides a detailed description of the operator command.

- Appendix K, "IBM Magstar 3590 Silo-Compatible Tape Subsystem"

  This appendix describes how the IBM 3590 tape drives can be installed in a StorageTek Automated Cartridge System that is usually called "Silo."

- Appendix L, "Sample Cleaning Program"

  This appendix shows how to get a sample cleaning program for IBM 3590 tape drives that are installed in StorageTek Automated Cartridge System.

The Team That Wrote This Redbook

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Comments Welcome

We want our redbooks to be as helpful as possible. Should you have any comments about this or other redbooks, please send us a note at the following address:

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Your comments are important to us!

Summary of Changes

This section describes the changes made to the first edition (SG24-2594-00) of this redbook.

SG24-2594-02.1 (Januray 1997)

Following items have been updated and added in this revision.

- Correct FIXCDS control statements for DFSMShsm in Chapter 12.6, "DFSMShsm or DFHSM" on page 217.

Minor corrections also have been made throughout.

SG24-2594-02 (November 1996)

Following items have been updated and added in this revision.

- IBM 3590-A00 ESCON tape controller
- IBM Magstar Virtual Tape Server
- IBM 3494 capacity enhancements
- IBM 3590 Silo-Compatible tape subsystem (see Appendix K, "IBM Magstar 3590 Silo-Compatible Tape Subsystem" on page 303)
- ADSM for MVS and VM read compatibility enhancement for IBM 3590 cartridges written on IBM 3591-A01 controller
- VMA IBM 3590 support

Minor corrections also have been made throughout.

SG24-2594-01 (July 1996)

Information about the IBM 3591 tape subsystem has been added as Part 2, "IBM 3490E Emulation Provided by IBM 3591 ESCON Tape Control Unit." Appendix G, "IBM 3591 Tape Subsystem Presentation" through Appendix J, "QTAPE Option of the DEVSERV MVS Operator Command," have also been added.

Information about the IBM 3591 SCSI cabling has been added to Appendix F, "SCSI Cabling for Magstar and IBM 3590 Tape Subsystem."

Minor corrections have been made throughout.

Part 1. Magstar and IBM 3590 High Performance Tape Subsystem

In Part 1 we describe the implementation of the new Magstar and IBM 3590 High Performance Tape Subsystem hardware. We cover attachment options, and the software support that is provided on different platforms. We provide detailed information about implementation tasks and operational considerations for the different environments.

Chapter 1. Introduction

In this chapter, we give an overview of the new Magstar and IBM 3590 High Performance Tape Subsystem hardware, including its attachment options, and the software support that is provided on different platforms. We provide detailed information on implementation tasks and operational considerations for the different environments in Chapter 2, "Planning for Magstar" on page 11 to Chapter 7, "Operational Considerations for IBM 3590" on page 141 of this book.

The IBM 3590 High Performance Tape Subsystem is a new family of tape drives designed to provide high capacity, high performance, high reliability, and connectivity for a wide range of hosts. The Magstar tape drive, a key component of the IBM 3590 High Performance Tape Subsystem, reads and writes in a new 128-track format. While reading or writing 16 tracks at a time, the Magstar tape drive 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 will index, or move vertically, when it completes each round trip so that the recorded tracks will be interleaved across the width of the tape.

The IBM 3590 High Performance Tape Subsystem uses a new metal particle medium in the IBM 3590 High Performance Tape Cartridge that can store 10 GB of uncompacted data. The Magstar tape drive uses a new compaction algorithm which can increase the storage capacity of these new cartridges to 30 GB. The IBM 3590 High Performance Tape Cartridges are the same physical size as today's cartridge system tape (CST or MEDIA1) and enhanced-capacity cartridge system tape (ECCST or MEDIA2) and can be placed in the IBM 3494 and 3495 Automated Tape Library Dataservers.

The Magstar tape drive is capable of reading and writing data at a rate of 9 MB/sec. This is three times the rate at which IBM 3490E devices can read and write data. The IBM 3590 High Performance Tape Subsystem can transfer data between the host and the tape subsystem at a rate of 20 MB/sec for hosts attached through small computer systems interface (SCSI), and a rate of 17 MB/sec for hosts attached through Enterprise System Connection (ESCON) channels.

We also introduce the concept of the IBM Magstar Virtual Tape Server (VTS). The VTS is an easy-to-use cost/performance solution intended for customers with a large number of partially full tape volumes. The VTS provides "volume stacking" capability, allowing the user to "stack" multiple virtual volumes onto a single IBM 3590 High Performance Tape Cartridge. The VTS also provides the 3490E emulation capability that will allow installation of the VTS without migrating to new software levels. The VTS is composed of the IBM 3494-B16 or IBM 3495-B16 Virtual Tape Server unit with IBM 3590 tape subsystem in the IBM 3494 or 3495 Automated Tape Library Dataserver.

The following sections give an overview of the hardware and software that we cover in this book. Refer to *Magstar and IBM 3590 High Performance Tape Subsystem Technical Guide* and *IBM Magstar Virtual Tape Server and Enhancements to Magstar: New Era in Tape* for details.

1.1 Hardware Overview

The IBM 3590 High Performance Tape Subsystem, which features the **Magstar** tape drive, introduces a new technology for longitudinal recording. The new technology can significantly increase the performance of longitudinal recording while considerably improving reliability.

1.1.1 Components

Figure 1 shows the hardware components that make up the IBM 3590 High Performance Tape Subsystem and how it fits in the IBM tape library subsystems.
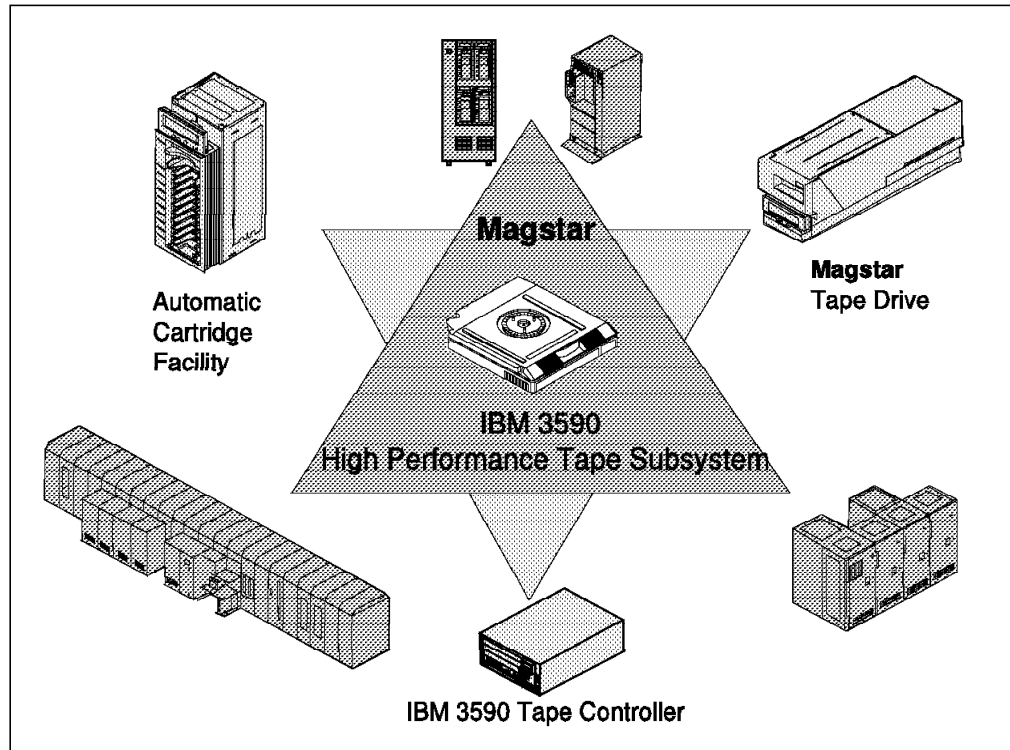
Figure 1. Magstar and IBM 3590 High Performance Tape Subsystem

A new type of metal particle medium is used in the new IBM 3590 High Performance Tape Cartridge. The new cartridge has the same dimensions as the cartridges currently used with IBM 3490 or 3490E tape subsystems which allows handling in the IBM 3494 and 3495 Automated Tape Library Dataservers.

The IBM 3590 High Performance Tape Subsystem consists of the following components:

- The **Magstar** tape drive, which has its own integral control unit function, a 9 MB/sec drive data rate, a 20 MB/sec small computer system interface (SCSI) data rate, and an improved compression algorithm IBMLZ1 that offers more efficiency than the algorithm currently used in the IBM 3480 and 3490 tape subsystem′s Improved Data Recording Capability (IDRC). The drives attach directly to the host when using SCSI connection.

- The **IBM 3590 tape controller**, if the Magstar tape drives are to be attached to the ESCON channel.

- The **automatic cartridge facility** (ACF) with a ten-cartridge magazine that provides quick loading and removing a set of ten cartridges to and from the

ACF. In addition to the magazine, the ACF has an eleventh slot for specific mounts. The ACF introduces two new modes of operation:

Accumulate mode   facilitates the removal of cartridges by the operator.

Random mode   allows the host programming software to control the ACF directly and utilize the IBM 3590 High Performance Tape Subsystem as a minilibrary.

The product range includes the following models:

IBM 3590-B11   is the Magstar tape drive that can be installed in the IBM 3590-A14 and a standard 19-inch rack, such as the IBM 7202 or the IBM 9309. IBM 3590-B11 has the ACF.

IBM 3590-B1A   is the Magstar tape drive installed in the IBM 3494 and IBM 3495 tape libraries. When installed in the IBM 3495, the IBM 3590-B1A must be installed in the IBM 3590-A14 frame as described below. IBM 3590-B1A does not have the ACF.

IBM 3590-A00   is the tape controller that is used to attach up to four Magstar tape drives to one or two ESCON channels. The IBM 3590-A00 controller can be installed in the IBM 3494 or in an IBM 3590-A14 frame, as described below.

A modem must be supplied for installation, and remote support service of the IBM 3590-A00.

Note: Because all SCSI ports of a Magstar tape drive are attached to the IBM 3590-A00, ESCON and SCSI attachments must not be intermixed.

IBM 3590-A14   is a new frame box in which one IBM 3590-A00 tape controller and up to four IBM 3590-B11 or four IBM 3590-B1A drives can be installed. The IBM 3590-A14 frame configured with four IBM 3590-B1A drives can be installed in a IBM 3495.

IBM 3590-C12   is a Silo-compatible frame where four IBM 3590-B1A drives can be installed. The IBM 3590-C12 with IBM 3590-B1A drives attached to one or two IBM 3590-A01 ESCON tape control units can bring the benefits of the Magstar 3590 technology to users of the StorageTek Automated Cartridge System. The IBM 3590-C12 can be installed in StorageTek Automated Cartridge System Models 4410 and 9310, with up to four IBM 3590-C12 frames for each Automated Cartridge System. IBM software support for the IBM 3590-C12 is the same as for the IBM 3591-A01.

For more information about IBM 3590-C12, see Appendix K, "IBM Magstar 3590 Silo-Compatible Tape Subsystem" on page 303 and *IBM 3590 Magstar High Performance Tape Subsystem Silo-Compatible Frame Model C12 Introduction, Planning and User's Guide* .

For more information about IBM 3591-A01, see Part 2, "IBM 3490E Emulation Provided by IBM 3591 ESCON Tape Control Unit" on page 157

For more details about the components listed above, except IBM 3590-C12, please refer to Chapter 2, "Planning for Magstar" on page 11 and to the *Magstar and IBM 3590 High Performance Tape Subsystem Technical Guide*.

1.1.2 Host Environments and Channel Attachment

The IBM 3590 High Performance Tape Subsystem attaches to RISC/6000, IBM RS/6000 Scalable POWERparallel Systems, AS/400, ES/9000, ES/3090-J, ES/3090-9000T, S/390 Parallel Server, and Sun systems either through SCSI-2 68-pin P cables or through ESCON channels by way of the IBM 3590-A00 tape controller. Table 1 shows the attachment options for the different host systems.

Table 1. IBM 3590 High Performance Tape Subsystem Host Attachment Options		
Host Environment	ESCON	SCSI
ES/9000	√	-
ES/3090-J, ES/3090-9000T	√	-
S/390 Parallel Server	√	-
AS/400	-	√
RISC/6000	-	√
IBM RS/6000 Scalable POWERparallel Systems	-	√
SUN	-	√

1.1.3 Automated Tape Library Support

The IBM 3590 tape subsystem can be integrated into IBM 3494 and 3495 Automated Tape Library Dataservers and can coexist with IBM 3490 enhanced models in an IBM 3494. In the IBM 3495, the IBM 3590 tape subsystem can coexist with both the IBM 3490 base models and the IBM 3490 enhanced models. The IBM 3495 model M10 Manual Tape Library Dataserver does not support the IBM 3590 High Performance Tape Subsystem.

When attached through ESCON channels, the communication between host and Library Manager of the IBM automated tape library is over the ESCON channel. If the IBM 3590 tape subsystem is attached to the host through a SCSI-2 connection, the communication between host and Library Manager is provided by means of a separate RS-232 or LAN (Token-Ring or Ethernet) connection.

1.1.4 IBM Magstar Virtual Tape Server

The IBM Magstar Virtual Tape Server provides new views of volumes and devices because of the different knowledge about volumes and devices in the host system and the hardware. Using a Virtual Tape Server subsystem, the host application writes tape data to virtual devices. The volumes created by the host are called *virtual volumes* and are physically stored in a Tape Volume Cache which is built from RAID DASD devices.

Through tape volume cache management policies, the Virtual Tape Server controller function moves host-created volumes from the tape volume cache to a Magstar cartridge managed by the Virtual Tape Server subsystem. Once a virtual volume is moved from the tape volume cache to tape, it becomes a logical volume.

The Virtual Tape Server subsystem presents itself to the host as 32 IBM 3490E tape drives in an IBM Automated Tape Library Dataserver, thus allowing much more parallelism in tape processing. Because of the large number of logical tape drives, more drives can now be dedicated to different hosts and platforms. In most cross-platform installations, dynamic and automatic sharing of tape

drives may no longer be required, although the Virtual Tape Server fully supports existing tape-drive sharing methods.

To allow software transparency and implementation of a Virtual Tape Server subsystem with no changes to the host's operating system software, the host is allowed only a virtual view of the volumes and tape drives managed by the Virtual Tape Server subsystem. The host cannot distinguish between physical and virtual volumes and tape drives and will treat them all as if they were "real" cartridges and devices.

Management of physical Magstar tape drives and Magstar cartridges is completely under the control of the Virtual Tape Server storage management software.

Please refer to *The IBM Magstar Virtual Tape Server and Enhancements to Magstar: New Era in Tape* for more details.

1.2 Software Overview

The IBM 3590 High Performance Tape Subsystem can be attached through SCSI or through ESCON channels to the host. Table 2 summarizes the software support for the IBM 3590 tape subsystem installed as a stand-alone or in an IBM 3494 or 3495 Automated Tape Library Dataserver.

Table 2. IBM 3590 High Performance Tape Subsystem Software Support			
Host Software	**3590 Stand-alone**	**3590 in 3494**	**3590 in 3495**
MVS DFSMS 1.2.0 and 1.3.0	ESCON	ESCON	ESCON
MVS BTLS with DFSMS 1.2.0 and 1.3.0	ESCON	ESCON	ESCON
MVS Non-DFSMS •	No support	No support	No support
VM/ESA V2.1.0	ESCON	ESCON	ESCON
VSE/ESA V2	ESCON	ESCON	No support
VM/VSE or VGS	ESCON	ESCON	No support
TPF V4.1	ESCON	ESCON	No support
AIX V3.2.5	SCSI	SCSI	No support
AIX V4.1	SCSI	SCSI	No support
OS/400 V3.1	SCSI	SCSI	No support
SunOS R5.2 or 5.3 Solaris R2.2 or 2.3	SCSI	SCSI	No support
•The IBM 3590 tape subsystem is not supported in environments that are running a pre-DFSMS/MVS version of DFP.			

1.2.1 MVS/ESA

The IBM 3590 support is provided as a small programming enhancement (SPE) to the MVS/ESA basic control program (BCP), JES3 component, and DFSMS/MVS.

MVS/ESA BCPs SP 4.3, 5.1.0, and 5.2.0 provide the basic device support, hardware configuration definition (HCD), the stand-alone dump (SADMP)

program, and a new generic unit name for the IBM 3590 tape subsystem in both stand-alone and library installations .

JES3 Version 4.2.1, 5.1.1, or 5.2.1 provides support for the IBM 3590 tape subsystem by means of a new library device group name for IBM 3590 devices installed in an IBM 3494 and 3495 Automated Tape Library Dataservers, a new DTYPE for JUNIT, and the JES3 Dump Job (DJ) Dynamic Support Program (DSP).

DFSMS/MVS 1.2.0 and subsequent releases support the IBM 3590 tape subsystem in both stand-alone and library environments and supports the ACF including the automated cartridge loaders (ACLs) in the IBM 3480 and the integrated cartridge loaders (ICLs) in the IBM 3490 and IBM 3490E tape subsystems. DFSMS/MVS 1.2.0 and subsequent releases support the IBM 3590 High Performance Tape Subsystem by providing tape error recovery (ERP), enhancements to the sequential access method (SAM), to Checkpoint/Restart, and the OPEN/CLOSE/End-of-Volume (EOV) routines. DFSMShsm and DFSMSrmm also support the IBM 3590 tape subsystem. The interactive storage management facility (ISMF) supports the IBM 3590 in a system-managed tape environment. The object tape support in the object access method (OAM), introduced in DFSMS/MVS 1.2.0, has been enhanced to support the IBM 3590 tape drive. The OAM tape library support, called library control system (LCS), including the CBRXLCS general programming interface macro, has also been enhanced to support the IBM 3590 tape subsystem in IBM 3494 and 3495 Automated Tape Library Dataservers.

EREP V3.5.0 plus PTF, DFSORT Release 13 plus SPE, and DITTO/ESA Release 1 also support the IBM 3590 tape subsystem.

ADSM (ADSTAR Distributed Storage Manager) for MVS V2.1 also supports the IBM 3590.

1.2.2 VM/ESA

VM/ESA Version 2 supports the IBM 3590 High Performance Tape Subsystem in both VM/ESA native and guest operating system environments. The IBM 3590 tape subsystem is supported as a stand-alone device as well as in the IBM 3494 and 3495 Automated Tape Library Dataservers.

VM control program (CP) provides basic device support such as device type definition and recognition, channel command word (CCW) translation and error recovery procedures.

Conversational monitor system (CMS) commands and macros support the IBM 3590 tape subsystem as a tape device.

The DFSMS/VM Removable Media Services (RMS) virtual machine and its interface routines have been enhanced to support the IBM 3590 tape subsystem in the IBM 3494 and 3495 Automated Tape Library Dataservers. The DFSMS/VM RMS recognizes the new Magstar tape device and the new IBM 3590 High Performance Tape Cartridge.

EREP V3 R5.0 plus PTF and DITTO/ESA Release 1 also support the IBM 3590 tape subsystem. ADSM for VM V2.1 also supports the IBM 3590.

1.2.3 VSE/ESA

VSE/ESA Version 2 supports the IBM 3590 tape subsystem. EREP V3 R5.0 plus PTF, DITTO/ESA Release 1, and a future release of ADSM for VSE also support the IBM 3590 tape subsystem.

We do not cover implementation in a VSE environment in this book because support is not available at time of writing.

1.2.4 RISC/6000 and IBM RS/6000 Scalable POWERparallel System Environments

AIX V3.2.5 and V4.1.1 support the IBM 3590 tape subsystem in both a RISC/6000 and IBM RS/6000 Scalable POWERparallel Systems environment. The device driver for the IBM 3590 is provided as a hardware feature (number 9603) of the IBM 3590-B11 tape drive. The driver is called the IBM AIX Tape and Medium Changer Device Driver and it also supports the IBM 3490 models C and E, and the IBM 7331 8-mm tape library.

For the IBM 3590-B1A tape drive in an IBM 3494 Automated Tape Library Dataserver, both the device driver for the tape drive and the Library Manager device driver are included in hardware feature number 5212 of the IBM 3494.

In addition to supporting all current application interfaces, such as *open, read, write, close,* and *ioctl*, the IBM AIX Tape and Medium Changer Device Driver provides support for standard AIX tape commands, a standard set of AIX device-management commands, and a set of tape drive service aids.

For the IBM 3590 and the ACF, the application interface *ioctl* provides a set of medium changer functions that can be accessed through the usual tape device special file, or independently through an additional special file, for the medium changer (the ACF in random Mode) only.

ADSM for AIX Version 1.2.1 and Version 2.1 supports the Magstar Tape Drive through Device Support Module 3 and, if installed in an IBM 3494 Automated Tape Library Dataserver, through Device Support Module 4. IBM Client Input Output/Sockets (CLIO/S), the Remote Tape Application Interface (RTAPI) service offering, and NSL UniTree Release 2.1 also support the IBM 3590 High Performance Tape Subsystem. REELlibrarian Release 4.2 supports the IBM 3590 tape subsystem.

1.2.5 AS/400 Environment

OS/400 Version 3.1 provides support for the IBM 3590 tape subsystem installed stand-alone or in an IBM 3494 Automated Tape Library Dataserver. RPQ 843860 provides support for alternate IPL.

The backup and archive software subsystems that support the IBM 3590 tape subsystem are:

- Backup Recovery and Media Services for OS/400 (BRMS/400) V3R1
- ADSM for OS/400 V3R1.
- Report/Data Archive and Retrieval System (R/DARS) for OS/400 V3R1.

All of these subsystems support the full capacity of the IBM 3590 High Performance Tape Cartridge and can utilize the IBM 3590-B11 as a minitape library by using the ACF in random mode.

1.2.6 Open System Environments

SunOS 5.2 and Solaris 2.2 are the minimum software levels to support the IBM 3590 tape subsystem on Sun systems. The IBM 3590 support for SunOS and Solaris is similar to the IBM 3590 support for AIX.

The IBM 3590 device driver for Sun/OS is provided as a hardware feature (number 9710) of the device driver of the IBM 3590-B11 tape drive. For the IBM 3590-B1A tape drive in an IBM 3494 Automated Tape Library Dataserver, both the device driver for the tape drive and the Library Manager device driver are included in hardware feature number 9204 of the IBM 3494. The IBM 3590 device driver provides a set of tape and SCSI-specific functions, and a set of medium changer functions to support the ACF in random mode through the *ioctl* application, and a set of tape drive service aids.

ADSM for Sun Solaris also provides support for the IBM 3590 tape subsystem.

Please contact your IBM representative for IBM 3590 tape subsystem support in additional environments.

1.2.7 Transaction Processing Facility

The Transaction Processing Facility (TPF) V4.1 will support the IBM 3590 tape subsystem. However, in this book, we do not cover the implementation of the IBM 3590 tape subsystem in that environment.

Chapter 2. Planning for Magstar

Implementing IBM 3590 High Performance Tape Subsystem introduces new media and new unit types to your tape environment while providing superior performance and capacity.

In this chapter, we explain which basic considerations have to be taken into account when implementing IBM 3590 High Performance Tape Subsystems especially when they are to be installed in an IBM 3494 or 3495 Automated Tape Library Dataserver.

2.1 Capacity Planning

The IBM 3590 High Performance Tape Subsystem offers new dimensions in tape-processing capacity and performance. When planning for the optimum size of your IBM 3590 tape subsystem, you should consider:

- The relative power of the **control units**, when attached to the host via ESCON channels, and the throughput of the ESCON or SCSI **channel attachments** to estimate the maximum throughput.

- The relative data rate of the **tape drives** and the concurrent number of tape drives that your applications require.

- The capacity of the **media** that you use for data storage and how your applications are using it.

The throughput delivered by a tape subsystem is usually reported as the maximum instantaneous channel data rate that can be achieved in an unconstrained environment. Typically, it is measured using a special I/O driver that does not perform any processing on the data.

In reality many factors affect the actual performance delivered; for example,

- How fast the application can write/read data.

  This depends on many factors, such as the data rate at which the data can be obtained from DASD or the network.

- How much time is usable because of such items as tape drive mechanics.

  Throughput is a measure of data transfer—that is, writing and reading data. However, there are times when data transfer is interrupted:

  - Tape is being mounted.
  - Tape is being loaded.
  - Tape is locating data to be read.
  - Tape is being unloaded and rewound.
  - System is waiting for control unit data path.

- The number of drives to be accommodated by a subsystem.

  A single drive typically cannot deliver the total potential of the subsystem, because of *unusable time* and the application power. However, the law of diminishing returns is involved. As drives are added to a control unit, they absorb the *unusable time*, but once that is done, adding more drives will not deliver any improved subsystem throughput. Typically, for full-volume dumps, the optimum number of drives is four behind a control unit to obtain

the maximum subsystem throughput. Adding additional drives may not improve the overall subsystem throughput.

- Compression in the host and compaction in the tape controller

  Host compression reduces the data sent down the channel, thus speeding up the overall tape processing time. Host software compressed data cannot be used for tape hardware compaction very efficiently, resulting in a low compaction ratio. It has been found that for full DASD volume dumps, switching off host software compression has little effect on the time needed for the dump, when native ESCON channels are used for the tape subsystem, since tape hardware compaction performs the equivalent function.

We describe general characteristics for the IBM 3590 High Performance Tape Subsystem components valid for all platforms in this section. For platform-specific tools and application-related topics, please refer to Chapter 4, "Software Implementation" on page 81 and to Chapter 6, "Migration in Non-MVS Environments" on page 129.

2.1.1 Control Units and Channel Attachments

When the Magstar Tape Drive is attached to the host through SCSI channels, no additional control unit is required. The drive itself contains an integrated control unit that, for example, performs the data compression. The data can be transferred over the SCSI bus at a rate of 20 MB/sec. The maximum effective sustained data rates are expected to be up to 12 MB/sec, from the preliminary measurements made at the Tucson laboratories.

The Magstar Tape Drive is attached to S/390 or ES/9000 host systems through ESCON channels. Because the tape drive is a SCSI device, a tape control unit is required to allow the attachment to ESCON channels. Data can be transferred on the ESCON channel at a rate of up to 17 MB/sec. With two ESCON channels and two tape drives active, the maximum effective sustained data rates are expected to be up to 12.5 MB/sec for the IBM 3590 tape subsystem.

Figure 2 on page 13 shows a schematic view of the host attachments, the control unit functions, and the tape drives for IBM 3490, IBM 3490E, and IBM 3590 tape subsystems. The IBM 3490 Model C subsystems are not included in Figure 2 on page 13. You can compare them to a configuration consisting of one IBM 3490 Model A01 or A10 tape controller and two tape drives.

The IBM 3490 models labeled x0x are base 3490 models that cannot be intermixed in one string with IBM 3490 enhanced models (xx0). For example, the IBM 3490 models B02 and B04 can be connected only to IBM 3490 model A01 or A02 tape controllers.
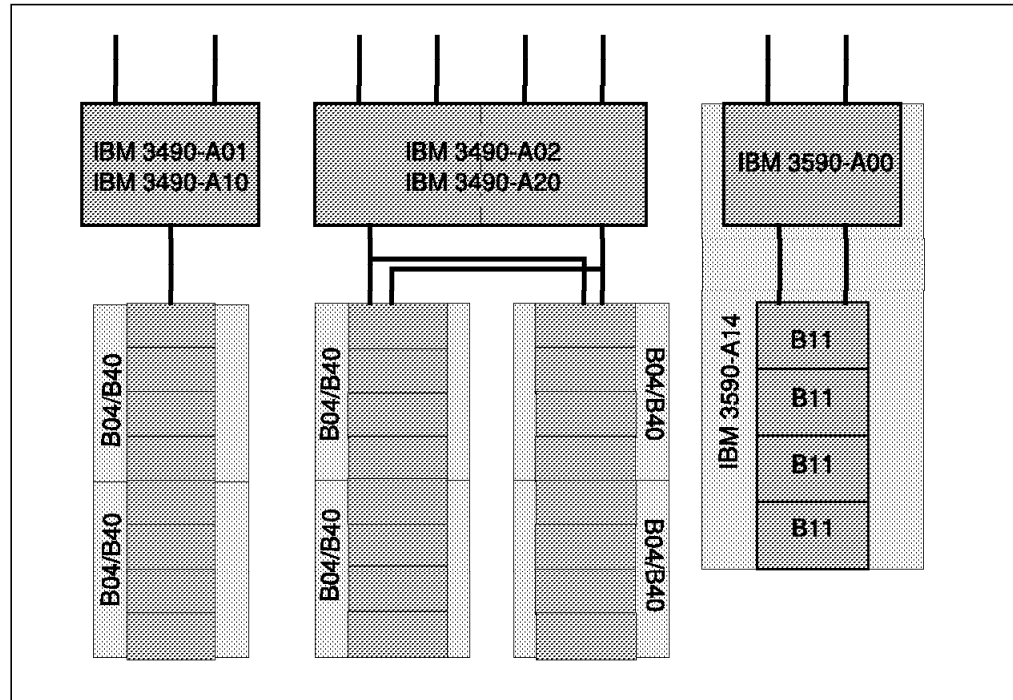
Figure 2. IBM 3480, 3490, and 3590 Tape Controllers and Tape Drives

For IBM 3490 tape subsystems, there is only one path from one control unit to the tape drives. Up to two drive-unit boxes can attach to the IBM 3490 model A01 or A10. Figure 2 shows two IBM 3490 model B04 or B40 drive-unit boxes attached to the control unit.

The IBM 3490 model A02 or A20 tape controllers act like a pair of IBM 3490 model A01 or A10 tape controllers that are interconnected such that each control unit function can control every single drive. This results in a total of two paths from the two control units to up to sixteen tape drives. The data can be transferred from the control unit to the tape drive at a rate of up to 3.0 MB/sec.

In the IBM 3590 High Performance Tape Subsystem, one or two tape paths are available from the tape controller to up to four tape drives, allowing simultaneous data transfer to up to two drives at the same time. Data is transferred from the control unit to the tape drive at a data rate of up to 9 MB/s.

2.1.2 Drives

Table 3 on page 14 compares the performance characteristics of the Magstar Tape Drive and IBM 3480 and 3490 tape drives. For IBM 3490E, the different characteristics for CST and ECCST are included.

Table 3. Tape Drive Characteristics				
Characteristic	3480/3490 (CST)	3490E (CST)	3490E (ECCST)	3590 (3590 Cartridge)
Number of tracks	18	36	36	128
Tape length	160 m	160 m	320 m	300 m
Tape data rate•	2.8 MB/s	2.8 MB/s	2.8 MB/s	9.0 MB/s
Tape access velocity	2 m/s	2 m/s	2 m/s	2 m/s
Load-to-ready time•	7 s	8 s	10 s	19 s•
Unload time•	10 s	10 s	12 s	18 s•
Nominal rewind speed	4 m/s	5 m/s	5 m/s	5 m/s
Time to rewind half the tape	20 s	16 s	32 s	30 s
Full-reel rewind time	40 s	0 s	0 s	0 s
Maximum rewind time	40 s	32 s	64 s	60 s
Tape scan (locate) speed	4 m/s	4 m/s	4 m/s	5 m/s
Time to scan half the tape	20 s	20 s	40 s	30 s
Maximum scan time	40 s	40 s	80 s	60 s
Forward space file (FSF)	2 m/s•	2 m/s•	2 m/s•	5 m/s•
Maximum FSF time	80 s•	160 s•	320 s•	60 s•
Cartridge capacity, uncompacted	200 MB	400 MB	800 MB	10,000 MB

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.

3. These times are without the ACF.

4. For IBM 3480/3490/3490E drives, FSF is slower than the locate function and ties up the tape control unit, just as does a tape read or write operation. Therefore, actual FSF time can be even greater, depending on control unit contention.

5. For IBM 3590 drives, FSF operates like locate. However, FSF time can still be considerably longer than locate for multiple single FSFs, as it is done by the host.

2.1.3 Media

The new IBM 3590 High Performance Tape Cartridge used in the Magstar tape drive introduces new dimensions for cartridge capacity. Figure 3 on page 15 shows the number of IBM 3480 cartridges (also known as *MEDIA1* or *CST*) and the number of IBM 3490 cartridges (also called *MEDIA2* or *ECCST*) that are required to store the same amount of uncompacted data as a single IBM 3590 High Performance Tape Cartridge.
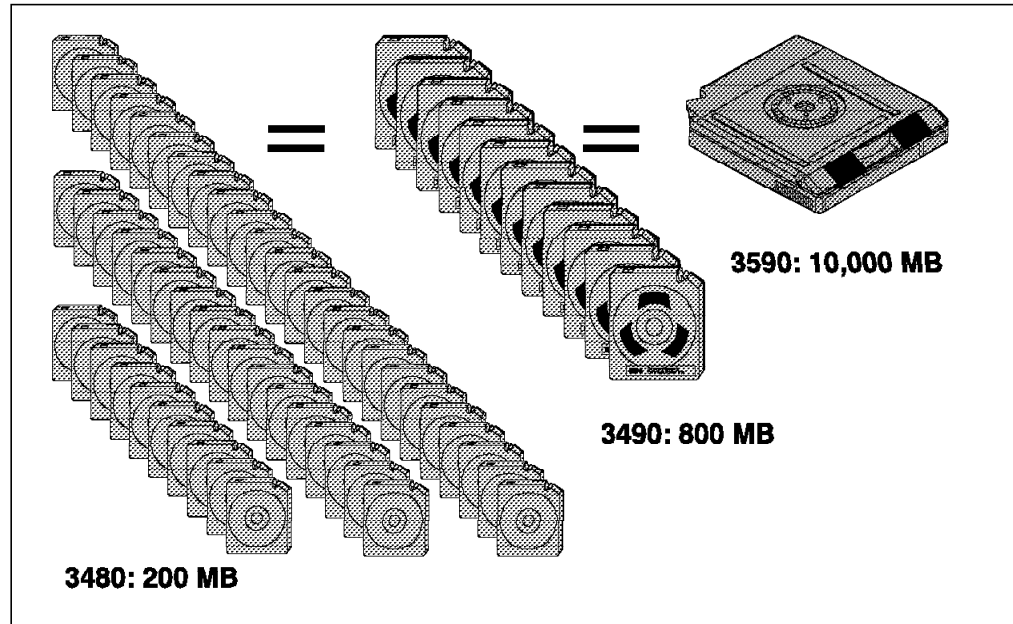
Figure 3. IBM 3480, 3490, and 3590 Cartridge Capacity

Remember that the new IBM 3590 High Performance 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. To simplify managing multiple media types in your tape environment, we highly recommend that you use a unique volume serial range for the new tape cartridges. This allows proper identification of the media type by the tape operator, the tape management system, and the host software that manages operation of an IBM 3494 or 3495 Automated Tape Library Dataserver.

How efficiently you can use the large capacity of the IBM 3590 High Performance Tape cartridge largely depends on the applications that use tape and on the size and structure of the data written to tape. For example, DFSMShsm, ADSM, and object tape support in OAM use the full capacity of the tape.

When planning for using the IBM 3590 tape subsystem in an IBM 3494 or 3495 Automated Tape Library Dataserver, you must plan for the number of storage cells. Therefore you need to analyze your tape environment regarding the data that will move to IBM 3590 High Performance Tape Cartridges, which is highly platform dependent. We list potential users of the IBM 3590 tape subsystem here, but refer you to Chapter 4, "Software Implementation" on page 81 to Chapter 6, "Migration in Non-MVS Environments" on page 129 for details of migration for your applications and data.

The IBM Magstar Virtual Tape Server in the IBM 3494 and 3495 Automated Tape Library Dataservers allows multiple virtual volumes to be stored on the same physical cartridge, using only the space needed for the written data. In this way, the full capacity of the cartridge is utilized. Please refer to *The IBM Magstar Virtual Tape Server and Enhancements to Magstar: New Era in Tape* for details.

Good candidates to use the IBM 3590 tape subsystem and take full advantage of the full capacity of its cartridge are, for example,

- DFSMShsm
- DFSMSdss
- ADSM on all platforms

- BRMS
- R/DARS
- OAM object tape support
- IBM Magstar Virtual Tape Server

2.2 Tape Library Configuration Planning

In both the IBM 3494 and 3495 Automated Tape Library Dataservers, each tape control unit is connected to the Library Manager through RS-422 connections. The maximum number of RS-422 connections in an IBM 3494 is 16 and in an IBM 3495 is eight. We discuss configuration options for both types of IBM automated tape libraries in this section.

2.2.1 IBM 3494 Automated Tape Library Dataserver Considerations

The IBM 3494 Automated Tape Library Dataserver is composed of four different types of frames, formerly configured through frame feature codes:

Control Unit Frame   This frame is mandatory. It contains the Library Manager, up to two tape drives, cartridge storage cells, and (optionally) convenience I/O stations.

Drive Unit Frame   This frame contains tape drives and cartridge storage cells. For future extension of the IBM 3494, the drive unit frames can be installed without any tape drives.

Storage Unit Frame   This frame contains cartridge storage cells only.

Virtual Tape Server Frame This frame contains the required hardware and software to perform Virtual Tape Server functions, and cartridge storage cells.

An IBM 3494 can be configured with up to 16 frames. In the first eight frames, it contains one control unit frame and up to seven drive unit or storage unit frames in any combination. If a Virtual Tape Server is part of the configuration, then IBM 3494-B16 Virtual Tape Server unit and its drive frame IBM 3494-D14 must be installed in the first eight frames. To expand the IBM 3494 capacity, up to two, fixed, four-frame configurations consisting of two drive unit models (D12 or D14) and two storage unit models (S10), should be added to give a total of 16 frames. These fixed configurations mean that the overall limit for drive unit frames (of any model) is 11. The maximum number of drives depends on the attachment protocol and control unit functions. Figure 4 on page 17 shows the 16-frame configuration.
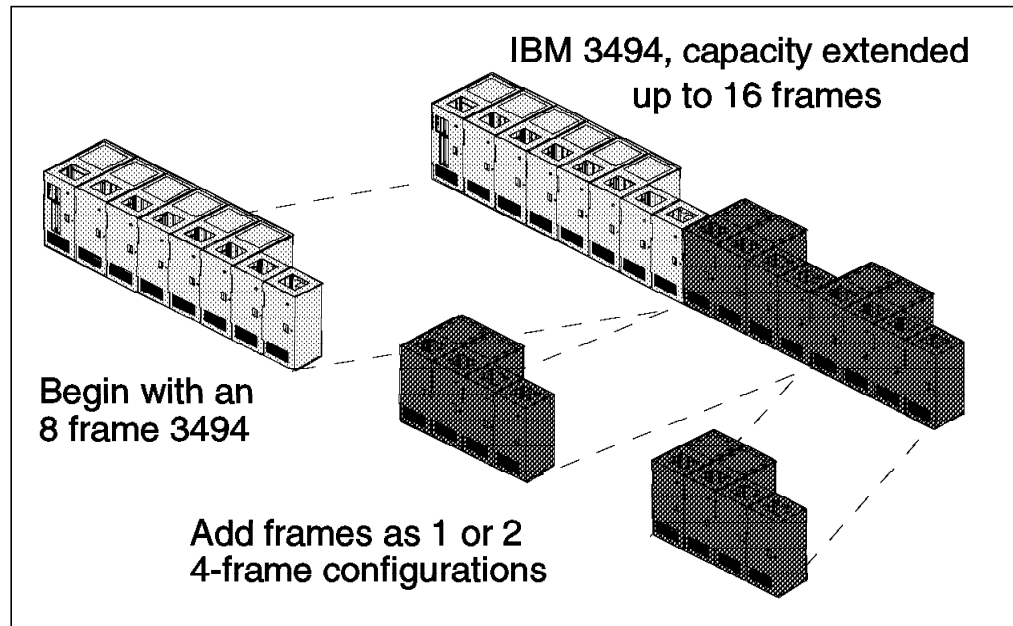
Figure 4. IBM 3494 16-Frame Configuration

In an IBM 3494 Automated Tape Library Dataserver, different IBM tape subsystems can be installed. The model numbers of the IBM 3494 frames to be used depend on the tape drives installed. The IBM 3494 models are:

IBM 3494-L10 Control unit frame containing IBM 3490-CxA tape drives

IBM 3494-L12 Control unit frame containing IBM 3590-B1A tape drives, which are attached to the host through SCSI channels.

IBM 3494-L14 Control unit frame containing IBM 3590-B1A tape drives, which are attached to the host through ESCON channels using the IBM 3590-A00 tape controller.

IBM 3494-D10 Drive unit frame containing IBM 3490-CxA tape drives, similar to the former feature code 5300.

IBM 3494-D12 Drive unit frame containing IBM 3590-B1A tape drives, which are attached to the host through SCSI channels.

IBM 3494-D14 Drive unit frame containing IBM 3590-B1A tape drives, which are attached to the host through ESCON channels using the IBM 3590-A00 tape controller.

IBM 3494-S10 Storage unit frame containing no tape drives, equivalent to the former feature code 5400.

IBM 3494-B16 This frame contains the Tape Volume Cache, which is built from RAID DASD devices, and the Virtual Tape Server subsystem controller.

Only one IBM 3494-B16 can be attached to one IBM 3494 control unit frame, and it must be installed within the first eight frames of the IBM 3494.

A IBM 3494-D12 drive unit frame with three or six IBM 3590-B1A drives must be attached to the left of the IBM 3494-B16 to implement the IBM Magstar Virtual Tape Server function.

The cartridges in the IBM 3494 created by the IBM 3494-B16 that contain "stacked" volumes of active data cannot be removed from the IBM 3494.

A modem must be supplied for installation, and for remote support service of the IBM 3494-B16.

Please refer to *IBM Magstar Virtual Tape Server and Enhancements to Magstar: New Era in Tape* for more information.

The number of tape drives that can be installed in an IBM 3494 Automated Tape Library Dataserver depends on types and models and, in the case of the IBM 3590 tape subsystem, on host channel attachment. The Library Manager allows a maximum of 16 control units to be connected through RS-422 connections. The SCSI-attached hosts need a separate additional RS-232 connection or a LAN connection to the Library Manager to send commands to the library.

The IBM 3494-B16 needs two RS-422 tape control unit connections and the RS-232 host connection to the Library Manager to perform Virtual Tape Server functions. Each 3590-B1A drive residing in the IBM 3494-D12 frame that is attached to the IBM 3494-B16 also needs the RS-422 connection. A total of five or eight RS-422 connections are required, depending on the number of Magstar tape drives installed in the Virtual Tape Server plus one RS-232 connection.

The number of RS-232 and RS-422 connections is chosen by selecting a combination of the TAPE CONTROL UNIT EXPANSION feature (Feature 5228) and EXPANSION ATTACHMENT CARD feature (Feature 5229). Table 4 summarizes the number of each type of connection and the feature combination.

Table 4. Supported Configurations for the IBM 3494 Expansion Features			
Features	**RS-232 connections**	**RS-422 connections**	**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 + 5228*2	0	16	LAN only

When you install the IBM 3494-B16 Virtual Tape Server, because IBM 3494-B16 needs one RS-232 connection, the maximum configuration in a IBM 3494 is four RS-232 connections and 12 RS-422 connections. Figure 5 on page 19 shows an IBM 3494 whose Library Manager is connected to five different tape subsystems through five RS-422 connections.
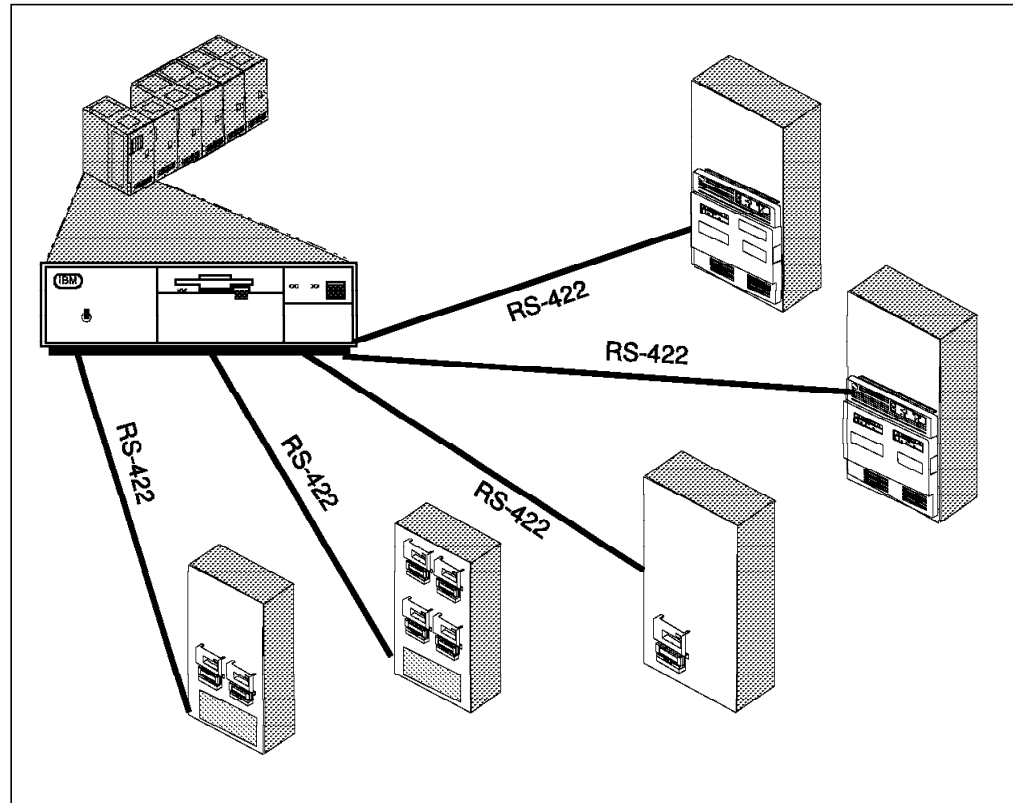
Figure 5. Drive Attachment to the Library Manager of an IBM Automated Tape Library Dataserver

Starting from the left, the tape subsystems shown in Figure 5 are:

• One IBM 3590-A00 tape controller with two IBM 3590-B1A tape drives, connected to the host through ESCON channels.

• One IBM 3590-A00 tape controller with four IBM 3590-B1A tape drives, connected to the hosts through ESCON channels.

• One IBM 3590-B1A tape drive, connected to the host through SCSI channels.

• One IBM 3490-C2A tape subsystem, containing an integrated control unit and two drives. The IBM 3490-C2A can be attached to the host through SCSI, parallel, or ESCON channels, or any combination not exceeding a total of two channel interfaces.

• One IBM 3490-C1A tape subsystem, containing an integrated control unit and one drive. The IBM 3490-C1A can be attached to the host through SCSI, parallel, or ESCON channels, or any combination not exceeding a total of two channel interfaces.

Table 5 shows the required number of RS-422 connection for each frame.

Table 5 (Page 1 of 2). Required RS-422 Connections for Each IBM 3494 Frame				
Frame Model	**3490 Drives•**	**3590 SCSI Drives**	**3590 ESCON Drives**	**Required RS-422 connection**
L10 with 3490 Drives	1– 2	–	–	1
L12 without 3590 Drives	–	0	–	0
L12 with 3590 Drives•	–	1– 2	–	1– 2 •

Table 5 (Page 2 of 2). Required RS-422 Connections for Each IBM 3494 Frame				
Frame Model	**3490 Drives•**	**3590 SCSI Drives**	**3590 ESCON Drives**	**Required RS-422 connection**
L14 without 3590 Drives	–	–	0	0
L14 with 3590 Drives	–	–	1– 2	1
D10 without 3490 Drives	0	–	–	0
D10 with 3490 Drives	1– 2	–	–	1
D12 without 3590 Drives	–	0	–	0
D12 with 3590 Drives•	–	1– 6	–	1– 6 •
D14 without 3590 Drives	–	–	0	0
D14 with 3590 Drives	–	–	1– 4	1
B16+D12 with three 3590 Drives•	– •	– •	– •	5
B16+D12 with six 3590 Drives•	– •	– •	– •	8

Notes:

1. The IBM 3490 Model C1A has one drive; the Model C2A has two drives.

2. The SCSI-attached hosts need a separate additional RS-232 connection or a LAN connection to the Library Manager.

3. Each SCSI-attached 3590 drive needs one RS-422 connection.

4. The IBM 3494-B16 Virtual Tape Server frame also needs one RS-232 connection to the Library Manager.

5. The physical tape drives installed in the Virtual Tape Server(B16+D12) are invisible to any attached host system. The Virtual Tape Server presents itself to the host as 32 IBM 3490E drives.

The IBM 3590-B1A tape drive which is attached through SCSI channel interfaces contains its own tape controller. In a pure IBM 3590 SCSI environment, the number of drives is limited to 16. A sample configuration is shown in Figure 6 on page 21.
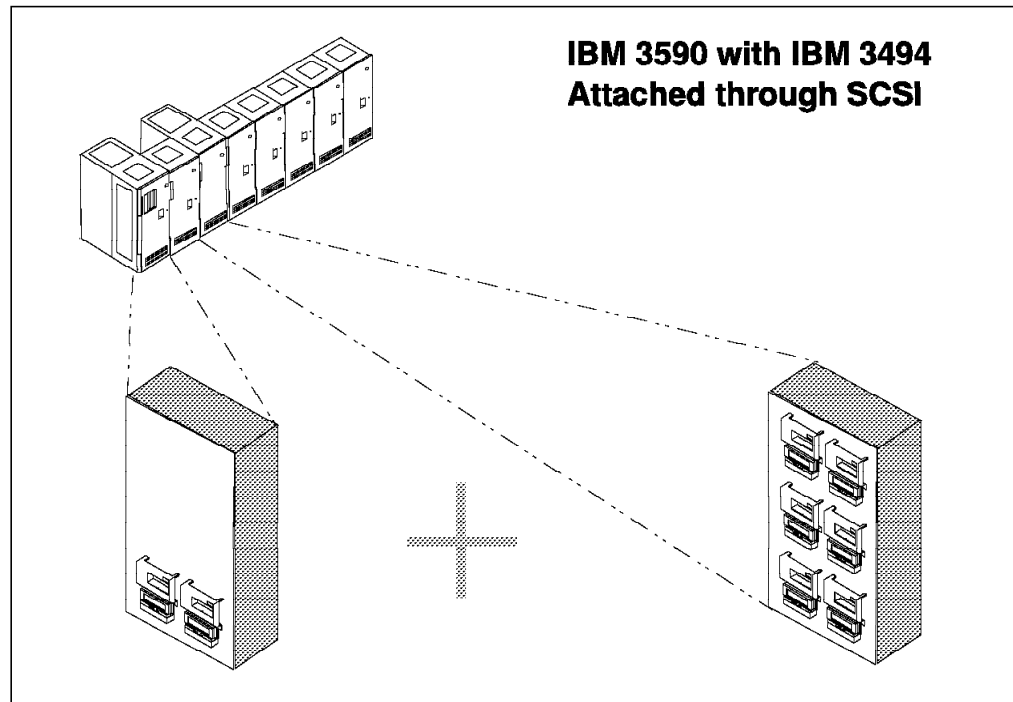
Figure 6. IBM 3590 High Performance Tape Subsystems Attached through SCSI in an IBM 3494 Automated Tape Library Dataserver

The IBM 3494 Automated Tape Library Dataserver in Figure 6 consists of the following frames, starting from the left:

- One IBM 3494-L12 Control Unit frame containing the Library Manager and two IBM 3590-B1A tape drives

- One IBM 3494-S10 Storage Unit frame

- One IBM 3494-D12 Drive Unit frame containing six IBM 3590-B1A tape drives

- Five IBM 3494-S10 Storage Unit frames

The Control Unit frame can contain a maximum of two drives. A Drive Unit frame can contain zero to six IBM 3590-B1A tape drives. For example, the number of tape drives that can be configured in a SCSI environment reaches a maximum if the IBM 3494 consists of one Control Unit frame and seven Drive Unit frames, each containing two IBM 3590-B1A tape drives.

If the IBM 3590 tape drives in an IBM 3494 Automated Tape Library Dataserver are attached via ESCON channels to the host, the IBM 3590-B1A tape drives are not directly attached to the Library Manager. The IBM 3590-A00 tape controller, which is also the interface to the Library Manager, must be installed through an RS-422 connection. The maximum number of tape drives is therefore limited to the maximum number of IBM 3590-B1A tape drives that can attach to 12 IBM 3590-A00 tape controllers. shows the sample configuration of the ESCON-attached IBM 3590 tape drives in a single IBM 3494.
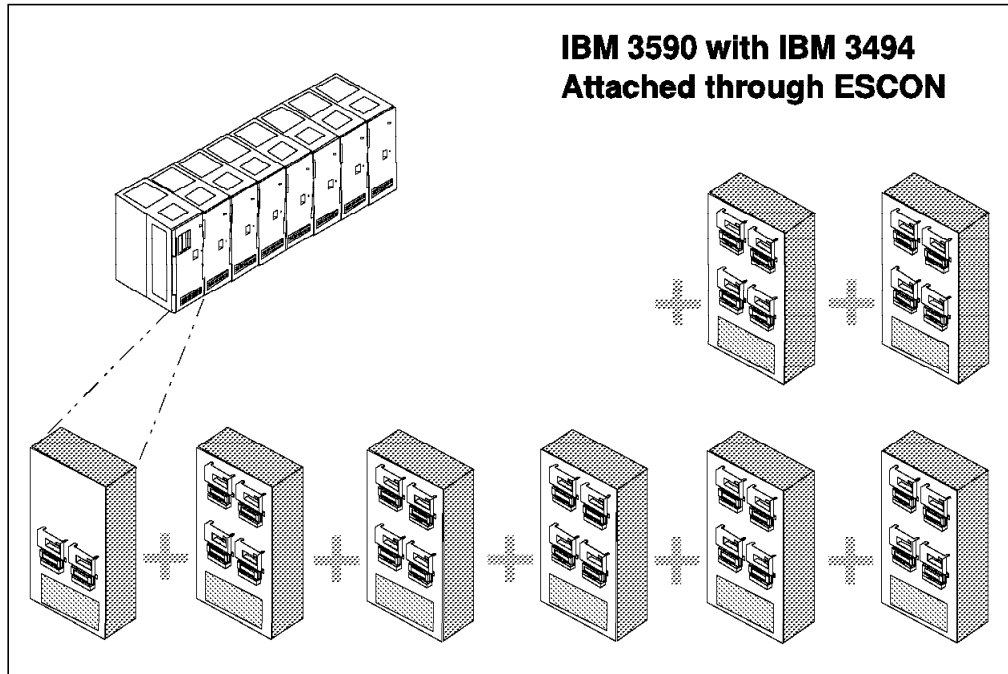
Figure 7. IBM 3590 High Performance Tape Subsystem Attached through ESCON in an IBM 3494 Automated Tape Library Dataserver

The IBM 3494 Automated Tape Library Dataserver in Figure 7 consists of the following frames, starting from the left:

- One IBM 3494-L14 Control Unit frame containing the Library Manager, one IBM 3590-A00 tape controller, and two IBM 3590-B1A tape drives

- Seven IBM 3494-D14 Drive Unit frames, each containing one IBM 3590-A00 tape controller and four IBM 3590-B1A tape drives

The Control Unit frame can contain a maximum of two drives. A Drive Unit frame can be installed without any tape controller and tape drive; otherwise, it contains one IBM 3590-A00 tape controller and up to four IBM 3590-B1A tape drives.

The maximum number of ESCON-attached IBM 3590-B1A tape drives in a single IBM 3494 Automated Tape Library Dataserver is 46.

Inside a single IBM 3494 Automated Tape Library Dataserver, you can mix IBM 3490-CxA tape drives, attached through SCSI, parallel, or ESCON channels, and IBM 3590-B1A tape drives attached through SCSI channels or by way of the IBM 3590-A00 tape controller through ESCON channels. Table 6 lists sample combinations and the maximum number of tape drives for each combination.

Table 6 (Page 1 of 2). IBM 3590 High Performance Tape Subsystem Host Attachment Options for IBM 3494 without Virtual Tape Server.						
3490-CxA (All)	3590-B1A (SCSI)	3590-A00 (ESCON)	3490 Drives•	3590 SCSI Drives•	3590 ESCON Drives•	Total No. of Drives•
0	0	12	0	0	46*	46*
0	5	11	0	5*	44	47*
0	6	10	0	6	40	46

Table 6 (Page 2 of 2). IBM 3590 High Performance Tape Subsystem Host Attachment Options for IBM 3494 without Virtual Tape Server.						
3490-CxA (All)	3590-B1A (SCSI)	3590-A00 (ESCON)	3490 Drives•	3590 SCSI Drives•	3590 ESCON Drives•	Total No. of Drives•
0	7	9	0	7	36	43
0	8	8	0	8	32	40
0	9	7	0	9	28	37
0	10	6	0	10	24	34
0	11	5	0	11	20	31
0	12	4	0	12	16	28
0	13	3	0	13	12	25
0	14	2	0	14	8	22
0	15	1	0	15	4	19
0	16	0	0	16	0	16
8	0	4	2	0	16*	32*
8	5	3	2	5	12*	33*
8	6	2	2	6	8*	30*
8	7	1	2	7	4*	27*
8	8	0	2	8	0*	24*

Notes:

1. The IBM 3490 Model C1A has one drive, the Model C2A has two drives.

2. If an IBM 3590 tape subsystem-B1A is installed in the Control Unit Frame, only two tape drives are supported. Reduce the maximum number to two only for configurations marked with an *.

3. If an IBM 3590 tape subsystem is installed in the Control Unit Frame, only two tape drives are supported. Reduce the maximum number by two except for configurations marked with an *.

4. The maximum number must be reduced by two if one IBM 3590-A00 is installed in the Control Unit Frame. This has been taken into account where the maximum number is marked with an *.

Inside a single IBM 3494, you can install only one IBM 3494-B16 Virtual Tape Server. When you install the IBM 3494-B16 into a IBM 3494, because IBM 3494-B16 needs one RS-232 connection, the maximum configuration in a IBM 3494 is four RS-232 connections and 12 RS-422 connections. The IBM 3494-B16 also needs two RS-422 connections, and each IBM 3590-B1A drive attached to IBM 3494-B16 needs one RS-422 connection. Depending on whether three or six tape drives are installed in the IBM 3590-D12 frame attached to the Virtual Tape Server, four or seven additional RS-422 connections are available. For the Virtual Tape Server with six tape drives installed, four additional RS-422 connections are available. Table 7 lists all possible combinations and the maximum number of tape drives for a maximum of four RS-422 connections.

Table 7 (Page 1 of 2). IBM 3590 High Performance Tape Subsystem Host Attachment Options for IBM 3494 with Virtual Tape Server (six drives)						
3490-CxA (All)	3590-B1A (SCSI)	3590-A00 (ESCON)	3490 Drives•	3590 SCSI Drives	3590 ESCON Drives•	Total No. of Drives•
0	0	4	0	0	4– 1 6	4– 1 6
0	1	3	0	1	3– 1 2	4– 1 3
0	2	2	0	2	2– 8	4– 1 0
0	3	1	0	3	1– 4	4– 7
0	4	0	0	4	0	4
1	0	3	1– 2	0	3– 1 2	4– 1 2
1	1	2	1– 2	1	2– 8	4– 1 1
1	2	1	1– 2	2	1– 4	4– 8
1	3	0	1– 2	3	0	4– 5
2	0	2	2– 4	0	2– 8	4– 1 2
2	1	1	2– 4	1	1– 4	6– 9
2	2	0	2– 4	2	0	4– 6
3	0	1	3– 6	0	1– 4	4– 1 0
3	1	0	3– 6	1	0	4– 7
1	5	2	1– 2	5	2– 8	8– 1 5
1	6	1	1– 2	6	1– 4	8– 1 2
1	7	0	1– 2	7	0	8– 9
2	0	6	2– 4	0	6– 2 4	8– 2 8
2	1	5	2– 4	1	5– 2 0	8– 2 5
2	2	4	2– 4	2	4– 1 6	8– 2 2
2	3	3	2– 4	3	3– 1 2	8– 1 9
2	4	2	2– 4	4	2– 8	8– 1 6
2	5	1	2– 4	5	1– 4	8– 1 3
2	6	0	2– 4	6	0	8– 1 0
3	0	5	3– 6	0	5– 2 0	8– 2 6
3	1	4	3– 6	1	4– 1 6	8– 2 3
3	2	3	3– 6	2	3– 1 2	8– 2 0
3	3	2	3– 6	3	2– 8	8– 1 7
3	4	1	3– 6	4	1– 4	8– 1 4

3490-CxA (All)	3590-B1A (SCSI)	3590-A00 (ESCON)	3490 Drives•	3590 SCSI Drives	3590 ESCON Drives•	Total No. of Drives•
3	5	0	3– 6	5	0	8– 1 1
4	0	4	4– 8	0	4– 1 6	8– 2 4
4	1	3	4– 8	1	3– 1 2	8– 2 1
4	2	2	4– 8	2	2– 8	8– 1 8
4	3	1	4– 8	3	1– 4	8– 2 3
5	0	3	5– 1 0	0	3– 1 2	8– 2 2
5	1	2	5– 1 0	1	2– 8	8– 1 9
5	2	1	5– 1 0	2	1– 4	8– 1 6
5	3	0	5– 1 0	3	0	8– 1 3
6	0	2	6– 1 2	0	2– 8	8– 2 0
6	1	1	6– 1 2	1	1– 4	8– 1 7
6	2	0	6– 1 2	2	0	8– 1 4
7	0	1	7– 1 4	0	1– 4	8– 1 8
7	1	0	7– 1 4	1	0	8– 1 5
8	0	0	8– 1 6	0	0	8– 1 6

Table 7 (Page 2 of 2). IBM 3590 High Performance Tape Subsystem Host Attachment Options for IBM 3494 with Virtual Tape Server (six drives)

Notes:

1. The IBM 3490-C1A has one drive, the IBM 3490-C2A has two drives.

2. If an IBM 3590 tape subsystem is installed in the Control Unit Frame, only two tape drives are supported.

3. If one IBM 3590-A00 is installed in the Control Unit frame, the maximum number must be reduced by two.

In case of the Virtual Tape Server with three tape drives installed, seven additional control unit connections are available. Table 8 lists all possible combinations and the maximum number of tape drives for a maximum of 7 RS-422 connections.

Table 8 (Page 1 of 2). IBM 3590 High Performance Tape Subsystem Host Attachment Options for IBM 3494 with Virtual Tape Server (three drives)						
3490-CxA (All)	3590-B1A (SCSI)	3590-A00 (ESCON)	3490 Drives•	3590 SCSI Drives	3590 ESCON Drives•	Total No. of Drives•
0	0	7	0	0	7– 3 8	7– 2 8
0	1	6	0	1	6– 2 4	7– 2 5
0	2	5	0	2	5– 2 0	7– 2 2
0	3	4	0	3	4– 1 6	7– 1 9
0	4	3	0	4	3– 1 2	7– 1 6
0	5	2	0	5	2– 8	7– 1 3
0	6	1	0	6	1– 4	7– 1 0
0	7	0	0	7	0	7
1	0	6	1– 2	0	4– 2 4	7– 2 6
1	1	5	1– 2	1	5– 2 0	7– 2 3
1	2	4	1– 2	2	4– 1 6	7– 2 0
1	3	3	1– 2	3	3– 2	7– 1 7
1	4	2	1– 2	4	2– 8	7– 1 4
1	5	1	1– 2	5	1– 4	1– 1 1
1	6	0	1– 2	6	0	7– 7
2	0	5	2– 4	0	5– 2 0	7– 2 4
2	1	4	2– 4	1	4– 1 6	7– 2 1
2	2	3	2– 4	2	3– 1 2	7– 1 8
2	3	2	2– 4	3	2– 8	7– 1 5
2	4	1	2– 4	4	1– 4	7– 1 2
2	5	0	2– 4	5	0	7– 9
3	0	4	3– 6	0	4– 1 6	7– 2 2
3	1	3	3– 6	1	3– 1 2	7– 1 9
3	2	2	3– 6	2	2– 8	7– 1 6
3	3	1	3– 6	3	1– 4	7– 1 3
3	4	0	3– 6	4	0	7– 1 0
4	0	3	4– 8	0	3– 1 2	7– 2 0
4	1	2	4– 8	1	2– 8	7– 1 7
4	2	1	4– 8	2	1– 4	7– 1 4
4	3	0	4– 8	3	0	7– 1 1
4	3	1	4– 8	3	1– 4	8– 2 3
5	0	2	5– 1 0	0	2– 8	7– 1 8
5	1	1	5– 1 0	1	1– 4	7– 1 5
5	2	0	5– 1 0	2	0	7– 1 2

3490-CxA (All)	3590-B1A (SCSI)	3590-A00 (ESCON)	3490 Drives•	3590 SCSI Drives	3590 ESCON Drives•	Total No. of Drives•
Table 8 (Page 2 of 2). IBM 3590 High Performance Tape Subsystem Host Attachment Options for IBM 3494 with Virtual Tape Server (three drives)						
6	0	1	6–12	0	1–4	7–16
6	1	0	6–12	1	0	7–13
7	0	0	14	0	0	14

Notes:

1. The IBM 3490-C1A has one drive; the IBM 3490-C2A has two drives.

2. If an IBM 3590 tape subsystem is installed in the Control Unit Frame, only two tape drives are supported.

3. If one IBM 3590-A00 is installed in the Control Unit frame, the maximum number must be reduced by two.

The number of storage cells available in an IBM 3494 for storage of tape cartridges depends on the number and type of frames, and on whether the Convenience I/O station and the Dual Gripper Feature (or both) is installed. Table 9 shows the storage capacity of each storage frame.

Table 9. IBM 3494 Cartridge Capacity		
Frame Model	**Without Dual Gripper**	**With Dual Gripper**
L10,L12,L14	240	216
L10,L12,L14 with Convenience I/O Station	210	190
L10,L12,L14 with Enhanced-Capacity Convenience I/O Station (30 cells)	160	144
D10 without IBM 3490 drives	400	360
D10 with IBM 3490 drives	300	270
D12 without IBM 3590 drives	400	360
D12 with 1–2 IBM 3590 drives	335	305
D12 with 3–4 IBM 3590 drives	290	260
D12 with 5–6 IBM 3590 drives	250	230
D14 without IBM 3590 drives	400	360
D14 with 1–2 IBM 3590 drives	345	305
D14 with 3–4 IBM 3590 drives	305	275
S10	400	360
B16	400	360

2.2.2 IBM 3495 Automated Tape Library Dataserver Considerations

If the Magstar tape drives are installed in an IBM 3495 Automated Tape Library Dataserver, the IBM 3590-A14 is used. The IBM 3590-A14 frame includes one IBM 3590-A00 tape controller, and one to four IBM 3590-B1A tape drives.

Note: If the IBM 3590-A14 is installed in an IBM 3495 Automated Tape Library Dataserver, it **must** contain four IBM 3590-B1A tape drives.

There are five different models of the IBM 3495 Automated Tape Library Dataserver, each of them supporting a mix of IBM 3490, 3490E, and 3590 tape subsystems, except IBM 3495-B16 Virtual Tape Server. The different models are:

IBM 3495-L20 storing 5660 to 6440 cartridges and supporting 4 to 16 tape drives

IBM 3495-L30 storing 8460 to 10580 cartridges and supporting 4 to 32 tape drives

IBM 3495-L40 storing 11280 to 14740 cartridges and supporting 4 to 48 tape drives

IBM 3495-L50 storing 14100 to 18900 cartridges and supporting 4 to 64 tape drives

IBM 3495-B16 is the frame that contains the Tape Volume Cache, which is built from RAID DASD devices and the Virtual Tape Server subsystem controller to perform Virtual Tape Server functions.

Only one IBM 3495-B16 can be attached to one IBM 3495 Model L20, L30, L40, and L50.

A IBM 3590-A14 frame with four IBM 3590-B1A drives must be attached to the left of the IBM 3495-B16 to implement the function of the IBM Magstar Virtual Tape Server. The IBM 3590-B1A drives in the IBM 3590-A14 frame are not attached to any host system. In addition, the IBM 3590-A00 controller is not included when the IBM 3590-A14 frame is part of a Virtual Tape Server subsystem. Management of the IBM 3590-B1A drives is performed by the Virtual Tape Server controller.

The communications between the Virtual Tape Server controller and the Library Manager are performed across an internal LAN connection. None of the RS422 control unit ports in the Library Manager is used by a Virtual Tape Server subsystem.

The cartridges in the IBM 3495 created by the IBM 3495-B16 that contain "stacked" volumes of active data cannot be removed from the IBM 3495.

A modem must be supplied for installation, and for remote support service of the IBM 3495-B16.

Please refer to *The IBM Magstar Virtual Tape Server and Enhancements to Magstar: New Era in Tape* for more information.

The Library Manager in the IBM 3495 Automated Tape Library Dataserver connects up to eight control unit functions (CUFs) through RS-422 links. Table 10 on page 29 lists the details for the different tape subsystems that can be installed in an IBM 3495.

Table 10. Tape Subsystems in an IBM 3495 Automated Tape Library Dataserver					
	IBM 3490-A01	IBM 3490-A02	IBM 3490-A10	IBM 3490-A20	IBM 3590-A14•
No. of control units	1	2	1	2	1
No. of paths to Library Manager	1	2	1	2	1
Type of drive boxes	B04	B04	B40	B40	- •
Max. no. of drive boxes	2	4	2	4	- •
Max. no. of drives in each subsystem	8	16	8	16	4
• The IBM 3590-A14 is a single box containing one IBM 3590-A00 tape controller and four IBM 3590-B1A tape drives when installed in an IBM 3495					

The maximum number of tape drives for the IBM 3495 Models L20 and L30 is independent of the type of tape subsystems installed. In an IBM 3495-L20, either one IBM 3490 tape subsystem with a maximum of 16 drives, or four IBM 3590-A14 tape subsystem each containing four IBM 3590-B1A tape drives can be installed.

In an IBM 3495-L30, one or two IBM 3490 tape subsystems, each with a maximum of 16 drives can be installed, or up to eight IBM 3590-A14 tape subsystems each containing four IBM 3590-B1A tape drives. Eight is also the maximum number of IBM 3590 tape subsystems that can be installed in any IBM 3495 model. Figure 8 on page 30 shows the maximum number of 32 Magstar tape drives that can be configured in an IBM 3495 Model L30, L40, or L50, if only IBM 3590 tape subsystems are installed. The IBM 3495 shown in Figure 8 on page 30 is an IBM 3495 Model L30.
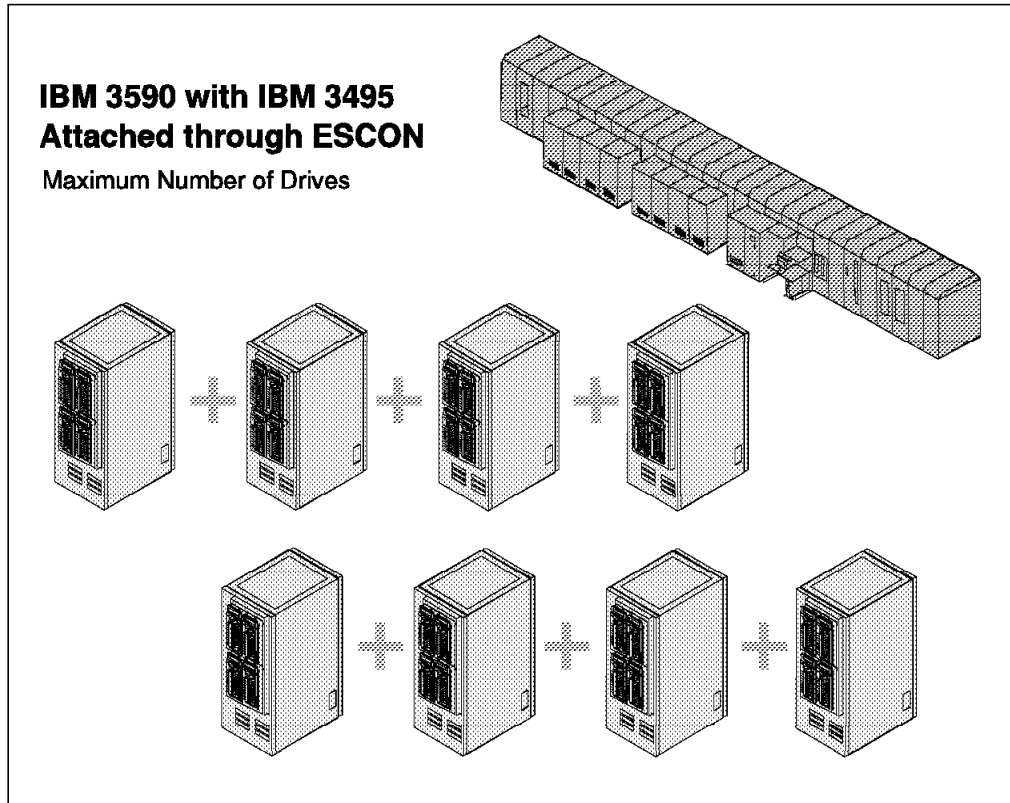
Figure 8. IBM 3590 High Performance Tape Subsystems in an IBM 3495 Automated Tape Library Dataserver Model L30

The IBM 3590-A14 can be installed in an IBM 3495 wherever the IBM 3490 Model B drive unit boxes are installed. If more than one IBM 3590-A14 is installed, up to four can be installed adjacent to one another. However, there is no interconnection between the single IBM 3490-A14 frames. Each IBM 3590-A00 tape controller installed in the 3590-A14 frame supports only the IBM 3590-B1A tape drives installed in the same IBM 3590-A14 frame. For more details on installation of the IBM 3590 tape subsystem in an IBM 3495, refer to Chapter 3, "Hardware Implementation" on page 37.

The number of cartridges that can be stored in an IBM 3495 differs by model as follows:

IBM 3495-L20   7000 storage cells

IBM 3495-L30   11140 storage cells

IBM 3495-L40   15300 storage cells

IBM 3495-L50   19460 storage cells.

IBM 3495-B16   no storage cells.

The base capacity listed above is not an ordering option. The IBM 3495 Automated Tape Library Dataserver must contain at least one IBM 3490 model A and B box or one IBM 3590-A14. The base capacity must be reduced for each tape subsystem and feature installed. The reduction numbers are:

IBM 3490-Axx   300

IBM 3490-Bxx   260

Single IBM 3590-A14   520

Two IBM 3590-A14 units	780
Three IBM 3590-A14 units	1040
Four IBM 3590-A14 units	1300
High Capacity I/O Facility	500

The reduction number of 500 is the same whether the passive high-capacity I/O facility is configured or the external high-capacity I/O facility is installed.

In addition, the number of storage cells reduced from the IBM 3495 when a Virtual Tape Server is installed is as follows:

0   If the combination of the IBM 3590-A14 and IBM 3495-B16 goes into the position previously occupied by an IBM 3490 tape subsystem or part of an IBM 3490 tape subsystem (since the cells were already gone).

520   If the combination of the IBM 3590-A14 and IBM 3495-B16 goes into a position that was not previously occupied by a IBM 3490 tape subsystem.

2.3 Installation Planning

Planning for implementing a new tape subsystem in your environment requires planning for hardware installation and software support. We describe the general planning tasks here and refer you to the appropriate chapter for details.

2.3.1 Supplies and Equipment

Planning for supplies and equipment should include the following:

- Three months supply of IBM 3590 High Performance Tape Cartridges for storing data.

- Cartridge labels for identifying the volume serial number assigned to the volume. If you are using the cartridges inside an IBM Automated Tape Library Dataserver, plan for the proper bar code labels including the seventh character **J** to identify the IBM 3590 cartridges.

- Storage shelves for storing shelf-resident tape cartridges.

- Additional ACF magazines for transporting and loading cartridges.

- Cleaner cartridges. One cleaner cartridge is provided with each IBM 3590 model B11 and B1A drive.

2.3.2 Programming Support

You must install the appropriate software levels to support the IBM 3590 High Performance Tape Subsystem. For details about the appropriate software levels, please refer to Chapter 4, "Software Implementation" on page 81.

If you are running independent software vendor (ISV) software products that you want to use with the IBM 3590 tape subsystem, please check with the software supplier on the required software levels or fixes to support the IBM 3590 tape subsystem.

2.3.3 Data Migration

When planning your data migration scenarios, you should consider the IBM Magstar Virtual Tape Server, whose capacity-enabling technology is one of the ways for data migration to the IBM 3590 High Performance Tape Subsystem. For more detail information, please refer to *IBM Magstar Virtual Tape Server and Enhancements to Magstar: New Era in Tape*.

Planning for data migration should include:

- Categorizing 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 because of large-scale data-transfers

  - Process tapes that are created during periodic execution of an installation's application program

  - Archive tapes that contain records held for historical, legal, regulator, or disaster-recovery purposes. For these tapes, you might consider merging existing cartridges onto fewer IBM 3590 cartridges.

  - Journal tapes that contain transactions recorded against another data set. These data sets are usually written using the write-validity-check option. Consider using DASD logging and migrating the data written to DASD to IBM 3590 tape subsystem later.

  - Interchange tapes that are prepared for use in other locations. These tapes require the receiving location to be able to process the IBM 3590 cartridge. These data sets might be candidates to remain on CST or ECCST cartridges.

- Managing multiple tape formats and recording technologies

  Figure 9 on page 33 illustrates which cartridge types can be processed on which devices. The magnifying glass indicates that a cartridge written in 18-track mode can be read only on an IBM 3490E drive but cannot be modified. The pencil indicates that a cartridge can be read, written, or modified. The X-mark indicates that it cannot be processed.
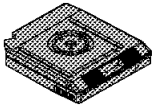
IBM Tape Drive \ Tape Cartridge	CST 18-Track	CST 36-Track	ECCST 36-Track	IBM 3590 Cartridge 128-Track
3480 No IDRC	(write)	X	X	X
3480/3490 IDRC	(write)	X	X	X
3490E	(read)	(write)	(write)	X
3590	X	X	X	(write)

Figure 9. Tape Drive and Cartridge Compatibility

- Developing a data migration sequence

  Determine the order in which to migrate your tape data sets. Typically, you start with DASD backup tapes.

- Developing a data migration strategy

  Tape processing and data migration is very much platform dependent. For details about data migration, please refer to Chapter 5, "Migration in an MVS/ESA Environment" on page 115 and Chapter 6, "Migration in Non-MVS Environments" on page 129.

- Verifying that data has been migrated successfully

2.3.4 Application Changes

Planning for application changes requires you to review the application programs that control your tape processing. The review should cover the following:

- Changes in status and sense byte information

  The IBM 3590 tape subsystem operates with expanded sense bytes to support error recovery, which may require modification for applications that refer to sense bytes.

- Write-validity-check option

  This option which is also called "tape-write-immediate" mode is used by applications that require a block to be written on tape and verified before they can proceed—for example, a data-base log facility. The channel is released when the block is in the buffer, but the device end signal is not sent to the system until the read-back check after the actual write operation on the Magstar tape drive is complete. This change could result in performance degradation. Consider DASD logging as an alternative.

- Device-type dependencies

Program functions that may depend on the device type and may need alteration include:

– Dynamic allocation
– Device-dependent parameters
– Accounting routines
– Stand-alone programs
– Interrupt routines
– Programs that call data-security erase.

• Data compaction

Data compaction is not recommended for encrypted data because the resulting compaction ratio may be less than one, so that the compacted file is actually larger than the uncompacted file.

• Data security characteristics

The following enhancements are introduced with the IBM 3590 tape subsystem:

– Logical-file protection

In addition to the host-selected logical-file protection, two new conditions can cause a volume to be made read only:

1. The volume control region is detected but not readable. When a volume control region is present but cannot be read error-free, the cartridge is made read only.

2. The servo track quality is below a set threshold. In this mode, reliable writing is not possible and the cartridge is made read only.

– Erase

The erase function causes data on the tape following the current location to become unreadable by the Magstar tape drive. The Magstar tape drive does not physically overwrite the data, but rather marks the end of valid data to ensure that it can no longer be accessed. Any attempt to read data in an erased area results in changing the status of the tape to void. The end of valid data is marked both where it physically ends and in the volume control region, to provide redundant protection against data being accessed.

– ACF security provisions

While the ACF is operating in random mode, the manual eject switch function is disabled.

2.3.5 Operator Training

You should ensure that the operators are provided with training and education for the IBM 3590 tape subsystem. This should cover typical operator tasks such as these:

• Handling and disposal of new media

• Cleaning of drives and cartridges

• Operation of the IBM 3590 tape subsystem drive

• Inserting and removing cartridges from the ACF

• Inserting and removing cartridge magazines from the ACF

• Performing problem determination

2.3.6 Planning for Operations

Planning for operations should include these considerations:

- Modifications in physical layout, such as equipment removal and installation, for example

- Changes in subsystem operations, such as drive assignment schedules, media considerations, and handling of the ACF

  If you are currently degaussing your tape cartridges, you need to review this procedure. Degaussing destroys the servo track and the IBM 3590 High Performance Tape Cartridge cannot be used until the servo track has been rewritten. Currently, this can only be done by the cartridge manufacturer.

- Updates of operating procedures based on operating systems changes.

Chapter 3. Hardware Implementation

In this chapter, we provide information, to assist with the hardware implementation of the IBM 3590 High Performance Tape Subsystem.

We specify the environmental requirements for the IBM 3590 High Performance Tape Cartridge and the IBM 3590 tape subsystem. We describe the components of the IBM 3590 tape subsystem and review their integration into IBM 3494 and 3495 Automated Tape Library Dataservers. We then go on to consider platform-specific hardware implementations and multiplatform attachment options.

3.1 IBM 3590 High Performance Tape Subsystem

The IBM 3590-B11 attaches to RISC/6000, IBM RS/6000 Scalable POWERparallel Systems, AS/400, and Sun systems using the small computer systems interface (SCSI). The drives are installed in an IBM 9309, 7202, 7015-R00, or customer-provided rack. For attachment to ES/9000 systems the drives are installed in an IBM 3590-A14 frame and use the IBM 3590-A00 controller. The IBM 3590-A00 controller attaches to the ES/9000 system by means of ESCON channels. Figure 10 illustrates the components of the IBM 3590 High Performance Tape Subsystem family of products.
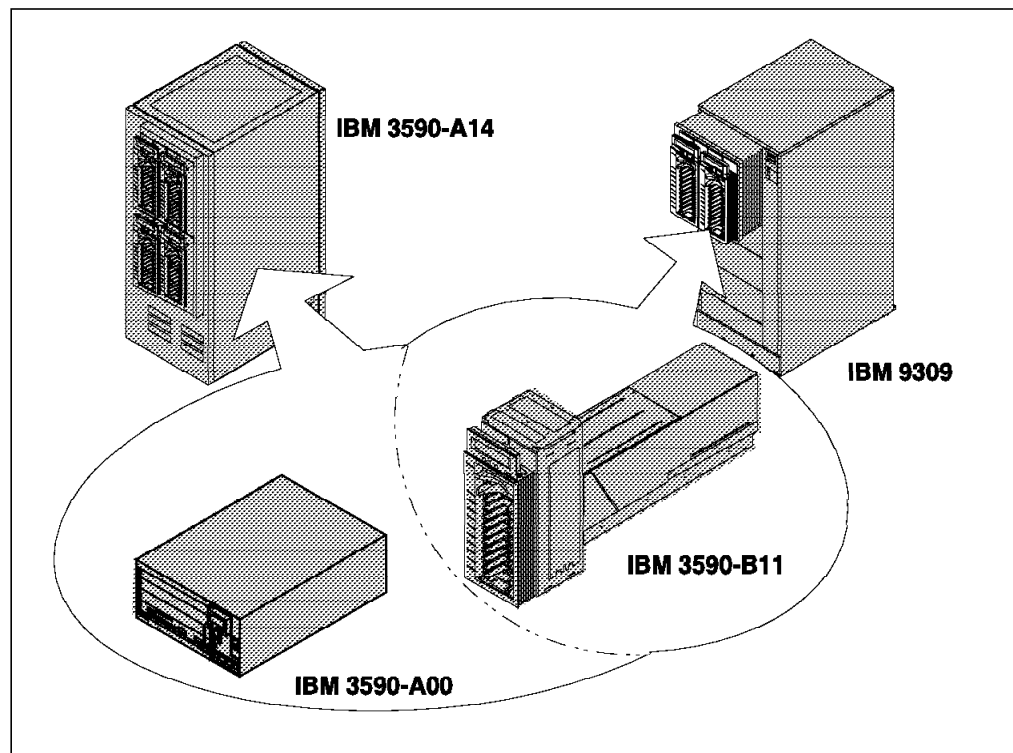
Figure 10. IBM 3590 High Performance Tape Subsystem Models

Depending on the requirement for number of drives and host system attachment, order the frame, rack and drive components. Specify the configuration by means of the device-installation feature codes. This chapter gives examples of feature codes for various platforms.

3.1.1 General Hardware Implementation Considerations

For the hardware implementation of the IBM 3590 tape subsystem you need to perform the tasks listed in the following areas:

1. Equipment Ordering

   - Order the IBM 3590 drives.
   - Order the IBM 3590 frames or racks.
   - Order the channel attachments.
   - Order the IBM 3590 controllers, if appropriate.
   - Order the host attachment features.
   - Order the library integration features, if appropriate.

   Note: Ensure that your implementation plan includes the lead time for the equipment.

2. New IBM 3590 Cartridges

   - Order a supply of IBM 3590 cartridges and labels.
   - Order additional cleaning cartridges.
   - Check to see whether new cartridge racks need to be ordered.

3. Equipment Delivery

   - Ensure a clear delivery route to the machine room.
   - Ensure that floor cuts for power supplies and channel attachments are in place.
   - Schedule system time to allow the IBM 3590 tape subsystems to be attached to the hosts.

4. Physical Positioning

   - Use IBM 3590 tape subsystem templates that include service clearances to site the drives. Please refer to *IBM 3590 High Performance Tape Subsystem Introduction and Planning Guide*.

5. Environmental Conditions

   - Provide the correct environmental conditions for the IBM 3590 tape subsystem and the new IBM 3590 High Performance Tape Cartridges.

6. Heat and Power Considerations

   - Make sure that your air conditioning equipment can handle the additional heat output of the equipment; upgrade if necessary.
   - Ensure that needed power supplies are available.

7. Integration into Existing Tape Environment

   - You need to ensure that the implementation causes minimum disruption to existing tape services.
   - If the new drives are to replace existing equipment, you must manage the discontinuance of the old drives.

8. Channel Attachments

   - Ensure that the necessary channel cables are available.
   - If possible, install channel attachments beforehand.
   - Check cable patch-panels and fix any that need to be modified.
   - Check that ESCON cable connectors match your patch-panel fittings.
   - Make appropriate changes to any ESCON Directors and ESCON Manager configurations.
   - Update your local hardware configuration documentation.

9. Special Device Drivers

   - Install any special device drivers for your host environment needs.

10. Defining the I/O Configuration

   - Define the new tape I/O configuration to all attached hosts.
   - Specify which channel paths are attached to which control units and which address ranges you will use for the drives.

For additional considerations when you install the IBM 3590 tape subsystem as part of a new or existing IBM Tape Library please refer to 3.2, "IBM 3590 Installed in IBM Tape Library Dataservers" on page 46.

A detailed discussion of platform-specific considerations is given in 3.2, "IBM 3590 Installed in IBM Tape Library Dataservers" on page 46 through 3.7, "Multiplatform Attachments" on page 75.

You will receive with each IBM 3590 High Performance Tape Subsystem model B11 or B1A the following components:

- One cleaner cartridge
- One blank IBM 3590 High Performance Tape Cartridge
- Two SCSI terminator.

An empty cartridge magazine will be included with the ACF on the model B11.

Consider ordering a spare ACF magazine. If you transport cartridges off-site, you could keep the tapes in the original magazine and insert the spare magazine in the ACF. It is also a good idea to have a spare magazine in the event that an original magazine is misplaced or accidentally damaged.

Additional supplies can be obtained through 3M or Lexmark International depending on your country. Table 11 shows the part numbers for ordering tape cartridges, cleaner cartridges, and magazines.

Table 11. IBM 3590 Supply Items		
Supply Item	**IBM Part Number**	**3M Part Number**
Tape cartridge	05H4434	84-9802-2133-1
Cleaner cartridge	05H4435	84-9802-2139-8
Cartridge magazine	39F4762	84-9802-2140-6
Cartridge magazine with ten tapes	Not available	84-9802-2141-4

The following publications are shipped with the IBM 3590 High Performance Tape Subsystem:

SA37-0301 IBM 3590 High Performance Tape Subsystem Maintenance Information

GA32-0330 IBM 3590 High Performance Tape Subsystem User's Guide

GA32-0331 IBM 3590 High Performance Tape Subsystem Hardware Reference

GA32-0303 IBM 3590 High Performance Tape Subsystem Safety Supplement

GC35-0154* IBM SCSI Tape Drive, Medium Changer and Library Device Drivers Installation and User's Guide.

* You will receive this tape drive manual with the IBM 3590 High Performance Tape Subsystem only when one of the following features are ordered:

- IBM 3590 feature code 9603, AIX device driver

- IBM 3590 feature code 9710, Sun device driver

- IBM 3494 feature code 5212, RISC System/6000 attachment

- IBM 3494 feature code 9204, Sun device driver

3.1.2 Machine Dimensions and Service Clearances

Table 12 shows the machine dimensions for the IBM 3590-A14 and the IBM 9309-2 rack.

Table 12. IBM 3590 Frame and Rack Dimensions			
Dimension	**Unit**	**IBM 3590-A14**	**IBM 9309-2**
Front	mm (in.)	724 (28.5)	650 (25.6)
Side	mm (in.)	1099 (43.3)•	921 (36.3)
Height	mm (in.)	1800 (70.9)	1578 (62.1)
• The ACF extends forward of the IBM 3590-A14 frame by 85 mm (3.3 in.).			

Table 13 shows the service clearances for IBM 3590-A14 and the IBM 9309-2 rack. You can overlap service clearances with other equipment service clearances.

Table 13. IBM 3590 Frame and Rack Service Clearances			
Dimension	**Unit**	**IBM 3590-A14**	**IBM 9309-2**
Front	mm (in.)	750x900 (29.5x35.5)	1524• (60)
Side	mm (in.)	0 (0)	0 (0)
Rear	mm (in.)	750x1218 (29.5x48)•	760 (30)
• Left and right front service clearances of 610x990 mm (24x39 in.) each are required. Left and right service clearances can overlap when racks are placed side by side.			
• Left and right rear service clearances of 610x1218 mm (24x48 in.) each are required. Left and right service clearances can overlap when Model A14s are placed side by side.			

Use the machine templates provided in *IBM 3590 High Performance Tape Subsystem Introduction and Planning Guide*, when planning the physical sitting of the equipment.

3.1.3 IBM 3590 Environmental Specifications

The environmental data shown in Table 14 applies to the components of the tape subsystem, not the IBM 3590 High Performance Tape Cartridges.

Table 14 (Page 1 of 2). IBM 3590 Environmental Specifications			
Condition	**Temperature**	**Relative Humidity**	**Maximum Wet Bulb**
Operating	16 to 32°C (60.8 to 89.6°F)	8 to 80%	23°C (73.4°F)

Table 14 (Page 2 of 2). IBM 3590 Environmental Specifications			
Condition	**Temperature**	**Relative Humidity**	**Maximum Wet Bulb**
Nonoperating	10 to 43°C (50 to 109.4°F)	8 to 80%	23°C (73.4°F)
Storage	0.6 to 60°C (33 to 140.0°F)	5 to 80%	0.6 to 29.4°C (33 to 85°F)
Shipping	-40 to 60°C (-40.0 to 140.0°F)	5 to 100% (excluding precipitation)	0.6 to 29.4°C (33 to 85°F)

For the environmental specifications for the IBM 3590 High Performance Tape Cartridges, please refer to Table 17 on page 43.

3.1.4 Power Requirements and Heat Output

Having positioned the IBM 3590 tape subsystem, you now need to connect it to the required power supply.

The IBM 3590-B11 and 3590-B1A include auto-ranging power supplies with input voltages of 85 to 264 volts. The IBM 3590-A00 and 3590-A14 include auto-ranging power supply with input voltages of 200 to 240 volts.

The appropriate IBM 3590-A14 power cord is attached at the factory to suit the destination country. No power cord needs to be specified for the IBM 3590-A14, unless specifically for the City of Chicago, where feature code 9986 is needed.

Table 15 shows the heat output and power requirements for the IBM 3590 High Performance Tape Subsystem.

Table 15. IBM 3590 Heat Output and Power Requirements						
Specifications	**Unit**	**Model B11**	**Model B1A**	**Model A00**	**Model A14**	**9309-2 Rack**
Heat Output	kW (kBtu/hr)	0.3 (1.02)	0.3 (1.02)	0.3 (1.02)	0.1 (0.34)	0.1 (0.34)
Power Requirement	kVA (max) (Phases)	0.3 (1)	0.3 (1)	0.3 (1)	0.1 (1)	0.1 (1)

For more detailed site planning information please refer to:

- *IBM 3590 High Performance Tape Subsystem Introduction and Planning Guide*
- *IBM 9309 Rack Enclosure General Information and Site Preparation Guide*.

3.1.5 Times for Equipment Installation

One IBM Customer Service Representative is required for installing an IBM 3590 tape subsystem, except for a field merge of the IBM 3590-B11 to IBM 3590-B1A, which requires two IBM Customer Service Representatives. Table 16 on page 42 shows the times to install the IBM 3590 tape subsystem models.

Table 16. Times for Installation of the IBM 3590 Tape Subsystem	
Type of installation	**Hours**
Field merge model B11 in rack	2.7
Install model B1A	1.8
Upgrade model B11 to B1A	3.9
Model change B11 to B1A	0.5
Install model A14	1.8
Install model A00	2.3
Install ESCON cards	1.5

On average, half an hour of system time is required for each of activities shown in Table 16. These activities need to be planned to ensure minimum disruption to production services.

There is no need to do preventive maintenance for the IBM 3590 tape subsystem.

3.1.6 IBM 3590 High Performance Tape Cartridge

You need to have a supply of 3590 cleaner cartridges and we recommend stocking enough IBM 3590 High Performance Tape Cartridges to last at least three months. All IBM 3590 High Performance Tape Cartridges should have an external label that is operator-readable, identifying the volume serial number. If the cartridge is used in IBM 3494 and 3495 Automated Tape Library Dataservers, the label should also be machine-readable. We recommend always applying both machine-readable and operator-readable labels, so that if, at some future date, you decide to install IBM tape automation, your cartridges will already be properly labelled.

Some installations use the barcode labels to keep track of cartridges that they interchange between sites. Typically a scanner is used to read the barcode and enter the volume serial number into a system that checks that the cartridge is authorized to either go off-site, or come on-site. Barcode labels are usually scrambled for security, but unscrambled barcode labels are available and can be scanned successfully. If you have this type of requirement we suggest you discuss it with your local label supplier.

The IBM 3590 High Performance Tape Cartridge and the 3590 cleaner cartridges both have a black case, but the IBM 3590 High Performance Tape Cartridge has two blue identification inserts on the edge, whereas on the 3590 cleaner cartridge the inserts are white. The identification notches on the 3590 cleaner cartridge are offset from the notches on the tape cartridge.

3.1.7 Cartridge Environmental Specifications

The environmental data shown in Table 17 on page 43 applies to the use, storage and shipping of IBM 3590 High Performance Tape Cartridges.

Table 17. IBM 3590 High Performance Tape Cartridge Environmental Specifications			
Condition	**Temperature**	**Relative Humidity**	**Maximum Wet Bulb**
Operating•	15.6 to 32.2°C (60 to 90°F)	20 to 80%	25.6°C (78°F)
Storage	4.4 to 32.2°C (40 to 90.0°F)	5 to 80%	26.7°C (80°F)
Shipping•	-23.3 to 48.9°C (-10.0 to 120.0°F)	5 to 80%	26.7°C (80°F)
Shipping•	4.4 to 37.8°C (40.0 to 100.0°F)	5 to 80%	25.6°C (78°F)
• The operating temperature applies to the ambient environment for the IBM 3590 High Performance Tape Subsystems using the IBM 3590 High Performance Tape Cartridges. • These are the environmental conditions for shipping IBM 3590 High Performance Tape Cartridges that are unrecorded (or contain no useful data). • These are the environmental conditions for shipping IBM 3590 High Performance Tape Cartridges that are recorded (or contain useful data).			

To protect the IBM 3590 tape subsystem and IBM 3590 High Performance Tape Cartridges, you must ensure that they are maintained within the environmental envelope specified in Table 17. Above the maximum wet-bulb temperature, the environment begins to approach the saturation point of air, and moisture begins to build up. If, at the upper limits of temperature and humidity, you allow the maximum wet bulb temperature to exceed the limit specified, you risk damage to the equipment and media deterioration. Similarly, you risk the buildup of electrostatic charge, at low temperature and humidity. The equipment is designed to deal with electrostatic discharge, but again we recommend not to operate outside the environmental specifications listed in Table 17

For successful long-term storage of IBM 3590 High Performance Tape Cartridges, it is vital that the storage environment is maintained as described above. Pay particular attention to the temperature of the storage environment and ensure that it remains within the range specified in Table 17.

3.1.8 Cartridge Care

When storing, using or shipping IBM 3590 High Performance Tape Cartridges:

- Keep the IBM 3590 High Performance Tape Cartridges in their original shipping containers until you use them. The plastic wrapping prevents contamination of the cartridges and partially protects them from humidity changes.

- Expose the IBM 3590 High Performance Tape Cartridge to the operating environment for as long as, or longer than, the time it was out of the operating environment. If the IBM 3590 High Performance Tape Cartridge has been out of the environment for more than 24 hours, it is not necessary to condition it to the operating environment for more than 24 hours.

- Place the IBM 3590 High Performance Tape Cartridge in a sealed, moisture-proof bag for shipping. Place the bag in a shipping container with enough packing material to cushion the IBM 3590 High Performance Tape Cartridge. If you ship more than one cartridge, ensure that the cartridges are held firmly together.

3.1.9 Cartridge External Volume Serial Number Labels and Barcodes

An IBM 3480 drive cannot read from, or write to, an IBM Enhanced Capacity Cartridge System Tape. Similarly, IBM 3590 cartridges cannot be used on IBM 3480 or 3490 drives. Thus 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.

IBM tape drives need to be cleaned on a regular basis, and this requires special cleaning cartridges. To ensure that the operator can identify a cleaning cartridge, external labels are placed on these cartridges by the manufacturer. With the IBM 3480 and 3490 models, a single type of cleaning cartridge can be used. However, the IBM 3590 requires a new 3590 cleaning cartridge.

To ensure that the operator can identify the correct tape volume and mount it on an IBM tape drive, a human-readable label, is employed. As with any other tape cartridge, you must label all IBM 3590 High Performance Tape Cartridges with a six-character external volume serial number identification label.

If you automate your tape operations, the same considerations apply, only now the IBM tape automation system 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.

Thus in addition to the human-readable external volume identification label, a machine-readable (barcode) label is needed.

To enable the IBM 3494 and 3495 Automated Tape Library Dataservers to recognize the different cartridge types, an additional, single character, media-type label is used. When a cartridge is inserted in an IBM automated 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, based on media type.

Within an IBM automated tape library, cleaning cartridges are identified by a particular set of volume serial masks, typically CLN***. The IBM 3590 cleaning cartridges need to be identified by the media type label, otherwise they could get mounted in an IBM 3490 drive, in response to a cleaning request.

Figure 11 on page 45 shows the three types of IBM cartridge.

With the exception of CSTs, we strongly recommend that **media-type E and J labels should be placed on all cartridges within IBM 3494 and 3495 Automated Tape Library Dataservers**. This applies to all environments and all platforms, and will eliminate the possibility of mounting incompatible cartridge types in the IBM tape drives.

IBM 3494 RPQ 8B3182, Specify Default with Mixed Media, allows specification of a default media type in an IBM 3494 Automated Tape Library Dataserver that contains mixed media types. This RPQ is not required for the IBM 3494 that has only one type of drives (IBM 3490E or IBM 3590). Without this RPQ a default media type is not allowed in a mixed tape drive types environment.

Note: Allowing a default media type in a mixed tape drive types environment creates the potential for mounting of the wrong media type in a tape drive which can result in a tape drive load error. Customer must have operational control in place to avoid this type of problem.

Currently, barcode labels supplied by two label manufacturers are suitable for IBM 3494 and 3495 Automated Tape Library Dataservers:

- Data Products (EDP) Tri-Optic

- Wright Line Tri-Code.

You can intermix these labels in your IBM 3494 and 3495 Automated Tape Library Dataservers.

We do not recommend that you print your own labels, since it is unlikely that you could achieve the same quality as the recommended labels. However, a facility is required to enable you to quickly replace a damage barcode label as a temporary measure.

3.2 IBM 3590 Installed in IBM Tape Library Dataservers

You install IBM 3590 tape subsystems in IBM 3494 and 3495 Automated Tape Library Dataservers to allow tape operation to be fully automated. For the IBM 3495, four IBM 3590-B1A tape drives and an IBM 3590-A00 controller are supplied within an IBM 3590-A14 frame, and the frame is integrated into the IBM 3495 configuration. IBM 3590 tape subsystems within a IBM 3495 attach to host systems using ESCON channels only. With the IBM 3494, the IBM 3590 tape subsystems are installed in the library and drive frames. IBM 3590 tape subsystems within a IBM 3494 can attach to SCSI channels, but need the IBM 3590-A00 to attach to ESCON channels.

The IBM 3590 High Performance Tape Subsystem drive attaches either directly to a host through one of its SCSI interfaces or to the IBM 3590-A00 controller. The IBM 3590-A00 controller provides for ESCON attachment of the IBM 3590 tape drives. The IBM 3590 tape drives cannot be directly attached to a host through a SCSI interface and also attached to the IBM 3590-A00 controller.

When a IBM 3590 tape subsystem is directly attached to a host through its SCSI interface, an RS-232 or LAN interface is used to provide communication between the host and the Library Manager. When a IBM 3590 tape subsystem is attached through the model A00 controller, the communication path for the Library Manager is through the same ESCON channels as for the drive.

When an IBM 3590 tape subsystem is directly attached to a host through its SCSI interface, an RS-422 interface is used between the Library Manager and the drive to communicate drive status and control. When a IBM 3590 High Performance Tape Subsystem is attached through the model A00 controller, the drive status and control path is through the RS-422 interface between the model A00 controller and the Library Manager. The model A00 controller acts as the path between the Library Manager and each drive.

3.2.1 Integration into Existing Tape Library

To integrate the IBM 3590 into the IBM Automated Tape Library Dataserver, follow these steps:

- For an existing library, plan to make the library available to the IBM Customer Service Representative to allow the IBM 3590 frames and drives to be installed.

  Switch the IBM 3494 and 3495 Automated Tape Library Dataservers offline from all attached systems, one at a time, before the IBM Customer Service Representative starts any installation activity.

  Ensure that the implementation causes a minimum of disruption, to automated tape services by warning all users well ahead of time.

- Shutdown the Library Manager and power off the IBM 3494 and IBM 3495.

- For an existing Library, the IBM Customer Service Representative

  - Installs a new level of Licensed Internal Code, if needed
  - Installs the new frames and new drives. The installation of each frame, including drives, will take approximately 5 hours.
  - Remove any old drives that are to be replaced. The IBM Customer Service Representative will perform a *partial teach* for the new frames. In an existing IBM 3494, the partial teaching process takes approximately 5 minutes to execute.
  - Insert a new IBM 3590 CE cartridge.
  - Perform a full inventory.
  - Hand back the IBM 3494 and IBM 3495.

- Insert the new IBM 3590 cleaner cartridges and the new IBM 3590 High Performance Tape Cartridges. Ensure that all IBM 3590 cartridges have a proper barcode, with a J media-type label.

- Set up the cleaning schedule to use the cleaner cartridges after every 100 tape uses.

- Vary the library and drives online, one at a time, and check that all paths and all drives come online with all attached hosts.

- Check that the information about the new cartridges has been uploaded to the hosts automatically; in some cases this requires operator action.

- If the host software environment has been set up properly, the new drives and cartridges are ready for testing.

- If the new drives are to replace existing equipment, you must manage the discontinuance of the old drives.

Note: If you are installing IBM 3590 tape subsystems as part of a new IBM Automated Tape Library Dataserver configuration, please refer to *IBM 3494 Introduction and Planning Guide* and *IBM 3495 Introduction and Planning Guide*.

If you are attaching to existing IBM Automated Tape Library Dataserver, the new frames need to be integrated into the library and attached to the Library Manager

The new drives and cartridges are ready for use.

3.2.2 ESCON-Attached IBM 3590 Installed in IBM 3494

Depending on the requirement for number of drives and host system attachment, specify the frame, rack and drive components by means of the device-installation feature codes, as shown in Table 18.

Table 18. IBM 3590 Device Installation Feature Codes for IBM 3494		
Feature Code	Description	Device
9631 9636	Factory Install	B1A A00
9630 9635	Field Install	B1A A00
4630	Field Install	B1A

Please refer to Appendix E, "IBM 3590, 3494 and 3495 Special Feature Codes" on page 261 for a complete list of IBM 3590 feature codes.

Figure 12 shows the ESCON-attached IBM 3590 models in an IBM 3494:

- The library unit frame, the IBM 3494-L14, with an IBM 3590-A00 controller and two IBM 3590-B1A drives. The actual drive addressing is as shown in Figure 12.

- The drive unit frame, the IBM 3494-D14, with an IBM 3590-A00 controller and four IBM 3590-B1A drives. The actual drive addressing is as shown in Figure 12.

Please refer to Appendix A, "Enterprise Systems Connection (ESCON) Tutorial" on page 225 for more information on ESCON attachment.
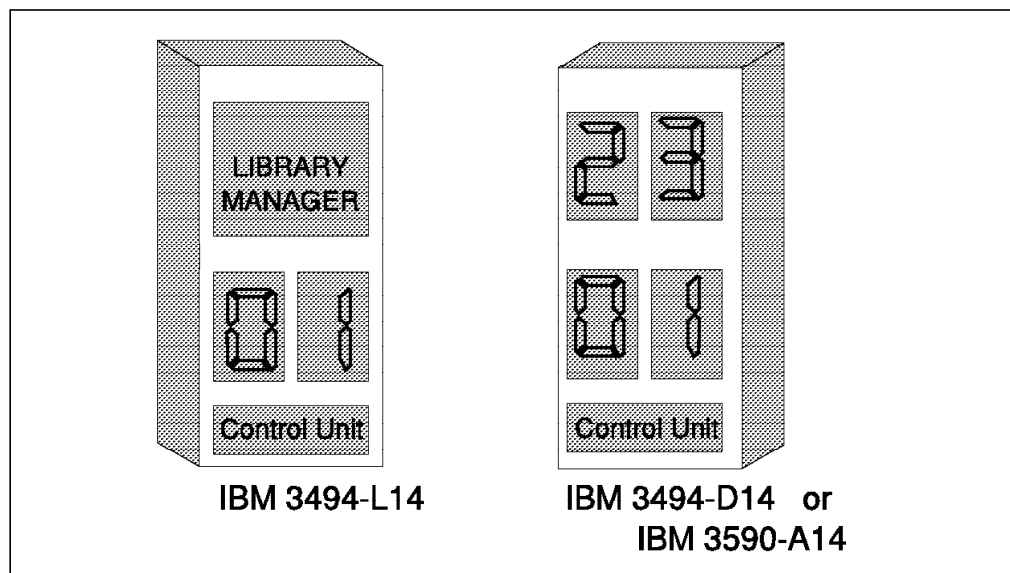
Figure 12. ESCON-Attached IBM 3590 Drives in an IBM 3494

Configure these frames as follows:

3494-L14   This frame can contain no IBM 3590-A00 controller and zero IBM 3590-B1A drives.

This frame can contain an IBM 3590-A00 and one or two IBM 3590-B1A drives. The IBM 3494-L14 frame has 240 cartridge cells.

3494-D14   This frame can contain no IBM 3590-A00 controller and zero IBM 3590-B1A drives.

This frame can contain an IBM 3590-A00 controller with one to four IBM 3590-B1A drives. The IBM 3494-D14 frame storage capacity is:

- 400 cartridges without IBM 3590-B1A drives

- 345 cartridges with one to two IBM 3590-B1A drives

- 305 cartridges with three to four IBM 3590-B1A drives.

Note: All capacities are quoted without the Dual Gripper Feature installed.

Feature code 5304 is an MES that converts an existing IBM 3494 drive frame unit (was feature code 5300) to an IBM 3494-D14. This feature provides for up to two IBM 3590-B1A drives and up to one IBM 3590-A00 controller, other configurations require an RPQ.

3.2.3 SCSI-Attached IBM 3590 Installed in IBM 3494

The IBM 3590 High Performance Tape Subsystem conforms to the following SCSI standards:

- The SCSI adapter complies with the ANSI standard "Small Computer Systems Interface-2 (SCSI-2)," ANSI X3T9.2/86-109, Revision 10 X3T39/89-042.

- The SCSI cables comply with the ANSI standard "Small Computer Systems Interface-3 (SCSI-3)," ANSI X3T9.2/91-10 Revision 2.

Please refer to Appendix B, "Small Computer Systems Interface Tutorial" on page 235 for more information on SCSI.

Figure 13 on page 50 shows the Library and Drive unit frames with SCSI-attached IBM 3590 tape subsystem drives installed. Table 19 shows the SCSI cables (and their feature codes) available for connecting multiple IBM 3590-B1A drives on the same SCSI bus within a IBM 3494-D12 frame.

Table 19. IBM 3494 SCSI Cable Feature Codes	
Feature Code	**Cable Length**
5134	3.4 m (11 ft)
5138	3.8 m (12 ft)

Figure 13 on page 50 shows:

- An IBM 3494-L12 library unit frame with two SCSI-attached IBM 3590-B1A drives. The actual drive addressing is as shown in Figure 13 on page 50.

- An IBM 3494-D12 drive unit frame with six SCSI-attached IBM 3590-B1A drives. The actual drive addressing is as shown in Figure 13 on page 50
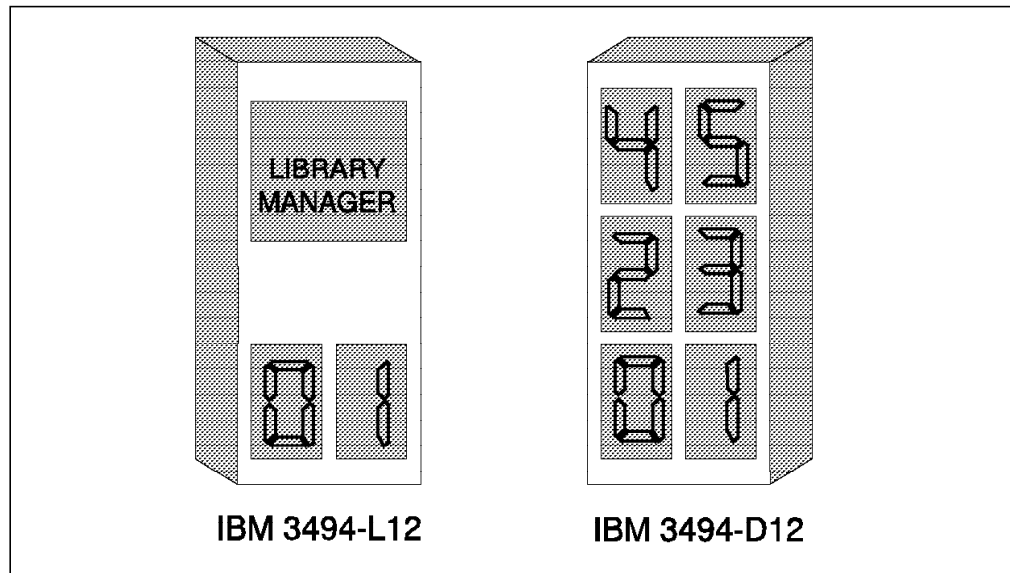
Figure 13. SCSI-Attached IBM 3590 Drives in an IBM 3494

Configure these IBM 3494 frames as follows:

IBM 3494-L12 This frame can contain zero, one, or two IBM 3590-B1A drives. The IBM 3494-L12 frame has 240 cartridge cells.

IBM 3494-D12 This frame can contain up to six IBM 3590-B1A drives. The IBM 3494-D12 frame storage capacity is:

- 400 cartridges without IBM 3590-B1A drives
- 335 cartridges with one or two IBM 3590-B1A drives
- 290 cartridges with three or four IBM 3590-B1A drives
- 250 cartridges with five or six IBM 3590-B1A drives.

Note: All capacities are quoted without the Dual Gripper Feature installed.

Feature code 5302 is an MES that converts an existing IBM 3494 drive frame unit (previous feature code 5300) to an IBM 3494-D12. This feature provides for up to two IBM 3590-B1A drives, other configurations require an RPQ.

3.2.4 Virtual Tape Server with IBM 3590 Installed in IBM 3494

For physical configuration of an IBM 3494 tape library including the Virtual Tape Server with IBM 3590, five basic configuration rules apply:

- The L12/L14 frame can be without drives.

  For a minimum configuration of an IBM 3494 with a Virtual Tape Server subsystem, the L12 or L14 frame can be installed without tape drives. Please submit an RPQ if you want to install a Model L10 frame without tape drives.

- The D12/B16 frame must be within the first eight frames.

  If you are extending your current library to more than eight frames, you cannot install the Virtual Tape Server subsystem beyond the eighth frame.

  If the configuration of frames in an installed IBM 3494 tape library has to be changed — for example, if frames must be moved to install a VTS subsystem, or if frames are moved from one IBM 3494 to another — an RPQ must be

processed before the IBM 3494 Tape Library can be reconfigured. This RPQ is required for moving feature numbers 5300, 5302, 5304, and 5400, or Models B16, D10, D12, D14, and S10, and will ensure that the proper cables are available. The RPQ will also prepare for future changes or enhancements.

- The D12 frame must always be to the left of the B16 frame.

  If you are planning to use an already installed IBM 3494-D12 frame to hold the IBM 3590-B1A tape drives of the Virtual Tape Server, it has to be installed to the left of the IBM 3494-B16 frame (between the IBM 3494-B16 and the IBM 3494-Lxx frames). If you want to change an existing empty IBM 3494-D14 frame into an IBM 3494-D12 frame, you must submit an RPQ.

- The D12 and B16 frames must directly attach to one another.

  You cannot install another frame between the IBM 3494-D12 and the IBM 3494-B16 frames that include an IBM Magstar Virtual Tape Server.

- A modem must be supplied for the IBM 3494-B16 frame.

  It is mandatory that you supply a modem for installation, operation, and remote support service of the IBM 3494-B16 frame. The same modems as for the IBM 3591-A01 and 3590-A00 Remote Support Facility (RSF) are supported. You can obtain a list of these modems from your IBM representative.

Please refer to *IBM Magstar Virtual Tape Server and Enhancements to Magstar: New Era in Tape* for more detail information.

3.2.5 ESCON-Attached IBM 3590 Installed in IBM 3495

The IBM 3495 supports three tape subsystems: the IBM 3490 base and enhanced models and the IBM 3590 models. The IBM 3490 models A01/A02/B04 and the IBM 3490 models A10/A20/B40 all have a common physical packaging which consists of a control unit (A01/A02/A10/A20) and a drive unit (B02/B04/B20/B40). Multiple B units can be attached and controlled by a single A unit. For the IBM 3590-A14, the control unit and the drives are packaged in the same unit. There are no B units, and the IBM 3590-A14 units cannot be intercoupled.

These are the IBM 3495 configuration rules for the installation of IBM 3590 tape subsystems:

- An IBM 3590-A14 cannot be located in front of the datum frame.
- At least one storage frame must be placed between an IBM 3590 tape subsystem and the service-area access doors.
- At least two storage frames must be placed between an IBM 3590 tape subsystem and the operator access doors.
- IBM 3590-A14 frames must be placed in the same locations as IBM 3490 B units.
- There must be a storage frame between every four IBM 3590-A14s.

The IBM 3590 tape subsystems are installed along the front side of the IBM 3495 as illustrated in Figure 14 on page 52.
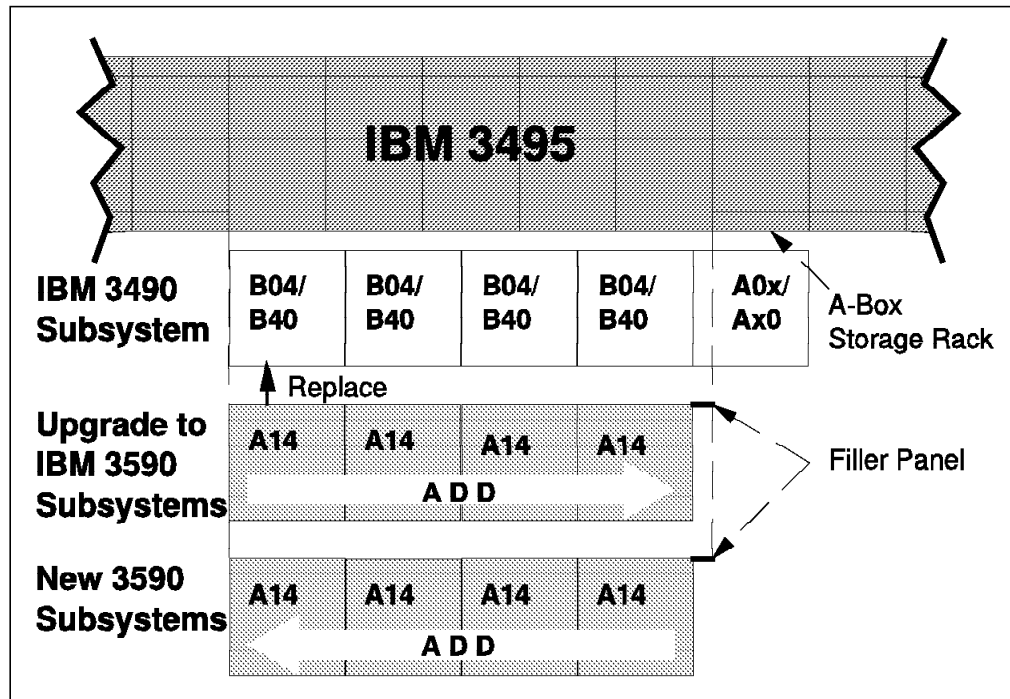
Figure 14. IBM 3590 High Performance Tape Subsystem Installation in an IBM 3495

When installed, the IBM 3590-A14 displaces an IBM 3490 B unit as follows:

- When upgrading an existing IBM 3490 string with IBM 3590 drives, the first IBM 3590-A14 unit will replace the IBM 3490 B unit farthest from the IBM 3490 A unit. Subsequent IBM 3590-A14 units replace 3490 B units, which are adjacent to the first IBM 3590-A14.

  When a subsequent IBM 3590-A14 unit is added, the existing IBM 3590-A14 units may have to be temporarily moved so that the existing IBM 3490 B units can be removed.

- To completely replace an IBM 3490 string, a *filler* panel is used to span the gap between the IBM 3490 A unit wall and the adjacent IBM 3590-A14 unit. The existing IBM 3490 A unit wall is not replaced with a storage wall.

- When adding a new IBM 3590-A14 string, the first IBM 3590-A14 unit is positioned where the IBM 3490 B unit closest to the IBM 3490 A unit is normally positioned, with a filler panel to close the gap to the adjacent storage frame. Starting with the installed IBM 3590-A14 unit, additional IBM 3590-A14 units occupy the space normally used for the IBM 3490 B units.

For additional information about the IBM 3495, please refer to *IBM 3495 Introduction and Planning Guide*.

3.2.6 Virtual Tape Server with IBM 3590 Installed in IBM 3495

For physical configuration of an IBM 3495 tape library including the Virtual Tape Server with IBM 3590, the following basic configuration rules apply:

- One IBM 3495-B16 frame must be installed.

  The IBM 3495-B16 frame provides the ESCON connection to the host, and houses the Tape Volume Cache and the Virtual Tape Server controller. In the IBM 3495 wall adjacent to the IBM 3495-B16 frame storage cells can still exist, as with the IBM 3490-Axx frames installed in an IBM 3495. These storage cells, which are managed by the Library Manager, can contain any

cartridge and are not restricted to storing only Magstar cartridges that are used by Virtual Tape Server subsystem.

- One IBM 3590 tape subsystem-A14 frame must be installed.

One IBM 3590 tape subsystem-A14 frame is required for the Virtual Tape Server subsystem. It contains four IBM 3590-B1A tape drives plus the necessary SCSI cabling to connect the tape drives to the IBM 3495 Model B16 frame. Other than with ESCON-attached Magstar tape drives, the IBM 3590 tape subsystem Model A14 frame used by a Virtual Tape Server does not require an IBM 3590 tape subsystem Model A00 control unit to be ordered.

You must order the IBM 3590-B1A tape drives in addition to the A14 frame. However, you do not need to specify SCSI cables for the drives.

- Library Manager attachment requires a LAN connection.

The Magstar tape drives residing in the IBM 3495-D12 frame are not attached to any host system. The drives are managed by the Virtual Tape Server controller. None of the IBM 3495 LM RS-422 control unit ports are used by the VTS subsystem. They are attached solely to the Library Manager through a LAN connection to provide the required communication path for library-related commands, and to the Virtual Tape Server controller IBM 3590-A14.

The Virtual Tape Server controller is connected to the Library Manager through a dedicated LAN connection to provide the required communication paths.

- B16 and A14 frames must be installed side by side.

The IBM 3495-B16 and the IBM 3590 tape subsystem-A14 frame must be installed adjacent to one another. You cannot separate the two frames.

- IBM 3495 tape library storage cells are usually reduced in number when a VTS is installed.

When a VTS is installed in a IBM 3495 tape library, the total amount of storage cells in the library may be decreased. If it is placed in a location where a IBM 3490 tape subsystem already existed, the cell count is not affected. If the VTS is installed on a Model L30, L40, or L50 in a position where no 3490 string existed, then the cell count drops by 520 tapes. For two 3495 storage racks, there is no reduction in the frame adjacent to the B16 frame.

- A modem must be supplied for the IBM 3495-B16.

It is mandatory that you supply a modem for installation, operation, and remote support service of the IBM 3495-B16. The same modems are supported as for the IBM 3591-A01, and 3590-A00 Remote Support Facility (RSF). You can obtain a list of these modems from your IBM representative.

Please refer to *IBM Magstar Virtual Tape Server and Enhancements to Magstar: New Era in Tape* for more detail information.

3.2.7 Other Implementation Activities

When you have completed the installation of the IBM 3590 tape subsystems in the IBM 3494 and 3495 Automated Tape Library Dataservers, the following activities and considerations need to be undertaken and understood before you use the tape library and IBM 3590 drives:

1. Scheduling Cleaning

   Typically, mounting an IBM 3590 High Performance Tape Cartridge means that significantly more data is transferred and more physical length of the tape is traversed than with CSTs and ECCSTs. Thus the IBM 3590 drives need to be cleaned more frequently, and the IBM 3590 cleaner cartridges need to be replaced more often.

   We recommend that you clean each IBM 3590 drive after 100 mounts and replace the IBM 3590 cleaner cartridge after 100 uses. This is an increase in frequency. Typically, with IBM 3490 drives, the drives are cleaned after 100 mounts and the IBM 3490 cleaner cartridges are replaced after 200 uses.

   The criteria for automatic cleaning are set in the *Clean Schedule* menu. This is accessed from the Library Manager primary option menu, by selecting *Commands* and *Schedule cleaning*. An alternative to specifying the number of mounts before a drive is cleaned is to specify a value of *999* for the *Usage clean* value. Specifying a value of 999 effectively means that you do want drive cleaning, based on the number of mounts, to be performed automatically. However, the drive itself automatically schedules a cleaning operation. The drive makes the decision to request a cleaning operation based on criteria such as temporary error rate, number of mounts, and amount of data transferred since the last cleaning operation. The IBM tape drives keep track of events such as:

   - Number of mounts
   - Cleaning operations
   - Amount of data transferred, since last clean
   - Temporary error rate.

   This information is stored in Statistical Analysis and Reporting (SARS) programs in the drive microcode.

2. Unlabeled tape support in IBM 3494

   The IBM 3494 can process IBM 3590 High Performance Tape Cartridges that do not have a valid internal volume serial number or external barcode or media-type label. Use the *Unlabeled Tape* option and then enter this information into the IBM 3494. Then insert, use, store, and eject these cartridges as usual.

   Note: This facility is designed to allow you to enter, process and eject the occasional cartridge that has no barcode. We do not recommend using this facility for large numbers of cartridges, or storing cartridges in the IBM 3494 for an extended period.

3. Reserved cells

   If only IBM 3590 drives are installed in the library, the CE cartridge will occupy cell Location "1 A 20". If both IBM 3490 Model C and IBM 3590 tape subsystem drives are installed, then the IBM 3590 High Performance Tape Subsystem CE cartridge will occupy Location "1 A 19".

Check to see if one of the existing cartridges occupies a cell to be used by the IBM 3590 CE cartridge and arrange for the cartridge to be moved if necessary.

For additional information about the IBM 3494, please refer to *IBM 3494 Introduction and Planning Guide*.

4. Reserved cells in IBM 3495

The reserved cell locations within the IBM 3495 do not change with the introduction of the IBM 3590 tape subsystem.

3.3 ES/9000 and S/390 Parallel Server Systems

The IBM 3590 High Performance Tape Subsystem is supported on all ES/9000 and S/390 Parallel Server Systems and the attachment is by means of ESCON channels only; there is no SCSI or parallel channel attachment.

Depending on the requirement for number of drives, IBM 3590 controllers, and IBM 3590-A14 frames, specify the required feature codes, as shown in Table 20.

Table 20. IBM 3590 Device Installation Feature Codes for A14		
Feature Code	**Description**	**Device**
3312	ESCON Adapter Card	A00
9000	ES/9000 Attach	B1A, B11, A00 or A14
9631 9637	Factory Install	B11 or B1A A00
4630	Field Install	B11

3.3.1 Attaching to the ES/9000 and S/390 Parallel Server

With ESCON channel attachments, there are numerous options for the physical location of the IBM 3590 tape subsystem in relation to the attached host system. Feature 3312 provides attachment capability to the IBM 3590-A00 for two concurrent IBM 3590 SCSI-2 two-byte-wide differential protocol attachments to two ESCON channels.

Each ESCON channel adapter on the IBM 3590 tape subsystem can support up to 64 logical attachments. ESCON Directors can only connect to a single attachment from a single channel adapter. ESCON Directors have the possibility to connect to up to 128 logical attachments. Decide how many hosts to attach your IBM 3590 tape subsystems to, and how to achieve the channel path attachment. The IBM 3590 tape subsystem can be attached up to 43 km (27 miles) from a host system. See Figure 15 on page 56 for some of the attachment options.

For additional information about ESCON attachments, please refer to *Planning for Fiber Optic Channel Links*.

Fiber-optic jumper cables are required to attach the IBM 3590 tape subsystem Model A00 to the ESCON channels. Duplex-to-duplex 62.5/125 μm fiber-optic jumper cables can be ordered from IBM in standard lengths of up to 122 m (400 ft). Custom built cables can be ordered up to a length of 500 m (1640 ft).

3.3.2 Creating the Input/Output Configuration

For ES/9000, ES/3090-J, ES/3090-9000T, and S/390 systems, define the IBM 3590 tape subsystem and ESCON channel configuration using the input/output configuration program (IOCP). MVS/ESA users can use the hardware configuration definition (HCD) to define the I/O configuration to the hardware. The following configuration rules apply when defining the IBM 3590 tape subsystem with IOCP or HCD:

- Define a single control unit with one or two ESCON channel path(s).

- Specify UNITADD=((00,4)) for the control unit to define all the possible unit addresses that it supports.

- If the ESCON channel paths attach to an ESCON Director, specify link addresses on the control unit. The link addresses must be the ones associated with the physical ports on the ESCON Director to which the IBM 3590 tape subsystem attaches.

- Define as many tape drive devices as you have installed. The unit addresses of the devices must match those defined in the control unit.

Note: Do not specify the *preferred path* option for IBM 3590 tape subsystems. For dual IBM 3490 tape subsystems, Model A20 and Model A02, however, specifying the preferred path is still a recommended option.

Figure 15 shows a sample configuration, with two IBM 3590-A14s, each with four IBM 3590-B11 drives, attached to an ES/9000 processor.
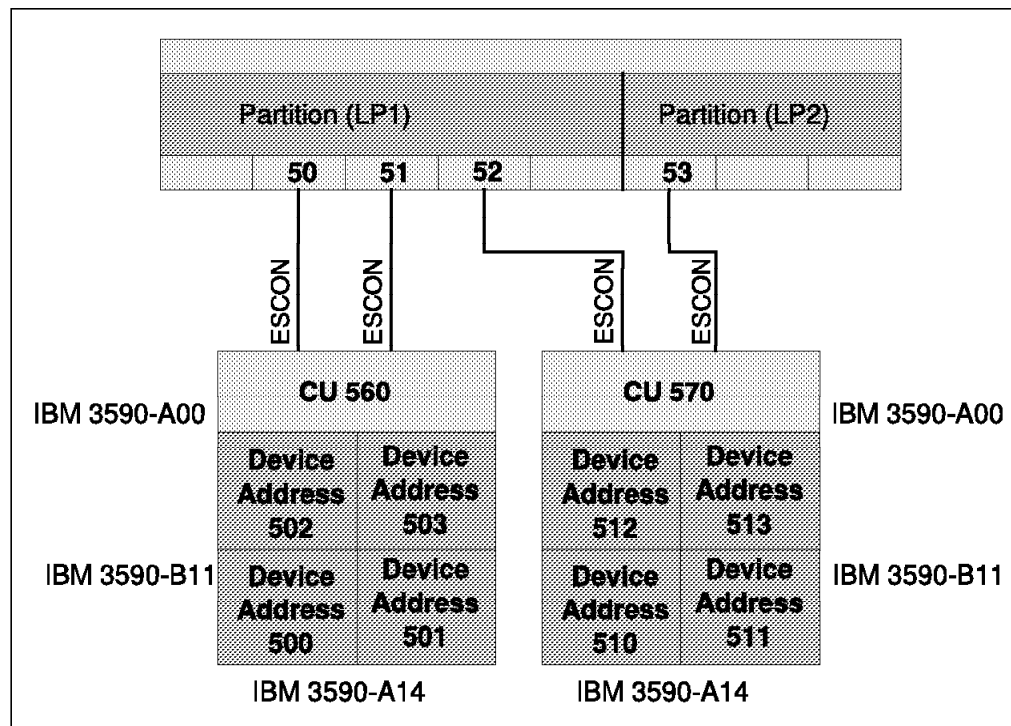
Figure 15. Sample Configuration with Two IBM 3590-A14s

Figure 16 on page 57 shows an example of the IOCP definition required for the configuration shown in Figure 15.

```
***********************************************************************
*   3590 TAPE STRINGS                                                 *
***********************************************************************
*
**  PATHS 50 & 51 & 52 & 53
*
        CHPID PATH=((50),(51),(52)),TYPE=CNC,PARTITION=(LP1,REC)     X
        CHPID PATH=((53)),TYPE=CNC,PARTITION=(LP2,REC)
*
**  CHPIDS 50 & 51
*
        CNTLUNIT  CUNUMBR=560,PATH=(50,51),UNIT=3590,               X
            UNITADD=((00,4))
        IODEVICE ADDRESS=(500,4),CUNUMBR=(560),UNIT=3590,           X
            UNITADD=00
*
**  CHPIDS 52 & 53
*
        CNTLUNIT  CUNUMBR=570,PATH=(52,53),UNIT=3590,               X
            UNITADD=((00,4))
        IODEVICE ADDRESS=(510,4),CUNUMBR=(570),UNIT=3590,           X
            UNITADD=00
```

Figure 16. Sample IOCP for Two IBM 3590 Model A14s

Please refer to Chapter 4, "Software Implementation" on page 81 for information on how to define the HCD for MVS/ESA systems. Using HCD, build the input/output configuration data set (IOCDS) from the input/output definition file (IODF).

3.4 RISC System/6000 and IBM RS/6000 Scalable POWERparallel Systems

Any RISC/6000 or IBM RS/6000 Scalable POWERparallel Systems (RS/6000 SP) that support the appropriate host SCSI adapter, feature 2416, 2412, or 2420, support the IBM 3590 tape subsystem. In addition to normal tape functions, the IBM 3590-B11 can operate as an integrated medium changer device to provide random access to cartridges in its ACF. Random mode operation of the ACF is supported by ADSM for AIX. A maximum block size of 2 MB is supported.

To install the IBM 3590 tape subsystem:

1. The IBM Customer Service Representative:

   • Installs the IBM 3590 tape subsystem in an IBM 7202, 7015-R00, or customer-provided rack.

   • May install the IBM 3590 tape subsystem in a new IBM 3494 or integrate the IBM 3590 tape subsystem into an existing IBM 3494.

   • Attaches the drive to the host adapter.

2. You:

   • Install the IBM 3590 tape subsystem tape device driver and configure the drives.

   • May need to install the IBM 3494 Device Driver.

3.4.1 Attaching to RISC/6000 and IBM RS/6000 Scalable POWERparallel Systems

An IBM 3590 tape subsystem is connected to a RISC/6000 or a RS/6000 SP through the SCSI attachment. There are three types of host adapter:

- The SCSI-2 Differential Fast/Wide Adapter/A, feature 2416. With this adapter a data transfer rate of up to 20 MB/sec is possible on the SCSI bus. The length of the SCSI bus can be up to 25 m.

- The Enhanced SCSI-2 Differential Fast/Wide Adapter/A, feature 2412. With this adapter a data transfer rate of up to 20 MB/sec is possible on the SCSI bus. The length of the SCSI bus can be up to 25 m.

- The SCSI-2 Differential High Performance External I/O Controller, feature 2420. With this adapter, a data transfer rate of up to 10 MB/sec is possible on the SCSI bus. The length of the SCSI bus can be up to 19 m.

Specify that you want to attach the IBM 3590 tape subsystem to your RISC/6000 by using the feature codes shown in Table 21.

Table 21. IBM 3590 Attachment Feature Codes for RISC/6000 and RS/6000 SP		
Description	**Model**	**Feature Code**
RS/6000 SP Attach	B11 or B1A	9076
RISC/6000 Attach	B11 or B1A	9600
AIX device driver	B11 or B1A	9603
Interposer, one-byte-wide RISC/6000 and RS/6000 SP	B11 or B1A	9701
Interposer, two-bytes-wide RISC/6000 and RS/6000 SP	B11 or B1A	9702

The following rules apply for SCSI bus attachment of IBM 3590 model B11 or B1A:

- The IBM 3590-B11 has two ports that can attach to two different RISC/6000 systems.

- Multiple IBM 3590-B11s can be attached to a single RISC/6000. The maximum number of IBM 3590 tape subsystems that can be attached depends on the maximum number of host adapter cards that can be installed and supported.

- A single IBM 3590-B11 with an ACF can be shared by two RISC/6000s or a RISC/6000 and an AS/400, for a maximum of two hosts. You can assign individual cartridges to a particular host by assigning each cartridge to a different category.

  Because the inventory of cartridges in an ACF used in random mode is kept by the host that uses it, we recommend that you not share any drive you plan to operate in this mode.

- Multiple drives can be *daisy chained* to the same adapter. However, in commercial environments, we recommend that no more than two drives

share the same SCSI bus. This recommendation should ensure optimum performance of your drives.

Table 22 shows the SCSI cable length feature codes that are available.

Table 22. IBM 3590 SCSI Cable Feature Codes for RISC/6000 and RS/6000 SP

Feature Code	IBM 3590 Model	Cable Length
5106	B11	0.6 m (1.9 ft)
5128	B11	2.8 m (9 ft)
5134	B1A	3.4 m (11 ft)
5138	B1A	3.8 m (12.5 ft)
5145	B1A and B11	4.5 m (15 ft)
5112	B1A and B11	12 m (39 ft)
5118	B1A and B11	18 m (59 ft)
5125	B1A and B11	25 m (82 ft)

Install the IBM 3590-B11 in a new IBM 7202, 7015, or one of your existing racks. Using an existing rack, 12 Electronics Industries of America (EIA) units of space are required. Install two IBM 3590-B11 drives on a rack shelf; four IBM 3590-B11s require the complete rack.

Do not install any *customer-access* devices below an IBM 3590-B11. Table 23 shows the drive-installation feature codes required to install the IBM 3590 tape subsystems in racks.

Table 23. IBM 3590 Device Installation Feature Codes for Rack Mounting

Description	Device	Install	Feature Code
First device	B11	Rack	9221
Second or fourth device	B11	Rack	9222
Third device	B11	Rack	9223
Field merge	B11	A14	9630

The hardware received is based on the feature codes that you order with the drive:

9221   Provides a shelf, an acoustic baffle (goes in the back of the full rack), mounting hardware for one drive, and a cover for the adjacent position. This drive will occupy the top left position in the rack, when viewed from the front.

9222   Provides the mounting hardware for one drive. This drive will occupy either the top right or the bottom right position in the rack, when viewed from the front.

9221 + 9222   Provides the sum of 9221 and 9222, as above, but leaves out the blank cover for the top right position.

9223   Provides the same parts as 9221 without the baffle. The drive will occupy the bottom left position in the rack, when viewed from the front.

9221 + 2 x 9222 + 9223   Provides the sum of the above (without blank covers as all four drives are present).

Please refer to Table 25 on page 66 for details of the IBM 3590 SCSI cable features. An interposer is required when an IBM 3590-B11 or 3590-B1A is connected to a RISC/6000 or IBM RS/6000 Scalable POWERparallel Systems. Depending on the type of host adapter, feature 2416, 2412 or 2420, use interposer feature 9702, or 9701. Figure 17 shows the connections between the host adapter port, the interposer, and the SCSI bus cable.

For SCSI cabling, please refer to Appendix F, "SCSI Cabling for Magstar and IBM 3590 Tape Subsystem" on page 267.
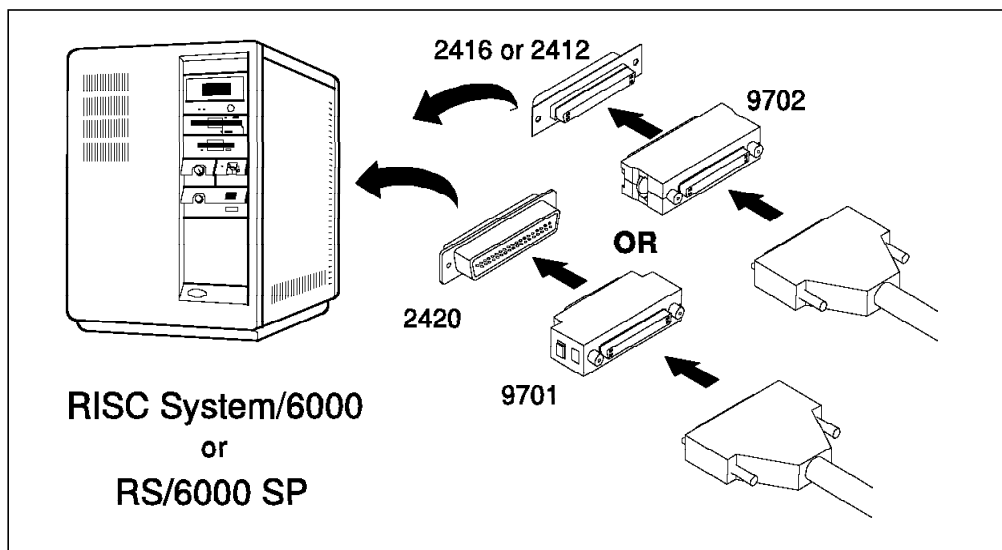
Figure 17. 3590 SCSI Cable Connection to RISC/6000 or RS/6000 SP

3.4.2 Installing IBM 3590 High Performance Tape Subsystems

To install the IBM 3590 tape subsystem, follow these steps:

1. Plan how to connect the device in advance. Ensure that the IBM 3590 tape subsystems have their own dedicated SCSI attachments available and that they do not share their individual buses with other device types

2. Determine which SCSI ID (or IDs) the device should have.

3. Obey the restrictions on bus cable length. Host adapter feature 2420 supports up to 19 m (62 ft.), and feature 2416 and 2412 support up to 25 m.

4. Draw a map of the bus showing:

    • Every device
    • All SCSI IDs
    • Where terminators are connected.

5. Provide a 7202, or 7015-R00 rack to accommodate the drive

6. Power down the system and hand it over to the IBM Customer Service Representative.

7. The IBM Customer Service Representative:

    • Installs the IBM 3590 tape subsystem in the appropriate rack.
    • May need to install a new host adapter.

- Checks all device SCSI IDs on the bus.
- Checks that the SCSI ID of the attachment feature is set to seven, is the highest priority on the bus.
- Removes the host SCSI adapter port terminator and connects the SCSI cable to the host adapter port.
- Completes the installation and runs drive diagnostics.

8. Power up your RISC/6000 or IBM RS/6000 Scalable POWERparallel Systems.

9. Verify all the connections. For AIX platforms, this can be done by issuing the AIX command DIAG. You must have root authority to execute the DIAG command. The sequence is as follows:

- Execute the DIAG command.
- Select **Service Aid**.
- Select **SCSI bus**.
- Select the **parent adapter**, or **bus**.
- Finally, select the SCSI ID of the device you want to verify.

10. Check every SCSI device by selecting its SCSI ID. This will send a Test Unit Ready (TUR) command to that address. If the device is powered on and properly connected, it will reply with a *valid response*, in which case the connection is okay. You may receive a valid response to a TUR with a CHECK-CONDITION from the device. This need not indicate a problem, for example it could mean that a tape drive does not have a cartridge loaded.

You are now ready to install the AIX Tape and Medium Changer Device Driver program.

3.4.3 Installing the AIX Tape and Medium Changer Device Driver

The device driver for the IBM 3590 tape subsystem is provided as a hardware feature (9603) of the IBM 3590-B11 tape drive. It is called the AIX Tape and Medium Changer Device Driver and it also supports the IBM 3490 models C and E, and the IBM 7331 8-mm tape library.

Use the installp utility to install the 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.

Use one of the following methods to configure the IBM 3590 tape subsystem:

1. Enter the **cfgmgr** command with no parameters. This will automatically configure all devices, including the new IBM 3590 tape subsystem

2. Turn off the system and reboot. This process automatically configures and makes available any new devices

3. Use the **mkdev** command. On AIX Version 4, for example,

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 LUN 0
and attached to the parent adapter, scsi1. It is type 3590 with a special file
name of */dev/rmt4*.

4. Use the **smit** menu and enter the **smit tapes** command.

Figure 18 shows the tape drive menu: *Add a Tape Drive*.

```
                     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 18. Defining the IBM 3590 Using the SMIT Menu

Note: 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 following are the recommendations for setting the configuration parameters
for IBM 3590 tape subsystem for best performance:

- Autoloading: **no** (default is off)
- Block size: **0**   (default is zero)
- Buffered mode: **yes** (default is on)
- Bus domination: **yes** (default is off)
- Compression: **yes** (default is on).

Note:

1. 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 placed in this field, it implies
   that 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.

2. Set DMA bus memory length to maximum to enable 2 MB block transfers, use SMIT CONFIG to do this.

   The level of device driver shipped with the IBM 3590 drives, for host adapter feature code 2420, 2416, and 2412, will automatically increase the direct memory access (DMA) bus memory length for 2 MB transfers.

3. With bus domination set to *on* the performance of intermediate block sizes, from 32 KB to 128 KB, may be improved. The improvement can be anything from 0.5 to 1 MB/sec.

4. The autoloading option is set to **no** when ADSM/6000 is used to manage the IBM 3590 tape subsystem ACF as a minilibrary.

5. The ACF mode can be can be queried by an application using the STIOCQRYP **ioctl** command.

You have completed the installation of the IBM 3590 tape subsystem. It is now ready for use.

3.4.4 Implementing the IBM 3590 Installed in IBM 3494 Tape Library

The IBM 3590 tape subsystem is supported for RISC/6000 and IBM RS/6000 Scalable POWERparallel Systems attachment using SCSI. The IBM 3494 supports SCSI attachment, but the IBM 3495 does not. Therefore, for IBM 3590 tape subsystems operating in the RISC System/6000 and IBM RS/6000 Scalable POWERparallel Systems environments, IBM tape library support is available only with the IBM 3494.

For a new IBM 3494 installation containing IBM 3590 tape subsystems, perform the following tasks:

• Insert IBM 3590 cartridges into the IBM 3494 through the Convenience I/O station. Place the cartridges in any empty cell locations, except the reserved cells or the high-capacity output cells, if this facility is configured.

• Add at least two IBM 3590 cleaner cartridges.

• Perform a library inventory. If you enter new cartridges only through the Convenience I/O station, then an inventory is not necessary. If you open the frame doors and only add cartridges, then the open door verification (or inventory) will register the new cartridges. However if, while the frame doors were opened, cartridges were moved or removed, then a full inventory is recommended to ensure Library Manager integrity.

• Set up the cleaner mask and define the cleaning schedule.

Before you can access the IBM 3494, you must install the AIX Tape Library Device Driver.

3.4.5 Installing the AIX Tape Library Device Driver

For the IBM 3590-B1A tape drive in an IBM 3494, both the device driver for the tape drive and the Library Manager device driver are included in hardware feature number 5212 of the IBM 3494.

Ensure that the RS-232 or LAN cable for IBM 3494 library communications is in place before you install the device driver. Install the AIX Tape Library Device Driver by performing the following tasks:

- Install the device driver software.

- Configure the IBM 3494 serial port (the library control path can use either an RS-232 or a LAN connection.

- Configure the IBM 3590 tape subsystems.

- Define the IBM 3494 to the daemon.

- Configure the Library Manager Control Point (LMCP).

- Load the daemon.

Loading the daemon requires performing the following tasks:

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 88 mm (3.5 in.) diskette labeled "IBM Automated Tape Library Device Driver, AIX LAN/TTY" in the workstation diskette drive.

2. Use the **smit** command to configure the serial port (the library manager control path). 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. Configure all the IBM 3590 tape subsystems (please refer to 6.4.3, "Types of Tape Data to Be Moved" on page 134). This is an example:

   `libmgrc7   /dev/tty0   mercury`

   This device-stanza entry defines a library *libmgrc7* connected to the workstation on */dev/tty0*. The identifier that *libmgrc7* uses to identify this particular host is *mercury*.

4. Define all the library names to the daemon by editing */etc/ibmatl.conf*.

5. Configure the LMCP by updating the **Add a LMCP Logical Device** menu using **smit**. The library name you choose must be one of the library names that you defined in the */etc/ibmatl.conf* file

6. Go to the Tape Drive Menu and select the option:

   Configure a Defined Tape Drive

7. Exit from the SMIT menu

8. Load the daemon with the following command:

   `cfgmgr`

You have now completed the installation of the IBM 3494 and should be able to access the IBM 3590 tape subsystems and IBM 3590 cartridges.

For detailed information please refer to *IBM SCSI Tape Drive, Medium Changer, and Library Device Drivers Installation and User's Guide.*

3.5 Application System/400

The IBM 3590-B11 and 3590-B1A can be attached to all Dxx and later models of the AS/400, except the X02 and P03 models, using the AS/400 Magnetic Media Subsystem Controller, feature number 6501.

The AS/400 supports most functions of the IBM 3590 tape subsystem, including the ACF function. Operating the ACF in random mode and using the IBM 3590 tape subsystem as a minilibrary is possible with Backup Recovery and Media Services (BRMS), but currently operating the ACF in system mode is *not* supported.

The IBM 3590 tape subsystem is a *self-defining* device; at system initialization, the IBM 3590 tape subsystem describes its configuration to the AS/400 system. Therefore, other than the installation work performed by the IBM Customer Service Representative, the IBM 3590 tape subsystem requires little effort to configure. (For example, The IBM 3590 will automatically be configured if automatic configuration is turned on.)

Installing the IBM 3590 tape subsystem requires the IBM Customer Service Representative to perform the following tasks:

- The IBM 3590 tape subsystem needs to be installed in a 9309-2 rack. Please refer to Table 23 on page 59 for details of the order feature codes and how the drives are positioned in the rack.

- Attach the drive to the host device adapter, feature 6501, using interposer, cable, and terminator.

- After the IBM 3590 tape subsystem has been installed, the IBM Customer Service Representative uses the Work and Hardware Products (WRKHDWPRD) command to update the local inventory to add the rack position of your IBM 3590 tape subsystems.

The IBM 3590 tape subsystem is now ready for use (assuming automatic configuration is on).

Note: A tape drive other than an IBM 3590 drive is required to support IBM software distribution.

3.5.1 Attaching to the AS/400

The IBM 3590 tape subsystem attaches to all AS/400 models that support the 6501 input/output processor (IOP) card. Specify that you want to attach the IBM 3590 tape subsystem to the AS/400 by using the feature codes shown in Table 24 on page 66.

Table 24. IBM 3590 Attachment Feature Codes for AS/400		
Description	**Model**	**Feature Code**
Attached to AS/400	B11 to B1A	9400
Interposer for AS/400	B11 or B1A	9410

Be aware that the following rules apply for SCSI bus attachment of IBM 3590 model B11 or B1A to system feature 6501:

- The IBM 3590-B11 has two ports that can attach to two different AS/400 systems, providing each AS/400 has the 6501 IOP card.

- Multiple IBM 3590-B11s can be attached to a single AS/400. The maximum number of IBM 3590 tape subsystems that can be attached depends on the maximum number of 6501 IOP cards that can be installed and supported

- A single IBM 3590-B11 with an ACF can be shared by both a AS/400 and a RISC/6000 for a maximum of two hosts. However, the drive should not be online to both systems at the same time.

  Because the inventory of cartridges in an ACF used in random mode is kept by the host that uses it, we recommend that you do not share a drive that you plan to operate in this mode.

- No other devices can be supported on a port equipped with feature code 6501 with a IBM 3590 attached.

Table 25 shows the various SCSI bus cable lengths that are available.

Table 25. IBM 3590 SCSI Cable Feature Codes for AS/400		
Feature Code	**IBM 3590 Model**	**Cable Length**
5128	B11	2.8 m (9 ft)
5145	B1A and B11	4.5 m (15 ft)
5112	B1A and B11	12 m (39 ft)
5118	B1A and B11	18 m (59 ft)
5125	B1A and B11	25 m (82 ft)

An interposer is required when a IBM 3590 model B11 or B1A is connected to feature 6501. Figure 19 on page 67 shows the connections between the host adapter port, the interposer, and the SCSI bus cable.

For SCSI cabling, please refer to Appendix F, "SCSI Cabling for Magstar and IBM 3590 Tape Subsystem" on page 267.
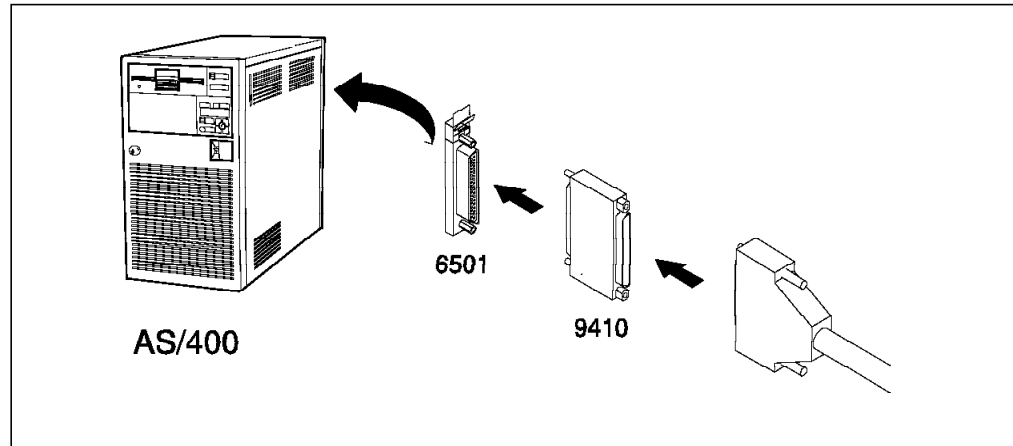
Figure 19. IBM 3590 SCSI Cable Connection to AS/400

3.5.2 Installing the IBM 3590

To install the IBM 3590 tape subsystem, follow these steps:

1. The IBM Customer Service Representative completes the hardware installation.

   Note: If you are connecting a single IBM 3590 tape subsystem drive, it should be cabled to port zero (bottom) of the 6501 IOP adapter card.

2. The IBM Customer Service Representative uses the *Work and Hardware Products* (WRKHDWPRD) command to update your local inventory. Figure 20 shows the IBM 3590 drive information that is entered to update the hardware inventory. Tell the IBM Customer Service Representative what resource name the IBM 3590 tape subsystem is to have. In Figure 20 TAP555 was entered as the resource name for this IBM 3590 tape subsystem.

```
                        Specify Device Information

                                         System:    RCHASL8U

A new device was detected by the system.


Tape I/O processor:              Tape I/O device:
   Type ............:    6501       Tape-Model ....:    3590-B11
   Frame ID ........:    A          Resource name .:    TAP555
   EIA location ....:               Address .......:    0040-0001FFFF
   Card position ...:    5          Serial number .:    99-0000099

Type choices, press Enter.

   Frame ID ......................... B
   EIA location ..................... 20







 F3=Exit    F12=Cancel
```

Figure 20. Defining the IBM 3590 to AS/400 (Screen 1 of 2)

The IBM 3590 tape subsystem is a *self-defining* device; at system initialization, the IBM 3590 tape subsystem describes its configuration to the AS/400 system. However, after the drives have been installed and the system reinitialized, if the drive has not reported the device serial number, the IBM Customer Service Representative may be prompted to enter it.

Use the CRTDEVMLB command to define the IBM 3590 and the ACF as a medium-change library, and to specify the library name.

Your IBM 3590 tape subsystem is now ready to use.

RPQ 843860 provides alternate IPL support. Special considerations must be dealt with if you wish to use the IBM 3590 tape subsystem as an *alternate IPL* device.

3.5.3 Adding a Media Library Device Configuration

The AS/400 host system requires special software to manage the behavior of the IBM 3590 tape subsystem and to manage the data transfer between the host and the device. This special software is called the *device driver*.

The device-driver code to support the IBM 3590 tape subsystem is part of both the OS/400 licensed program and the IOP card (feature 6501). The driver code is a standard OS/400 command set provided for driving all tape library devices.

The library-manager software for the 3590 with ACF is part of the AS/400 program. All controls and inventory data are stored on the host AS/400 system. Tape library commands to manage the ACF are sent from the OS/400 licensed program directly through the SCSI channel.

3.5.4 Implementing the IBM 3590 Installed in IBM 3494 Tape Library

The IBM 3590 tape subsystem is supported for AS/400 attachment using SCSI. The IBM 3494 supports SCSI attachment, but the IBM 3495 does not. Therefore for AS/400 environments, IBM tape library support is available only with the IBM 3494 for IBM 3590 tape subsystem.

For the IBM 3590 tape subsystem devices in an IBM 3494 to function:

• No special subsystems beyond the controlling subsystem need to be active.

• No special libraries except the base operating system QSYS library need to be installed.

When the library has been installed, perform the following tasks:

• Insert IBM 3590 cartridges into the IBM 3494 through the Convenience I/O station. Place the cartridges in any empty cell locations, except the reserved cells or the high capacity output cells, if this facility is configured.

• Add at least two IBM 3590 cleaner cartridges.

• Perform a library inventory.

• Set up the cleaner mask and define the cleaning schedule.

• Set the library manager to PAUSE and ONLINE mode.

Bring the IBM 3494 online and access the drives and cartridges.

3.5.5 Installing IBM 3494 Tape Device Driver

The IBM 3494 comes with an AS/400 licensed program offering called Media Library Device Driver (MLDD). MLDD commands perform functions in these areas:

- Library management

- Cartridge manipulation

- Category processing.

Instructions generated by these commands are sent over a communication line from the AS/400 to the IBM 3494.

Issue the ADDMLD command to add an IBM 3494:

- For RS-232 connected IBM 3494, enter:

  - Media library device name

  - Adapter type

  - Resource name.

  An example of the ADDMLD command screen for a RS-232 port is shown in Figure 21.

```
                      Add MLD Configuration (ADDMLD)


Type choices, press Enter.

                                                           .

Media library device . . . . . . . .> mld3590   Name
Adapter Type . . . . . . . . . . . .> *RS232    *RS232, *LAN
Resource name  . . . . . . . . . . .> lin011    Name




                      Additional Parameters

Message queue  . . . . . . . *USRPRF___       Name, USRPRF
                             _____        Name, *LIBL, *CURLIB




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

Figure 21. Add MLD Configuration Screen (RS-232)

> **Note:** The *resource name* must be that of a V.24 port. The ADDMLD command will fail if the port cannot be changed online.

- For a LAN-connected IBM 3494 enter:

  - Media library device name

  - Host adapter type

  - Line description

  - Library manager location name

  - Library manager network ID

  - Library manager adapter address.

An example of the ADDMLD command screen for a LAN is shown in
Figure 22 on page 70.

```
                      Add MLD Configuration (ADDMLD)


 Type choices, press Enter.


 Media library device . . . . . .> mld3590      Name
 Host Adapter Type  . . . . . . .> *LAN         *RS232, *LAN
 Line Description . . . . . . . .> TRLINE       Name
 Library Manager Location Name. .> LIBMGRC5     Name
 Library Manager Network ID . . .> USIBMSU      Name
 Library Manager Adapter Address.> 40003494001A Character Value



                       Additional Parameters

 Message queue  . . . . . . . *USRPRF___       Name, USRPRF
                              _____         Name, *LIBL, *CURLIB



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

Figure 22. Add MLD Configuration Screen (LAN)

To obtain the information needed to configure the LAN and display it on the
screen, enter the DSPLANMLD (library manager display LAN information
AS/400) command.

At least one IBM 3494 configuration must be added and the MLDD must be
initialized before any MLDD commands can be issued.

For detailed information on device drivers please refer to *AS/400 Automated
Tape Library Planning and Management*.

3.6 Sun System

The IBM 3590-B11 can be installed on all Sun systems that support a SCSI-2
differential-ended adapter.

Note: The maximum block size of the IBM 3590 drive is limited to 256 KB, this is
a limitation of the SCSI adapter in the Sun system.

In addition to normal tape functions the IBM 3590-B11 can operate as an
integrated medium changer device to provide random access to cartridges in its
ACF. Random mode operation of the ACF is also supported by ADSM for Sun.

To install the IBM 3590 tape subsystem:

 1. The IBM Customer Service Representative:

    • Installs the IBM 3590 tape subsystem in an IBM 7202, 9309, or
      customer-provided rack.

    • Attaches the drive to the host adapter.

 2. You:

    • Install the IBM SCSI tape device driver and configure the drives.

    • Install the IBM SCSI medium changer device driver.

3.6.1 Attaching to Sun

To attach an IBM 3590 tape subsystem to the Sun system the following items are required:

- Suitable rack for the drive, new or existing
- IBM 3590-B11 drive (specified with Sun-attach feature)
- Host SCSI-2 adapter
- SCSI bus cable
- Suitable interposer (may be required).

The IBM 3590-B11 is installed in an IBM 7202, or 9309 rack, or in an existing customer rack. Table 26 shows the feature needed to attach the IBM 3590 tape subsystem to a Sun system.

Table 26. IBM 3590 Attachment Feature Codes for Sun		
Description	**Model**	**Feature Code**
Sun Device driver	B11 or B1A	9710

Table 27 is a **partial** list of SCSI-2 host adapter cards, suitable for IBM 3590 tape subsystem attachment.

Table 27. SCSI-2 Host Adapter Cards for Sun		
Manufacturer	**Type**	**Interposer**
Sun SBus	F/W Differential Bus Card	No
Performance Technologies	F/W Host Adapter	No
Performance Technologies	Fast Host Adapter	Yes•
• Needs a 1 to 2 byte interposer, IBM 3590 feature code 9701.		

Please refer to Table 22 on page 59 to see the SCSI bus cables that can attach to any Sun system that supports a SCSI-2 differential-ended adapter.

The following rules apply for SCSI bus attachment of IBM 3590-B11 or 3590-B1A:

- The IBM 3590-B11 has two ports that can attach to two different Sun systems
- Multiple IBM 3590-B11s can be attached to a single Sun system. The maximum number of IBM 3590 tape subsystems that can be attached depends on the maximum number of host adapter cards that can be installed and supported
- A single IBM 3590-B11 with an ACF can be shared by two Sun systems, or a Sun and RISC/6000 for a maximum of two hosts. Assign individual cartridges to a particular host by assigning each cartridge to a different category.

  Because the inventory of cartridges in an ACF used in random mode is kept by the host that uses it, we recommend that you avoid sharing a drive that you plan to operate in this mode.
- Multiple drives can be *daisy chained* to the same adapter. However, in commercial environments we recommend that no more than two drives share the same SCSI bus. This recommendation should ensure optimum performance of the drives.

For SCSI cabling, please refer to Appendix F, "SCSI Cabling for Magstar and IBM 3590 Tape Subsystem" on page 267.

Install the IBM 3590-B11 in a new IBM 7202, 9309 or one of your existing racks. If using an existing rack, 12 EIA units of space are required. Install two model B11 drives on a rack shelf, four model B11s require the complete rack.

Do not install any *customer-access* devices below an IBM 3590-B11. Table 23 on page 59 shows the drive-installation feature codes required to install the IBM 3590 tape subsystems in racks.

3.6.2 Installing IBM 3590

To install the IBM 3590 tape subsystem, do the following:

1. Plan how to connect the device in advance. Ensure that the IBM 3590 tape subsystems use their own dedicated SCSI attachments and that they do not share their individual buses with other device types.

2. Determine which SCSI ID (or IDs) the device should have.

3. Obey the bus cable-length restrictions.

4. Draw a map of the bus showing:

   • Every device
   • All SCSI IDs
   • Where terminators are connected.

5. Provide a 7202, or 9309 rack to accommodate the drive.

6. Power down the system and hand it over to the IBM Customer Service Representative.

7. The IBM Customer Service Representative:

   • Installs the IBM 3590 tape subsystem in the appropriate rack.
   • May need to install a new host adapter.
   • Checks all device SCSI IDs on the bus.
   • Checks that the SCSI ID of the attachment feature is set to seven, the highest priority on the bus.
   • Removes the host SCSI adapter port terminator and connects the SCSI cable to the host adapter port.
   • Completes the installation and runs drive diagnostics.

8. Power up your Sun system.

9. Verify all the connections.

You next install the Tape and Medium Changer device drivers.

3.6.3 Installing the IBM Tape and Medium Changer Device Driver for SunOS

For full support of the IBM 3590 tape subsystem install the IBM SCSI Tape Device Driver for SunOS and the IBM SCSI Medium Changer Device Driver for SunOS. Both these device drivers are included on the same product distribution diskette.

ADSM also requires installing both of the above device drivers to be able to manage the IBM 3590 ACF as a minilibrary.

If installing the IBM 3590 tape subsystem within a new IBM 3494, then also install the IBM tape library daemon for SunOS.

The installation of the Tape and Medium Changer device drivers is accomplished by using the standard Sun *stdd* package.

You must root authority to perform this procedure.

If your system has a diskette drive, insert the distribution diskette and enter the following commands:

```
volcheck
pkgadd -d /vol/dev/aliases/floppy0 stdd
eject
cd /
shutdown -y -go -i6
```

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:

```
volcheck
dd if=/vol/dev/aliases/floppy0 of=/tmp/image.pkg
eject
```

Now enter the following commands on the target workstation:

```
pkgadd -d /tmp/image.pkg stdd
cd /
shutdown -y -go -i6
```

To verify that the installation was successful, enter:

```
pkginfo stdd
```

After the device driver is installed, the configuration defaults for the IBM 3590 tape subsystem can be modified. For example,

- Set the *block_size* to **0** (variable length)
- Set the *compression* to **1** (means **on**)
- Set the *compression* to **1** (means **on**)

Note: The maximum block size for Sun systems is 256 KB.

You have completed the installation of the IBM 3590 tape subsystem.

3.6.4 Implementing IBM 3590 Installed In IBM 3494 Tape Library

The IBM 3590 tape subsystem is supported for Sun systems attachment using SCSI. The IBM 3494 supports SCSI attachment, but the IBM 3495 does not. Therefore, for Sun environments, IBM tape library support is available only with the IBM 3494.

For a new IBM 3494 installation containing IBM 3590 tape subsystems, perform the following tasks once the hardware has been installed:

- Insert IBM 3590 cartridges into the IBM 3494 through the Convenience I/O station. You can also place the cartridges in any empty cell locations,

except the reserved cells or the high capacity output cells, if this facility is configured.

- Add at least two IBM 3590 cleaner cartridges.

- Perform a library inventory. If you enter new cartridges only through the Convenience I/O station, then an inventory is not necessary. If you open the frame doors and only add cartridges, then the Open Door Verification (or Inventory) will register the new cartridges. However, if cartridges were moved or removed while the frame doors were opened, then a full inventory is recommended to ensure the Library Manager integrity.

- Set up the cleaner mask and define the cleaning schedule.

Before you access the IBM 3494, install the IBM 3494 device driver.

3.6.5 Installing the IBM Tape Library Daemon for SunOS

The distribution diskette contains a file system comprising the *Lmcpd* package with the library daemon and other associated files and utilities.

Note: For the following commands, use the special file name for the installation source device that is appropriate for your system.

Ensure that the RS-232 or LAN cable for IBM 3494 library communications is in place before you install the device driver. The library control path is established by either of the following methods:

1. Using a standard 25-pin null modem D-shell RS-232 cable. The cable may be placed in a native serial port, or on an 8- or 16-port asynchronous adapter.

2. Using a LAN connection (either Ethernet or Token Ring) with Transmission Control Protocol/Internet Protocol (TCP/IP).

Install the IBM Tape Library daemon for SunOS by performing the following tasks:

- Install the IBM 3494 daemon, called *Lmcpd*.

- Configure the IBM 3494 serial port (the library control path can use a RS-232, or LAN connection).

- Configure the IBM 3590 tape subsystems.

- Define the IBM 3494 to the daemon.

- Define the host port if using TCP/IP for the library control path.

If using TCP/IP, define the host port as follows:

If the system has a diskette drive insert the distribution diskette and enter the following commands:

```
volcheck
pkgadd -d /vol/dev/aliases/floppy0 Lmcpd
eject
cd /
shutdown -y -go -i6
```

If the 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:

```
volcheck
dd if=/vol/dev/aliases/floppy0 of=/tmp/image.pkg
eject
```

Enter the following commands on the target workstation:

```
pkgadd -d /tmp/image.pkg stdd
cd /
shutdown -y -go -i6
```

To verify that the installation was successful, enter:

```
pkginfo lmcpd
```

To configure the serial port set the following:

- Baud rate: 9600
- Data bits: 8
- Stop bits: 1
- Parity: None

Define the IBM 3494 to the daemon by:

- Editing file */etc/ibmatl.conf* and defining the *Symbolic name, Connection type*, and *Identifier parameter* For example:

  ```
  3494a   /dev/ttya   mercury
  ```

  This entry defines a library *3494a* connected to the workstation on */dev/ttya*. The identifier that library *3494a* uses to identify this particular host is *mercury*.

If you want to use a LAN connection for the IBM 3494 control path using TCP/IP, then a port must be defined that the *Lmcpd* uses to listen for messages from the library manager. The installation procedure inserts a line into the */etc/services* which looks like:

```
lmcpd   3494   tcp   #IBM Automated Tape Library Daemon
```

This specifies that port number *3494* will be used by the *Lmcpd* to listen for messages from the IBM 3494.

You have now completed the installation of the IBM 3494 and should be able to access the IBM 3590 tape subsystems and 3590 cartridges.

3.7 Multiplatform Attachments

The IBM 3590-B1A drive attaches to the AS/400, RISC/6000, IBM RS/6000 Scalable POWERparallel Systems, and Sun systems by means of SCSI. The SCSI bus is used for data transfer, and is called the "data path." These SCSI-attached platforms require a RS-232 or LAN attachment for passing library commands to the IBM 3494 library manager. ES/9000 processors using VSE/ESA also require a LAN attachment for the library-manager control path. Up to four SCSI-attached tape control units can be attached to a single IBM 3494, or up to

16 using the EXPANSION ATTACHMENT CARD (Feature 5229) and the TAPE CONTROL UNIT EXPANSION (Feature 5228). If 16 tape control unit connections are available, there is no RS-232 host process connections. Therefore, a LAN adapter card will be required to provide the host processor connection. The SCSI attachment allows an attachment distance of up to 25 m.

Attachment to ES/9000, ES/3090-J, ES/3090-9000T, and S/390 systems is by means of ESCON channels, connected to the IBM 3590-A00 controller. In this environment, the library manager control path uses the same ESCON channel as the data path. Up to four ESCON-attached tape control units can be attached to a single IBM 3494, or up to 12 using the EXPANSION ATTACHMENT CARD (Feature 5229) and the TAPE CONTROL UNIT EXPANSION (Feature 5228). The ESCON attachment allows an attachment distance of up to 43 km (16.6 miles), using two ESCON directors.

Please refer to Chapter 2, "Planning for Magstar" on page 11 for details of IBM 3590 frame models and IBM 3494 configuration options.

Notes:

- Parallel attachment of the IBM 3590-A00 controller is not supported.

- The IBM 3590 tape drive does not allow intermixing of ESCON and SCSI attachments.

3.7.1 Mixed Drives and Mixed Attachments in a Library

Figure 23 illustrates an example of IBM 3490 and IBM 3590 tape subsystem attachments within an IBM 3494.
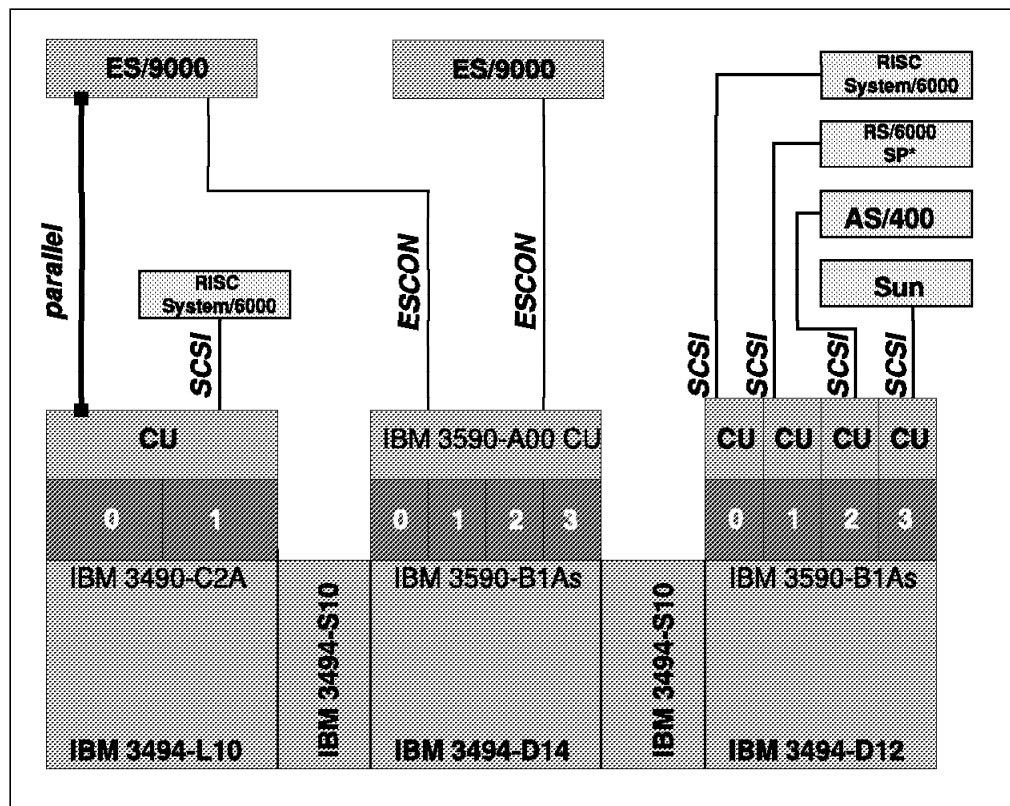
Figure 23. Multiplatform Attachments for IBM 3590 Drives in IBM 3494

Mixed Drive Attachments need to be considered. The IBM 3494 shown in Figure 23 has IBM 3590 tape subsystems with both ESCON and SCSI attachments. In the IBM 3494 model D14 frame, four IBM 3590-B1A drives are attached to two ES/9000 platforms through ESCON channels. In the IBM 3494 model D12 frame, four IBM 3590-B1As are attached to four different SCSI platforms.

Note: For SCSI platforms, multiple drives can be *daisy chained* on the same SCSI bus, except for AS/400 systems.

For the ES/9000 platforms, you need to have a process in place to manage access to the drives from each platform and from each system within each platform. You have the option to either make all drives available for use on both ES/9000 platforms, or to decide to dedicate some of the drives to each platform. Similarly, within each platform you have the same options for sharing within systems. See Chapter 4, "Software Implementation" on page 81 for a description of the new dynamic tape switching facility in MVS V5.2.

For the SCSI platforms, you need to have a process in place to ensure that only one SCSI platform can access a drive at any one time. You can either allow all drives to be available for use on all hosts, or alternatively dedicate individual drives to particular hosts.

The approach taken will depend on the number of drives installed and the total concurrent drive requirement of the host. Dedicating drives to individual hosts is the simplest and safest method, and is recommended. If you decide to make all drives available to all systems, then you need to ensure that a drive is free on its current host, take it offline (use SMIT on AIX systems), then bring it online to the target host and allocate it.

Mixed Drive Attachments and Mixed Drive Types need to be considered. In addition to different IBM 3590 models, we can also have IBM 3490 models in an IBM 3494. Figure 23 on page 76 shows an IBM 3490-C2A installed in the IBM 3494 model L10. The IBM 3490-C2A can be attached to hosts by parallel, ESCON, and SCSI attachments. Again, the consideration is whether to dedicate individual drives to particular hosts or make them available for use on both.

IBM 3590 drives can share the same SCSI bus as IBM 3490-CxA drives, as long as they are attached to a fast/wide differential-host adapter. The total length of the SCSI bus must not exceed the maximum allowed, up to 25 m with host adapter feature code 2416 or 2412.

For an IBM 3490 tape subsystem, *never* define the tape control unit to a single system using more than one attachment type. As an example, do not define a tape control unit to an MVS system that is attached by both parallel and ESCON channels. Such a definition gives unpredictable results and leads to hardware errors, such as missing interrupts.

The IBM 3495 supports the attachment of IBM 3490 base models, which are 18-track devices; IBM 3490 E models, which are 36-track devices; and IBM 3590-B1As, which are 128-track devices. The IBM 3490 base and E models can be attached by either parallel or ESCON attachments.

Drive Addressing needs to be considered. For the IBM 3494 models D14 and L14, drive addressing is shown in Figure 12 on page 48. We recommend that you use the same address for an individual drive on all sharing hosts. This will

avoid the operational confusion of, for example, addressing the same drive as "900" on one host and "540" on another. Thus, in Figure 23 on page 76, the first drive in the IBM 3494-D14 would be addressed as "900" on both the ES/9000 platforms.

On the SCSI hosts the drives will have SCSI addresses of the form **ab-cd-ef-gh** where

ab   Is the *drawer* address (cpu and bus) and is common for any device type.

cd   Is the *slot* or adapter address and is common for any device type. For an adapter with feature code 2416 or 2412, the default address is 7. Thus the target SCSI ID cannot be 7, since all SCSI addresses on the same bus must be unique.

ef   Is the *connector* address and is device-type dependent. The address is typically zero, but depends on the SCSI adapter.

gh   Is the *port* address and is device-type dependent. This is the SCSI address of the tape drive, where

> **g** is the *SCSI target ID*.
>
> **h** is the *logical unit number*.

For example, in Figure 23 on page 76 the second drive in the IBM 3590-D12 could be addressed as 01-07-00-10 (*rmt0*) on the RISC/6000.

The use of common naming conventions for the special file definitions is recommended. Thus *rmt4* should refer to the same actual tape drive on all attached RISC/6000s. This convention holds regardless of the actual SCSI ID being used for the target tape drive.

In the IBM 3490-C2A, the first drive address will end in 0 and the second drive address will end in 1, as in Figure 23 on page 76. For example, these two drives could be addressed in an MVS system as 900 and 901. However, on the RISC/6000, the drives could have SCSI IDs of 01-07-01-10 (*rmt0*) and 01-07-01-11 (*rmt1*).

3.7.2 Other Considerations

Connecting more than two or three IBM 3590 drives on a single SCSI bus may lead to poor performance.

The ability to share SCSI buses with AS/400 is very restricted, with usually only a single initiator and a single target on the same bus. Please refer to 3.5, "Application System/400" on page 65, for information on AS/400 attachment to IBM 3590 tape subsystems.

For SCSI cabling, please refer to Appendix F, "SCSI Cabling for Magstar and IBM 3590 Tape Subsystem" on page 267.

With only IBM 3590-B1A drives installed in the IBM 3494, only IBM 3590 high-performance tape cartridges will reside in the tape library. However, when IBM 3490-CxA drives are also installed, CSTs, ECCSTs or both reside in the IBM 3494, in addition to the IBM 3590 cartridges.

For detailed information on how to manage the sharing of IBM 3494 and 3495 Automated Tape Library Dataservers, please refer to *Guide to Sharing and Partitioning IBM Tape Library Dataservers*.

A single IBM 3590-B11 with an ACF can be shared by more than one SCSI host. You assign individual cartridges to a particular host by assigning each cartridge to a different category. Because the inventory of cartridges in an ACF used in random mode is kept by each host that uses it, we recommend that you avoid sharing a drive that you plan to operate in this mode.

The IBM 3490-CxA can be attached to ES/9000 and RISC/6000 platforms using ESCON attachments through an ESCON director. If you use ESCON Manager software to switch the director ports, you need to ensure that the RISC/6000 ports are not inadvertently removed. Since the ESCON Manager is not supported on RISC/6000, this software running on MVS is unaware of the ports used by the RISC/6000.

Chapter 4. Software Implementation

In this chapter, we guide you through the software implementation steps in all environments that currently support the IBM 3590 High Performance Tape Subsystem. In each section, we first describe how to implement one or more stand-alone Magstar tape drives. Next, we explain additional implementation steps to be performed when using IBM 3590 tape subsystems inside an IBM 3494 or 3495 Automated Tape Library Dataserver.

In 4.1, "MVS/ESA Environments," we cover the MVS environment including special JES3 definitions, subsystems like DFSMS/MVS components or ADSM for MVS, tape management systems, and system-managed tape implementation steps. If you are using your IBM 3590 tape subsystem exclusively in an MVS environment, we refer you to Chapter 5, "Migration in an MVS/ESA Environment" on page 115 for migration of your applications and data to IBM 3590 tape subsystems after completing the implementation steps described in 4.1, "MVS/ESA Environments."

In 4.2, "VM/ESA Environments" on page 98, we guide you through implementation of the IBM 3590 tape subsystem in a VM/ESA environment. Migrating your applications and data to IBM 3590 tape subsystem is discussed in Chapter 6, "Migration in Non-MVS Environments" on page 129.

In 4.3, "AIX Environment" on page 100, we describe implementation in an RISC/6000 environment including using the ACF of the 3590 drive as a minilibrary and using the IBM 3590 tape subsystem through ADSM for AIX. Migration issues are discussed in Chapter 6, "Migration in Non-MVS Environments" on page 129.

The last section of this chapter, 4.4, "OS/400 Environment" on page 108, covers the implementation in an AS/400 environment including ADSM for OS/400, BRMS, and R/DARS considerations as well usage of the ACF. For migration topics, please refer to Chapter 6, "Migration in Non-MVS Environments" on page 129.

4.1 MVS/ESA Environments

In this section, we cover all implementation steps to be taken to initially implement the IBM 3590 tape subsystem in your MVS environment.

4.1.1 Software Levels

The following software levels are required to support the IBM 3590 tape subsystem in an MVS environment:

- MVS/ESA SP V4.3.0, V5.1.0 or V5.2.0 plus small program enhancements (SPEs).

  For dynamic tape sharing, MVS SP V5.2.0 is required.

  If you are running MVS/JES3, JES3 V4.2.1 or V5.1.1 plus SPEs is also required.

- DFSMS/MVS V1.2.0 or higher plus SPEs.

- EREP V3.5.0 plus program temporary fixes (PTFs).

If you are using the following software products, they must be at the listed minimum level:

- ADSM for MVS V2.1.0

  Device support module 2 includes support for stand-alone IBM 3590 drives attached by way of the 3590-A00 tape controller. Support for IBM 3590 in a single-frame IBM 3494 is included in device-support module 3. Device-support model 4 is required for support of IBM 3590 in a multiframe IBM 3494 or in an IBM 3495.

- DITTO/ESA Release 1

- DFSORT Release 13 plus SPEs

- DB2 Version 4

  However, we recommend that you move DB2 archive logs from cartridge to disk and use DFSMShsm archiving to support the IBM 3590 tape subsystem.

After having installed the appropriate software levels and additional SPEs and PTFs, you need to define the Magstar tape drives to your system.

4.1.2 Basic Installation Steps for Stand-Alone Drives

Before you can use the Magstar tape drive you need to define it to the MVS system through hardware configuration definition (HCD). You may need to update missing interrupt handling (MIH) values as well or you might want to use dynamic tape sharing provided by MVS/ESA V5.2. The necessary implementation steps are listed below.

1. Define devices through HCD.

   Defining the IBM 3590 tape subsystem requires that you use the HCD dialogs to define it to your MVS system. The MVS Configuration Program (MVSCP) does not support 3590 devices.

   Figure 24 on page 83 and Figure 25 on page 83 show the two important panels for specifying an IBM 3590 tape control unit.

```
------------------------ Add Control Unit --------------------
CBDPCU10

Specify or revise the following values.

Control unit number  . . . . 0560  +

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 24. Adding an IBM 3590 Control Unit through HCD, Part 1

> After you have specified the control unit number and the type (here, 3590) as
> shown in Figure 24, and after you have chosen the processor, the control
> unit is connected to the panel shown in Figure 25 is displayed.

```
------------------------ Add Control Unit ------------------------
CBDPCU12

Specify or revise the following values.

Control unit number  . : 0560        Type . . . . . . : 3590
Processor ID . . . . . : PROC1       This is the main processor

Channel path IDs . . . . 50   51   __  __  __  __  __  __  +
Link address . . . . . . __   __   __  __  __  __  __  __  +

Unit address . . . . . . 00   __   __  __  __  __  __  +
Number of units  . . . . 04   ___  ___ ___ ___ ___ ___

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 25. Adding an IBM 3590 Control Unit through HCD, Part 2

> The number of drives to be specified for a IBM 3590-A00 control unit is
> always four, because this is the maximum number of drives that can attach
> to a single IBM 3590 controller.

> To define the IBM 3590 drives, you need to go to the Device List Panel either
> from the Main Panel by entering 1 and then 5, or via the Control Unit List

Panel by using action *s*. To add the IBM 3590 tape subsystems, press PF11. The screen shown in Figure 26 on page 84 is displayed.

```
----------------------------- Add Device --------------------------
CBDPDV10


Specify or revise the following values.


Device number  . . . . . . . . 0500   (0000 - FFFF)
Number of devices  . . . . . . 4___
Device type  . . . . . . . . . 3590_____   +


Serial number  . . . . . . . . _____
Description  . . . . . . . . . _____


Connected to CUs . . 0560  ____  ____  ____  ____  ____  ____  ____  +



 F1=Help     F2=Split    F3=Exit     F4=Prompt   F5=Reset    F9=Swap
F12=Cancel
```

Figure 26. Adding Magstar Tape Drives through HCD, Part 1

After entering the required information and specifying to which processors and operating systems the devices are connected, the screen in Figure 27 is displayed, where you can update the device parameters.

```
CBDPDV13           Define Device Parameters / Features        Row 1 of 6
Command ===> _____ Scroll ===> PAGE


Specify or revise the values below.


Configuration ID . : AB          MVS operating system
Device number  . . : 0500        Number of devices  : 4
Device type  . . . : 3590


Parameter/ Value    P Req.  Description
Feature
OFFLINE    yes              Device considered online or offline at IPL
DYNAMIC    yes              Device supports dynamic configuration
LIBRARY    No•              Device supports auto tape library
AUTOSWITCH No               Device is automatically switchable
ALTCTRL    No               Separate physical control unit path
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 27. Adding Magstar Tape Drives through HCD, Part 2

Note: 1. If you are defining drives that are installed in an system-managed IBM 3494 or 3495 Tape Library, you must specify LIBRARY=YES. For BTLS-managed library drives, specify LIBRARY=YES or NO.

If you define esoteric device names containing multiple tape-device types, the default device preference list is built in the following order:

a. 3590-1

b. 3490

c. 3480

2. Initial program load (IPL) or activate IODF

After having created the new I/O Definition File (IODF) and installed the new devices, you need to IPL your system or activate the new IODF.

Note: You have to IPL your system only after having installed the SPE for IBM 3590 tape subsystem device support.

To activate the IODF, make sure that the LOADxx member in column 34 of the IODF statement has a Y. This means that MVS will load device support for all device types defined in the IODF, plus all devices that support dynamic I/O configuration. If column 34 is blank, then MVS will load only device support for devices defined in the IODF. In addition, you must have set DYNAMIC=YES during HCD definition of your IBM 3590 tape subsystems. You can activate the IODF using the command shown in Figure 28 or by means of the *Activate New Configuration* panel of HCD.

```
ACTIVATE IODF=xx,SOFT=NOVALIDATE
```

Figure 28. Activate the New IODF

An IPL is required for activation of the SPE for DFSMS/MVS that contains the IBM 3590 tape subsystem support.

3. Label the tape volumes.

If you do not have DFSMSrmm installed, you can use the IEHINITT utility to label the IBM 3590 high performance tape cartridges.

Note: You can also use IEHINITT for volumes that reside inside an IBM 3494 or 3495 Automated Tape Library Dataserver.

4. Update or set values for the missing interrupt handler (MIH).

The Magstar tape drive returns recommended MIH timeout values to the host operating system in Read Configuration Data. It is not necessary that you specify MIH timeout values for IBM 3590 devices; the device-supplied values handle all MIH timeouts.

If you currently specify your own MIH timeout values for non-3590 tape devices, we recommend that you review your procedures to see if a timeout value other than the IBM-supplied default of 3 minutes needs to be used. If so, specify the timeout for each individual device. MIH timeout values can be 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 Magstar tape drive devices. You can specify the MIH values either in PARMLIB member IECIOSxx or by the MVS operator command SETIOS.

Figure 29 on page 86 shows how to specify MIH values for IBM 3480 devices (addresses 800 to 807), for IBM 3490E drives using CST cartridges (addresses

900 to 907), and for IBM 3490E drives with ECCST cartridges (addresses 9E0 to 9EF).

```
    MIH=(0800-0807),TIME=03:00
    MIH=(0900-0907),TIME=10:00
    MIH=(09E0-09EF),TIME=20:00
```

Figure 29. Sample MIH Specification in PARMLIB member IECIOSxx

In Figure 30, we give an example of the operator commands to specify the MIH values on a device basis.

```
    SETIOS MIH=(0800-0807),TIME=03:00
    SETIOS MIH=(0900-0907),TIME=10:00
    SETIOS MIH=(09E0-09EF),TIME=20:00
```

Figure 30. Sample Operator Commands to Set MIH Value

5. Use MVS/ESA automatic tape switching.

MVS/SP V5.2 offers a way of dynamically switching tape drives between systems within one multiple-MVS system environment (sysplex) even without using JES3. Tape drives defined as *automatically switchable* are not dedicated to any system; they can instead be used by all systems in a sysplex that are connected through a coupling facility. Devices defined in this way do not require a VARY OFFLINE command on the owning system and a VARY ONLINE command on the target system. Figure 31 on page 87 gives a schematic overview of automatic tape switching.
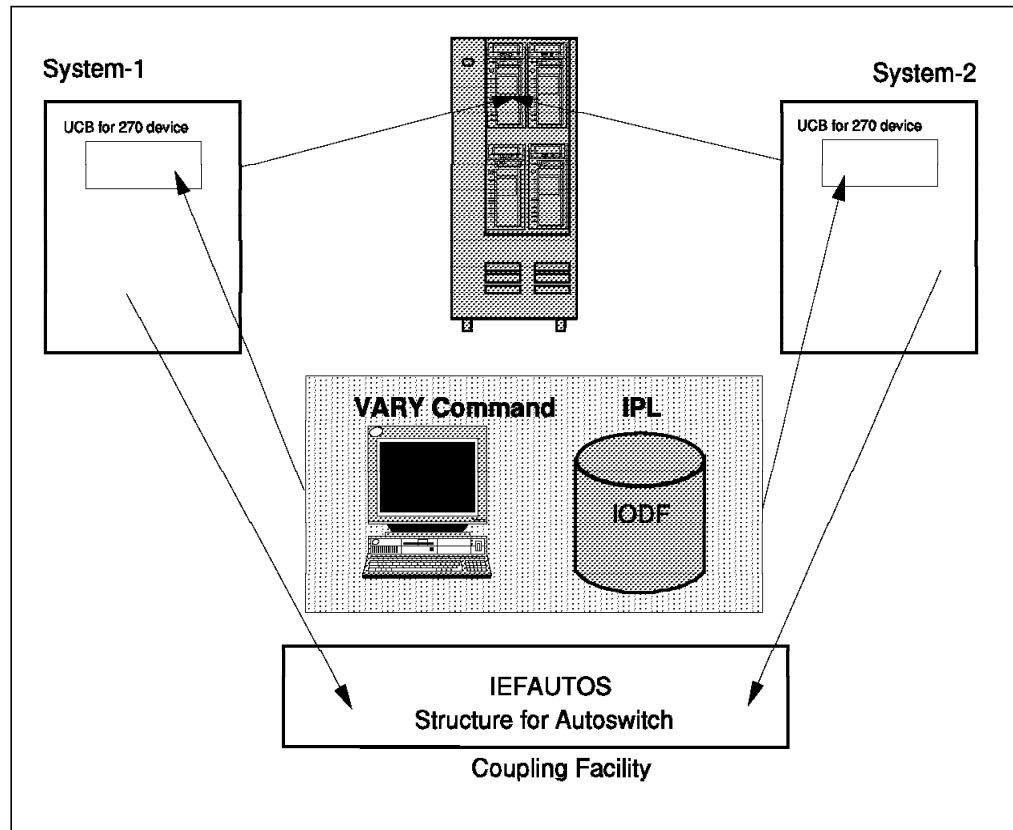
Figure 31. Automatic Tape Switching under MVS/ESA V5.2

To enable the sysplex for automatic tape switching, define a new structure, IEFAUTOS, in the coupling facility resource management (CFRM) policy. You define appropriate tape devices as automatically switchable either

- At IPL, according to your specification in the HCD device definition panel.

- Dynamically through a new AUTOSWITCH key word on the VARY command.

- Through the IEEVARYD macro.

- Through the ESCON manager.

4.1.3 Access Method Services (AMS) Command Changes

ALTER, CREATE, and LISTCAT AMS commands have been changed to support the new media type and recording technology. Because AMS cannot change the library manager inventory in an automated tape library, use Interactive Storage Management Facility (ISMF) for normal tape library alter and create functions. Use AMS commands to recover from volume catalog (VOLCAT) errors.

One new subparameter, 128TRACK, for the RECORDING parameter has been added for the CREATE and ALTER VOLUMEENTRY commands. Another new subparameter, MEDIA3, for the MEDIATYPE parameter has been added for the CREATE and ALTER VOLUMEENTRY commands:

```
CREATE VOLUMEENTRY
       (NAME(entryname)
        RECORDING(128TRACK)
        MEDIATYPE(MEDIA3)
        )

ALTER entryname VOLUMEENTRY
       RECORDING(128TRACK)
       MEDIATYPE(MEDIA3)
```

The number of scratch volumes and the threshold value for the new media type
MEDIA3 subparameter have been added to the CREATE and ALTER
LIBRARYENTRY commands:

```
CREATE LIBRARYENTRY
       (NAME(entryname)
        NUMBERSCRATCHVOLUMES(MEDIA1(num) MEDIA2(num)
                             MEDIA3(num))
        SCRATCHTHRESHOLD(MEDIA1(num) MEDIA2(num)
                             MEDIA3(num))
        )

ALTER entryname LIBRARYENTRY
       NUMBERSCRATCHVOLUMES(MEDIA1(num) MEDIA2(num)
                            MEDIA3(num))
       SCRATCHTHRESHOLD(MEDIA1(num) MEDIA2(num)
                            MEDIA3(num))
```

The LISTCAT command has been enhanced to display the value associated with
the MEDIATYPE and RECORDING parameters for volume entries and the
NUMBERSCRATCHVOLUMES and SCRATCHTHRESHOLD for library entries.

4.1.4 Interactive Storage Management Facility (ISMF)

On the ISMF dialog panels, a new generic device type, **3590-1**, is used for the
IBM 3590. The new media type, MEDIA3, and recording technology, 128TRACK,
subparameters are also used. The scratch threshold value and number of the
scratch volumes for MEDIA3 also have been added. The following ISMF panels
have been updated to support the IBM 3590:

- Data set application

  - Data Set Selection Entry
  - Data Set List
  - Data Set Filter Entry

- Tape library application

  - Tape Library Define
  - Tape Library Alter/Redefine
  - Tape Library Display
  - Tape Library List
  - Tape Library View Entry
  - Tape Library Sort Entry

- Data class application

  - Data Class Define/Alter

　　　－　Data Class Display
　　　－　Data Class List

　・　Mountable tape volume application

　　　－　Mountable Tape Volume List

4.1.5 DFSMSdfp Component Object Access Method (OAM)

If you want to use the OAM Object tape support that allows you to store objects and object backups with the IBM 3590 tape subsystem, you need to make the following updates:

1. Define one or more new storage groups of type OBJECT or OBJECT BACKUP.

2. Update the CBROAMxx member in SYS1.PARMLIB to include the new storage groups and define their TAPEUNITNAME as 3590-1. Figure 32 shows a sample SETOAM command for storage group OBJTAPE.

```
SETOAM .....
        .....
        STORAGEGROUP(OBJTAPE
                    TAPEUNITNAME(3590-1)
                    TAPECOMPACTION
                    DEMOUNTWAITTIME(120)
                    .....)
```

Figure 32. Sampe SETOAM Command in SYS1.PARMLIB Member CBROAMxx

The SETOAM command will be rejected if you specify an esoteric unit name for TAPEUNITNAME (that is, a mixed esoteric group consisting of at least one IBM 3590-1 and at least one tape drive of any other recording technology). If you do not specify the TAPEUNITNAME on the SETOAM command, then OAM will not be able to store any object to tape. An attempt to write an object on tape, as a result of a store or a transition, will fail.

You can use the optional parameter DEMOUNTWAITTIME to specify the number of seconds that OAM is to wait before demounting and deallocating a tape drive that is not currently being used by OAM. The default for DEMOUNTWAITTIME is 120 seconds. When the time expires, OAM will rewind and unload the currently mounted tape cartridge and then deallocate the device.

The Optical Configuration Database has not been changed. However, the following columns of the TAPEVOL table of the OAM Optical Configuration Database can contain information related to a IBM 3590 High Performance Tape Cartridge:

UNITNAME: the MVS unit name that was used when the tape volume was originally written and that will be used when the tape volume is subsequently allocated by OAM.

MEDIATYP: a value of 05 represents a IBM 3590 High Performance Tape Cartridge

CAPACITY: a value of 9,765,888 represents the approximate number of kilobytes of data of an IBM 3590 High Performance Tape Cartridge. This value is returned from the Magstar tape drive and is used as an approximation that is close to the actual value.

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> **Note:** For 3480 or 3490 cartridges, "capacity" represents the number of millimeters of tape instead of the number of kilobytes.

FRESPACE: the available free space in kilobytes left for writing data on the volume. It has also been reduced by the tape volume percentage full value for the storage group this volume is assigned to.

4.1.6 DFSMSdss

DFSMSdss stand-alone restore processing has been enhanced to support multiple physical full-volume dumps on a single tape volume by allowing you to specify a file number for the dump you want to restore. Before you can run the DFSMSdss stand-alone, you must create an IPLable core image by invoking the DFSMSdss program ADRDSSU using the command BUILDSA. Figure 33 shows a sample DFSMSdss job to create the stand-alone program on tape and on DASD.

```
//BUILDSA JOB .........
//STEP1   EXEC PGM=ADRDSSU
//SYSPRINT DD SYSOUT=*
//SAMODS    DD DSN=SYS1.ADRSMLIB,DISP=SHR
//TAPEDD    DD DSN=DSSA,UNIT=3590-1,LABEL=(,NL),
//             DISP=KEEP,VOL=SER=TAPE01
//SYSIN     DD *
 BUILDSA -
      INDD(SAMODS) -
      OUTDD(TAPEDD) -
      IPL(TAPE)
/*
//STEP2   EXEC PGM=ADRDSSU
//SYSPRINT DD SYSOUT=*
//SAMODS    DD DSN=SYS1.ADRSMLIB,DISP=SHR
//SYSIN     DD *
 BUILDSA -
      INDD(SAMODS) -
      OUTDYNAM(IPLVOL) -
      IPL(DASD)
/*
```

Figure 33. Sample DFSMSdss Jobs to Create a DFSMSdss Stand-Alone Program

For a complete description of the BUILDSA parameters, please refer to the *DFSMSdss Storage Administration Guide*.

To restore a physical full-volume dump, created as the fourth file on a standard-labeled volume, you could use the RESTORE command listed in Figure 34

```
RESTORE FROMDEV(TAPE) FROMADDR(0500)
        TOADDR(0A00) NOVERIFY
        FULL
        NOREADCHECK
        FILE(4)
        LABEL(SL)
```

Figure 34. Sample Stand-Alone RESTORE Command

4.1.7 **DFSMShsm**

DFSMShsm supports the IBM 3590 tape subsystem for all commands where you can specify a tape device. Table 28 lists all commands and the parameters affected.

Table 28. DFSMShsm User Commands	
Command	**Parameter**
ABACKUP	UNIT(*tape-unitname*)
ADDVOL	UNIT(*tape-unitname*)
ARECOVER	UNIT(*tape-unitname*)
BACKVOL	UNIT(*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(*tape-unitname*,*tape-unitname*)
TAPEREPL	ALTERNATEUNITNAME(*tape-unitname*)

4.1.8 **DFSMSrmm**

To define your IBM 3590 High Performance Tape Cartridges to DFSMSrmm, you can follow the implementation steps listed below.

1. Define a new scratch pool.

   You define a new scratch pool through the VLPOOL statement in SYS1.PARMLIB member EDGRMMxx. Figure 35 on page 92 shows an example of scratch pools defined by cartridge type.

```
  VLPOOL PREFIX(1*) -
         TYPE(S) -
         MEDIANAME(STANDARD) -
         NAME(3480) -
         RACF(Y) -
         EXPDTCHECK(N) -
         DESCRIPTION(¢Scratch Pool of CST¢)

  VLPOOL PREFIX(E*) -
         TYPE(S) -
         MEDIANAME(ENHANCED) -
         NAME(3490) -
         RACF(Y) -
         EXPDTCHECK(N) -
         DESCRIPTION(¢Scratch Pool of ECCST¢)

  VLPOOL PREFIX(J*) -
         TYPE(S) -
         MEDIANAME(HIPERC) -
         NAME(3590) -
         RACF(Y) -
         EXPDTCHECK(N) -
         DESCRIPTION(¢Scratch Pool of 3590 High Performance Tape¢)
```

Figure 35. Sample DFSMSrmm Scratch Pool Definitions

Use the DFSMSrmm installation exit EDGUX100 to manage your scratch
pools. If you do not, DFSMSrmm does not verify that a volume from the
requested scratch pool has been mounted. The steps for using EDGUX100
are:

- Tailor the EDGUX100 Installation Exit.

- Define the MNTMSG parmlib options.

- Define an MCS Console for JES3.

- Activate MONITOR DSNAMES.

- Activate the EDGUX100 installation exit.

2. Define volumes to DFSMSrmm.

   When defining your IBM 3590 High Performance Tape Cartridge volumes to
   DFSMSrmm, you can use following operands of the ADDVOLUME command:

   MEDIATYPE   3590

   RECORDINGFORMAT 128TRACK

   COMPACTION   YES

   Note: COMPACTION can be specified only for a user or master volume.
   The value *YES* is also used for volumes written on IBM 3480 or 3490
   tape drives using IDRC. For compatibility reasons, the value of *IDRC*
   is still accepted by the ADDVOLUME command. However, if you
   specify COMPACTION(IDRC) the compaction value will be listed by
   DFSMSrmm as YES.

3. Initialize volumes.

   Use the DFSMSrmm EDGINERS utility to initialize your IBM 3590 High
   Performance Tape Cartridges. Figure 36 on page 93 shows the sample job

stream used to initialize the first ten IBM 3590 cartridges previously defined as belonging to scratch pool HIPERC.

```
//INIT     JOB  ...........
//STEP1    EXEC PGM=EDGINERS,
//              PARM=¢INITIALIZE,COUNT(10),MEDIANAME(HIPERC),NOVERIFY¢
//SYSPRINT DD   SYSOUT=*
//TAPE     DD   UNIT=(3590-1,,DEFER)
```

Figure 36. Sample EDGINERS Job to Initialize IBM 3590 High Performance Tape Cartridges

4. Control the tape-volume data set recording.

   DFSMSrmm automatically records information about tape volumes and the data sets created on tape volumes. If, for example, a tape volume can contain a large number of files or if an application tracks the tape contents, use the DFSMSrmm installation exit EDGUX100 to request that DFSMSrmm not record details of all files on a tape volume. DFSMSrmm then records only the first file details, but does keep track of the statistics at the volume level.

   During OPEN processing for the first file on a volume, the EDGUX100 exit retrieves the data-set name, job name, and job step program name before scanning table EDMTAB for a match. If there is a match, the exit sets the PL100_SET_IGNORE_FILE2_TON bit to request that DFSMSrmm maintain data set details for the first file only.

   For each entry, table EDMTAB contains an 8-byte field for the job name, a 44-byte field for the data set name, and an 8-byte field for the program name. Figure 37 shows how the table might look.

```
    EDMTAB   DS    0F                   Start of Table
    *
             DC    CL8¢BU*      ¢        Job Name
             DC    CL44¢BU%%.DUP.*    ¢  Data Set Name
             DC    CL8¢*        ¢        Program Name
    *
             DC    CL8¢*        ¢        Job Name
             DC    CL44¢*         ¢      Data Set Name
             DC    CL8¢ABCSAVE ¢         Program Name
    *
             DC    CL8¢*        ¢        Job Name
             DC    CL44¢TOO.MUCH.FILES¢  Data Set Name
             DC    CL8¢*        ¢        Program Name
    *
             DC    CL8¢EDMEND¢           End-of-Table Marker
```

Figure 37. Sample EDGUX100 Table EDMTAB

The fields can contain alphanumeric and national characters, following MVS naming conventions including % and *.

%   causes DFSMSrmm to ignore a single positional character.

*   causes DFSMSrmm to ignore all remaining characters. A single * in the job name field means that the entry applies to all job names.

When EDGUX100 tells DFSMSrmm to record only the first file, this information is set for the volume until the first file is rewritten. So, no matter how many different jobs write extra files, the original decision stands until the first file is rewritten, when the decision can be remade.

4.1.9 ADSTAR Distributed Storage Manager (ADSM) for MVS

To use the IBM 3590 tape subsystem with ADSM for MVS, you need to define at least one additional device class with the device type of CARTRIDGE for the new tape devices. A device class should not consist of devices that cannot read or write all of the same media; therefore, the IBM 3590 tape subsystem needs a new device class which specifies:

- The unit name to define a group of tape devices

- Whether or not data will be compressed on tape

- The protection status of the data stored on tape

- The retention period of the tape.

These attributes are passed to the MVS operating system whenever ADSM for MVS dynamically allocates a tape volume.

You can further define

- How long the server retains an idle time mount.

- The number of tapes that can be mounted simultaneously.

- How long the stored data needs to be retained.

- How much data can be stored on a tape.

4.1.10 JES3

For the most part, the use of the IBM 3590 tape subsystem as an execution device in a JES3 complex is transparent to JES3. You need to define the devices to JES3 in the Initialization stream, if JES3 is to manage the devices. Once you have done this, JES3 manages the IBM 3590 drives the same way other tape devices are managed.

To update the JES3 Initialization stream follow the steps described below:

1. Specify the generic unit name and any esoteric unit names by which the IBM 3590 drives may be requested; use one or more SETNAME statements.

2. Specify these unit names on HWSNAME statements, if you are using High Watermark Setup, or catalog overrides—for example, if a unit name specified on JCL is more restrictive than the IBM 3590 generic unit name of 3590-1. In these case, the JCL unit name will override the unit name in the catalog.

   The rules for specifying the IBM 3590 unit names on these statements are the same as for other device types. For example, each unit name must appear as the primary unit name on one HWSNAME statement.

   Note: Since IBM 3590 is not compatible with other tape device types, the alternate unit names that follow the primary name must not contain any other device type.

3. Define the IBM 3590 drives through DEVICE statements. If the JUNIT parameter is specified, the DTYPE should be specified as TA435901.

To request an IBM 3590 drive for the DUMP Job DSP, you may specify TA4 or TA435901 or the device address on the IN= or OUT= parameter. You can request compaction using the existing MOD= key word. Do not use the DEN= key word: it is ignored except for a warning message because the IBM 3590 writes a single density tape.

Other JES3 Tape Dynamic Support Programs (DSPs) such as Tape Label or Tape-to-tape do not support the IBM 3590 devices.

4. If the IBM 3590 tape subsystems are installed in an IBM 3494 or 3495 Automated Tape Library Dataserver, you need to 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 38 shows the sample JES3 definitions for an IBM 3494 or 3495 Automated Tape Library Dataserver with one string of four Magstar tape drives. 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 38. Sample JES3 Definitions for IBM 3590 with an IBM 3494 or 3495 Automated Tape Library Dataserver

The complex-wide library name is always *LDGW3495*, no matter whether you have installed only an IBM 3494, only an IBM 3495, or both.

Note: IBM 3590 drives installed in IBM 3494 or 3495 Automated Tape Library Dataserver cannot be used to as support units for JES3 DSPs. Therefore, do not specify DTYPE, JUNIT, and JNAME parameters on the DEVICE statement. No check is made during initialization to prevent 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 or 3495 fails because the DSP is unable to allocate an IBM 3494 or 3495 drive.

4.1.11 System Management Facility (SMF) Record

In two fields of the SMF type 21 record (Error Statistics by Volume), SMF21BRN and SMF21BWN, the number of bytes read and written has been increased by 1 byte to accommodate the increase in size of the counter returned by the IBM 3590 control unit. The source of these two fields is stored in the UCB device class extension (DCE).

The SMF Volume Statistics Print Utility program, IFHSTATR, has been updated to format and print the updated SMF type 21 records.

Users employing programs that process the SMF record type 21 and the output of the IFHSTATR should reevaluate their programs.

4.1.12 Integration with a System-Managed IBM Automated Tape Library Dataserver

Integration of an IBM 3590 tape subsystem in a system-managed tape library does not require many updates to your configuration. In this section, we assume that you are already using an IBM 3494 or 3495 Automated Tape Library Dataserver. When you integrate an IBM 3590 tape subsystem with Virtual Tape Server into IBM 3494 or 3495 Automated Tape Library Dataserver, you must define the Virtual Tape Server subsystem as a separate tape library with 32 IBM 3490E drives. For more information about the Virtual Tape Server subsystem, please refer to *IBM Magstar Virtual Tape Server and Enhancements to Magstar: New Era in Tape*. If you are implementing an IBM 3494 or 3495 Automated Tape Library Dataserver for the first time, please refer to the *IBM 3495 Implementation Primer for MVS* which covers installation of an IBM 3494 or 3495 Automated Tape Library Dataserver in an MVS environment. Further information can be found in the *Guide to Sharing and Partitioning IBM Tape Library Dataservers*.

You do not need to define the library itself to MVS. It is sufficient that you define the drives with LIBRARY=YES during HCD definition. In a system-managed environment, you need to perform the following tasks:

 1. Update library definition.

    In the ISMF library definition panel, you can specify a scratch threshold for each media type. Setting the threshold results in the display of a warning message on the operator console when the number of scratch cartridges in the IBM 3494 or 3495 Automated Tape Library Dataserver is below the threshold. The message disappears when the number of scratch cartridges exceeds twice the number specified for the scratch threshold.

    DFSMSrmm can automatically initiate expiration processing if the message appears.

    If you want to specify a scratch threshold for the IBM 3590 High Performance Tape Cartridge, which is called *MEDIA3* in a system-managed tape library, update the library definition using the ISMF Tape Library Alter panel.

 2. Update SMS constructs.

    Media type and recording technology for a new data set are determined by the data class assigned during allocation. To direct your data sets to IBM 3590 High Performance Tape Cartridges, you need to define a new data class or change an existing one. Figure 39 on page 97 shows the ISMF Data Class Define panel. Note that the compaction and media interchange fields have moved to a new panel: the third panel for defining a data class.

```
 DGTDCD05                         DATA CLASS DEFINE                  Page 3 of 3
  COMMAND ===>

  SCDS NAME:        USER1.ISMF.SCDS2¢
  DATA CLASS NAME: MEDIA3

  TO DEFINE DATA CLASS, SPECIFY:

    COMPACTION              ===>                    (Y, N or blank)
    MEDIA INTERCHANGE
      MEDIA TYPE            ===>                    (1=MEDIA1, 2=MEDIA2,
                                                     3=MEDIA3, of blank)
    RECORDING TECHNOLOGY    ===>                    (1=18TRACK, 2=36TRACK,
                                                     3=128TRACK, or blank)






  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 39. ISMF Data Class Define Panel Page 3

You do not need additional storage classes or management classes since the IBM 3590 High Performance Tape Cartridge and IBM 3590 tape subsystem bring no changes.

If you want to separate your MEDIA3 private volumes from other private volumes, you might consider creating one or more new storage groups of type TAPE. However, doing so is neither necessary nor required.

3. Update ACS routines

   To assign tape data sets to system-managed MEDIA3 volumes, you need to update your data class automatic class selection (ACS) routine to assign the new data class.

   Depending on your selection criteria in storage class and management class ACS routines, updates may not be required. Also, if you did not specify a new storage group, your storage group ACS routine need not be changed.

   Having completed these updates, you must translate the ACS routines into executable form. To translate an ACS routine, select option 2 on the ACS Application Selection panel.

4. Install the new OAM installation exits (provided by DFSMSrmm)

   To support a new device type and a new media type, the parameter lists for the OAM installation-wide exits have been changed. You should review and possibly update the following exits if they are active on your system:

   CBRUXENT   The cartridge-entry-installation exit is invoked during entry processing of a volume into a system-managed tape library.

   CBRUXCUA   The change-use-attribute exit is invoked when the use attribute "scratch" or "private" of a volume in a system-managed tape library is updated.

CBDUXEJC   The cartridge-eject exit is invoked when a volume is ejected from a system-managed tape library.

CBRUXVNL   The volume not-in-library exit receives control when a job or dynamic allocation request asks for a volume that does not currently reside in a system-managed tape library.

DFSMSrmm provides the updated versions of the exits listed above.

The tape device selection information (TDSI), mapped by macro CBRTDSI, has been enhanced to support the new media type and recording technology. Source code for CBRTDSI is distributed in SYS1.MACLIB.

5. Validate and activate your SMS configuration.

You can now process MEDIA3 volumes in your IBM 3494 and 3495 Automated Tape Library Dataservers. For coexistence considerations, please refer to section 4.1.13, "Coexistence." Migration consideration are discussed in detail in Chapter 5, "Migration in an MVS/ESA Environment" on page 115.

4.1.13 Coexistence

DFSMS/MVS V1.1.0, V1.2.0 and V1.3.0 systems without the IBM 3590 device-support SPEs installed can share an IBM 3494 or 3495 Automated Tape Library Dataserver with DFSMS/MVS V1.2.0 and V1.3.0 where the Magstar tape drive is defined as a part of the IBM automated tape library. To do so, however, you need to install coexistence PTFs on the pre-SPE-level systems.

The coexistence PTFs allow lower-level systems to ignore media types other than MEDIA1 or MEDIA2. The following functions can therefore only be performed on the DFSMS/MVS system that has the SPE installed:

- Cartridge entry processing of MEDIA3 cartridges
- LCS external services functions on a MEDIA3 or 128TRACK recorded volume
- Ejecting a cartridge from the IBM automated tape library
- Library audits.

All systems sharing an DFSMSrmm control data set must be on the SPE level, before the EDGUX100 can be updated to exploit the data set recording control function.

4.2 VM/ESA Environments

In this section, we describe the required software support and the software installation steps for an IBM 3590 tape subsystem in a VM/ESA environment.

4.2.1 Software Requirements

Support for the IBM 3590 tape subsystem will be provided in VM/ESA Version 2 when the ESCON-attached IBM 3590 is available. The IBM 3590 enabling PTF may be required. The control program (CP) provides guest operating system support through enhanced channel command word (CCW) translation to handle the new and changed CCWs that are used by the IBM 3590 High Performance Tape Subsystem. The guest operating systems that support the IBM 3590 tape subsystem can use the tape subsystem in the same way as in its native environment.

For IBM 3590 tape drives installed in an IBM 3494 or 3495 Automated Tape Library Dataserver, you need to have DFSMS/VM FL221 installed.

If you are using a tape management system or other OEM software, you must check whether they provide support to recognize the new media and the new device type.

4.2.2 Basic Implementation Steps

Implementation in a VM/ESA environment is more or less done automatically. Once you define your IBM 3590 tape subsystem through the input/output configuration program (IOCP), VM/ESA automatically senses the drives and sets them online. You cannot define the IBM 3590 tape subsystem using the RDEVICE macro in HCPRIO. As with 3480 and 3490 drives, you do not need to define the IBM 3590 drives in the CP CONFIG file.

Support for the ACF is the same as for the IBM 3490 integrated cartridge loaders (ICLs). If your IBM 3590 tape subsystem is installed in an IBM 3494 or 3495 Automated Tape Library Dataserver you need to perform the following additional steps.

 1. Define the drives to DFSMS/VM removable media sevices (RMS).

    To define the IBM 3590 tape drives available in the IBM 3494 and 3495 Automated Tape Library Dataservers to DFSMS/VM RMS you must use the *RMCONFIG DATA* configuration file. This file is kept in the SFS VMSYS:DFSMS.CONTROL directory. Add the device addresses of your IBM 3590 tape drives to the DFSMS/VM RMS configuration file.

 2. Restart DFSMS/VM RMS.

    After you have changed the DFSMS/VM RMS configuration file, you must restart the DFSMS/VM RMS machine.

 3. Assign the volumes to a separate scratch category that is currently not used.

    To simplify the management of incompatible multiple device types and multiple media types in an IBM 3494 and 3495 Automated Tape Library Dataservers, we highly recommend that you assign a unique scratch category to your new cartridges when using scratch tape processing.

    The volumes can be assigned to a scratch categories in one of two ways:

 4. Manually, by invoking an RMS interface function.

    To assign a group of inserted volumes to a scratch category, you can use the DFSMSRM SET VOLCAT VOL *volser targetcat* command where *targetcat* is the scratch category you want to assing to volume *volser*. Or you can use an *on-request bulk processing file* which you can execute using the DFSMSRM SET VOLCAT BULK *fully_qualified_filename* command. Figure 40 shows a sample on-request bulk processing file.

```
 *
 * vol-label     target    source
 *
  J00000-J02000  SCRATCH3  INSERT
  E00000         SCRATCH1
```

Figure 40. Sample On-Request Bulk Processing File

5. By assigning the scratch category to the IBM 3590 tape drives.

   To associate a scratch category with a drive, you can use the DFSMSRM SET DEVCAT command. However, you must ensure that any scratch mount requests to IBM 3590 drives always ask for an IBM 3590 High Performance Tape Cartridge; otherwise, the mount request will fail. The library manager will not mount a scratch cartridge of the wrong media type.

4.2.3 ADSM for VM

In general, the same recommendations apply as for ADSM/MVS and the IBM 3590 High Performance Tape Subsystem For details about the tape usage of ADSM for VM please refer to Chapter 8 (Managing Tape Operations) of the *ADSTAR Distributed Storage Manager Administrator's Guide*.

Before ADSM for VM uses your IBM 3590 cartridges, you have to label the volumes. If you are using the volumes inside an IBM 3494 or 3495 Automated Tape Library Dataserver, you must ensure that the internal label and the external bar code label match. To label a volume that is inside an IBM Automated Tape Library Dataserver, use these commands:

1. DFSMSRM MOUNT VOL vlabel (VDEV 181 READWR

2. TAPE WVOL1 volid

   where volid must be the same as vlabel.

3. REW 181

4. TAPE DVOL1

   to display the VOL1 label.

5. DET 181

Repeat Steps 1 through 5 until all volumes for use of ADSM/VM are labeled.

4.3 AIX Environment

In the RISC System/6000 and IBM RS/6000 Scalable POWERparallel Systems environment, support is basically provided through the device driver. The support for the Magstar tape drive is comparable to the support for SCSI-attached IBM 3490 models C and E.

In this section, we describe the support that is new for the Magstar tape drive.

4.3.1 Software Support

The IBM 3590 tape subsystem is supported in AIX V3.2.5 and in AIX V4.1.1. All current application interfaces such as *open, read, write, close,* and *ioctl* are supported. ADSM/6000 V1.2.1 plus PTF and ADSM for AIX V2.0 also support the IBM 3590 as a stand-alone tape drive, as a minilibrary, and when installed in an IBM 3494.

IBM Client Input Output Sockets V2.1 is a set of commands and application programming interfaces (APIs) that can be used for high-speed communication and for accessing tape devices on a network of AIX workstations and MVS/ESA mainframes. CLIO/S makes it easier to distribute work and data across a network of IBM RS/6000 Scalable POWERparallel Systems, RISC/6000 and MVS/ESA mainframe systems. CLIO/S also provides an API to tape drives

anywhere in the network. The API supports IBM 3590 High Performance Tape Subsystem. For more information please see the *IBM Client Input Output/Sockets Version 2 Release 1 General Information* for details.

Remote Tape Application Interface (RTAPI) is a service offering developed by the IBM Scientific and Technical Systems and Solution group. The RTAPI provides data transfer from tape servers to tape clients at near-tape-head speeds. Clients can access the tape devices on tape servers located at remote sites throughout a network. The Magstar tape drive is supported by the tape server. The client interface is an API, not a device driver, so you must develop the client applications.

REELlibrarian for AIX Release 4.2, a tape management product developed by Storage Technology Corporation, also supports the IBM 3590 High Performance Tape Subsystem.

Release 2.1 of National Storage Laboratory (NSL) UniTree, an online mass storage management system that gives users direct access to data stored on a variety of different storage devices, supports the IBM 3590 tape subsystem.

4.3.2 Using the IBM 3590 Tape Subsystem as a Minilibrary

After the AIX Tape and Medium Changer device driver (and for IBM 3494 the AIX Tape Library device driver) is installed, and an instance of a tape device is configured and made available, then access is available through special files. In turn, opening and performing I/O to the special file performs I/O to the tape drive.

A new special file **/dev/rmt*.smc** exits for IBM 3590 devices where * represents the number assigned to a particular device. The **/dev/rmt*.smc** file can be opened independently of the other special files. It provides a path for issuing *ioctl* calls to control the medium changer device—the IBM 3590′s ACF—as a separate medium changer device. While **/dev/rmt*.smc** is open, access to the following *ioctls* is restricted to **/dev/rmt*.smc** and any attempt to access them through the tape special file such as **/dev/rmt*** fails.

SMCIOC_ELEMENT_INFO   This *ioctl* requests device information.

SMCIOC_MOVE_MEDIUM   This *ioctl* allows moving a cartridge from one element (one of the ACFs cells) to another.

SMCIOC_INVENTORY   This *ioctl* returns information on the four types of elements. The application inputs the number of elements it requires information on and allocates a buffer large enough to hold the output for each type.

These commands and associated structures are defined in the */usr/include/sys/Atape.h* header file, which you should include in the corresponding C program using this function.

A sample **tapeutil.c** program is provided with the device driver in the */usr/lpp/Atape/samples* directory that demonstrates the use of these *ioctl* commands. The program provides an interactive menu version and an AIX command line version similar to the *tctl* and *mt* commands.

You can invoke the command line version of the *tapeutil* program from the AIX command line or from within a shell script. The syntax for the command-line version of the *taputil* program is:

```
tapeutil -f Device Subcommand [ Subcommand ... ]
```

where device is the name of a device special file such as /dev/rmt0. and
Subcommand is a valid subcommand for the device. Figure 41 shows the
subcommands that are available.

```
General Subcommands

  devinfo    inquiry    print"text"         vpd
  reserve    release    reqsense            tur

Medium Changer Subcommands

  audit      elementinfo position -d Destination
  inventory              move -s Source -d Destination

Tape Subcommands

  append     bsf[Count]  bsr[Count]
  autoload   eof[Count]  weof[Count]
  compress   fsf[Count]  fsr[Count]
  nocompress erg         logsense
  mtdevice   rewind      read -d Destination
  qrypos     retension   write -s Source
  setpos     status      rtest [-b Blocksize] [-c
  Count] [-r Repetition]
  offline    parms       rtest [-b Blocksize] [-c
  Count] [-r Repetition]
  rewoffl    sync        rwtest [-b Blocksize] [-c
  Count] [-r Repetition]
  unload     volid"name"
```

Figure 41. Subcommands of the Tape Utility Program

You can invoke the interactive version of the tape utility program from the AIX
command line by entering *tapeutil* without additional parameters. Most of the
general, medium changer, and tape commands that are displayed require a
device to be opened first. After a device has been opened, you can select by
entering the appropriate number of the command from the menu. For some
commands you must enter additional information after their selection.

For more information about the *ioctl* commands, please refer to *IBM SCSI Tape
Drive, Medium Changer, and Library Device Drivers Installation and User's Guide*.

Standard AIX tape commands such as *tctl, mt, dd, tar, cpio, backup,* and *restore*
are supported for IBM 3590 tape subsystem You can use the standard AIX device
commands *chdev, rmdev, mkdev,* and *lsdev* to bring the Magstar tape drive
online or change attributes that determine the status of the tape devices.

4.3.3 Implementation in IBM 3494 Automated Tape Library Dataserver

The implementation of Magstar tape drives in an IBM 3494 Automated Tape
Library Dataserver is basically the same as for SCSI-attached IBM 3490 model C
drives. Inside an IBM 3494 Automated Tape Library Dataserver, the IBM
3590-B1A tape drive without an ACF is installed. Therefore, no new or changed
commands to control the tape library are required to support the ACF.

The library system calls are accepted by the library device driver only, if the special file that is opened by the calling program is a library manager control point. To control the operation of a tape library device, use the following library commands:

MTIOCLM   Mount a volume on a specified drive.

MTIOCLDM   Demount a volume from a specified drive.

MTIOCLQ   Return information about the tape library and its contents.

MTIOCLSVC   Change the category of a specified volume.

MTIOCLA   Verify that a specified volume is in the library.

MTIOCLC   Cancel the queued operations of a specified class.

MTIOCLSDC   Assign a category to the automatic cartridge loader of a specified device.

MTIOCLRC   Release a category previously assigned to a specified host.

MTIOCLRSC   Reserve one or more categories for a specified host.

MTIOCLCSA   Set the category attributes for a specified category.

MTIOCLEW   Wait until an event occurs that requires the tape device driver to notify the library manager.

You can also use the following programs that provide the full interface to the IBM 3494 Automated Tape Library Dataserver.

mtlib   The mtlib program is a command line interface to control the IBM 3494. This program provides the full interface to the library as defined by the *ioctl.* system calls except for the MTIOCLEW library system call.

mtevent The mtevent program is a command line interface to the MTIOCLEW command.

For more information about the system calls, please refer to *IBM SCSI Tape Drive, Medium Changer, and Library Device Drivers Installation and User's Guide*.

When reserving a category for a specified host and when choosing the volume category for the new IBM 3590 High Performance Tape Cartridges used inside the IBM 3494, you should be aware of the following:

- The new medium is not compatible with any other media and can only be mounted on Magstar tape drives. Therefore, keep your cartridges in separate volume categories and assign those to the Magstar tape drives using the MTIOCLSDC tape library system call or the mtlib program.

- When selecting the category you can basically choose a cartridge category between X'0001' and X'FEFF'. However, when sharing your IBM 3494 Automated Tape Library Dataserver with a non-AIX system, you should avoid using the volume categories that are explicitly assigned. For a complete list of the library manager volume categories and their assignment to a particular host operating system, please refer to Appendix D, "Library Manager Volume Categories" on page 253.

4.3.4 ADSM for AIX

The **IBM 3590-B11 tape drive** with the ACF can be used by ADSM for AIX as a **SCSI Library**. To enable ADSM for AIX to use the ACF and the Magstar tape drive, perform the following steps. Please note that the examples listed in this section are based on ADSM for AIX Version 2.

1. Prepare the ACF.

   Before defining the Magstar tape drive as a SCSI library (minilibrary) to ADSM, you should prepare the ACF by filling it with the volumes you want ADSM to use, locking it, and setting it to RANDOM mode.

2. Label the IBM 3590 High Performance Tape Cartridges.

   ADSM includes a DSMLABEL utility that writes labels to new volumes. Before the server can use a volume, the tape must contain special header information. Figure 42 shows the sample invocation of the DSMLABEL utility.

```
dsmlabel –search –keep –drive=/dev/rmt4 library=/dev/rmt4.smc
```

Figure 42. Invoke DSMLABEL to Label IBM 3590 Cartridges in the ACF

   The dsmlabel command requires the ACF to be set to sequential mode. If you need to label the cartridges, set the ACF to SEQUENTIAL. After labeling the cartridgesm reset the ACF to random mode. The -keep parameter will result in returning the volumes to the ACF location where they were originally located.

3. Define the Magstar tape drive to ADSM as library and drive.

   You do not need to configure the ADSM device driver for IBM 3490 or 3590 tape drives because ADSM uses the AIX tape and medium changer device driver for those drives.

   You must define one library per Magstar tape drive because each drive is treated as a minilibrary.

   Figure 43 shows the command to define a Magstar tape drive to ADSM for AIX. We choose the library name MAGL0 and the drive name MAGD0; the terminal zero relates to the device number represented in the name of the special files such as rmt4.

```
define library magl0 libtype=scsi device=/dev/rmt4.smc
define drive magl0 magd0 device=/dev/rmt4
```

Figure 43. Define an IBM 3590 Tape Drive to ADSM as SCSI Library

4. Define a new device class.

   To use the IBM 3590 High Performance Tape Cartridge, you must define a device class with a device type of 3590. In Figure 44 on page 105, we list a sample device-class definition command for device class MAGC0 using the Magstar tape drive's hardware compression. You need to define one device class for each Magstar tape drive that is used as a SCSI library.

```
define devclass magc0 devtype=3590 format=3590c -
        library=magl0 mountlimit=1 mountretention=60 -
        prefix=adsm estcapacity=20g mountwait=60
```

Figure 44. Define a Device Class with Device Type 3590

The definition in Figure 44 shows all parameters for the define devclass command. However, for the parameters mountlimit, mountretention, prefix, and mountwait we used the ADSM supplied default values.

If you do not want to use hardware compression, you must specify *format=3590b* and *estcapacity=10g*. We defined 20 GB (20 g) for the estimated capacity of a compressed IBM 3590 High Performance Tape Cartridge. ADSM for AIX is not able to determine how much data is actually on the tape. The specification does not prevent ADSM from using the full length of the tape it is likely that more data fits on the IBM 3590 cartridge.

5. Check-in the volumes to the library.

   Before the server can use a volume in a library, the volume must be checked into the library. To inform the server about the volumes available in the ACF, use the CHECKIN command in Figure 45.

```
checkin libvolume magl0 status=scratch checklabel=yes search=yes
```

Figure 45. Sample CHECKIN Command for SCSI Libraries

6. Define a storage pool.

   You must define a sequential-access storage pool that relates to the device class for IBM 3590 cartridges. The pool can be either a primary or a copy storage pool. For detailed information about managing storage pools, please refer to the *ADSTAR Distributed Storage Manager for AIX Administrator′s Guide Version 2*.

7. Define tape volumes to the storage pool.

   You can assign those tape volumes that reside in the ACF to the storage pool that is related to the drive through the devclass definition. We recommend that you avoid using scratch volumes with the Magstar tape drive operating as a SCSI library. To assign volume VOL111 to storage pool magp0, use the define volume command in Figure 46.

```
define volume magp0 vol111 access=readwrite
```

Figure 46. Assign a Volume to the Storage Pool

The **IBM 3590 model B1A tape drive** without the ACF can be used by ADSM for AIX in an **IBM 3494 Automated Tape Library Dataserver**. If you are using an IBM 3494 Automated Tape Library Dataserver with ADSM for AIX, some special considerations apply when adding Magstar tape drives to the IBM 3494 for use by ADSM for AIX.

> **Please Note**
>
> In adding the 3590 support, it was necessary for ADSM to use a third category code. The third code is for ADSM scratch 3590 volumes. The original private category will now be used for *both* 3490 and 3590, as it is not a problem for nonscratch volumes to share the same category codes.
>
> When 3590 support is enabled, the ADSM server will automatically begin to use the category whose number is one greater than the existing scratch category code that was specified on the ADSM server DEFINE LIBRARY command. If a new library is being defined, the server will automatically use the specified SCRATCHCATEGORY value, as well as the next numerically higher category code.
>
> With these issues in mind, it is necessary to issue a WARNING to existing users of ADSM with 3494 libraries. If you are currently sharing your library between ADSM and other systems or applications, note that ADSM will begin using a third category code as part of the 3590 support. If this new category, as described above, has already been assigned for use by a non-ADSM system or application, you will have a conflict that *COULD RESULT IN DATA LOSS* if you blindly enable ADSM's 3590 support.

There are two options to solve this problem:

1. Update the non-ADSM application so that all of its volumes are moved out of the category that ADSM is about to start using.

2. Before enabling IBM 3590 support for the ADSM server, delete the existing library definition and recreate it using a new set of category codes, as described above, that do not conflict with other systems or applications. With this option, you will have to use an external utility, such as the "mtlib" program that ships with the library device driver, to reset all of the ADSM volumes to the special "INSERT" category. Then, when the new ADSM library definition has been completed, and the 3590 support enabled, you can issue a CHECKIN LIBVOLUME command with SEARCH=YES to reintroduce the volumes into the ADSM library volume inventory.

If all of the above items have been read and understood, and any possible volume category conflicts resolved, you can enable the ADSM server's support for 3590 drives in 3494 libraries. You do this by adding an option to the "dsmserv.opt" file and then restarting the ADSM server. The option line should read:

    ENABLE3590LIBRARY YES

If you have not yet been using an IBM 3494 with ADSM for AIX, you must perform the following steps to define the IBM 3590 drives and volumes to ADSM for AIX.

1. Define the IBM 3494 library.

   If the IBM 3494 is not already defined, you must define it to ADSM, specifying the name of one or more library management control points. Figure 47 on page 107 shows a sample library definition.

```
define library mag3494 libtype=349x device=/dev/lmcp0
```

Figure 47. Define an IBM 3494 Tape Library Dataserver to ADSM for AIX

In the define library command shown in Figure 47, we did not specify the library manager volume categories that ADSM for AIX should use. ADSM for AIX uses as a default:

PRIVATECAT 300 (equals X′012C′)

> This category is used for 3490 and 3590 ADSM private volumes.

SCRATCHCAT 301 (equals X′012D′)

> This category is used for 3490 ADSM scratch volumes.

(implicit) 302 (equals X′012E′)

> This category is used for 3590 ADSM scratch volumes.

2. Define the new devices.

   The definition of the tape drives is the same as for SCSI libraries listed in Figure 43 on page 104.

3. Define a new device class.

   You must define one device class for each different device type inside a single IBM 3494. The syntax of the define devclass command is shown in Figure 44 on page 105.

4. Label the library volumes.

   The DSMLABEL utility allows labeling of volumes in an IBM 3494 library in search mode on one drive in the library. The labeling utility attempts to label only volumes that reside in the INSERT category; all other volumes are ignored by the DSMLABEL utility.

   When sharing an IBM 3494 library with other systems, you must ensure that only volumes designated to ADSM for AIX are in the INSERT category before issuing the DSMLABEL command.

5. Check in the library volumes.

   To check in all IBM 3590 cartridges currently residing in the library manager INSERT category, you can use the command shown in Figure 48.

```
checkin libvolume mag3494 status=scratch checklabel=yes search=yes -
        devtype=3590
```

Figure 48. Sample CHECKIN Command for IBM 3590 Volumes in an IBM 3494

6. Define a new storage pool.

   This is the same as for SCSI libraries.

7. Define volumes to the storage pool.

   In an environment with mixed media and mixed drives inside a single IBM 3494, you should preassign your volumes to a storage pool to prevent ADSM from assigning scratch volumes of incompatible media type to a storage pool.

4.4 OS/400 Environment

In an OS/400 environment, the user application program itself typically does not use the tape drive directly. The backup and archive software subsystems, such as BRMS/400 and ADSM for OS/400, use tape drives and tape libraries. Therefore we describe implementation steps related to these subsystems.

4.4.1 Software Support

OS/400 Version 3.1 plus PTF is required to use the IBM 3590 High Performance Tape Subsystem in tape-library and non-tape-library environments.

If you want to use the Magstar tape drive for an alternate IPL, RPQ 843860 is required.

BRMS/400 is recommended to support automation in tape handling, media management, and automatic migration of data between tape and DASD based on user-defined policies. PTFs are required for BRMS/400 Version 3 Release 1 to support the IBM 3590 tape subsystem

ADSM for OS/400 Version 1.2 with PTFs provides the support for the IBM 3590 tape subsystem. Both ADSM for OS/400 and BRMS/400 can take advantage of the IBM 3590-B11 by using the ACF in random mode.

R/DARS for OS/400 also supports the IBM 3590 tape subsystem

Note: You cannot use the Magstar tape drive for IBM software distribution in an OS/400 environment. Please use a non-3590 tape drive or migrate to the CD-ROM software distribution system.

4.4.2 Media Library Device Driver

The IBM 3494 Automated Tape Library Dataserver support for the AS/400 environment is supplied in the Media Library Device Driver (MLDD). This is the basic support to control an IBM 3494 Automated Tape Library Dataserver from AS/400. For MLDD installation details please refer to the *IBM 3494 Tape Library Dataserver User's Guide: Media Library Device Driver for Application System/400*.

The only change that you should be aware of when installing an IBM 3590 tape subsystem in an IBM 3494 is that you will see a new media type of MEDIA3 for the IBM 3590 High Performance Tape Cartridges in the IBM 3494. Displaying media information using the dsmedmld command will return a value of X′11′ in field DMEDT in the DSMEDMLD output file for MEDIA3 cartridges.

4.4.3 Backup Recovery and Media Services (BRMS)

BRMS treats the ACF of the Magstar Tape Drive like the IBM 9427 tape library. Unlike the IBM 3494, BRMS has no library management software that uses a Library Manager for the ACF. Tape library commands sent from OS/400 to control the accessor are sent directly through the SCSI channel attachment. This is the same attachment that is used to send data to the tape drives. The connection is through the 6501 tape IOP feature card. Because of this implementation, all control and inventory data is stored on the owning host AS/400 system.

The device driver software is built into the OS/400 and the IOP card that drives the Magstar Tape Drive and the ACF. To manage the ACF under BRMS, no software other than BRMS/400 and the OS/400 CL commands and APIs is necessary. Perform the following steps to ready your Magstar Tape Drive and the ACF for use:

- Define the Magstar Tape Drive's ACF using the CRTDEVMLB command.

- Define a new cartridge category using the CRTTAPCGY command.

- Enroll the cartridges in the ACF using the ADDTAPCTG command or WRKTAPCTG, option 1.

You can now use the cartridges in the IBM 3590 tape subsystem to perform tape operation such as save operations using the SAVOBJ, SAVLIB, or SAVDLO commands

If you are using the IBM 3590 tape subsystem inside an IBM 3494, the definition of the drives and the communication is through MLDD. However, you should define a new cartridge category to separate the IBM 3590 cartridges from incompatible media in the same library. You must also enroll the IBM 3590 tape cartridges in the IBM 3494.

We describe the methods that you can use with BRMS/400 to drive a tape automation system, such as the IBM 3494 Automated Tape Library Dataserver or the IBM 3590 with ACF in random mode. Using a media management application is recommended when using your tape automation.

4.4.3.1 Setting up BRMS/400
Before any work can be done with your tape automation and BRMS/400, you must have installed and initialized the BRMS/400 licensed program. For details on installing and setting up BRMS/400, please read *Backup Recovery Media Services/400* book. This allows you to make full preparations and complete a thorough design for the implementation of BRMS/400 on your systems.

4.4.3.2 Adjustments to BRMS/400 When Using Tape Automation
If you were using BRMS/400 before installing a tape automation system, you need to make a few adjustments.

When using BRMS/400 to manage and control daily operations such as save or archive, very little will change when you begin to use a tape automation system. Once the tape automation system is set up and the media is appropriately enrolled, BRMS/400 assumes control of the tape library.

You do not need to alter your BRMS/400 control groups, scheduling, or reporting. As part of your initial setup, you may need to adjust the following:

    Locations
    Devices
    Move policies
    Media policies

You should review your backup and archive strategy, based on using a tape automation system. For example, you may want to:

    Alter the size of backup groups
    Alter the frequency of backups
    Increase the size of archive groups

> Alter the frequency of archive operations
>
> Introduce dynamic recall

4.4.3.3 Setting up Tape Automation with BRMS/400

This topic describes some of the actions required in setting up a tape automation system before you use it with BRMS/400.

This topic assumes that a tape automation system is installed and operational. For full planning and installation instructions, consult the IBM publication associated with a tape automation system device.

4.4.3.4 Creating Tape Automation on Your System

Initially, you need to create a tape automation system device on your AS/400 system. If you plan to group your cartridges into logical sets (for example, weekly and daily backup sets), you want to create user categories.

Creating a Tape Automation Device: Use the INZBRM command to create your tape automation device. See *Backup Recovery Media Services/400* for instructions on adding the device to the BRMS/400 table.

Creating Tape Automation Media Categories: All cartridges in a tape automation system are logically grouped into categories. On the AS/400, the categories are represented by a 10-character name and the system associated with it. Every category has the system assigned to it except for *SHARE400, *INSERT, and *EJECT.

*NOSHARE   Used to contain any cartridges that are members of a BRMS/400 media class that is defined as SHARE(*NO).

*SHARE400   Implies that any tapes in this category can be used by any AS/400 connected to the automated tape library. This is the most commonly used category in an AS/400 environment.

*IPL   Assigned to cartridges that are used for an alternate IPL.

*NL   Assigned for nonlabeled cartridges.

*INSERT   BRMS/400 performs an ADDTAPCTG operation on a cartridge only after a move media operation has completed, and only for a cartridge that is enrolled in BRMS/400. New cartridges in the library stay in the *INSERT category until they are enrolled in BRMS/400.

*EJECT   Contains cartridges that have been ejected to the high capacity I/O cells and are to be removed by an operator when either no convenience I/O station exists or the convenience I/O station is full. Cartridges are usually in this state for an interim period.

User-defined   Used to create other logical groupings of your cartridges in the tape automation. BRMS/400 handles these the same as those cartridges that are defined as *SHARE400. You can create and use your own user-defined category when doing a save system or save storage operation outside BRMS/400. When using BRMS/400, do not use user-defined categories.

Creating a User Category: When using the BRMS/400 media management application, there is no need to create or use user categories except in exceptional circumstances. BRMS/400 manages all your media, including the grouping of cartridges into logical sets. These sets are dependent on the data

that is saved to a cartridge at that time and is then saved in different groups of media classes.

To create a category, enter the Create Tape Category (CRTTAPCGY) command. Specify the category's name and the name of the system that owns that category (*CURRENT is the default).

Newly inserted cartridges can be moved directly from the *INSERT category to this user category with the Add Tape Cartridge (ADDTAPCTG) command. You can use the Change Tape Cartridge (CHGTAPCTG) command to move cartridges in other categories into your new user category. A much easier way to do this is by using the Work Tape Cartridge (WRKTAPCTG) command and choosing option 2.

To view all the user and system categories available on your system, enter the Display Tape Category (DSPTAPCGY) command.

If you want to delete your user category, you must first move all the cartridges assigned to that category to another category with CHGTAPCTG (a quicker way may be to enter a WRKTAPCTG DEV(ATL name) CTG(*ALL) CGY(category name) and enter an option 2 on all of them). You can then delete the category with DLTTAPCGY.

4.4.3.5 Basic Setup of a Tape Automation System with BRMS/400

Before a tape automation system can be used, you must add media to it and enroll that media into BRMS/400. If the tape automation system is empty, remove the magazine and add all available media into empty cells rather than add only a small number at a time through the convenience I/O station. When inserting the magazine, the tape automation system checks each cell and records the volume ID of each cartridge. This information is kept in OS/400 for the IBM 3590 devices.

From AS/400, you can view this same information using the Work Media Library BRM (WRKMLBBRM) command. This command lists all media library devices on your system. If you select option 8 (Work with MLB Media), the status of the volumes that are currently in the automated tape library is displayed. The Work with MLB Media display is shown in Figure 49 on page 112. (The WRKMLMBRM command can be used to go directly to this display.) When setting up a tape automation system for the first time, the Media Class is *NONE and the category is *INSERT because the cartridge is not enrolled in BRMS/400.

```
                   Work with MLB Media                    RCHAS400

 Media library device . . : MLB01
 Position to . . . . . . . .  _____  Starting characters


 Type options, press Enter.
   1=Add MLB media 2=Work with media 5=Initialize
   6=Change category 7=Eject 8=Mount 9=Demount

                              ---BRM Information---
 Opt Volume   Category    Media Class    Expired    Status
     BCD161   *SHARE400   FMT3590          *YES      Available
     BCD164   *SHARE400   *NONE                      Available
     BCD165   *SHARE400   FMT3590          *YES      Available
     BCD166   *SHARE400   *NONE                      Available
     BCD167   *SHARE400   *NONE                      Available
     BCD168   *SHARE400   *NONE                      Available
     BCD170   *INSERT     *NONE                      Available
     BCD173   *INSERT     *NONE                      Available
                                                        More...
```

Figure 49. Work with MLB Media Display

Other options from this display, including mount, demount, and eject, can be
used to manipulate the volumes within a tape automation system.

BRMS/400 communicates changes in its media inventory to be reflected in the
tape automation system media inventories. For example, when you change the
shared media attribute of a media class, BRMS/400 enters the CHGTAPCTG
command to change the category of all volumes of that media class in any tape
automation.

4.4.3.6 Enrolling Tape Automation Media (Cartridge) into BRMS/400

From the Work with Media Libraries display (WRKMLBBRM command), select
option 11 (Add MLB media) against the MLB device that is attached to your
system. The ADDMLBBRM prompt display in Figure 50 is shown.

```
              Add MLB Media using BRM (ADDMLMBRM)

 Type choices, press Enter.

 Media library device  . . . . . > MLB01      Name
 Volume identifier . . . . . . .   *INSERT     Character value, *INSERT
             + for more values
 Add volume to BRM . . . . . . . > *YES        *NO,   *YES
 Initialize tape . . . . . . . .   *NO         *NO,   *YES
 Media class . . . . . . . . . . > CART3490E   CART3490E, QIC120...
 Last moved date . . . . . . . .   *NONE       Date,  *NONE
 Move policy . . . . . . . . . .   *NONE       *NONE, OFFSITE
```

Figure 50. Add MLB Media using BRM Display

You can enroll all newly-inserted volumes into the BRMS/400 media inventory. If
you use the default value for the VOL parameter (*INSERT) and change the *Add
volume to BRM* field to *YES, all volumes that were previously in the *INSERT

category (from the Work with MLB Media display) are enrolled into the
BRMS/400 media inventory and are available for use.

4.4.4 ADSM for OS/400

To allow ADSM for OS/400 to use the Magstar tape drive, you must define the
following items from an administrative client:

1. Library

   You must define the Magstar tape drive as library to allow ADSM for OS/400
   to use the ACF in random mode. You must also define the Magstar tape
   drives installed in an IBM 3494 Automated Tape Library Dataserver as a
   library to ADSM for OS/400. You must also define a category for the 3590
   ACF just like the IBM 3494. ADSM for OS/400 does *not* have a default
   category. When you define the IBM 3590 ACF to ADSM for OS/400, you must
   specify a category name that does not already exist. The ADSM for OS/400
   server will then create the category. Figure 51 shows how to define the
   stand-alone library MAGL400 and the IBM 3494 library MAG3494.

```
DEFINE LIBRARY MAGL400 LIBTYPE AS400MLB CATEGORY=*SYSNAME/category -
      MLD=MLD3590

DEFINE LIBRARY MAG3494 LIBTYPE 349X CATEGORY=*SYSNAME/category -
      MLD=MLD3590
```

Figure 51. Sample ADSM for OS/400 Library Definitions

2. Device class

   The sample device class definition in Figure 52 shows how to define device
   class MAGC400 related to the library MAGL400.

```
DEFINE DEVCLASS MAGC400 DEVTYPE=3590 FORMAT=3590 LIBRARY=MAGL400 -
      MOUNTLIMIT=1 MOUNTRETENTION=60 PREFIX=ADSM ESTCAPACITY=10G -
      MOUNTWAIT=60
```

Figure 52. Sample DEVCLASS Definition for ADSM for OS/400

   We used the defaults for all parameters in the second and third line of
   Figure 52. Please note that ADSM for OS/400 always uses compaction; as a
   result, the estimated capacity (ESTCAPACITY) can be much higher,
   depending on your data and the compaction factor you can achieve.
   Typically, you can expect a compression ratio as on other platforms, which is
   an average 1:3. This results in a capacity of 30 GB per IBM 3590 cartridge.

3. Drive

   For OS/400 Version 3 Release 6 and any subsequent releases, the DEFINE
   DRIVE command applies only to libraries of type MANUAL.

   To inform ADSM for OS/400 on OS/400 V3.1 that the device TAP500 belongs
   to a library definition, you define the drive MAG400 as shown in Figure 53.

```
DEFINE DRIVE MAGL400 MAG400 DEVICE=TAP500 SHARE=NO
```

Figure 53. Sample Drive Definition for ADSM for OS/400

4. Storage pool

   You must define a storage pool to name a set of volumes, belonging to the same device class, that is used as the destination of backup and archive files.

5. Volume

   Use the DEFINE VOLUME command to assign your IBM 3590 cartridges to the storage pool that is associated with your IBM 3590 tape subsystem.

In addition, on the AS/400 you need to ensure that you have sufficient tapes initialized for ADSM's use. Before you can use the Magstar tape drive as a minilibrary, you must fill the ACF, lock it, and set it to Random mode.

After you have completed these steps, you should be able to

- Use the Magstar tape drives and IBM 3590 cartridge as a tape storage pool.

- Allow migration to this storage pool.

- Export data to IBM 3590 cartridges.

- Import data from IBM 3590 cartridges to disk.

4.4.5 Report/Data Archive Retrieval System (R/DARS)

R/DARS for OS/400 V3.1 is an application solution to store large amounts of data and retrieve selective data, whether on disk, optical storage, tape media, or combinations of these. It provides computer output to laser disk (COLD) and extended archiving functions for the AS/400. R/DARS provides tape management for tapes that R/DARS uses, but it usually uses BRMS/400 as the tape manager.

The three modules of R/DARS (spool file archive, record archive, and object archive) allow it to use the Magstar tape drive. The ACF of the IBM 3590-B11 is supported the same way as the ICL of the IBM 3490 subsystems.

For detailed installation information, please refer to the *IBM Report/Data Archive and Retrieval System for OS/400, Version 3 Release 1 Installation and User's Guide*.

Chapter 5. Migration in an MVS/ESA Environment

In this chapter we discuss migration considerations related to implementing an
IBM 3590 tape subsystem in an MVS/ESA environment. Before we discuss the
actual implementation, we want you to know the changes that have been
introduced with the IBM 3590 tape subsystem and the latest versions of the MVS
software regarding tape and tape management. We then discuss which data and
applications can make the best use of the superior capacity and performance of
the IBM 3590 High Performance Tape Subsystem and how to identify those in
your environment as well as how to migrate them.

5.1 Processing Changes

In this section, we summarize the processing changes that have been introduced
by the IBM 3590 tape subsystem and the supporting MVS/ESA software.

5.1.1 Automatic Cartridge Facility (ACF) Operation and Software Support

The IBM 3590′s ACF can operate in the same three modes as the IBM 3490′s
ICL—either manual, automatic, or system. In addition, the ACF can operate in
accumulate or in random mode. All ACF modes are hardware settings that
determine how the ACF reacts to system requests.

The different modes for the ACF are explained briefly below:

- Manual

  Manual mode allows operator mounting of individual cartridges or
  operator-initiated mounting of a preloaded cartridge in the ACF. Manual
  mode is automatically set when the magazine is full.

- Accumulate

  The accumulate mode is similar to manual mode. Cartridges that have been
  mounted by the operator are returned to the next available cell in the
  magazine upon demount.

- Automatic

  Cartridge loading is under the control of the ACF, which processes the
  cartridges sequentially. Once the tape has finished processing, it is exported
  to its cell and the next cartridge is imported to the drive, even without a
  mount request from MVS. For a scratch mount request, the premounted
  cartridge is used. If DFSMSrmm or any other tape management system
  does not allow the respective cartridge to be used, it will be exported to its
  cell and the next cartridge will be loaded. For a specific mount request, if
  the requested volume is not loaded or premounted in a drive, each volume
  in the magazine is imported and exported in turn, as MVS searches for the
  specified volume.

- System

  System is the recommended (and default) mode for MVS operations. For a
  nonspecific request, the next sequential volume from the magazine is
  mounted: volumes are not premounted in the drive. For a specific volume
  request, the volume is mounted by the operator using the priority cell.

- Random

  In random mode, the host programming software can control the ACF directly. The cartridges are locked in the magazine in import position. Specific mount requests for a cartridge that is not in the magazine can be satisfied from the priority cell. This mode of operation is currently not supported by MVS. However, the STAGE command offers the possibility to manipulate the ACF.

To control the ACF in random mode, the new **STAGE** command provides a new channel command word (CCW) X′53′. The Stage CCW has several parameters called stage orders. The command causes 16 bytes of data to be transferred from the channel to the control unit which includes an order code in the parameter data that indicates the function to be executed.

In random mode, you can use the stage orders to perform the actions listed below.

Unload   to rewind and unload the cartridge and return it to the specified cell. If the number specified is zero, the cartridge is returned to the cell from which it was obtained when it was loaded.

Load   to fetch a cartridge from the specified cell and load it in the drive. A cell value of zero causes a unit check.

Move   to move a cartridge from a specified source cell to a specified target cell.

Read Cell Status to obtain information about the status of a specific cell or of all cells in the ACF, such as operational or not, full or empty, or whether a cartridge is in export position.

The Read Cell Status order is used during the execution of a Read Subsystem Data command that immediately follows the Read Cell Status order.

Read Volume Loader Data to obtain information about the ACF itself, such as the mode of operation and the status of the ACF.

The Read Volume Loader Data order has to be followed by a Read Subsystem Data command in order to be performed.

The **Move** stage order works only when the ACF is set to Random mode. The **Load** and **Unload** stage orders work differently when the ACF is not set to Random mode.

For a detailed description of the STAGE command, please refer to the *IBM 3590 High Performance Tape Subsystem Hardware Reference* after the IBM 3590-A00 becomes generally available.

If you plan to use the STAGE command to control the ACF, please consider that currently open, close, and end of volume (O/C/EOV) routines need to manage the volume in MVS. Having the application issue its own RUN CCW can lead to problems, such as no off-load of statistics, or no updates to VOLID in UCB, for example. If the application calls CLOSE, it might not be able to issue its own I/O command after that. Logically, STAGE needs to be issued after CLOSE and before OPEN.

5.1.2 New and Changed Read Channel Commands

The Magstar tape drive itself is a SCSI device and has its own set of SCSI commands. To control the Magstar tape drive from a System/370 or S/390 system, the IBM 3590-A00 tape controller is required to convert the channel command words (CCWs) or channel programs to corresponding SCSI commands. New channel commands and channel commands that have been changed are described in this section.

IPL Read and **Read Forward**

To distinguish between a normal read and IPL read, the existing Read Forward CCW (X′02′) for IBM 3480/3490 tape drives has been redefined. The X′02′ command code is now the IPL Read CCW, and a new X′06′ command code has been defined to be the Read Forward CCW. The new Read Forward CCW, X′06′, is subject to resetting event notification, as should be the case for normal Read CCWs issued by applications or other host software.

Even though different CCWs are used for IBM 3480/3490 and IBM 3590 tape subsystems, you can concatenate data sets written on different types of devices. End-of-Volume (EOV) detects this condition which results in a close and an open thus rebuilding the CCWs that the open executor builds and that the access method uses later on.

Read Previous

The ESCON-attached Magstar tape drive does not support the Read Backward CCW, command code X′0C′. It supports a new Read Previous CCW, command code X′0A′, that allows processing of an IBM 3590 cartridge in the backward direction without the performance penalties that exist with the Read Backward CCW.

The Read Previous CCW operates somewhat like the Read Backward CCW in that it can be used to process the volumes in the backward direction. However, the data is transferred to the host in the same direction as it was written. Figure 54 on page 118 shows the difference in the order data is transferred between Read Previous and Read Backward.
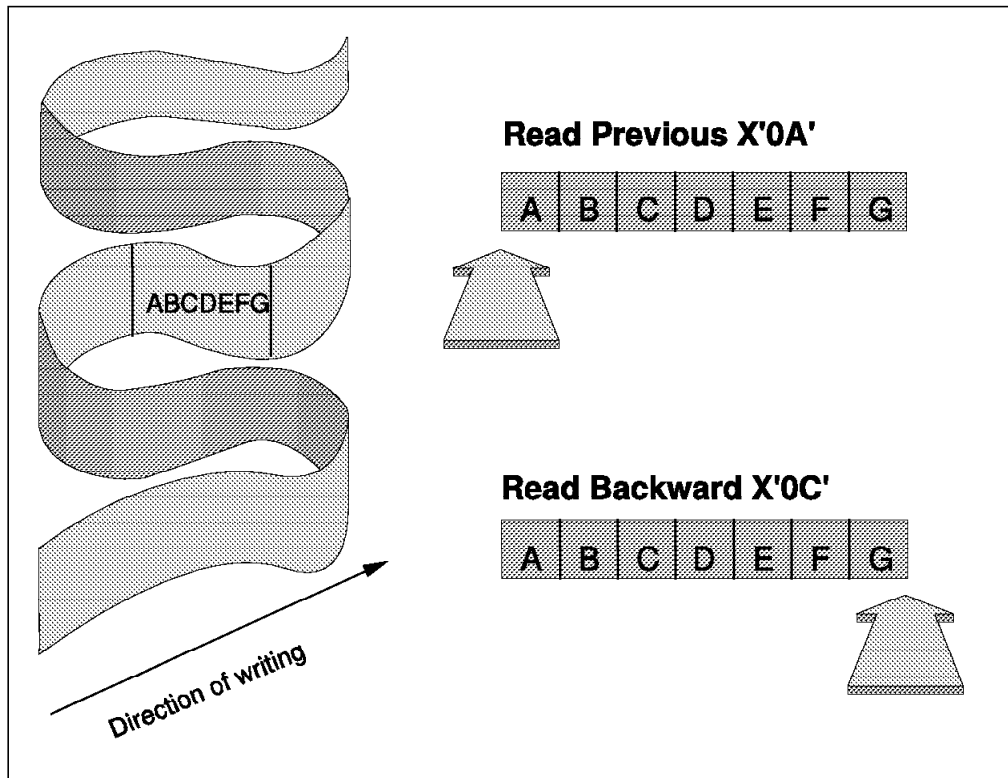
Figure 54. Data Transfer for Read Previous and Read Backwards

The DFSMS/MVS tape error recovery procedure (ERP) program for the IBM 3590 tape subsystem changes a rejected Read Backward CCW to a Read Previous CCW and vice versa, where appropriate. The Magstar tape drive requests the read alternate recovery action only for the case where the original failing CCW was a Read Backward. The read alternate recovery action is similar to the existing Read Opposite Recovery (ROR) procedure in 3480/3490 ERP. In particular, the data is read into ERP storage first and then transferred to the user's storage in much the same manner as is used today during 3480/3490 ROR. That is, the Read Backward command's data address will point to the end of the storage area, while a Read Previous command points to the beginning of the storage area as indicated by the arrows in Figure 54.

You do not have to modify your application programs that use Read Backward. The ERP will convert the Read Backward to a Read Previous. However, this might result in some performance penalty for the ERP to handle the Read Backward.

Read Media Characteristics

The new Read Media Characteristics CCW, command code X′62, provides up to 256 bytes of information about the media and formats supported by the Magstar tape drive.

Read Block ID

The Read Block ID CCW, command code X′22′, has been modified to handle the new format of the block ID. The definition of block IDs for the 3480 and 3490 is as follows:

Bits	Used for
0	Direction bit
1-7	Segment number
8-9	Format
10-31	Logical block number

The Magstar tape drive uses 32 bits for block numbering in combination with a block identifier table recorded in a reserved area at the beginning of the tape. When the IBM 3590 cartridge is written, the block IDs written to the middle of a pass and at the end of a pass are recorded in the block table. The last block written is also recorded. The table is used to move quickly and directly to the correct block in response to a high-speed search request from applications such as ADSM, DFSMShsm, and BRMS/400.

Read Buffered Log

The Read Buffered Log CCW, command code X′24′, transfers the new format of the log data which is increased to 256 bytes.

Other CCWs such as **Read Device Characteristics** (command code X′64′) and **Read Configuration Data** (command code X′FA′) for example, have been updated to support the Magstar tape drive and the IBM 3490-A00 tape controller.

5.1.3 Device Support

If applications use the **NOTE TYPE=ABS** macro and calculate the number of data blocks remaining in the control unit buffer based upon the values returned in register 0 and register 1 you may have to modify those values. The Magstar tape drive will now use all 32 bits in both register 0 and 1 to contain the logical block identifiers that were contained in the low-order 20 bits of the registers for previous tape devices.

If applications invoke **force end-of volume** based on cartridge capacity thresholds, review these thresholds in terms of IBM 3590 cartridges.

The IBM 3590 tape subsystem is the first tape device to report **Service Information Message (SIM)** data to the host. The SIMs provide service information for the hardware maintenance representative. MVS/ESA issues the following SIM:

```
IEA480E cuu,type,model,severity ALERT,
        SER=ssssss,MC=mc,ES=es,REF=ref1-ref2-ref3
```

The SIM type indicates which component the SIM relates to:

- TCU is a tape control unit error.
- TAPE is a tape device error.
- TLIB is a tape library error.

The severity can either be SERVICE, MODERATE, SERIOUS, or ACUTE, and indicates the impact of the failure on the availability of the component. Table 29 on page 120 shows the meaning of the different severities for each component.

Table 29. Service Information Message Type and Related Severity			
Severity	**Type=TCU**	**Type=TAPE**	**Type=TLIB**
SERVICE	No performance impact	No performance impact	No performance impact
MODERATE	Error threshold exceeded within control unit	Degraded operation, high temporary error rate	Degraded operation, no loss of cartridge accessibility
SERIOUS	Degraded operation, no loss of device accessibility	Degraded operation, no loss of data or cartridge access	Degraded operation, loss of some cartridge accessibility
ACUTE	Loss of device accessibility	Loss of data or cartridge access	Loss of all cartridge accessibility

The IBM 3590 High Performance Tape Subsystem stores media statistics on the cartridge each time it is used. This information is stored in a reserved area at the beginning of the tape in the same place as the logical block identifiers. When a failure occurs, the media statistics are used to help to determine whether the failure is caused by media or hardware. The IBM 3590 tape subsystem is the first tape device to report **Media Information Messages (MIMs)** to the host. MVS/ESA issues the following MIM:

```
IEA486E cuu,TVOL,severity ALERT,
        volume=volid,MC=mc,ES=es,RC=rc-mid-fid
```

TVOL indicates the MIM as opposed to a SIM. The severity can be as follows:

Moderate High temporary read/write errors detected

Serious Permanent read/write errors detected

Acute Block 0 Error (possibly VOL1 label error), length error, or severe volume control region error

The MIM can be detected automatically by NetView. You can then, if necessary, automatically have NetView issue commands such as DFSMShsm RECYCLE or the ADSM MOVE DATA command to automatically move valid data from the failing cartridge to new one.

The IBM 3590 cartridge is preformatted with three servo tracks at the time of manufacture. These servo tracks are used to ensure proper reading and writing of data. Only one of the servo tracks is required to write data on the tape. If all servo tracks are damaged, you can only read data from the cartridge but no longer write to it. To initialize label the cartridges, you can use IEHINITT or the DFSMSrmm utility EDGINERS which support the IBM 3590 cartridge. Currently, you cannot rewrite the servo tracks yourself. If you are degaussing your tapes to destroy any information written on the tape, this will also destroy the servo tracks.

To erase the data on the tape, you can use the Data Security Erase CCW or the Erase order of the Write File Mark CCW, which causes the cartridge to be overwritten with all zeros. The previously recorded information may be recoverable with special equipment. DFSMSrmm policies can be used to identify

data sets that should be erased before the tape volumes is allowed to return to scratch. When a RELEASE ACTION of erase is identified, DFSMSrmm will drive the erase function and automatically reinitialize the tape volume.

5.1.4 MVS/ESA V5.2 Automatic Tape Switching

MVS/ESA V5.2 introduced a new automatic tape switching function in sysplex environments. Consideration points for the new function are as follows:

- MVS no longer supports the SELTAPE option on the IEAOPTxx member of SYS1.PARMLIB. Leaving this option in the IEAOPTxx member does not cause an error, since the system does not now use the SELTAPE option to make allocation decisions. In making decisions about assigning tape drives, if all other factors are equal, MVS chooses a tape device randomly.

- The system resource manager (SRM) no longer participates in the selection of tape drives for allocation.

- The effect of the VARY ONLINE/OFFLINE command for tape drives now causes different things to happen, depending on whether the device is dedicated or automatically switchable:

  − For a dedicated device, the drive is assigned at VARY ONLINE time and unassigned at VARY OFFLINE. Only the system issuing the command can use the device while it is online

  − For an automatically switchable device, the VARY ONLINE command issued by a system connected to IEFAUTOS places the drive online and eligible for allocation by the system.

  For a device that is automatically switchable, a system not connected to IEFAUTOS (that is, a nonparticipating system) can vary the drive online and allocate it to a job step. While in this state the drive is assigned to the nonparticipating system, and at this time it is considered a dedicated device. Once the drive has been taken offline by the VARY OFFLINE command, the drive again becomes available to participating systems, and other systems connected to IEFAUTOS can allocate the device.

- Programs that check the UCBALOC field to determine whether a tape drive is allocated to a particular system, using MVS/ESA V5.2, must now check two fields:

  − The UCBALOC bit. If this bit is *on*, the device is allocated to this or another system.

  − A nonzero value in the UCBASID field indicates that the device is allocated to this system.

  Installations that currently use software products, or automated procedures, to manage the sharing of tape drives between MVS/ESA systems need to be looked at carefully to see how these new automatic switching capabilities might be integrated into their existing environment.

5.2 Evaluating the Environment

Before migrating your tape data and applications to the IBM 3590 High Performance Tape Cartridge and the IBM 3590 High Performance Tape Subsystem, you should analyze your environment regarding the data that can use the new tape subsystem, benefit from its performance, and use its high

cartridge capacity effectively. Many tape data sets do not even use the capacity of 2.4 GB that an ECCST cartridge provides.

5.2.1 Tools to Evaluate the Environment

It is rare to replace all your current tape equipment, such as IBM 3480 or 3490 tape drives with IBM 3590 tape subsystems at once. To find out which data to migrate, you can use the Volume Mount Analyzer (VMA) which is part of DFSMSdfp.

To find out the effect of moving your backup and migration data to IBM 3590 cartridges, you can run a VMA analysis using the input parameters listed in Figure 55.

Note: You must install VMA PTF UW90305 for DFSMS/MVS 1.2 or UW90349 for DFSMS/MVS 1.3 to support IBM 3590 device type.

```
DSN(INCLUDE(HSM**))
PROGRAM(INCLUDE(your_backup_program_name))
TAPEDEV(3590)
IDRCFACTOR(4)
REPORT(EST,GB,USE)
```

Figure 55. Sample VMA Input Parameters for HSM-Managed Data Sets

Note that the default for the TAPEDEV key word has been changed from IBM 3490E to 3590. The default for IDRCFACTOR has been changed from 3.0 to 4.0 to reflect the 33% improved data compression of the IBM 3590 tape subsystem over current IDRC.

Besides the backups and dumps that you want to direct to IBM 3590 cartridges, you can get an idea about other multivolume data sets residing on tape by running VMA with the parameters listed in Figure 56.

```
DATASET(EXCLUDE(data_exchange_data_sets))
USAGE(NONHSM)
TAPEDEV(3590)
IDRCFACTOR(4)
MOUNT(MULTIPLE)
REPORT(EST,GB,USE,DSN,TOP)
```

Figure 56. Sample GFTAVMA Input Parameters for Large Data Sets

Note that we included only data sets that span multiple volumes by using the MOUNT(MULTIPLE) key word. You can use the Data Set Report, requested by the REPORT(...,DSN,...) key word to identify data sets that are larger than a single volume and as such are candidates to move to the IBM 3590 cartridge.

The Estimate Report, requested through the REPORT(EST,...) key word, shows you the impact of using IBM 3590 cartridges regarding the number of mounts and volumes.

The Gigabyte Report, requested through the REPORT(...,GB,...) key word, lists you the number of gigabytes transferred for multivolume data sets and an indication of the workload that will move to the IBM 3590 tape subsystem.

The Usage Report, requested through the REPORT(...,USE,...) key word, shows you the maximum concurrent number of tape drives used for these data sets and may give an indication about the extent of parallelism required by your applications.

The Top Report, requested through the REPORT(...,TOP) key word shows the most frequent high level qualifiers, low-level qualifiers, programs, jobs, expiration dates, account codes, and data set ages for your multivolume data sets. You can use these lists to identify filters to direct tape data sets to IBM 3590 tape subsystems in a system-managed tape library through the ACS routines.

For more details about VMA, please refer to the *DFSMS/MVS Version 1.2 Using the Volume Mount Analyzer*.

You may also use your tape management system's catalog to identify large multivolume data sets.

Figure 57 shows a sample report obtained from the DFSMSrmm extract data set that lists multivolume dataset DS1.

```
 VOLSER VSEQ DSEQ DSN EXPDT FIRSTVOL PRIVVOL NEXTVOL UID JOB CRDATE  CRTIME
 ------ ---- ---- --- ----- -------- ------- ------- --- --- ------  ------
 010010   1    1  DS1 99365 010010            010200   X  JX  95200   12:45
 010200   2    1  DS1 99365 010010   010010  010345   X  JX  95200   12:45
 010345   3    1  DS1 99365 010010   010200  010001   X  JX  95200   12:45
 010001   4    1  DS1 99365 010010   010345            X  JX  95200   12:45
```

Figure 57. Sample DFSMSrmm Multivolume File Report

Before you start moving process data sets that do not fill an IBM 3590 cartridge please check on the availability of the capacity-enabling technology. The announcement of the IBM 3590 High Performance Tape Subsystem includes a Statement of Direction (SOD) indicating that, with future enhancements, it will be possible to fully use the IBM 3590 cartridge even if the single data sets do not occupy the full volume capacity.

5.3 Migration Approaches

When integrating your IBM 3590 tape subsystem in your tape environment, you have two basic choices for migrating your data and applications:

1. You can leave existing tape data sets on the cartridges where they currently reside and let them age there.

2. You can move data sets currently residing on CST or ECCST cartridges to IBM 3590 High Performance Tape Cartridges.

The simplest migration is to just start using the IBM 3590 tape subsystem by writing new data sets onto the IBM 3590 cartridges. This is the migration path we recommend for DFSMShsm-owned data sets such as ML2 and backup data. This path is suggested for most application data, because it avoids any additional considerations regarding data group generation or expiration processing.

You may, however, want to copy data sets such as archived data that is never rewritten or you may want to drastically reduce the number of cartridges when introducing an IBM Automated Tape Library Dataserver at the same time.

5.4 Moving Tape Data

Because the IBM 3590 High Performance Tape Cartridge is not compatible with other media, and because the IBM 3590 tape subsystem cannot process any media other than the IBM 3590 cartridge, you must copy your data sets to the new medium rather than just recataloging. Because many software products have their own inventory about data sets residing on tape or keep track of the volume serial numbers their data sets reside on, you must use different techniques to copy or move special data sets to the IBM 3590 cartridge. We list major tape users and how to migrate their data.

5.4.1 ADSM for MVS Storage Pools

Before you can move your ADSM data to IBM 3590 cartridges, you must define a new storage pool as described in Chapter 4, "Software Implementation" on page 81.

To move data from an existing storage pool to the new storage pool defined for the IBM 3590 tape subsystem, use the MOVE DATA command. The following restrictions apply:

- You cannot move data from a primary storage pool volume to a copy storage pool volume.
- You cannot move data on a copy storage pool to a volume located in a different storage pool.

In certain situations, such as for disaster recovery purposes, you can also use the ADSM export-import facility that allows you to copy all or part of a server to IBM 3590 tape subsystem so that you can transfer data to another server or store it in an off-site location.

5.4.2 DFSMShsm

To move your DFSMShsm backup and ML2 data to the IBM 3590 cartridges, you should use the RECYCLE command. This is the only command to perform the requested task under control of DFSMShsm. To direct the recycled data to IBM 3590 tape subsystem, use the SETSYS RECYCLEOUTPUT command and direct future migrations and backups to IBM 3590 tape subsystem using the appropriate SETSYS commands.

Recycling IBM 3590 cartridges. entails moving more data per cartridge when using the same thresholds than for ECCST cartridges. This may extend the RECYCLE time, even though fewer tape mounts will occur. It might take longer until a single cartridge is subject to recycling. If your recycling window is limited, review your recycle thresholds carefully.

When using IBM 3590 cartridges we recommend employing the SETSYS PARTIALTAPE(MARKFULL) parameter in SYS1.PARMLIB member ARCCMDxx for stand-alone IBM 3590 drives that have the ACF loader. The SETSYS PARTIALTAPE(REUSE) parameter is recommended for automated tape libraries.

To limit tape spanning, do not use the SETSYS TAPEUTLIZATION(NOLIMIT) parameter. The NOLIMIT parameter increases the risk that a backup or migrate ML2 tape cannot be duplicated (TAPECOPY) because the first tape had more physical medium than the second. TAPECOPY is often used to ensure that an offsite copy of each tape is available for disaster recovery purposes.

SETSYS TAPESPANSIZE(nn) reduces the chance that a small data set will be written at the end of one tape, and span to a second tape. Spanned data sets are more difficult to manage in a stand-alone tape drive environment. Those with automated tape libraries will not see as much benefit, other than less robotic movement, to mount two tapes for a single recover or recall. Given that the typical data set on ML2 or Backup is 2 MB, the IBM 3590 cartridge would contain 20,000 data sets, and the chance that a data set spans is 1 in 20,0000. The default for TAPESPANSIZE is 8 MB.

Currently, DFSMShsm does not support multiple control data set (CDS) backups on one single tape. Therefore, we recommend that you store you CDS backups on DASD or, based on CDS size, on CST or ECCST cartridges.

In a system-managed IBM Automated Tape Library Dataserver, direct the data to IBM 3590 tape subsystem by assigning a new data class that specifies a media type of MEDIA3, a recording technology of 128TRACK, and compaction YES.

5.4.3 DFSMSdss Full Volume Dumps

You can now 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 IBM 3590 cartridge, use DFSMSdss COPYDUMP command.

5.4.4 Image Copies and Data Base Logs

You can write DB2 image copies directly on IBM 3590 cartridges. To place archive logs on IBM 3590 cartridges, you must store them on DASD first and use DFSMShsm to migrate them to the IBM 3590 cartridge later.

CICS releases after V4.2 do not support any tape devices for its online logging. So you cannot use IBM 3590 tape device for the logging.

You should not use cartridge tape devices, such as IBM 3480, 3490, 3490E and IBM 3590, for IMS online log because it causes performance degradation. IMS should use DASD logging. You can use IBM 3590 for IMS image copies.

5.4.5 Utilities

To move other data sets to a IBM 3590 cartridge, you can use the following software products and their utilities:

• DFSMS/MVS utility IEBGENER

   You can use IEBGENER to copy sequential data sets from IBM 3480/3490 to IBM 3590 cartridges. IEBGENER also provides the possibility of copying user labels.

   You can also use IEBGENER when moving generation data sets (GDS) without creating an additional generation in the generation data group. You must follow the order in which the DD statement are listed in Figure 58 on page 126 such 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=SCHLUM.TESTGDG.G0009V00,DISP=(OLD,UNCATLG)
    6 //SYSUT2    DD    DSN=SCHLUM.TESTGDG.G0009V00,
      //               DISP=(,CATLG,DELETE),
      //               UNIT=3590-1,
      //               DCB=(GDG,RECFM=F,LRECL=80,BLKSIZE=80)
ICH70001I SCHLUM   LAST ACCESS AT 13:26:35 ON FRIDAY, JULY 7, 1995
IEF236I ALLOC. FOR RMMTESTG STEP01
IEF237I J21E ALLOCATED TO SYSPRINT
IEF237I DMY  ALLOCATED TO SYSIN
IEF237I 04C1 ALLOCATED TO SYSUT1
IGD100I 04C0 ALLOCATED TO DDNAME SYSUT2   DATACLAS (        )
IEF142I RMMTESTG STEP01 - STEP WAS EXECUTED - COND CODE 0000
IEF285I    SCHLUM.RMMTESTG.JOB15200.D0000101.?          SYSOUT
IEF285I    SCHLUM.TESTGDG.G0009V00                      UNCATALOGED
IEF285I    VOL SER NOS= SC1417.
IEF285I    SCHLUM.TESTGDG.G0009V00                      CATALOGED
IEF285I    VOL SER NOS= SC1505.
```

Figure 58. Sample IEBGENER Job

For more details about IEBGENER, please refer to *DFSMS/MVS Version 1 Release 3 Utilities*.

• DFSORT utility ICEGENER

If you have DFSORT installed, you can achieve more efficient processing for jobs set up to use the IEBGENER system utility by using the ICEGENER facility of DFSORT. Qualifying IEBGENER jobs are processed by the equivalent (although not identical), 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 system utility. The ICEGENER facility can be used either for selected IEBGENER jobs or, automatically, for all IEBGENER jobs.

To use ICEGENER for copying data sets to IBM 3590 cartridges, substitute the name ICEGENER (or the alias SORTGENR) for the name IEBGENER in any jobs you choose.

• DITTO/ESA

You can use the DITTO function Tape to Labeled Tape (TLT) to copy files from IBM 3480/3490 to IBM 3590 cartridges. The TLT function copies IBM-standard labeled tapes without requiring you to specify every file ID. Labels read from the input tape are interpreted and copied to the output tape. DITTO/ESA supports copying multivolume and multifile tapes so that you can use DITTO/ESA to replace multiple CST and ECCST cartridges with one IBM 3590 cartridge.

When using DITTO/ESA to copy your data sets to tape, please consider:

– Bypass label processing (BLP) is used for both the input and output tapes. Output volumes must be initialized beforehand, because the VOL1 label is checked for security reasons.

    – DFSMShsm backup or ML2 tapes should not be copied using TLT because DITTO cannot update the DFSMShsm internal information regarding the location of the backup or ML2 data sets.

    – No recataloging or RACF processing of the data sets takes place because of data-set naming conventions on tape.

    – Premounting volumes with the operator MOUNT command is not allowed and will produce unpredictable results.

    – In batch mode, DITTO frees both the input DDNAME and the output DDNAME. These ddnames cannot be used for additional DITTO commands in the same batch job.

5.5 Tape Management Systems

Usually there are no special considerations regarding your tape management system and the definition of the new tape volumes. However, if you are not using DFSMSrmm, which includes the support for the IBM 3590 tape subsystem and the IBM 3590 cartridge, please check with your software supplier on support for IBM 3590 tape subsystem in your tape management software. If you are migrating tape data sets, consider your expiration processing. To migrate your tape data to a new medium actually involves creating a new data set that may be out of compliance in some way. Figure 58 on page 126 shows a sample job stream to move generation data sets without creating an additional generation in the generation data group.

5.6 Managing Mixed Devices and Mixed Media Inside an IBM Automated Tape Library Dataserver

Special considerations apply to managing mixed devices and mixed media types inside an IBM Automated Tape Library Dataserver.

5.6.1 System-Managed Tape

In a system-managed tape library, introduction of new media and new devices is straightforward. The support is fully integrated in all four components of DFSMS/MVS. However, after having defined the IBM 3590 tape subsystem as part of your IBM Automated Tape Library Dataserver as described in Chapter 4, "Software Implementation" on page 81, you need to direct different types of data to different media. We recommend that you avoid leaving the data class media type specification blank. Clearly define your data classes and explicitly assign the media type you want this data set to reside on. Otherwise, the drives in the library will be allocated in the order that uses the Magstar tape drives first and may result in using large-capacity cartridges for small amounts of data.

In a mixed environment including IBM 3490, 3490E, and 3590 tape drives, we recommend that you use the following minimum data class definitions regarding media type, recording technology, and compression, listed in Table 30 on page 128.

Table 30. Data Class Specifications for Mixed Media				
Media Type	MEDIA1	MEDIA1	MEDIA2	MEDIA3
Recording Technology	18TRACK	36TRACK	36TRACK	128TRACK
Compression	NO	YES	YES	YES
Usage	Data Exchange	Data Exchange / Small Tape Data Sets	Large Tape Data Sets / ADSM / DFSMShsm ML2	DFSMShsm Backups / DFSMShsm ML2 / DFSMSdss Full Volume Dumps / ADSM

After the future enhancement "volume stacking" is available, you may consider migrating small tape data sets to the IBM 3590 High Performance Tape Cartridge as well.

Chapter 6. Migration in Non-MVS Environments

In this chapter, we discuss migration considerations related to implementing IBM 3590 tape subsystems in VM/ESA, AIX, and OS/400 environments. We do not cover VSE/ESA migration.

6.1 Evaluating the VM Environment

The IBM 3590 High Performance Tape Subsystem introduces greatly improved levels of tape performance and tape storage capacity when compared with existing tape subsystems, such as the IBM 3480 and 3490.

To fully exploit these new capabilities, you need to analyze tape usage and ensure that the most appropriate data is used with the IBM 3590 tape subsystem. You will see a dramatic decrease in the number of tape cartridges required and a reduction in elapsed tape-processing time. However, if you continue to write small single files to the IBM 3590 High Performance Tape Cartridges, these benefits will not be realized.

As with the integration of any new technology into your environment, review the implications of the IBM 3590 tape subsystem. If you use a Tape Management product, ensure that it has support for IBM 3590 tape subsystem. If you use the IBM 3590 tape subsystem to produce off-site full-volume dumps, access is needed to an IBM 3590 tape subsystem in the disaster recovery site.

6.1.1 Tools to Evaluate the Environment

Typically, in a VM/ESA environment, tape is used for storing minidisk backups and DASD volume dump data. It is a relatively straight forward exercise to estimate the cartridge savings from migrating to IBM 3590 High Performance Tape Cartridge. Files that previously spanned multiple CSTs or ECCSTs will now fit on a single IBM 3590 cartridge.

A tape management system will provide information on the size of files, which files are multivolume files and so on. Use this information to categorize the files and identify those that would be better placed on IBM 3590 cartridges.

6.1.2 Tools and Utilities for Moving Tape Data

The following utilities and programs can be used to move data to IBM 3590 cartridges:

- DDR

  DDR is a VM/ESA utility that is used to produce tape dumps of DASD volumes. This utility can be used to direct dumps to IBM 3590s.

- SPXTAPE

  SPXTAPE is a VM/ESA utility that saves and restores spool files. You can use SPXTAPE to dump and restore your spool files to IBM 3590s.

- MOVEFILE

  MOVEFILE is a VM/ESA utility that can be used to move files from existing cartridges to the IBM 3590 High Performance Tape Cartridge.

- DITTO/ESA

DITTO/ESA is a program that can be used to move files from older tape technologies to IBM 3590 High Performance Tape Cartridges. With DITTO/ESA, you can copy CST and ECCST multivolume and multifile tapes to IBM 3590 High Performance Tape Cartridges.

- SAD

SAD is the Stand-Alone Dump Program, and can be used to produce and restore stand-alone dumps on IBM 3590s.

- MONITOR

VM system performance data is collected by the Monitor program, and can be stored on IBM 3590 cartridges. Typically, this data is later reused and analyzed by a performance package.

- PIPELINES

CMS Pipelines is a program that can be used to use to read, write, and copy data to IBM 3590 tape subsystems.

When a TAPE stage is the first stage of a pipeline, it reads records from the specified tape into the pipeline. When a TAPE stage is not the first stage of a pipeline, it copies the input records to the specified tape and to the primary output stream.

To write a multivolume file from a single input file, you may want to create a subroutine pipeline that invokes the TAPE stage command repetitively.

The TAPE stage command writes a tape mark after the output records only if you specify WTM. By not specifying WTM, you can build a single tape file using several PIPE commands.

The TAPE stage command does not inspect tape labels, but you can create tape labels with a pipeline.

Figure 59 shows a sample EXEC that could be used to copy data from an IBM 3490 cartridge (TAP1) to an IBM 3590 cartridge (TAP2):

```
¢tape rewind¢            /* rewind tape on 181 */
¢tape rewind (tap2¢      /* rewind tape on 182 */
do until recs.1=0        /* do until all records processed */
  ¢pipe¢,
    ¢tape¢,              /* read file from 181 */
    ¢| tape tap2 wtm¢,   /* copy to 182 and write tape mark */
    ¢| count lines¢,     /* count number of lines read */
    ¢| stem recs.¢       /* set count for loop control test */
end
```

Figure 59. Sample CMS Pipelines Tape Copy EXEC

For more information about tape file handling, see the *VM/ESA: CMS Application Development Guide* and the *VM/ESA: CMS Command Reference*.

6.1.3 Types of Tape Data to Be Moved

Any data type that can exploit the 10 GB of uncompacted data storage available with the IBM 3590 High Performance Tape Subsystem should be moved to the new cartridge.

The following are good IBM 3590 candidates:

- Minidisk backups

- DASD volume dumps

- Large tape files

- Applications that stack small data sets on individual tapes.

Aim to store as much of your data as possible on IBM 3590 cartridges to maximize the benefit of this technology. However, you may decide to retain some of your existing tape drives to be able to support the following types of tape processing:

- Off-site disaster tape backups and dumps, if the off-site facility does not have access to an IBM 3590 tape subsystem

- Interchange tapes, where the target site does not have any IBM 3590 tape subsystems installed.

- Small files that must be written to single tapes such as files isolated for security reasons.

  Note: At time of writing, IBM software is not distributed on IBM 3590 High Performance Tape Cartridges.

6.1.4 Tape Management Systems

If using a Tape Management system, ensure that it supports the IBM 3590, before moving any data to the new tape cartridge. Similarly, ensure that the tape management system continues to manage the existing tape environment, as well as the new IBM 3590 data.

Assign a new volume serial (VOLSER) range for the IBM 3590 cartridges and create a new scratch pool of these volumes. This will assist in ensuring that the correct drive type is selected for IBM 3590 tape mounts.

Some products are available, usually from vendors of tape-management software, that also manage the backup process, schedule the backup jobs, and so on. Before using one of these products, make sure that it supports the IBM 3590.

6.2 Migration Scenarios for VM

There are several considerations when planning for migration of data. If replacing all your existing tape drives with IBM 3590 tape subsystems, you must either recreate or copy the existing tape data to IBM 3590 cartridges. If you plan to keep some existing drives, you should aim to have all appropriate data stored on the new IBM 3590s. The issue then becomes one of what to do with data that resides on existing CSTs and ECCSTs. Several approaches are possible:

1. Let the data continue to reside on CSTs and ECCSTs. Since most VM/ESA data is cyclic and is eventually rewritten, the data on the CSTs and ECCSTs will become redundant. These old cartridges would return to scratch status and could either be disposed of or used to store data not suitable for the IBM 3590.

2. Copy the data currently stored on CSTs and ECCSTs to the new IBM 3590 cartridges.

3. Leave data that is cycled on existing cartridges and copy to the new IBM 3590 cartridges data that is stored but not rewritten. This data is usually not recycled so you need to take action to move it to IBM 3590 cartridges.

4. A typical example of data that is stored for a long time is archive data. The recommendation for tape archive data is to rewrite it every five to ten years using later, if not the latest, tape technology. The stability of the components of the tape media, such as the substrate, the metal particles and the binder deteriorate over time. After about ten years the archive life of magnetic tape media cannot be guaranteed.

   Periodic rewriting has two benefits:

   • It ensures that either the archive data can still be read or, if not, you are made aware of the problem in time to deal with it before a crisis arrives.

   • It increases the likelihood that the tape drive technology needed to retrieve the data is still available.

   Failure to recycle archive data onto newer technology could lead to the situation where, when you want to read the data, the tape drives have been retired as obsolete. Also, the older the tape technology, the harder it is to find replacement parts.

Make sure, by testing, that all your tape data types can be written to, and read from the IBM 3590 cartridges. Select a noncritical data type or application and perform a pilot migration exercise. Having tested the IBM 3590s and run a successful pilot migration, formulate your migration master plan. Decide the sequence of data types to migrate, for example:

• DASD dumps
• Backups
• Application data
• ADSM data
• MVS guest data.

The final activity is to implement the migration plan.

6.2.1 Migrating ADSM for VM

Before moving data to IBM 3590 cartridges, define a new storage pool as described in Chapter 4, "Software Implementation" on page 81.

One migration strategy is to make the CST and ECCST cartridges read only and update the ADSM management classes to direct new data to the IBM 3590 cartridges. To make a volume read only, use the UPDATE VOLUME command, for example:

    UPDate Volume VO3490 Access=READonly

To move data from an existing storage pool to the new storage pool defined for IBM 3590 tape subsystem, use the MOVE DATA command.

In certain situations, such as for disaster recovery purposes, you can also use the ADSM export-import facility that allows you to copy all or part of a server to an IBM 3590 tape subsystem so that you can transfer data to another server or store it off-site.

6.2.2 Migrating Application Data

The general considerations for migration also apply to application data. If you have a significant amount of application data stored on tape, you most likely will also use tape-management software. These relevant considerations have already been discussed above.

6.2.3 MVS Guest Operating Systems

The considerations for migrating MVS guest operating system data relate entirely to the MVS environment. Please refer to Chapter 5, "Migration in an MVS/ESA Environment" on page 115 for details of migration strategies for MVS/ESA.

6.3 Managing Mixed Devices and Mixed Media Inside an IBM Automated Tape Library Dataserver with VM

The IBM 3494 supports IBM 3490-CxA and IBM 3590 tape subsystems. The IBM 3495 supports IBM 3490, 3490E, and 3590 tape subsystems. Both automated tape libraries store CST, ECCST and IBM 3590 cartridges.

Once the IBM 3590 is installed in the IBM automated tape library, define the IBM 3590 drives to Removable Media Services (RMS).

With mixed drive and cartridge types you have additional considerations, mainly ensuring that the correct type of device is selected, and that the correct volume is mounted on the correct drive. Assign a new volume serial range for IBM 3590 cartridges and assign them to a unique scratch category. Thus, if you need to code device-selection exits, use the IBM 3590 cartridge volume serial range, or scratch category to ensure that the correct medium is chosen.

Please refer to Chapter 4, "Software Implementation" on page 81 for information on defining the IBM 3590 tape subsystem to IBM 3494 and 3495 Automated Tape Library Dataservers and Chapter 3, "Hardware Implementation" on page 37 for considerations when sharing the drives.

For more information on sharing IBM automated tape libraries please refer to *Guide to Sharing and Partitioning IBM Tape Library Dataservers*.

6.4 Evaluating the AIX Environment

To fully exploit the 10 GB, uncompacted, storage capacity of the IBM 3590 cartridge and the greatly improved performance of the tape subsystem, you need to analyze tape usage to ensure that the best use is made of the IBM 3590 High Performance Tape Subsystem.

6.4.1 Tools to Evaluate the Environment

The AIX environment contains no tape usage analysis tools; however it is a relatively straightforward exercise to estimate the cartridge savings from migrating to IBM 3590 High Performance Tape Cartridge. Data that previously spanned multiple CSTs or ECCSTs will now fit on a single IBM 3590 cartridge.

6.4.2 Tools and Utilities for Moving Tape Data

The following utilities and programs can be used to move data to IBM 3590 cartridges:

- tar (Tape ARchive)
- dd (Data Dump)
- backup/restore.

The IBM 3590 device driver supports **tar, DD** and **backup/restore** commands. For tape to tape copy, the **tcopy** command addresses this function specifically.

Tapeutil is a sample utility program that is provided with the device driver. It demonstrates the use of **ioctl** commands. The interactive version of the program is invoked by entering **tapeutil** on the AIX command line. The utility also has a command line version; for example, to write a source file specified with the *-s* flag on to tape, enter:

```
tapeutil –f/dev/rmt0 write –s myfile.tar
```

6.4.3 Types of Tape Data to Be Moved

In the AIX environment, any data that is currently stored on a CST or ECCST can be copied to an IBM 3590 cartridge.

Aim to store as much as possible on IBM 3590 cartridges to maximize the benefit of this technology. However, you may decide to retain some of your existing tape drives to be able to support the following types of tape processing:

- Off-site disaster tape backups and dumps, if the off-site facility does not have access to IBM 3590 tape subsystems.
- Interchange tapes, where the target site does not have any IBM 3590 tape subsystems installed.

  Note: At the time of writing, IBM software is not distributed with IBM 3590 High Performance Tape Cartridges.

6.5 Migration Scenarios for AIX

There are several considerations when planning for migration to IBM 3590s. Plan to phase in the IBM 3590 cartridges and phase out the older cartridges. Aim to minimize the migration of data, and only copy, for example, data that has a long retention period.

If you are replacing all the existing tape drives with IBM 3590 tape subsystems, you must either recreate or copy the existing data stored on tape to IBM 3590 cartridges.

If you retain some old tape drives, the issue then becomes one of what to do with the data stored on existing CSTs and ECCSTs. There are several approaches:

1. Leave the data to reside on CSTs and ECCSTs. Since most tape processing is cyclic, the contents of the CSTs and ECCSTs will become redundant. These scratch cartridges can be reused or disposed of.
2. Copy the contents of the CSTs and ECCSTs to the new IBM 3590 cartridges.

3. Leave the contents of the existing cartridges and copy to the new IBM 3590 cartridges data that is stored but not rewritten. A typical example of data that is stored for a long time is archive data. This data is usually not recycled, and therefore you need to take positive action to move it to IBM 3590 cartridges.

4. A typical example of data that is stored for a long time is archive data. We recommend rewriting tape archive data every ten years using later, if not the latest, tape technology. Components of the tape media, such as the stability of the substrate, the metal particles and the binder deteriorate over time. After about ten years the archive life of magnetic tape media cannot be guaranteed.

   Periodic rewriting has two benefits:

   • It ensures that the archive data can still be read or, if not, that you are made aware of the problem in time to address it before a crisis arrives.

   • It makes it more likely that the tape drive technology needed to retrieve the data is still usable.

   Failure to recycle archive data with newer technology could lead to the situation where, when you want to read the data, you discover that the tape drives needed have been retired as obsolete. Also, the older the tape technology, the harder it is to find replacement parts.

Make sure, by testing, that all your tape data types can be written to, and read from the IBM 3590 cartridges. Select a noncritical data type or application and perform a pilot migration exercise. Having tested the IBM 3590s and run a successful pilot migration, formulate your migration master plan. Decide the sequence of data types to migrate, for example:

• DASD dumps and backups

• ADSM data.

The final activity is to implement the migration plan.

6.5.1 Migrating ADSM for AIX

Before moving data to IBM 3590 cartridges, define a new storage pool as described in Chapter 4, "Software Implementation" on page 81.

One migration strategy is to make the CST and ECCST cartridges read only and update the ADSM management classes to direct new data to the IBM 3590 cartridges. To make a volume read only use the *UPDATE VOLUME* command, for example:

```
UPDate Volume VO3490 Access=READonly
```

To move data from an existing storage pool to the new storage pool defined for IBM 3590 tape subsystem, use the *MOVE DATA* command.

In certain situations such as for disaster recovery purposes, you can also use the ADSM export-import facility that allows you to copy all or part of a server to IBM 3590 tape subsystem so that you can transfer data to another server or store it in an off-site location

6.6 Managing Mixed Devices and Mixed Media on an AIX System

The IBM 3494 supports IBM 3490-CxA and 3590 tape subsystems. The IBM 3495 supports IBM 3490, 3490E, and 3590 tape subsystems. Both automated tape libraries store CST, ECCST and IBM 3590 cartridges.

The AIX environment has no dynamic tape-drive-sharing capability. At any one time, a tape drive needs to be online only to the system that is using it. Therefore, you must establish a procedure to manage tape drive usage among the sharing systems.

Volumes, within IBM 3494 and 3495 Automated Tape Library Dataservers can be shared among attached RISC/6000s by assigning the cartridges to identical categories on each system.

With mixed drive and cartridge types, you have additional considerations, mainly ensuring that the correct type of device is selected, and that the correct volume is mounted on the correct drive. Assign a new volume serial range for IBM 3590 cartridges and assign them to a unique scratch category. Thus if you need to code device selection exits, use the IBM 3590 cartridge volume serial range, or scratch category to ensure that the correct medium is chosen.

Please refer to Chapter 4, "Software Implementation" on page 81 for information on defining the IBM 3590 tape subsystem to IBM 3494 and 3495 Automated Tape Library Dataservers and Chapter 3, "Hardware Implementation" on page 37 for considerations when sharing the drives.

For more information on sharing IBM automated tape libraries please refer to *Guide to Sharing and Partitioning IBM Tape Library Dataservers*.

6.7 Evaluating the OS/400 Environment

To fully exploit the uncompacted, 10 GB storage capacity of the IBM 3590 cartridge and the greatly improved performance of the tape subsystem, you need to analyze tape usage to ensure that the best use is made of the IBM 3590 High Performance Tape Subsystem.

6.7.1 Tools to Evaluate the Environment

There are no tape usage analysis tools in the OS/400 environment; however, it should be relatively straightforward to estimate the cartridge savings from migrating to IBM 3590 High Performance Tape Cartridges. Data that previously spanned multiple CSTs or ECCSTs will now fit on a single IBM 3590 cartridges.

6.7.2 Tools and Utilities for Moving Tape data

Use the OS/400 DUPTAP command to copy the contents of a CST or ECCST cartridge to an IBM 3590 cartridge.

In the BRMS/400 environment use DUPMEDBRM to copy data from older tape cartridges to IBM 3590.

6.7.3 Types of Tape Data to be Moved

In the OS/400 environment, any data that is currently stored on a CST or ECCST can be copied to an IBM 3590 cartridge.

Aim to store as much as possible on IBM 3590 cartridges to maximize the benefit of this technology. However, you may decide to retain some of your existing tape drives to be able to support the following types of tape processing:

- Off-site disaster-tape backups and dumps, if the off-site facility does not have access to IBM 3590 tape subsystems.

- Interchange tapes, where the target site does not have any IBM 3590 tape subsystems installed.

    Note: At time of writing, IBM software is not distributed on IBM 3590 High Performance Tape Cartridges.

6.8 Migration Scenarios for OS/400

There are several considerations when planning for migration to IBM 3590s. Plan to phase in the IBM 3590 cartridges and phase out the older cartridges. Aim to minimize the migration of data and, for example, only copy data that has a long retention period.

If you are replacing all the existing tape drives with IBM 3590 tape subsystems, you must either recreate or copy the existing data stored on tape to IBM 3590 cartridges.

If you retain some old tape drives, the issue then becomes one of what to do with the data stored on existing CSTs and ECCSTs. There are several approaches:

1. Let the data continue to reside on CSTs and ECCSTs. Since most tape processing is cyclic, the contents of the CSTs and ECCSTs will become redundant. These scratch cartridges can be reused or disposed of.

2. Copy the contents of the CSTs and ECCSTs to the new IBM 3590 cartridges.

3. Leave the contents of the existing cartridges and copy data that is stored but not rewritten to the new IBM 3590 cartridges. This data is usually not recycled, and therefore you need to take action to move it to IBM 3590 cartridges.

4. A typical example of data that is stored for a long time is archive data. We recommend rewriting tape archive data every ten years using later, if not the latest, tape technology. Components of the tape media, such as the stability of the substrate, the metal particles and the binder deteriorate over time. After about ten years the archive life of magnetic tape media cannot be guaranteed.

    Periodic rewriting has two benefits:

    - It ensures that the archive data can still be read or, if not, that you are made aware of the problem in time to address it before a crisis arrives.

    - It makes it more likely that the tape drive technology needed to retrieve the data is still usable.

    Failure to recycle archive data onto newer technology could lead to the situation where, when you want to read the data, you discover that the tape

drives needed have been retired as obsolete. The older the tape technology, the harder it is to find replacement parts.

Make sure, by testing, that all your tape data types can be written to, and read from the IBM 3590 cartridges. Select a noncritical data type, or application and perform a pilot migration exercise. Having tested the IBM 3590s and run a successful pilot migration, formulate your migration master plan. Decide the sequence of data types to migrate, for example:

- DASD dumps and backups

- BRMS/400 data

- ADSM data

- R/DARS data.

The final activity is to implement the migration plan.

6.8.1 Migrating ADSM for OS/400

Before moving data to IBM 3590 cartridges, define a new storage pool as described in Chapter 4, "Software Implementation" on page 81.

One migration strategy is to make the CST and ECCST cartridges read only and update the ADSM management classes to direct new data to the IBM 3590 cartridges. To make a volume read only use the *UPDATE VOLUME* command, for example:

```
UPDate Volume VO3490 Access=READonly
```

To move data from an existing storage pool to the new storage pool defined for IBM 3590 tape subsystem, use the *MOVE DATA* command.

In certain situations such as for disaster recovery purposes, you can also use the ADSM export-import facility that allows you to copy all or part of a server to IBM 3590 tape subsystem so that you can transfer data to another server or store it in an off-site location

6.8.2 Migrating BRMS

If you are introducing BRMS/400 with the IBM 3590 tape subsystem, we recommend that you not perform both migrations at the same time. If you decide to implement BRMS/400 first, for the existing IBM 3490 environment, allow this to run for at least one month before starting the migration to IBM 3590.

We recommend assigning a new volume serial range for the IBM 3590 cartridges to distinguish them from existing cartridges.

New IBM 3590 cartridges are enrolled, by volume serial, into BRMS and assigned a media class. The media class will be used for media selection of scratch volumes. Policies are then established for usage, expiration processing, and volume movement.

BRMS/400 uses the DUPMEDBRM command to perform the migration of the data from CSTs and ECCSTs to IBM 3590 cartridges and logs details of both tapes.

It is desirable to have a period of parallel running with the existing drives and the IBM 3590s. However, one issue with this approach will be the ability to

perform parallel backups and dumps, during the processing window allowed for these tasks.

New media policies need to be established for the IBM 3590 environment.

For more information on BRMS/400 please refer to *Backup Recovery and Media Services/400 Implementation Tips and Techniques*.

6.8.3 Migrating R/DARS

If BRMS/400 is installed and used to manage tape data we recommend that BRMS/400 is also used to manage the R/DARS tape archive data. In this case, define only the IBM 3590 drives and cartridges to BRMS/400. R/DARS uses the information in the collection to link to BRMS/400.

In the absence of BRMS, initialize the new IBM 3590 cartridges and define them to R/DARS.

The R/DARS-400 command INZMEDRDAR initializes the cartridges with a standard volume label, for full R/DARS tape management. The R/DARS initialization provides better data protection for R/DARS data than the OS/400 command INZTAP.

Use the panel-driven Media Administration Menus to add the IBM 3590 cartridges to the media inventory. To do this:

- Select **Work with Tape Devices**
- Create a new tape device generic for the IBM 3590 drives
- For Media supported enter **HIC**
- For loader capacity enter **10**.

6.9 Managing Mixed Devices and Mixed Media Inside an IBM Automated Tape Library Dataserver with OS/400

The IBM 3494 supports IBM 3490-CxA and 3590 tape subsystems. The IBM 3495 supports IBM 3490, 3490E, and 3590 tape subsystems. Both automated tape libraries store CST, ECCST and IBM 3590 cartridges.

The AS/400 environment does not support dynamic drive sharing. Therefore, you must put a procedure in place to manage tape-drive access among the sharing systems.

With mixed drive and cartridge types, you have additional considerations, mainly ensuring that the correct type of device is selected, and that the correct volume is mounted on the correct drive. Assign a new volume serial range for IBM 3590 cartridges and assign them to a unique scratch category. Thus, if you need to code device-selection exits, use the IBM 3590 cartridge volume serial range, or scratch category to ensure that the correct medium is chosen.

Sharing of volumes in an OS/400 environment is provided by means of the *SHARE400* volume category. Volumes in this category are accessible by all attached AS/400 systems. The CHGMEDMLD command is used to move volumes into a desired category.

Please refer to Chapter 4, "Software Implementation" on page 81 for information on defining the IBM 3590 tape subsystem to IBM 3494 and 3495 Automated Tape Library Dataservers and Chapter 3, "Hardware Implementation" on page 37 for considerations when sharing the drives.

For more information on sharing IBM automated tape libraries please refer to *Guide to Sharing and Partitioning IBM Tape Library Dataservers*.

Chapter 7. Operational Considerations for IBM 3590

The IBM 3590 tape subsystem introduces new media and drives into the operational environment. In this chapter, we explain the new operational considerations associated with this tape subsystem. Operating the IBM 3590 tape subsystem, handling the new media, and problem recovery procedures are discussed in detail.

Additional information can be obtained from the following publications:

Quick Operator's Guide, GA32-0354

Operator's Video Tape, GV38-0290

Care and Handling of IBM Magnetic Tape Cartridges, GA32-0331

IBM 3590 Users Guide, GA32-0330.

7.1 What's New with the IBM 3590

The IBM 3590 tape subsystem has some new hardware facilities that need to be understood in order to operate the tape subsystem successfully. The new cartridge loader facility is similar to the integrated cartridge loader on previous IBM tape drives, but it has some significant differences that you need to be aware of. You control the IBM 3590 drive through a menu-driven operator panel. The operator panel also displays status and message information. A new IBM 3590 High Performance Tape Cartridge is used with the IBM 3590 drive and it is very important to adopt proper handling procedures when using this tape.

7.1.1 Automatic Cartridge Facility

The Automatic Cartridge Facility (ACF) provides selection and automatic loading of mounted cartridges, or the manual loading of single cartridges. Up to ten cartridges can be mounted in a magazine that is loaded in the ACF. Figure 60 shows the components of the IBM 3590-B11.
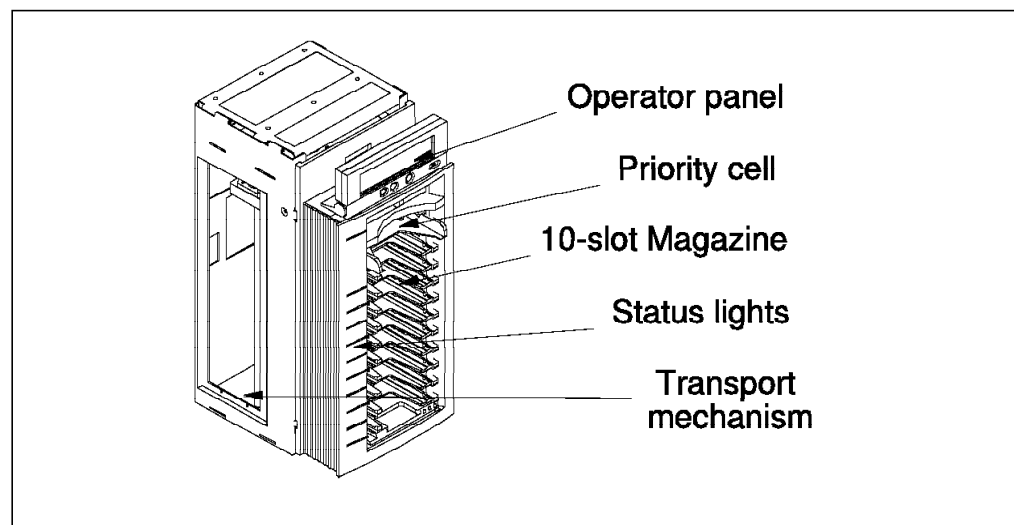
Figure 60. Automatic Cartridge Facility (ACF)

The ACF consists of five major elements:

Operator Panel The operator panel is mounted on the ACF. The panel consists of control buttons and a liquid crystal display (LCD) and can be titled for optimum viewing.

Priority Cell The priority cell is integrated into the front of the ACF. Requests for specific mounts can be inserted into this cell without affecting the cartridges in the magazine

Magazine The ACF magazine can hold up to ten cartridges and can be detached from the ACF.

Status Lights Each of the magazine cells is equipped with a bicolored (yellow and green) light-emitting diode (LED) cell status indicator. These indicators allow the operator to determine the following machine conditions:

- Attention
- Alert
- In Use
- Selected.

Transporter The transport mechanism within the ACF moves the cartridges between the magazine, the priority cell and the drive.

For more information please refer to *IBM 3590 High Performance Tape Subsystem User's Guide*.

7.1.2 ACF Modes of Operation

The Automatic Cartridge Facility can operate in five different modes:

SYSTEM Cartridges loaded under system control.

AUTOMATIC Cartridges automatically fed from magazine to drive.

MANUAL A cartridge placed in the priority cell is returned to the priority cell.

ACCUMULATE A cartridge loaded from the priority cell is returned to the magazine.

RANDOM Cartridges fed automatically from locked magazine.

The system, manual, and automatic modes operate in much the same way as the Integrated Cartridge Loader (ICL) functions on an IBM 3490E drive.

Choose the ACF mode from a menu on the operator panel display.

The two new ACF modes introduced with the IBM 3590-B11 are the accumulate and random mode, which are now discussed in more detail:

1. Accumulate mode

   This mode is designed for the situation where you need to process a set of cartridges in a known sequence and can allow the processed tapes to reside (accumulate) in the ACF until it is convenient for the operator to retrieve the groups of cartridges, or to remove the magazine for off-site storage.

   In accumulate mode, you insert cartridges into the priority cell. After they are processed they are exported to the next available magazine cell, thus accumulating up to ten cartridges in the magazine.

   To set accumulate mode, select this mode of operation from the operator panel. The ACF operation is as follows:

- If the ACF is disabled and in accumulate mode, and the operator selects START on the operator panel, the ACF then becomes enabled and waits until a cartridge is inserted in the import position of the priority cell.

- When a cartridge is inserted into the priority cell, the cartridge sets the priority cell status indicator to in-use (steady green) and waits for the tape drive to become available.

- When the tape drive is available, the cartridge is loaded in the tape drive and the priority cell indicator is turned off.

- When a cartridge is unloaded from the drive, it is moved to the magazine. The ACF places the cartridge in the top cell of the magazine unless the cell is occupied. If the top cell is occupied, the ACF searches down the magazine for the next available cell. Each cartridge is placed in the export position.

- When the magazine has its last available cell filled, the ACF warns the operator by activating all magazine cell-status indicators to alert (steady yellow). If another cartridge is unloaded, it is placed back in the priority cell, if possible, and the priority cell indicator is set to alert (steady yellow).

The ACF becomes disabled when the magazine is filled and the last imported cartridge is returned to the priority cell, or an attention condition is detected in the ACF.

2. Random mode

This mode is designed to enable the ACF to act as a small, self-contained library of up to ten cartridges. This mode of operation is currently supported only on SCSI platforms, such as RISC/6000 and AS/400.

Being in random mode does not preclude requests for specific mounts, and the priority cell is used to satisfy such requests. The ACF notifies the host (initiator) of the presence of a cartridge in the priority cell, but the host must address that specific cell to access the cartridge.

To ensure that cartridges are not removed or inserted into the ACF the magazine must be locked when in random mode. The state of the lock is sensed by the ACF and random mode will not be enabled unless the lock is engaged.

In random mode, the priority cell is used as an input/output port for the ACF library. The host can move any cartridge from any cell to any cell, including the priority cell. The inventory of cartridges in the ACF and control of that inventory is entirely the responsibility of the host. The host uses SCSI medium mover commands to manage the ACF and its contents.

To set random mode, select this mode of operation from the operator panel. You must have a magazine installed in the ACF, with the lock engaged, and choose START from the operator panel. The ACF operation is as follows:

- The ACF waits for initiating medium move commands.

- All magazine cell-status indicators are set to in-use (steady green). The in-use indicator remains on unless random mode is disabled. The priority cell-status indicator is activated as it is used.

- All cartridge movement is under control of the initiator using the medium-move commands.

- The ACF honors the **Prevent and Allow Media Removal** command by not allowing operator-initiated export of cartridges any time the command has specified **Prevent Media Removal**.

- The priority cell has an assigned element address and can be accessed under initiator control. If an operator inserts a cartridge in the priority cell, the ACF notifies the host with a unit attention and sense data (71, unit attention, import or export element accessed). The ACF will not access the cartridge in the priority cell unless commanded by the host.

- If a cartridge that was loaded while in random mode is unloaded, it may not always be returned to the same cell where it was previously located. The host controls the cartridge location. When a cartridge is placed in a magazine cell, it is placed in the import position.

The ACF is disabled in random mode if the magazine is removed or an attention condition is detected.

For more information on ACF modes of operation please refer to *IBM 3590 High Performance Tape Subsystem User's Guide* and *Magstar and IBM 3590 High Performance Tape Subsystem Technical Guide*.

7.1.3 Operator Panel

The operator panel allows different drive options to be selected from menu-driven panels. It also displays drive-status information, messages, and error conditions. The operator panel is usually plugged into a socket located in the front of the drive or mounted on the ACF, if installed. The IBM Customer Service Representative uses the operator panel to run drive diagnostics and perform repairs. To enable rear servicing, the operator panel can be plugged into the back of the drive. Figure 61 shows the operator panel, the control buttons and the format of the LCD display.
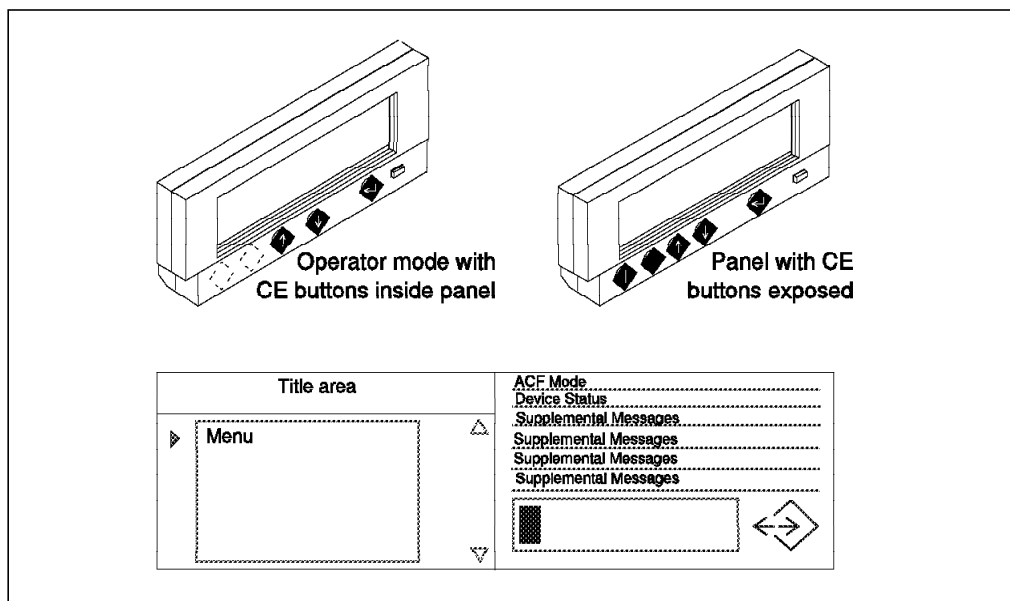
Figure 61. The IBM 3590 Operator Panel

The panel consists of the following components:

Control Buttons	Two buttons are used to scroll through the menus and an enter button is used to select the required item.
Menu Area	The menu area lists the control functions to select from.
Status Area	The status area displays ACF mode, messages, tape position indicator, and device status.

The **Tape Position Indicator** gives a graphical representation of the position of the tape relative to the beginning and the end of the volume, or the beginning and end of the medium, if rewinding.

The **File Protect Indicator** is a status icon that shows whether the cartridge is physically file-protected, logically file-protected, or unprotected.

Note: If you plan to insert a cartridge into an IBM 3494 and 3495 Automated Tape Library Dataservers, set the file-protect thumbwheel to unprotected, and allow the system to logically protect the cartridge. This will avoid the situation where a private cartridge returns to scratch, forcing you to eject the tape and reset the file protect thumbwheel before the tape can be reused.

An eight-character intervention messages is displayed in a large font on the **intervention screen**. Two-part messages alternate on the screen. Mount requests and *CLEAN messages will appear in large font characters on this screen.

An optional top-mounted operator display that connects directly to the IBM 3590-A14 has been designed by Texas Digital Systems, Inc. (TDS). The TDS 3590 Display Station features an eleven-color LED display that can be used to read up to a distance of 90 feet. The Display Station also provides flexible user-controlled display functions that are menu-selected by means of an infrared keyboard.

7.1.4 Hardware Error Detection

The IBM 3590 tape subsystem is extremely reliable. This high level of reliability is achieved, in part, by highly sophisticated error detection mechanisms. Under certain operational conditions, for example during power up, particular types of hardware error detection are performed.

Error detection in the IBM 3590 tape subsystem is done by the hardware and microcode using the

- Power-on self-test (POST)

- Idle-time self-test (ITST)

- Functional microcode during the real-time operations.

The power-on self-test (POST) automatically performs a complete diagnostic test of all electrical and mechanical functions whenever the IBM 3590 tape subsystem is powered up.

Idle-time self-test (ITST) is automatically performed whenever the IBM 3590 tape subsystem is not executing any commands. If diagnostics are interrupted by a command from the host, the status of the diagnostics is immediately stored before the command is carried out. Whenever the IBM 3590 tape subsystem drive becomes idle again, the diagnostics resume from the point where they had been previously suspended.

Statistical analysis and reporting (SAR) are programmed in the IBM 3590 tape subsystem microcode. The SAR algorithms aim to allow the IBM 3590 tape subsystem drive to automatically determine if write and read data error rates are rising because of drive problems or problems with the IBM 3590 High Performance Tape Cartridge. There are two functions:

- One function maintains a record of write and read error rates in special memory in the device. A sophisticated algorithm is designed to detect significant degradation in overall performance of the tape drive.
- The second function maintains a record of write and read error rates in a special *reserved* area in the tape itself. A sophisticated algorithm is designed to detect significant degradation in performance of the IBM 3590 High Performance Tape Cartridge.

Using new technology and hardware design, all of the new modules (with the exception of some analog modules) for the IBM 3590 tape subsystem drive have the ability to detect failures at the module level during power-on and diagnostic execution.

The IBM 3590 tape subsystem requires no preventive maintenance.

7.1.5 IBM 3590 High Performance Tape Cartridge

The new IBM 3590 High Performance Tape Cartridge has the same external shape and size as existing CST and ECCST cartridges. However, it cannot be used in existing IBM 3480, 3490 or 3490E drives. Similarly, you cannot use non-IBM 3590 High Performance Tape Cartridges in IBM 3590 tape subsystems.

The new tape is 300 m long and a half-inch wide and is composed of a new metal-particle recording medium. Figure 62 on page 147 illustrates the elements of the IBM 3590 High Performance Tape Cartridge.
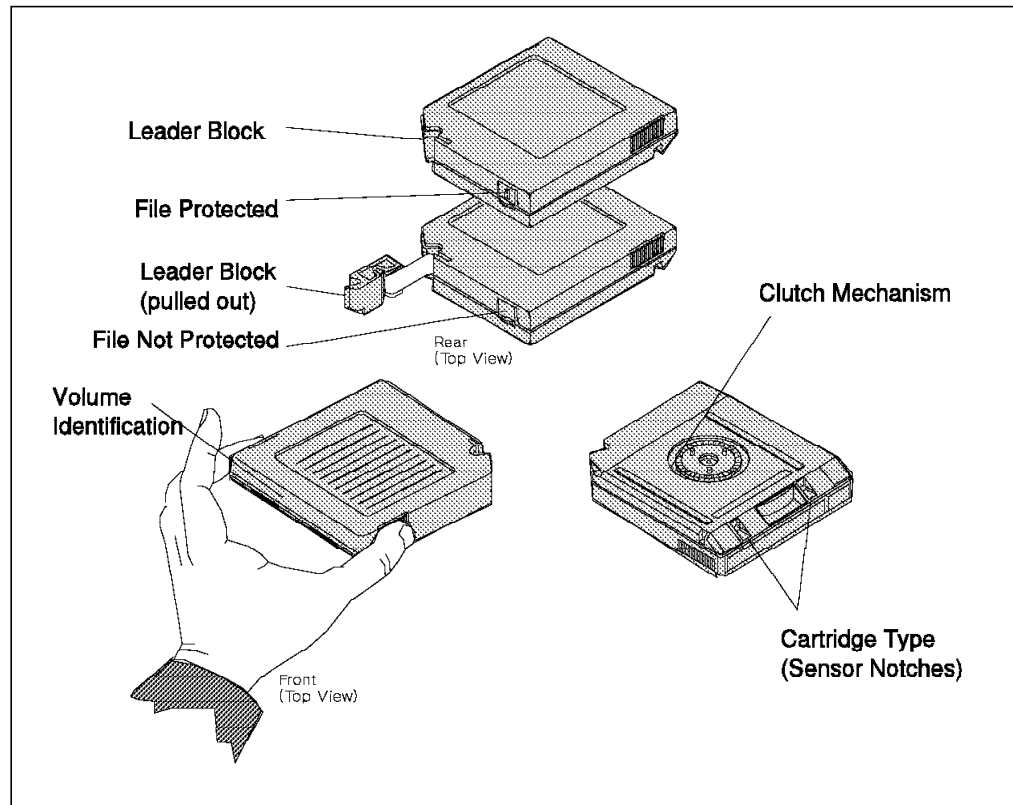
Figure 62. IBM 3590 High Performance Tape Cartridge

Leader block   The leader block (colored blue) is attached to the end of the tape. During threading, it is pulled out of the cartridge by the threader pin and wound on to the drive reel.

Clutch gear   The clutch gear on the bottom of the cartridge engages the file reel gear, allowing the motor to rotate the tape reel.

File protect   The cartridge protect mechanism is a thumbwheel that is set to the *protect* or *not protect* position. A closed-lock symbol on the face of the thumbwheel indicates that the cartridge is file protected.

Identification   The volume identification area is at the front of the cartridge and it is here that the operator readable label, with or without barcode, is placed. Please refer to Chapter 3, "Hardware Implementation" on page 37 for more information on cartridge barcode labels.

Sensor notches The cartridge sensor notches allow the IBM 3590 tape subsystem to recognize 3590 cartridges and to reject all other cartridge types.

The IBM 3590 tape subsystem uses two different classes of cartridge, data storage cartridges, and cleaning cartridges. When viewed from the front, the sensor notches for the data storage cartridges are oriented to the left of the sensor notches of the cleaning cartridges. The presence of a notch signifies a binary 1; thus data cartridges are recognized as "0100" and cleaning cartridges as "0001."

Also, to assist the operator, the IBM 3590 cleaning cartridge inserts are white, whereas the tape cartridge inserts are blue.

The new IBM 3590 High Performance Tape Cartridge cannot be mounted in any other tape drives. The IBM 3590 High Performance Tape Cartridge has a different type of tape leader block than other cartridges, and this prevents the IBM 3590 High Performance Tape Cartridge from being successfully loaded in any other tape drive. Similarly, a Cartridge System Tape (CST) or Enhanced Capacity Cartridge System Tape (ECCST) cannot be mounted in a IBM 3590 tape subsystem drive.

7.2 New Operations Procedures

Now that we have reviewed what's new in the IBM 3590 from an operations perspective, we move on to discuss how we operate these facilities. We look at handling the ACF magazine, the proper way to treat the 3590 cartridges, drive cleaning, and problem-handling procedures.

Note:

If you degauss a 3590 cartridge, the cartridge will need to be returned to the manufacturer before it can be reused.

7.2.1 Handling the ACF Magazine

The cartridge magazine slots into the ACF. It may be loaded with up to ten cartridges and transported using the carrying handle. Figure 63 shows the components of the IBM 3590-B11 ACF magazine.
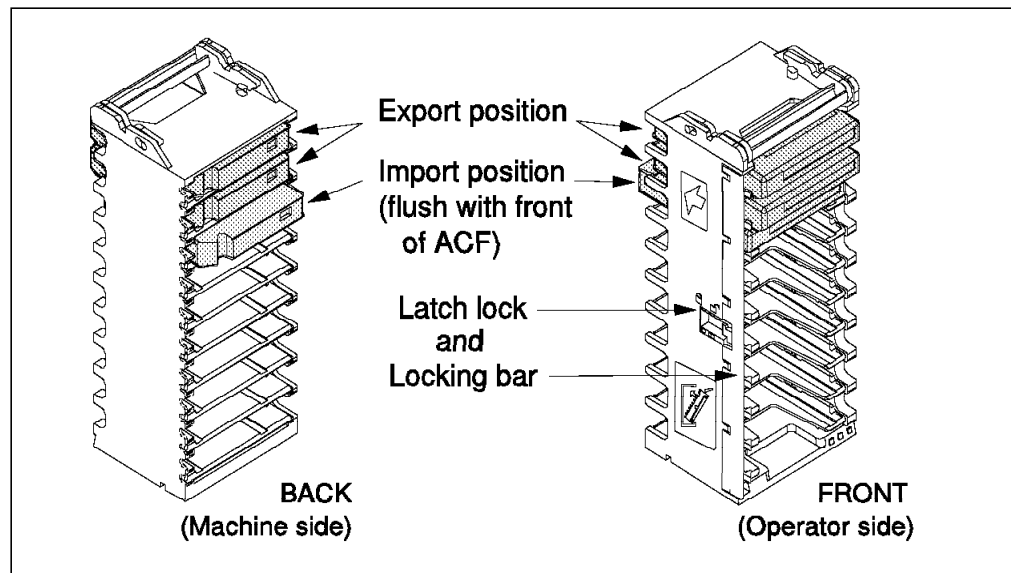
Figure 63. The Automatic Cartridge Facility (ACF) Magazine

The following is a list of the typical tasks that the operator will need to perform:

1. Inserting cartridges

   See Figure 62 on page 147 for the correct cartridge orientation for inserting a cartridge into the ACF. When you insert a cartridge into the ACF

magazine, the cartridge is automatically moved into the **import** position. In this position the edge of the cartridge is flush with the edge of the magazine.

2. Removing cartridges

   After a cartridge has been processed, it is returned to its cell. It is now placed in the **export** position, approximately 16 mm outside the edge of the ACF. This allows the operator to easily identify cartridges that have been processed and to remove them.

   Note:

   - When in random mode, the ACF returns cartridges that have been processed back to the magazine in the import position.

   - The drive transport mechanism can access cartridges in either import or export position at all times.

3. Manual loading and unloading of cartridges

   If the loader motor fails, you can load or unload a cartridge. A protruding gear on the left side of the ACF is turned completely in each direction to perform the load and unload sequence as follows:

   - To unload a cartridge, turn the gear completely away from you.

   - To load a cartridge turn the gear completely toward you.

4. Locking the ACF door

   A physical lock in the magazine prevents the removal or insertion of cartridges. To operate the lock, the magazine must be removed from the ACF.

   The lockbar is located at the front side of the magazine and extends along the entire length. The lockbar is enabled by means of a hand-operated slider, located in the middle of the magazine frame.

   To lock the ACF, push the slider toward the back of the magazine (middle position).

   Note: In random mode the ACF magazine must be locked.

5. Unlocking the ACF door

   To unlock the ACF push the slider towards the front of the magazine. The lockbar should now be open and you can insert and remove cartridges.

   Note: There is a third position for the slider where it is pushed fully toward the back of the magazine. Here, the lockbar can be opened or closed manually. This position of the slider is used for installation or removal of the lockbar, it is not a position used in normal operation.

6. Loading the magazine

   Use two hands to load the magazine as follows:

   - Using one hand, hold the handle.
   - With the other hand, hold the body of the magazine at a 45 degree angle.
   - Ensure that the lower edges of the magazine are secure in the ACF loading tray.
   - Push the magazine handle into the ACF lockbar.

7. Removing the magazine

   Lift the handle until it clears the ACF lockbar and pull the magazine out.

A **latch lock** is designed into the magazine that keeps the cartridges in their import or export positions whenever the magazine is removed from the ACF.

If you transport the magazine containing cartridges, you should first lock it to ensure that the cartridges do not get displaced.

7.2.2 Taking a Drive SCSI Port Offline

You may need to take one of the drive SCSI interfaces offline to allow an IBM Customer Service Representative to perform repair actions. First,ensure that all drives are offline to all attached hosts. To take SCSI port 0 offline, follow this procedure:

1. From the IBM 3590 operator panel select *Services Menu*.

2. From the Services menu select *Set Offline*.

3. From the Set Offline menu select *SCSI 0*.

If the tape drive interface to SCSI port 0 successfully goes offline, the Options menu appears. Otherwise proceed to the *Confirm Offline Menu*.

- From the Confirm Offline menu select *Proceed*.

This now forces the SCSI port offline.

Note: If any write activity existed, it is now lost. If not previously stopped, any task using a drive terminates.

7.2.3 Handling the IBM 3590 High Performance Tape Cartridge

The preceding IBM 3480 and 3490 model E tape drives recorded in 18- and 36-track format, respectively. The new IBM 3590 High Performance Tape Cartridge records at the much higher density of 128 tracks, and is composed of a new metal-particle tape medium, different from the chromium dioxide formulation used with preceding media.

Operations personnel need to understand how to use and store the IBM 3590 High Performance Tape Cartridge and the implications of degaussing the cartridge:

- DeGaussing the Cartridge

  Each IBM 3590 High Performance Tape Cartridge has three prerecorded servo tracks, recorded at time of manufacture. The servo tracks enable the IBM 3590 tape subsystem drive to position the read/write head accurately during the write operation. If the servo tracks are damaged, the tape cannot be written to. In this event, copy the contents of the tape to a new IBM 3590 High Performance Tape Cartridge and return the original to the manufacturer for reformatting of the servo tracks.

  The data on a IBM 3590 High Performance Tape Cartridge can be erased by using a high-energy ac degausser; a minimum of 1200 oersted peak field over the entire cartridge is needed. This process will not harm the cartridge or tape and the volume can be reused. **However the servo tracks are destroyed during the degaussing process**. The cartridge needs to be returned to the manufacturer for reformatting of the servo tracks.

  Note: Since the IBM 3590 High Performance Tape Cartridge has a higher magnetic coercivity than earlier tape technologies, a stronger magnetic field is required to erase the stored data. Check that your existing degaussing equipment can deliver the 1200 oersteds required for this purpose.

- Disposal of Cartridges

  The IBM 3590 High Performance Tape Cartridge is classified as nonhazardous waste, and can be disposed of in the same way as other office waste. However, review the local regulations covering such disposal. You can destroy the tape and cartridge in three ways:

  1. Heat the cartridge to a temperature above 130 °C (266 °F).

  2. Burn the cartridge and tape.

  3. Shred the cartridge and tape. IBM does *not* recommend this method.

- Recommendations for Handling IBM 3590 Cartridges

  – Leave the cartridges in their protective wrapping until you plan to use them.

  – Before use, expose the cartridges to their operating environment for at least 24 hours.

  – When loading the cartridge, ensure that the cartridges case is not dirty. To remove dirt, wipe the outside of the cartridge with a lint-free cloth that has been lightly moistened with IBM Tape Unit Cleaner fluid, or its equivalent.

  – Do not load a damaged cartridge into a tape drive.

  – Ensure that the leader block is snapped into position before loading the cartridge.

  – Do not expose the cartridge to moisture or direct sunlight.

  – Do not expose recorded cartridges (cartridges containing useful data) to stray magnetic fields greater than 40 oersteds, such as those existing near high-current cables or power supplies.

  – Do not expose unrecorded cartridges (cartridges containing no useful data) to stray magnetic fields greater than 100 oersteds, such as those existing near dc motors or ac generators.

  – Cartridges should always be stored in the vertical position. If you need to stack cartridges horizontally, do not stack more than six high.

  – Regarding the placement and removal of external labels:

    - External labels that extend outside of the recess areas can cause loading problems on the drive.
    - Use peel-clean labels that do not leave a residue after they are removed.
    - Always remove the old label before applying the new one.
    - If you write on the external labels, do not use markers that will smear or leave a residue. Do not use china-marking pencils.

  Note: Please refer to Chapter 3, "Hardware Implementation" on page 37 for information on the environmental requirements of IBM 3590 High Performance Tape Cartridges.

- Recommended Supplies

  We recommend that you keep the following supplies on hand to maintain your cartridges:

  – Lint-free cloth, part 2108930, or equivalent

  – IBM Tape Unit Cleaner, part 8493001, or equivalent

7.2.4 Drive and Cartridge Cleaning

The drive tape path and the cartridges must be kept clean to prevent errors caused by contamination. A cleaning cartridge is shipped with each drive. Keep track of the number of uses by marking the label provided, but do *not* use a china-marking pencil for this purpose. The cleaning cartridge should be replaced after the recommended number (100) of uses.

Before cleaning the drive, place it in MANUAL mode. You must clean the drive at least once a week, and as soon as possible after a *CLEAN message has been posted.

You need to establish cleaning schedules. The IBM 3590 tape subsystem keeps track of the number of times it has been cleaned. However, these clean counters can be reset to zero by a power off. Therefore, always clean any drive that has been:

- Powered off, or reset

- Attached to a controller that was powered off, or reset

- Undergone maintenance.

Please refer to Chapter 3, "Hardware Implementation" on page 37 for recommendations for the cleaning schedules for IBM 3494 and 3495 Automated Tape Library Dataservers.

To clean the tape drive, insert the cleaning cartridge (IBM part number 4780527 or its equivalent) in the ACF priority cell. The cleaning cartridge will be automatically loaded. After cleaning is complete the cleaning cartridge will be unloaded and returned to the priority cell. Remove the cartridge and update the use count on the label provided.

Note: Never wet clean the read/write head or tape path. The only approved cleaning method is to use the cleaner cartridge. Be aware that wet cleaning may damage the tape path components.

Dirty cartridges can reduce subsystem reliability and cause the loss of recorded data. If dirt appears on the cartridge, wipe the outside surface with a lint-free cloth (part 2108930) that has been lightly moistened with IBM Tape Unit Cleaner (part 8493001) or its equivalent.

Do not allow anything wet, including the cleaning fluid, to come in contact with the tape.

7.3 Problem Handling

In this section, we discuss IBM 3590 tape subsystem problem handling. The process of problem handling involves recognizing that a problem exists, identifying the failing component, performing the correct recovery procedures, and saving any relevant information associated with the incident.

7.3.1 Error Messages

Several sources of information are available to assist in determining that a problem exists, and to help to identify the cause, for example:

- Applications error messages
- Host operating system error messages and logs
- The IBM 3590 operator panel
- Service information messages (SIMs) and media information messages (MIMs).

Please refer to Chapter 5, "Migration in an MVS/ESA Environment" on page 115 for details of new SIMs and MIMs that MVS/ESA issues for IBM 3590 tape subsystem. Table 31 lists the message codes that are sent to the host and a short description of their meanings.

Table 31. System Information Message Codes	
Message Code	**Message Meaning**
40	Operator intervention required
41	Device degraded
42	Device hardware failure
43	Service circuits failed
44	Failure, operations can continue
45	Replace the FRU at customer convenience
46	Microcode dump in buffer for upload
50	Bad media, read-only permitted
52	Replace cleaner cartridge
53	Drive needs special cleaning
54	Bad media, cannot read or write
55	Clean drive•
56	Bad media, high temporary error rate
Typically the SIMs are accompanied by an FID displayed on the operator panel with error code messages.	
• This message is not posted if the drive is attached to IBM 3494 and 3495 Automated Tape Library Dataservers	

7.3.2 Recovery Procedures

The following discussion looks at four possible areas where problems could arise, and recommends recovery procedures.

1. Cartridge loading or unloading

   - Unable to insert a tape cartridge

     – Inspect the tape for damage. If the cartridge is undamaged and cannot be loaded, call your IBM Customer Service Representative
     – Try to load another cartridge, if this works, the original cartridge may be defective.

   - Error code on the message display

- If an error code appears, record the code. If there is a problem on the ACF, always perform the recovery action for the loader before attempting any recovery action on the drive.

- Tape drive is not ready

  - Press the READY switch on the drive operator panel.
  - Remove and reinsert the cartridge.
  - If an error message appears on the message display, record the code, press the UNLOAD switch, and retry the operation.
  - If the drive does not become ready, call your IBM Customer Service Representative.

- Leader block detaches from the tape

  - Replace the leader block using a special leader block repair kit
  - If the leader block does not come out of the drive, do *not* use the drive. Report the problem to your IBM Customer Service Representative.

    Note: Replacing the leader block is a temporary repair measure. Set the file-protect selector on the cartridge to protect and copy the contents of the cartridge to another cartridge. If the original cartridge is still under warranty, return it to the manufacturer.

- Unloading a cartridge after a power failure

  - Press the drive UNLOAD switch.
  - If the cartridge does not unload, press the UNLOAD switch again.
  - If the cartridge still does not unload, report it to your IBM Customer Service Representative and save any error code messages that appear on the operator panel.
  - If the drive unloads the cartridge, retry the procedure to ensure that the drive is functioning normally.

- Tape winds completely out of the cartridge

  - Call your IBM Customer Service Representative and save any error codes.

- Tape does not rewind or unload

  - Switch the READY switch on the operator panel to the not-ready position.
  - Press the UNLOAD switch and try the procedure again; save any error codes.
  - If the drive still does not unload or rewind, call your IBM Customer Service Representative and save any error codes.

2. Initial microcode load (IML) procedure failed (indicated by error code or blank display).

- Power the subsystem OFF, then ON.
- If the IML procedure continues to fail, call your IBM Customer Service Representative.

3. Message Display is Blank

- Ensure that the POWER ON/OFF switch is set to ON.
- Ensure that the power supply to the drive is operational, if it is and the message display is still blank report the incident to IBM Customer Service Representative.

4. ACF attention indicator is illuminated.

- If the attention indicator flashes,

  – Remove the cartridge from the priority cell, if a cartridge is present.
  – Add cartridges to the magazine if the ACF is in Auto or System mode.
  – Press the START switch to resume operation.

  Note: Further action is required if either of the following conditions occurs:

    – A cartridge that was in the drive was returned to the priority cell. Remove the cartridge and press START.
    – In Manual or System mode, an attempt was made to load the same cartridge that was processed. If the same cartridge was used again, remove it and reinsert it and press START.

  The attention light goes off when the problem is corrected.

- If the attention indicator is permanently ON,

  – Save any error-code messages.
  – Press the UNLOAD switch.
  – If, after three UNLOAD attempts, the attention indicator remains ON, issue a VARY ONLINE from the hosts console.

    If the attention indicator still remains on, then,
    - Issue a VARY OFFLINE command.
    - Issue a VARY ONLINE command.
    - If an error-code message appears on the operator panel, save it and report the incident to your IBM Customer Service Representative.

  – If the attention indicator remains permanently ON, after repeating this recovery procedure three times, call your IBM Customer Service Representative and save any error code messages.

Part 2. IBM 3490E Emulation Provided by IBM 3591 ESCON Tape Control Unit

In Part 2 we describe the implementations of the IBM 3591-A01 ESCON tape control unit with IBM 3590 tape drives. The IBM 3591 tape subsystem consists of one IBM 3591-A01 tape control unit and up to four IBM 3590 tape drives. The control unit and tape drives can be mounted in an IBM 9309, IBM 7202, IBM 7015-R00, or customer-provided rack.

The IBM 3591-A01 control unit provides IBM 3490E emulation. From a software point of view, the IBM 3591 tape subsystem works as an IBM 3490E tape subsystem even though it uses IBM 3590 tape drives.

Chapter 8. IBM 3591 Tape Subsystem Overview

The IBM 3591-A01 tape control unit provides attachment of the IBM 3590-B11
tape drives to ESCON channels on ES/3090 and ES/9000 systems or S/390
Parallel Transaction and Enterprise servers. The IBM 3591 tape subsystem
consists of an IBM 3591-A01 control unit, IBM 3590 tape drives, and a rack such
as the IBM 9309, IBM 7202, IBM 7015-R00, or customer-provided rack.

Note: When you want to install the IBM 3590-B1A tape drive in a rack and attach
to the IBM 3591-A01, RPQ 8B3188 is required.

The IBM 3591 tape subsystem allows the operating systems to communicate with
the IBM 3590 Magstar tape drives and take advantage of new levels of function,
performance, reliability, and cartridge capacity.

The IBM 3591 tape subsystem can be used to:

- Create tapes for archive files
- Back up and restore systems
- Store high capacity sequential application data sets
- Store data sets at low cost
- Satisfy offsite data storage for disaster recovery
- Provide data interchange to the IBM 3590 tape subsystem

Note: The IBM 3590 tape subsystem consists of an IBM 3590-A00 ESCON tape
control unit, up to four IBM 3590-B11 tape drives, and an IBM 3590-A14
frame.

Figure 64 shows an IBM 3591 tape subsystem as it looks with two IBM 3590-B11
tape drives and an IBM 9309 rack. An IBM 3591-A01 control unit is installed in
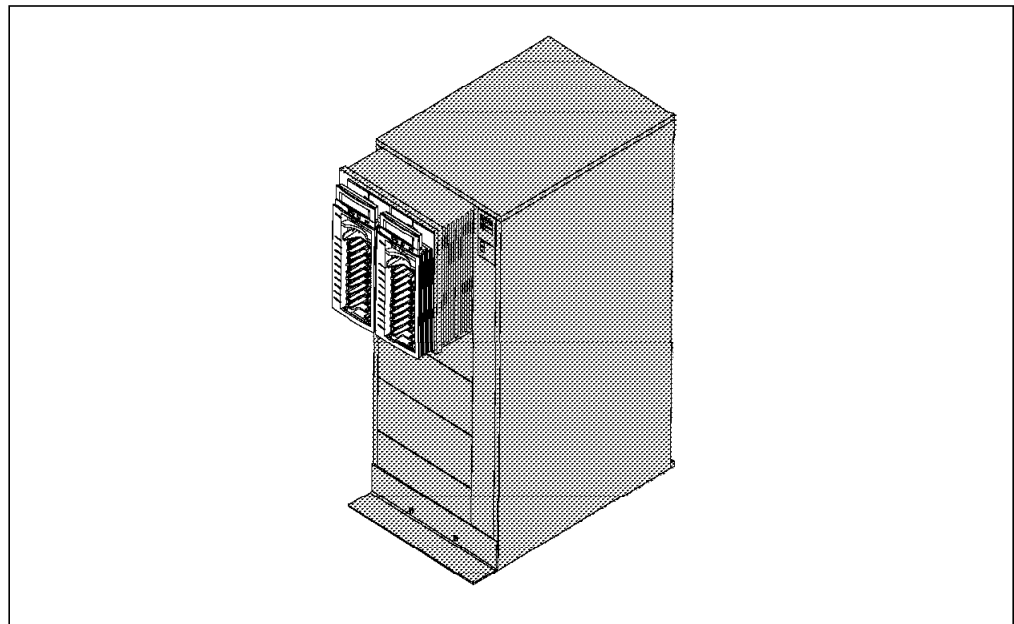the bottom of the IBM 9309 rack.

Figure 64.   IBM 3591 Tape Subsystem

From a software point of view, the IBM 3591 tape subsystem provides emulation
of an IBM 3490E tape subsystem even though IBM 3590 Magstar tape drives are
used. Therefore, support for the IBM 3591 tape subsystem does not require new

levels of software, however, full capacity exploitation may need PTFs (see 11.3.4, "DFSMShsm and DFHSM" on page 199 for detail.) Support for the IBM 3591 tape subsystem is provided in OS/390, MVS/ESA, VM/ESA, and VSE/ESA operating system environments. Chapter 11, "IBM 3591 Software Implementation" on page 187 provides more details on operating system levels and releases.

Data in the IBM 3590 cartridge is written in 3590 format even though the IBM 3591 tape subsystem is used. The 3590 cartridge written by the IBM 3591 tape subsystem can be read by the IBM 3590 tape subsystem and vice versa.

Note: The IBM 3590 tape subsystem cannot be used in the IBM 3494 and 3495 Automated Tape Library Dataservers.
The IBM 3591-A01 control unit cannot be placed in the IBM 3590-A14 frame.
The IBM 3490E tape drives cannot be attached to IBM 3591-A01 or IBM 3590-A00.

In addition to the ESCON attachment provided with the IBM 3591-A01 control unit, the IBM 3590 tape drives can also be simultaneously connected to SCSI host systems. This connection allows sharing of the same drives in a multiple, heterogeneous host system environment with ES/3090, ES/9000, S/390 as well as RISC System/6000, POWERparallel SP, AS/400, and open systems.

8.1 What′s New for the Customer?

By installing the IBM 3591 tape subsystem, customers can take advantage of its higher performance provided by IBM 3590 Magstar tape drives and greater storage capacity of the new IBM 3590 cartridge.

See Appendix I, "Tape Subsystem Comparison Chart" on page 291 for a general comparison of tape subsystems.

8.1.1 IBM 3591-A01 Control Unit

The IBM 3591-A01 tape control unit offers these opportunities:

ESCON channel attachment Many installations still have IBM 3480 or IBM 3490E tape subsystems with parallel channel attachments. An ESCON channel attachment provides:

- More flexibility in sharing multiple hosts and upgrading or migrating the configuration
- Greater distances with the use of ESCON fiber laser cables and ESCON directors and converter
- Multiple logical addresses (64 max.)
- Increased availability of tape processing

Better performance IBM 3591-A01 is designed to provide higher performance than the IBM 3480, IBM 3490 and IBM 3490E tape subsystems. High data rates can also be cost justified by replacing current tapes drives with a fewer number of IBM 3590-B11 tape drives

Sharing facility It is no longer necessary to use multiple types of tape subsystems. You can now use the same tape drives through central processors as well as AIX and UNIX

processors. Thus customers can standardize and consolidate their tape environments.

Reliability   Combined with IBM 3590 tape drives, the IBM 3591 tape subsystem, offers greater reliability than the IBM 3490E tape subsystem provides.

Floor space reduction The IBM 3591-A01 is mounted in a standard rack with one to four IBM 3590 tape drives. The new 10 GB IBM 3590 cartridge capacity reduces the number of cartridges required to store data, thus reducing both space and storage costs.

8.1.2 New Type of Media

10 GB of uncompacted data could be perceived as a huge amount of tape to fill. Most users concerned with this new technology believe that they will have no problem filling IBM 3590 cartridges without software volume stacking (through TMM, HSM, or other vendor products).

The IBM 3590 cartridge also offers a tape solution at a cost per megabyte that is lower than previous costs.

The new technology and appropriate software products offer the capability to stack more data on one volume:

- DFSMShsm and DFHSM can accumulate data with migration and backup functions.

- DFSMSdss and DFDSS enable multiple stand alone dumps on the same volume and the stacking of multiple physical disk dumps with minor job stream changes (see 11.3.7, "DFSMSdss and DFDSS" on page 207 for detail).

- ADSM servers for MVS, VM, or VSE can also exploit the full cartridge capacity for data backed up, archived or migrated from personal computers, LAN servers, and workstations.

- Utilities or applications and program products under VM/ESA and VSE/ESA can record files on the entire tape cartridge.
  See Chapter 11, "IBM 3591 Software Implementation" on page 187 for more details.

Because drives are perceived as IBM 3490Es, and data is written in IBM 3590 media format on an IBM 3590 cartridge, it is possible:

- Share data among platforms

- Exchange data between centers using IBM 3590 tape drives.

- Rapidly migrate to an IBM 3590 tape subsystem with or without IBM Automated Tape Library Dataservers.

Chapter 9. IBM 3490E Emulation

IBM 3590-B11 tape drives attached through an IBM 3591-A01 control unit are perceived by the operating systems as IBM 3490E tape drives. Therefore users have to be cautious when processing tape jobs with the IBM 3591 tape subsystem.

In this section we compare the IBM 3591 tape subsystem with a native IBM 3490E and IBM 3590 and an IBM 3590 ESCON with a SCSI-attached IBM 3590.

9.1.1 Compared with Native IBM 3490E

Although the IBM 3590 tape drive is perceived by the attached host as an IBM 3490E, there are some major differences between the IBM 3591 tape subsystem and an native IBM 3490E tape subsystem from a host processor point of view:

- Data is written in IBM 3590 media format on IBM 3590 tape cartridge.

  With IBM 3591, inventories and catalogs describe cartridges as IBM 3490E media. The IBM 3590 devices look to the system as IBM 3490E tape drives and that in certain cases a cartridge written on an IBM 3480 tape drive may be requested to be mounted on the IBM 3590 drives controlled by IBM 3591-A01. Therefore in some cases of mixed configurations, users must be cautious in directing their allocations.

- The block ID returned from the IBM 3591 to the host does not provide wrap, segment, or format-mode indicators. See 9.2, "Block ID" on page 164 for more details.

- Access to a given host is through a single path

  Multiple paths cannot be used to access IBM 3591-attached tape drives from specific host.
  Refer to 10.3, "Host Attachment" on page 173 for further details.

- All channel commands are not interpreted as identical.
  Refer to 9.3, "Channel Command Updates for IBM 3591" on page 166 for further more details.

- An MVS DDR swap processing to another drive may fail in certain cases that would be successful with native IBM 3490E drives.

  Differences between the way the IBM 3490E and IBM 3590 handle buffered data during certain error scenarios could result in an unsuccessful completion of DDR swap during error recovery.

- Host error logging for control unit functions is inconsistent with that reported by the IBM 3490E control unit.

- Not all error scenarios possible with an IBM 3591 are comparable to an IBM 3490E control unit error and vice versa.
  See Chapter 13, "Operational Considerations for IBM 3591" on page 221 for further details.

- Drives cannot be placed in I/O Assist mode

  The IBM 3591 does not support the Set Special Intercept Condition (SSIC) order of the Perform Subsystem Function (PSF) command.

- This IBM 3591 cannot be installed in an IBM 3494 or 3495 Automated Tape Library Dataserver.

The IBM 3591 attachment for IBM 3490E emulation is only a stand-alone tape drive configuration.

- Some operator actions for stand-alone tape utilities differ when compared to those for the IBM 3490E.

  There are differences between the IBM 3490E and IBM 3590 tape drives. For example, there is no manual rewind function on an IBM 3590, so an operator must manually unload then reload the cartridge to restart a stand-alone operation.

9.1.2 Compared with Native IBM 3590

Although IBM 3590 tape drives are connected to host processors through the IBM 3591-A01 control unit, the IBM 3490E emulation offering has further differences:

- Host error logging is not always parallel to that of the IBM 3590.

  The fault-symptom codes presented in IBM 3490E emulation mode are not identical for IBM 3590 device types.

- There is a 22-bit logical block number in the IBM 3490E, and a 32-bit logical block number is associated with IBM 3590 media and interfaces.

  See 9.2, "Block ID" for further more details.

9.1.3 IBM 3590 ESCON Compared with IBM 3590 SCSI

ESCON attachment of an IBM 3590 tape drive entails several operational differences when compared to a SCSI-attached IBM 3590.

- The Automatic Cartridge Facility (ACF) cannot operate in random and library mode.

  Only system and manual mode are supported when attached to an IBM 3591-A01.

- There is no interface for scaling volume capacity.

  At this time, an IBM 3590 scaling function is not available. Customers with SCSI-attached IBM 3590s who created scaled tapes must be cautious when attempting to write on such tape using the ESCON host, as the host software application may encounter logical end-of-tape sooner than expected.

9.2 Block ID

From a logical processing point of view, the IBM 3591 tape subsystem looks like an IBM 3490E tape subsystem. CCWs are sent from the host as they are for IBM 3490E tape drives. Therfore, IBM 3591-A01 control unit could react differently than the processor or the applications expects.

Below we explain how the block ID is interpreted and what is changed in some CCWs.

The block ID is used to refer to each block of data on the tape.

The 8 bytes of information (4-byte channel and 4-byte device block IDs) are transferred to the host processor when Read Block ID CCW is issued. It contains logical block numbers and several other information fields and bits. The CCW

enables an application such as ADSM or DFSMShsm to know and reference the data location on a tape volume.

The block ID is sent to the controller when the host issues a Locate command. The 4 bytes received are used to position the tape in high speed mode (4 m/sec for IBM 3490E or 5 m/sec for IBM 3590) for accessing the data faster. Although the CCW are identical for 3490E and 3590 media, the information contained in the block IDs differs.

Let's discuss the three implementations of block IDs for the IBM 3490E, IBM 3590 and IBM 3591 tape subsystem.

9.2.1 IBM 3490E

Table 32 shows the block ID format for the IBM 3480, IBM 3490, and IBM 3490E.

Table 32. IBM 3480 and IBM 3490 Block ID Format		
Bits	**Contents**	**Description**
0	Wrap 1 or 2	Tape motion direction
1-7	Segment number	High speed locate
8-9	Format mode	Media format type
10-31	Logical block number	Block position

The IBM 3490 tape subsystem uses a 22-bit logical block number to reference logical blocks. This is large enough to position all possible data blocks even on an ECCST tape volume.
The segment number and the wrap information allows a high-speed search during data location.

9.2.2 IBM 3590

Table 33 shows the block ID specification for the IBM 3590.

Table 33. IBM 3590 Block ID Format		
Bits	**Contents**	**Description**
0-31	Logical block number	Block position

The IBM 3590 tape subsystem uses a block ID structure and a principle of locating data blocks on tape that differ from those of the IBM 3490.
The Magstar tape drive uses a 32-bit logical block number without any other bits of information to perform Locate and Space commands at high speed search. It locates the blocks on the tape volume by comparing the received logical block number with an *Identifier Block Table* written at the beginning of each 3590 tape cartridge. See the *Magstar and IBM 3590 High Performance Tape Subsystem Technical Guide*.

9.2.3 IBM 3591

Although the IBM 3591 tape subsystem writes on IBM 3590-B11 tape drives, the Read Block ID and Locate CCWs are in IBM 3490E format and thus have 22-bit logical block number.
To maintain compatibility with the two types of structures, the IBM 3591-A01 control unit uses the block ID format shown in Table 34 on page 166.

Table 34. IBM 3591 Block ID Format		
Bits	**Contents**	**Description**
0	B′0′	Wrap N/A
1-7	B′0000000′	Segment number N/A
8-9	B′00′	Format N/A
10-31	Logical block number	Block position

The block ID returned from the IBM 3591 to the host does not provide wrap, segment, and format-mode figures. These bits are set to B′0′ to conform to the 32-bit block ID format of the IBM 3590.

For Locate CCWs, a nonzero value in the 0, 1-7, and 8-9 bits of the block ID is interpreted as 0 as part of the 32-bit logical block number for the IBM 3590.

Note: Applications and products with dependencies on wrap, segment, or format-mode bit settings as returned from the tape subsystem may experience unpredictable results.

The 22-bit logical block number limits the number of blocks to 4,194,303. Furthermore, assuming an average compaction ratio between 3:1 and 4:1, we recommend using a block size of no less than **8 KB** to prevent ending the tape before it reaches the physical end. Further details are provided in Chapter 11, "IBM 3591 Software Implementation" on page 187.

9.3 Channel Command Updates for IBM 3591

While most software designed to run on IBM 3490E tape subsystems will run transparently on IBM 3591-attached IBM 3590 tape drives, exploitation of IBM 3590 device and media capabilities as well as management of tape resources may be enhanced when the host software has access to information about true device and media characteristics.

9.3.1 Read Device Characteristics (RDC, X′64′) Data

The Read Device Characteristics CCW transfers 64 bytes of data from the control unit to the host. Some of these bits, which were reserved for IBM 3490E, are now used to reflect the 3490E emulation mode state. See Appendix H, "Read Characteristic and Read Buffered Log CCWs" on page 289 for details of the bit definitions.

This CCW can be requested with the QTAPE option of the DEVSERV MVS operator command. It is used to assist system operators, system programmers, configuration administrators, and customer service personnel in acquiring physical identification or status information about tape devices in large configurations.

9.3.2 Read Buffered Log (RBL, X′24′) Format-30 Data

The Read Buffered Log (format-30) CCW transfers 64 bytes of buffered log data from the control unit to the host. See Appendix H, "Read Characteristic and Read Buffered Log CCWs" on page 289 for details of the bit definitions.

9.3.3 Erase Gap Command (X′17′)

On IBM 3490E, the Erase Gap CCW is used to "blank out" an area on the tape that cannot be used to successfully write data. It causes a unique Erase GAP pattern to be written on a tape.

Due to technology difference in 3590 media format, the IBM 3490E Erase Gap CCW is effectively a No-Op, but it causes synchronization of the drive buffers.

Chapter 10. IBM 3591 Hardware Implementation

In this chapter we provide information to assist with the hardware implementation of the IBM 3591. We also provide a general description of the IBM 3591-A01 control unit, host attachment capability options, and platform-specific hardware implementations. Where appropriate, we distinguish between the IBM 3490 tape subsystem and the IBM 3591 and IBM 3590 tape subsystem.

10.1 IBM 3591 Tape Subsystem Control Unit

The primary function of the IBM 3591-A01 control unit is to provide an interface between the SCSI adapters on the IBM 3590-B11 tape drives and the ESCON channels on the host systems.

The IBM 3591-A01 is designed to be mounted in an IBM 9309, 7202, 7015-R00, or customer-provided rack with one to four IBM 3590-B11 tape drives and their 10-cartridge ACF.

Note: You can order RPQ 8B3188 to use IBM 3590-B1A tape drive instead of IBM 3590-B11 tape drive that does not have ACF.

Figure 65 illustrates the components of the IBM 3591 Tape Subsystem product. IBM 3590-A01 must be installed in the bottom of the rack.
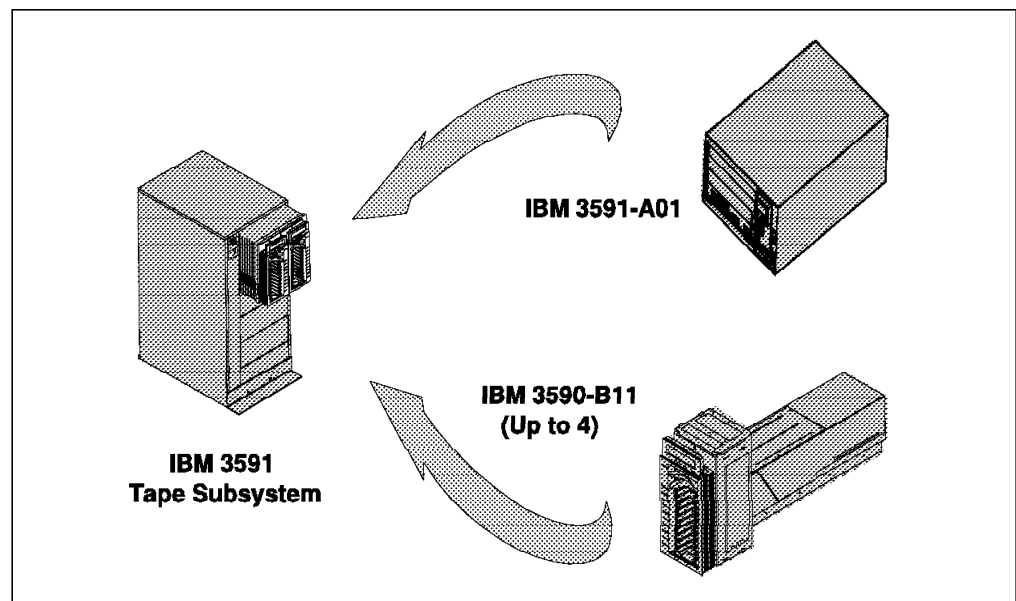
Figure 65. IBM 3591 Tape Subsystem Models

Important:

The IBM 3591-A01 cannot be mounted in an IBM 3590 Model A14, an IBM 3494 Automated Tape Library Dataserver, or an IBM 3495 Automated Tape Library Dataserver.

10.1.1 IBM 3591-A01 Control Unit Interfaces

The IBM 3591-A01 control unit is equipped with one ESCON adapter card and one SCSI adapter card.

The IBM 3591-A01 control unit communicates in two directions:

- Toward the host, with optical fiber ESCON cables

- Toward devices, with SCSI cables

ESCON Interface (Host)

The characteristics of the ESCON interface are as follows:

- Addressing
    - Logical control unit address: 0 (only one image)
    - Device addresses: 0 - 3
    - 64 logical paths per physical path
- Data transfer rate
    - 200 Mb/s link data rate
    - 17 MB/s instantaneous
- Interconnect
    - 2 or 3 km LED (50 or 62.5 micron)
    - 43 km channel distance

SCSI Interface (Device)

The characteristics of the SCSI interface are as follows:

- Addressing from 0 to 3 device addresses
- Data transfer rate
    - Fast and wide
    - 20 MB/s instantaneous
- Interconnect
    - 25 m maximum distance
    - 2-byte wide/differential

10.1.2 IBM 3591-A01 Control Unit Features

Table 35 shows the details of the feature codes available for the IBM 3591 Tape Subsystem.

Table 35 (Page 1 of 2). IBM 3591 Tape Subsystem Feature Codes			
Feature Codes	**Description**	**Machine**	**Model**
3311	ESCON channel adapter	3591	A01
2700	Remote support facility	3591	A01
2701	Remote support switch	3591	A01
2702	Remote support attachment	3591	A01
9632	Attachment to 3591	3590	B11
5106	0.6 m SCSI cable	3590	B11
5128	2.8 m SCSI cable	3590	B11
5134	3.4 m SCSI cable	3590	B11
5138	4.0 m SCSI cable	3590	B11
5145	4.5 m SCSI cable	3590	B11

Table 35 (Page 2 of 2). IBM 3591 Tape Subsystem Feature Codes			
Feature Codes	Description	Machine	Model
9221	First B11 in rack	3590	B11
9222	Second and Fourth B11 in rack	3590	B11
9223	Third B11 in rack	3590	B11

10.2 Equipment Ordering

For the hardware implementation of the IBM 3591 tape subsystem you have to perform several tasks. Refer to 3.1.1, "General Hardware Implementation Considerations" on page 38 to step through the implementation process.

From the given list, several changes may be applied. Review each item and adapt them to match the IBM 3591 tape subsystem preparation task and order as per the defined configuration.
Pay special attention when:

- The IBM 3591-A01 control unit is to be shared between several host processors.
- The IBM 3590 tape drives are shared with SCSI-attached hosts.
- The IBM 3591 tape subsystem coexists with the IBM 3490E tape subsystem.

Integration into Existing Tape Environment

In the majority of cases, the IBM 3591 tape subsystem can be installed easily and share the existing configuration without major changes. In an MVS operating system environment, however, when shared with the IBM 3490E, the IBM 3591 may require BTLS to direct the allocations to avoid massive JCL changes.
Refer to Chapter 11, "IBM 3591 Software Implementation" on page 187 for directing allocations under MVS.

Define the I/O Configuration

For the IBM 3591 tape subsystem, the IBM 3590-B11 tape drives look like IBM 3490Es. For the host, the IBM 3591 only has a single ESCON channel connection. All details will be covered in 10.3.1, "ESCON-Attached IBM 3591 High Performance Tape Control Unit" on page 173.

Remote Support

A remote Support Facility is available for the IBM 3591 tape subsystem. Remote support is part of maintenance strategy for the product. Feature codes are included when ordering the configuration. The modem and the telephone line must be provided by the customer.

- Remote Support Facility

  Feature code 2700 provides a cable and connectors for the attachment of a customer-supplied modem to the IBM 3591-A01 control unit for installation, operation and remote diagnostic support. It should be ordered for the first IBM 3591-A01 in an installation. Only one feature code 2700 should be specified per site because up to 16 IBM 3591-A01 can use the same remote

support facility. Each IBM 3591-A01 must specify either feature code 2700, 2701 or 2702. Feature code 2700 is plant or field installable.

- Remote Support Switch

  Feature code 2701 provides a switch, cables and connectors for the attachment of multiple IBM 3591-A01 control units to the remote support facility (feature code 2700). It should be ordered for the second IBM 3591-A01 in an installation. Only one switch should be specified per installation site. Feature code 2701 is plant or field installable.

- Remote Support Attachment

  Feature code 2702 provides an additional cable and connector to attach to the Remote Support Switch (feature code 2701). It should be ordered for the third through 16th IBM 3591-A01 in an installation. Feature code 2702 is plant or field installable.

Configuring

The ESCON fiber cable is not provided with the IBM 3591-A01 control unit. It can be ordered separately from IBM in standard lengths of up to 122 m (400 ft). Special, custom-built fiber cables up to 500 m (1640 feet) can also be ordered. Because of the single ESCON attachment, no jumper cable is required.

SCSI cables for internal IBM 3591-A01 control unit to IBM 3590-B11 tape drive connections are included in the configurator from the HONE CFSYSTEM.

If the IBM 3591 tape subsystem is to be shared with SCSI-attached host processors, extra SCSI cables are required. They are not included in the configurator.

The IBM 3590-B11 tape drives are not available from the plant installed in rack and therefore must be field merged into a customer supplied rack. Included in the shipment with each IBM 3590-B11, you will receive one cleaner cartridge, one blank IBM 3590 tape cartridge, one cartridge magazine and two SCSI terminators.

Figure 66 on page 173 shows a typical HONE CFSYSTEM order for an IBM 3591 tape subsystem. The order consists of four IBM 3590-B11 tape drives with an IBM 3591-A01 control unit to be installed in a IBM 9309 model 002 rack. The Remote Support Facility is also included for this first IBM 3591 tape subsystem.

Refer to 10.4, "Installation and Cabling" on page 178 and Chapter 3, "Hardware Implementation" on page 37 for all details on SCSI cable definition.

```
UNIT MDL/FC              DESCRIPTION               QTY

  3591-A01 ¢LIC¢ TAPE CONTROL UNIT                  1
      2700 REMOTE SUPPORT FACILITY                  1
      3311 ESCON ADAPTER                            1

  3590-B11 ¢LIC¢ TAPE DRIVE WITH RACL               1
      5145 4.5 M SCSI CABLE                         1
      9221 FIRST B11 IN RACK                        1
      9632 3591 ATTACH                              1

  3590-B11 ¢LIC¢ TAPE DRIVE WITH RACL               1
      5106 0.6 M SCSI CABLE                         1
      9222 SECOND OR FOURTH B11                     1
      9632 3591 ATTACH                              1

  3590-B11 ¢LIC¢ TAPE DRIVE WITH RACL               1
      5134 3.4 M SCSI CABLE                         1
      9223 THIRD B11 IN RACK                        1
      9632 3591 ATTACH                              1

  3590-B11 ¢LIC¢ TAPE DRIVE WITH RACL               1
      5106 0.6 M SCSI CABLE                         1
      9222 SECOND OR FOURTH B11                     1
      9632 3591 ATTACH                              1


  9309-002 RACK ENCLOSURE, 1.6 METER                1
     *9081 NON-WATERTIGHT POWER CORD                1
      9201 PRIMARY RACK ENCLOSURE                   1
     *9203 BLANK COVER 3HI                          3
     *9204 BLANK COVER 1HI                          3
     *9205 BLANK COVER 5HI                          4
```

Figure 66. HONE CFSYSTEM Output

Note: IBM 9309-002 features 9203, 9204, and 9205 are not shown on the output of the configurator, but you must order these features.
A feature 9081 is differs by country.

10.3 Host Attachment

Although the IBM 3591-A01 control unit primarily provides attachment to ESCON-attached host processors, it only uses a single SCSI interface to connect to the IBM 3590-B11 tape drives. The second available IBM 3590 tape drive SCSI port can be used to establish communication from tape drives to AIX or UNIX or AS/400 processors.

10.3.1 ESCON-Attached IBM 3591 High Performance Tape Control Unit

Feature code 3311 of the IBM 3591-A01 control unit is the ESCON channel adapter card. It is not field installable.

Neither a second ESCON adapter nor parallel attachment is available.

One or more hosts can access the IBM 3591 tape subsystem through an IBM 9032 or 9033 ESCON Director or the ESCON Multiple Image Facility (EMIF).

Figure 67 on page 174 through Figure 70 on page 176 show typical attachment configurations.

While preparing the configuration, observe the following conventions for the IBM 3591 tape subsystem:

- Do not define multiple paths from a given host to an IBM 3591 tape subsystem. Each host image can have only **one logical path** to an IBM 3591. Refer to 10.3, "Host Attachment" on page 173 for I/O device specification.

- The IBM 3591 ESCON attachment can connect to up to 64 logical channels.

- On each attached host, add four IBM 3490E devices even if fewer than four IBM 3590-B11 tape drives are physically installed. The addition of these devices will enable you to update the configuration without changing the IOGEN.

Figure 67 represents a single-host connection. One ESCON channel connects the host processor to the IBM 3591-A01 control unit.
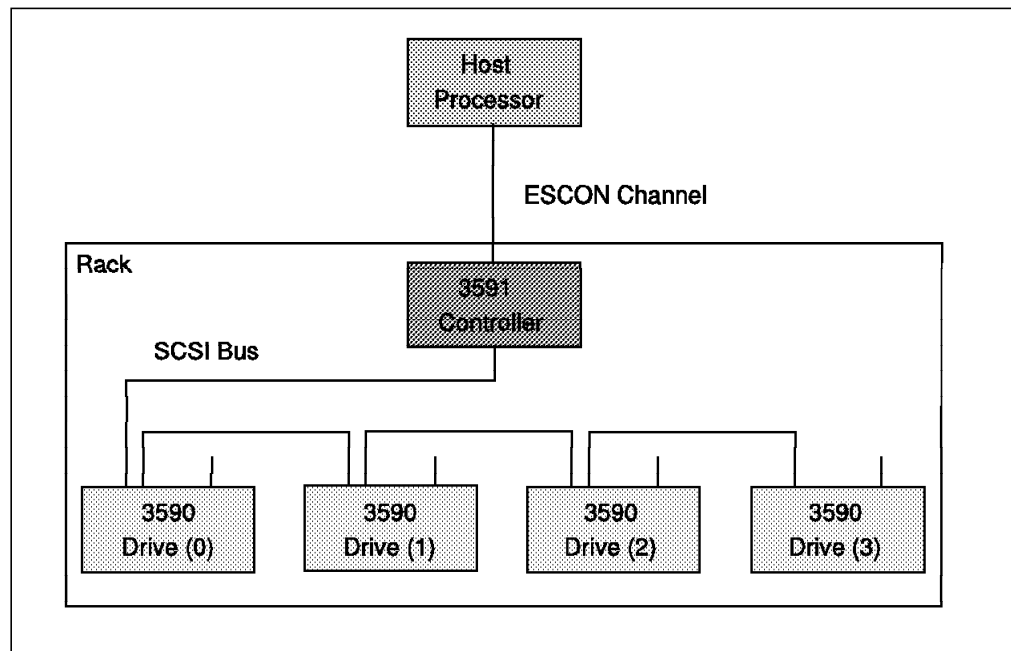

Figure 67. Single-Host Attachment

Figure 68 on page 175 depicts a multiple-host connection. Each host is connected through the IBM 9032 or 9033 ESCON Director to a single IBM 3591 control unit.
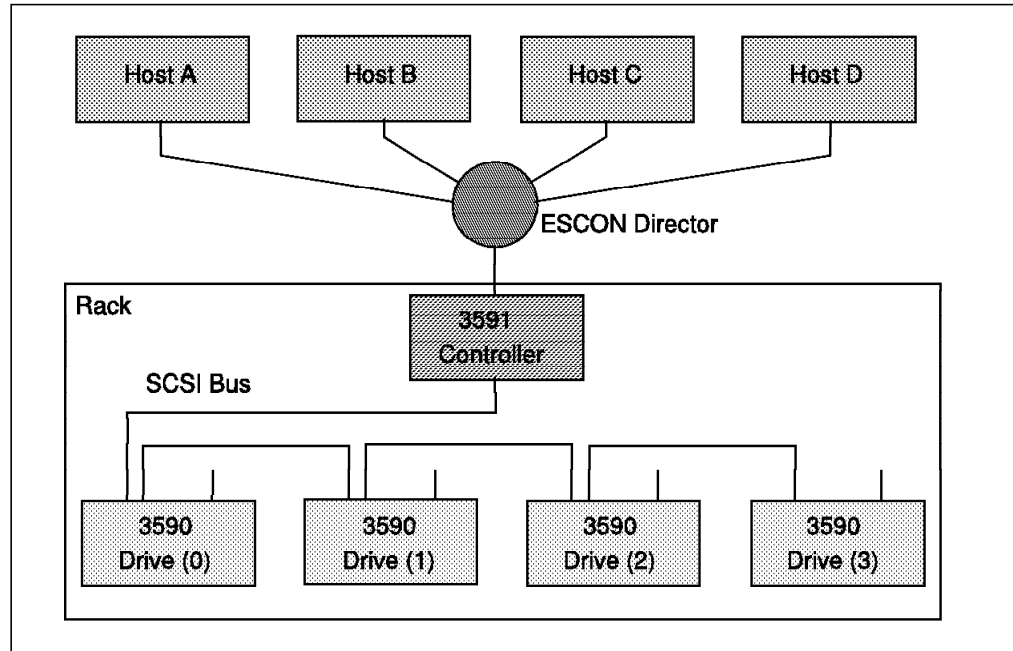
Figure 68. Multiple-Host Attachment through the ESCON Director

Figure 69 shows a multiple host connection through the EMIF. In this case only one ESCON channel is used. The EMIF enables sharing of the channel among the four hosts.
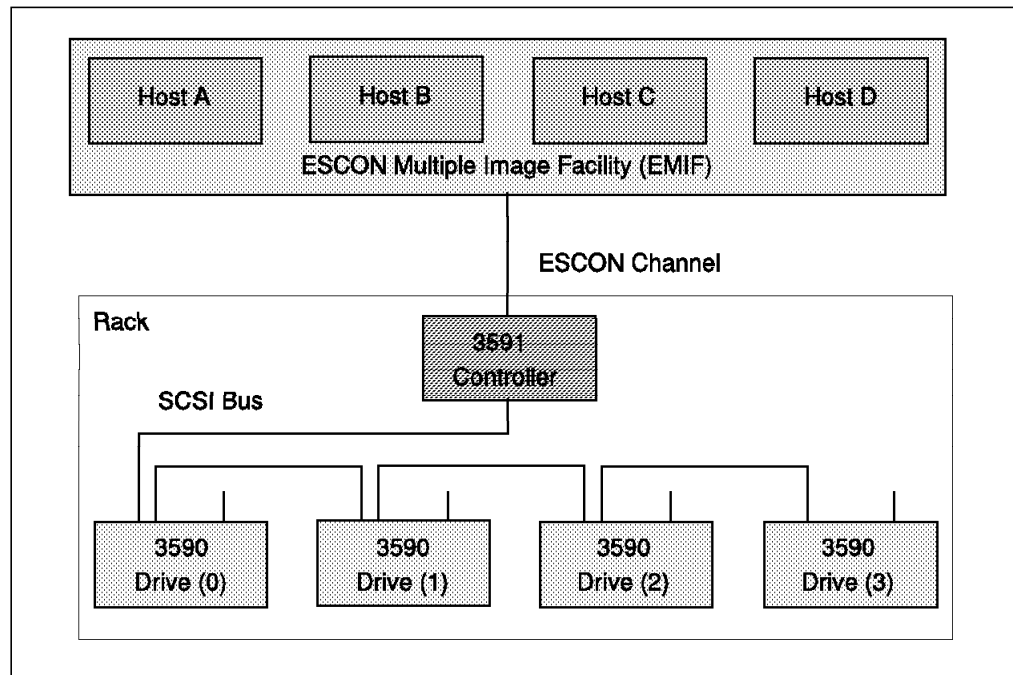

Figure 69. Multiple-Host Attachment through ESCON Multiple Image Facility (EMIF)

Figure 70 on page 176 depicts multiple-host attachment through the ESCON Director and EMIF.
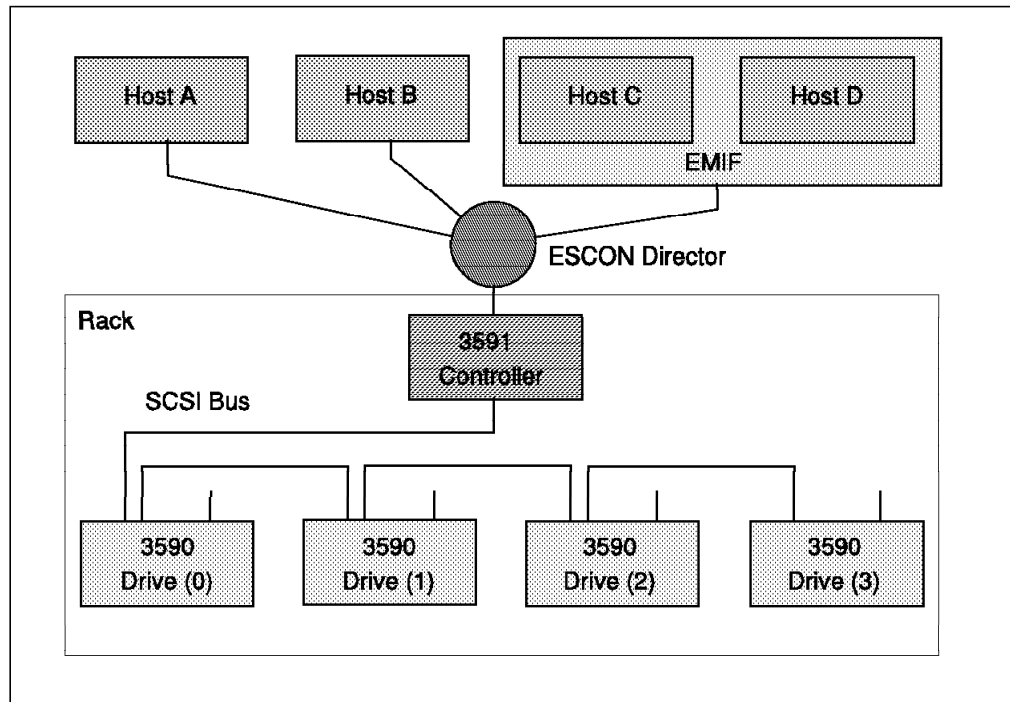
Figure 70. Multiple-Host Attachment through the ESCON Director and EMIF

Performance

The ESCON channel attachments can be configured to host channels with a data transfer rate of either 10 MB per second or 17 MB per second.

The IBM 3490 tape subsystem limits the maximum data transfer rate to either 4.5 MB per second or 9 MB per second. In comparison, the IBM 3591-A01 control unit does not limit this interface data transfer rate.

Distance

With the use of ESCON channels, the IBM 3591 tape subsystem can be installed in different physical locations from the host. It can be located up to 43 km (27 miles) from the processor.

By using ESCON LED fiber or ESCON laser fiber cables and IBM 9032 or 9033 ESCON Directors or IBM 9036 ESCON Remote Channel Extender, the IBM 3591 tape subsystem can be installed within the 43 km limit with minimum loss of performance.

Figure 71 on page 177 summarizes various connections for short and long distances.
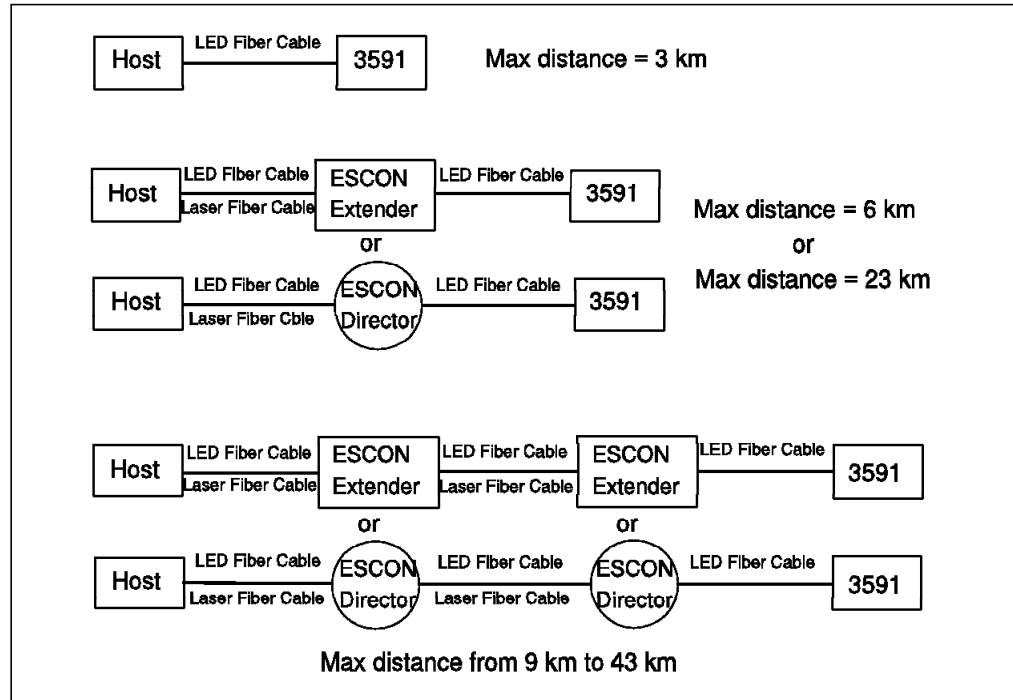
Figure 71. ESCON Distance Capabilities

For additional information about ESCON attachments refer to *Planning for Fiber Optic Channel Links*.

10.3.2 SCSI-Attached IBM 3590 Tape Drive

When attached to SCSI-capable processors (AS/400, RISC System/6000, SP2, or Open systems), and although the IBM 3590-B11 tape drives are at the same time connected to an IBM 3591-A01 control unit, the drives look like IBM 3590 and the media is written as 3590 media type. To prepare for and order SCSI-attached host connections requires following the same rules as if it was a SCSI IBM 3590 tape subsystem:

- There can be only one SCSI interface from the IBM 3590-B11 tape drives. The other interface is for the IBM 3591 connection.
- The maximum SCSI cable length is 25 m.
- The same RISC System/6000 or SP2 host SCSI adapter features can be used (2416, 2412, or 2420).
- The AS/400 IOP card (feature code 6501) allows only one IBM 3590 drive host connection.
- Multiple hosts can be daisy chained to a single drive.
- Multiple drives can be daisy chained to a single host.
- IBM 3590-B11 tape drives cannot be connected to two IBM 3591 control units.

Figure 72 on page 178 summarizes the connection capabilities of SCSI-attached hosts when the IBM 3590 tapes drives are shared.
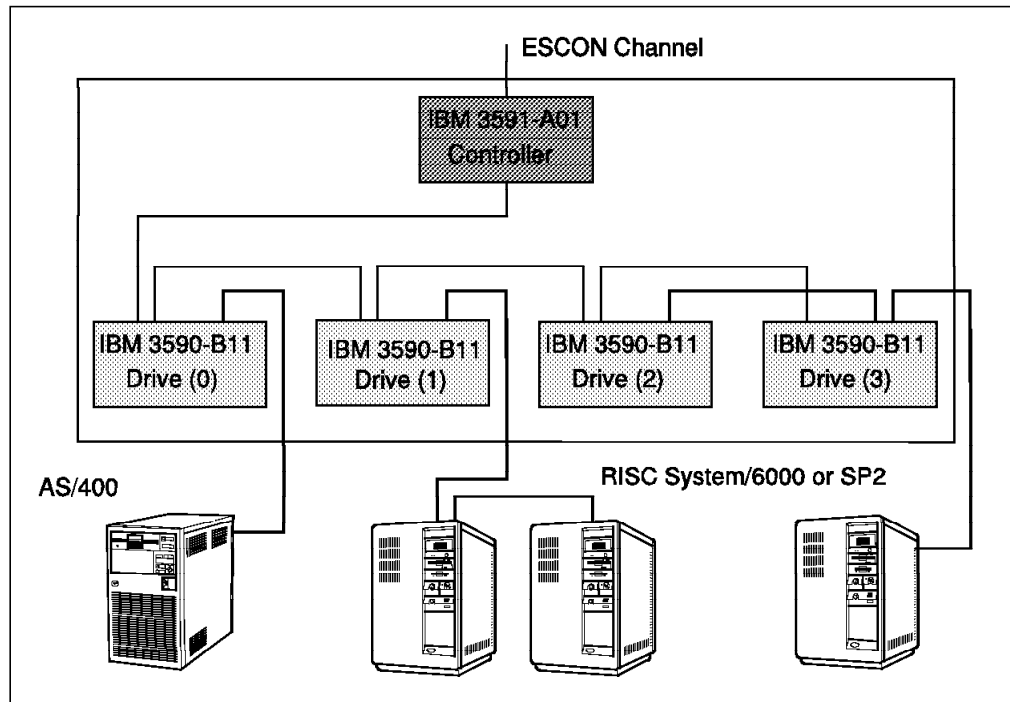
Figure 72. Sharing IBM 3590 Tape Drives

Refer to 3.4, "RISC System/6000 and IBM RS/6000 Scalable POWERparallel Systems" on page 57, and 3.5, "Application System/400" on page 65 for more details on the specific AS/400 and RISC System/6000 or RS/6000 Scalable POWERparallel (SP2) connections.

10.4 Installation and Cabling

Even if you order the IBM 3590-B11 tape drives, the IBM 3591-A01 control unit, and the IBM 9309 rack in the same order, they **do not arrive installed in the rack**. The IBM customer engineer must plan on installation time for the devices, although all of the required mounting hardware will be available.

It may be possible to install the IBM 3591 and the IBM 3590-B11 tape drives in the same or in different racks. For the installation consider these items:

- The IBM 3591-A01 control unit must be installed at the bottom of the rack.

- Only one of the IBM 3590 tape drive SCSI ports can be attached to an IBM 3591-A01 control unit. The other port can be used by a different SCSI (AS/400 or RISC System/6000) host connection.

- Any unused SCSI ports on the IBM 3590 tape drives must be terminated.

- SCSI cable total length must not exceed 25 m.

- One or more IBM 3590-B11 tape drives can be installed in a second rack. In this case, longer cable is used to interconnect the two racks. The total length for the complete cabling must not exceed the maximum length of 25 m.

Figure 73 on page 179 shows tape drive positions, feature codes for the drives, and SCSI-IDs and device numbers of each drives in an IBM 3591 tape subsystem. This configuration is same as the HONE configurator output shown in Figure 66 on page 173.
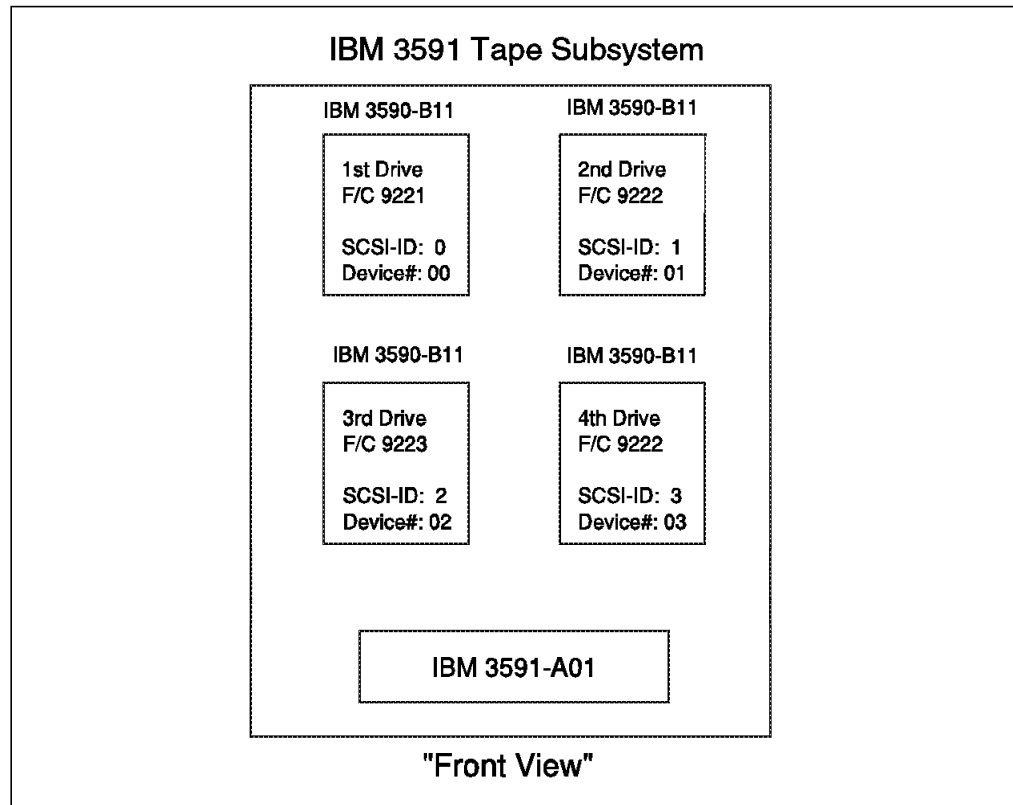
```
                    IBM 3591 Tape Subsystem

          IBM 3590-B11              IBM 3590-B11

        ┌──────────────┐         ┌──────────────┐
        │ 1st Drive    │         │ 2nd Drive    │
        │ F/C 9221     │         │ F/C 9222     │
        │              │         │              │
        │ SCSI-ID:  0  │         │ SCSI-ID:  1  │
        │ Device#: 00  │         │ Device#: 01  │
        └──────────────┘         └──────────────┘

          IBM 3590-B11              IBM 3590-B11

        ┌──────────────┐         ┌──────────────┐
        │ 3rd Drive    │         │ 4th Drive    │
        │ F/C 9223     │         │ F/C 9222     │
        │              │         │              │
        │ SCSI-ID:  2  │         │ SCSI-ID:  3  │
        │ Device#: 02  │         │ Device#: 03  │
        └──────────────┘         └──────────────┘


                 ┌────────────────────┐
                 │   IBM 3591-A01      │
                 └────────────────────┘


                      "Front View"
```

Figure 73. An IBM 3591 Tape Subsystem Configuration

In the rack, the cable installation must follow what has been ordered through the HONE configutator. Table 36 shows the cable feature codes and lengths.

Table 36. Cable Specifications for IBM 3591		
Feature Code	**Feature Code Description**	**Length**
5106	Between adjacent IBM 3590s in same rack	0.6 m
5128		2.8 m
5134	Between upper IBM 3590 and lower IBM 3590	3.4 m
5138		4.0 m
5145	Between upper 3590 and the 3591	4.5 m

Rack cabling

Figure 74 on page 180 shows the SCSI cabling between the IBM 3591-A01 control unit and four IBM 3590-B11 tape drives. This example follows the order list that was specified in Figure 66 on page 173.

A 4.5 m SCSI cable (feature code 5145) is required between IBM 3591-A01 to the first IBM 3590 tape drive located on top left. Because the cable is required to be long enough to allow the tape drive to be pulled out of the rack for maintenance service.
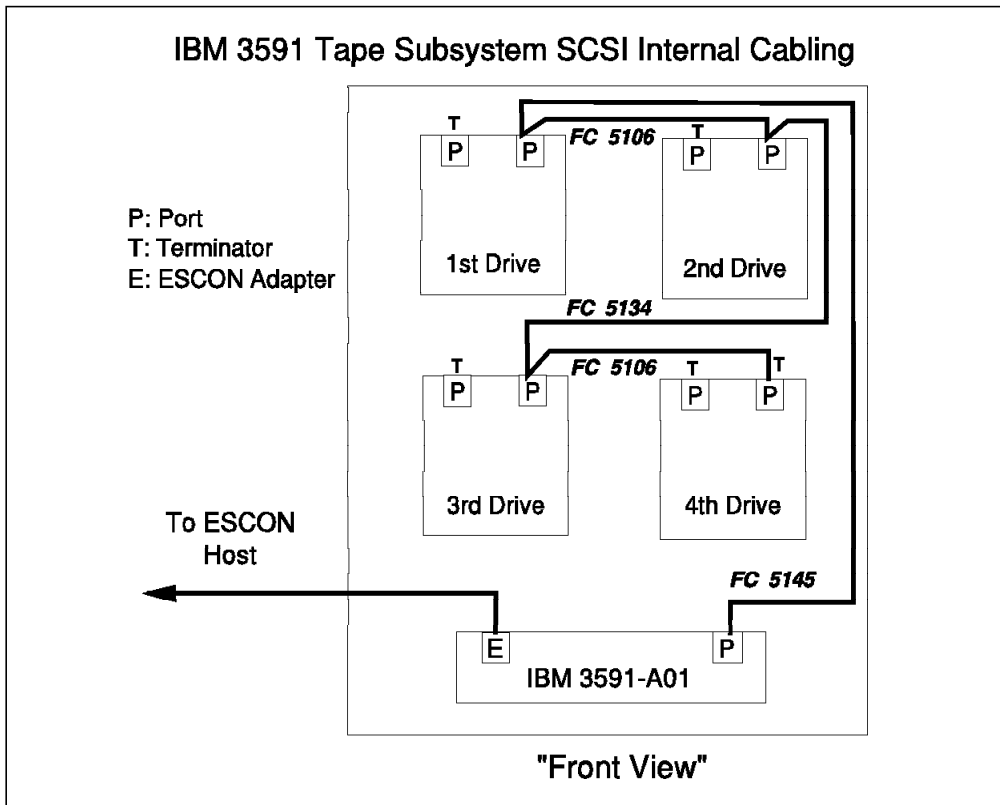
Figure 74. IBM 3591 Tape Subsystem SCSI Internal Cabling: Four drives

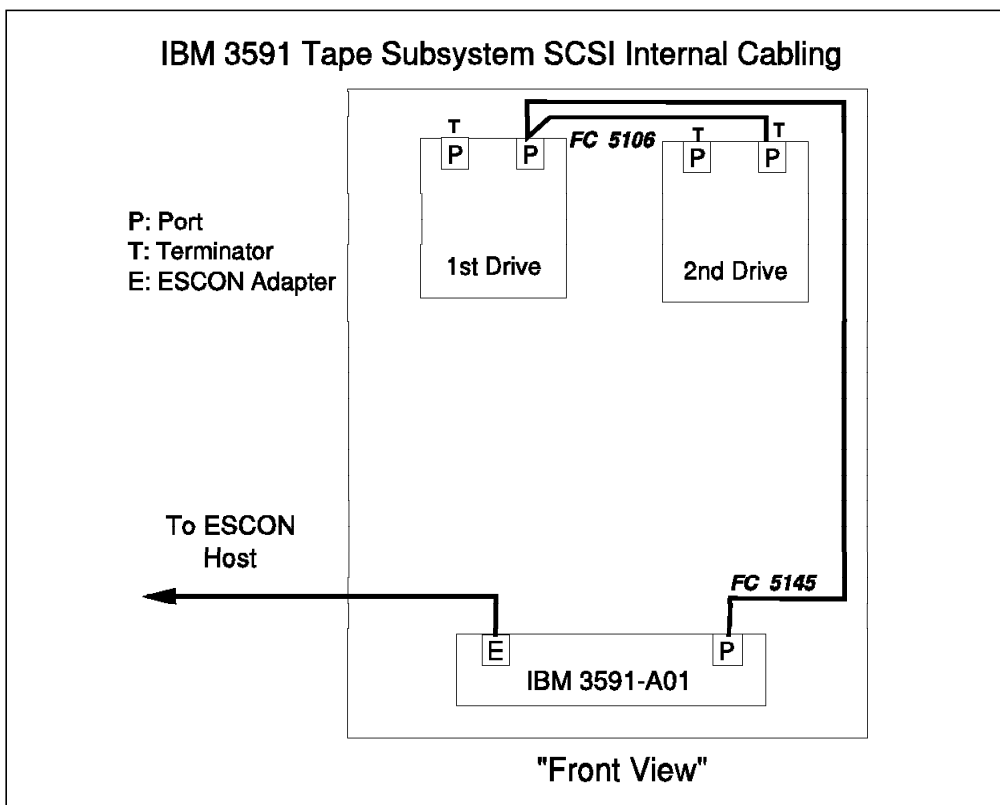Figure 75 shows the SCSI cabling in case of two tape drives.

Figure 75. IBM 3591 Tape Subsystem SCSI Internal Cabling: Two drives

Please refer to Appendix F, "SCSI Cabling for Magstar and IBM 3590 Tape Subsystem" on page 267 for the SCSI cabling.

Installation time

The estimated installation workload is as follows:

```
     Machine
   Type  Model    Estimated time
   ----  -----    -------------

   3591  A01       6.75 h
```

One trained customer engineer is required throughout most of the installation. For a short time, two engineers must be involved because of the weight of the IBM 3591-A01 control unit.

10.4.1 ESCON Host Connection

For the ES/9000 and the S/390, define the IBM 3591 tape subsystem and the ESCON channel configuration, using the IOCP. For MVS/ESA or OS/390, use the Hardware Configuration Definition (HCD) when available.

The following configuration rules apply when defining the IBM 3591 tape subsystem:

- Define a single control unit with one ESCON channel path.
- Specify UNITADD=((00,4)) for the control unit to define all the possible unit addresses that it supports.
- If the ESCON channel paths attach to an ESCON Director, specify link addresses on the control unit. The link addresses must be the ones associated with the physical ports on the ESCON Director to which the IBM 3591 tape subsystem attaches.
- Define as many tape drive devices as you have installed. The unit addresses of the devices must match those defined in the control unit.

Note: For software I/O configuration including HCD definition, you must specify a control unit type and device type as the IBM 3490E tape subsystem. In case of MVSCP, specify a device type of 3490. For the hardware I/O configuration, not including HCD definition, you can specify a control unit type as 3591 and device type as 3590 to IOCP.

Figure 76 on page 182 is an example of the hardware IOCP definition required for a configuration with one IBM 3591-A01 control unit and four IBM 3590-B11 tape drives attached to a single S/390 processor.

```
*
**   PATH 50
*
        CHPID PATH=50,TYPE=CNC


*
**   CHPID 50
*
        CNTLUNIT  CUNUMBR=180,PATH=(50),UNIT=3490,
                  UNITADD=((00,4))
        IODEVICE  UNIT=3490,ADDRESS=(180,4),CUNUMBR=(180),
                  UNITADD=00
```

Figure 76. Sample IOCP Definition for One IBM 3591 and One Host

Figure 77 is an example of IBM 3591 device MVSCP definitions for installation in two different locations as two BTLS libraries. Esoteric names BTLSLIB1 and BTLSLIB2 are defined for both IBM 3591 tape subsystems.

```
        IODEVICE  UNIT=3490,ADDRESS=(180,4)
        IODEVICE  UNIT=3490,ADDRESS=(190,4)
        UNITNAME  NAME=BTLSLIB1,UNIT=(180,4)
        UNITNAME  NAME=BTLSLIB2,UNIT=(190,4)
```

Figure 77. Sample MVSCP Definition for BTLS Logical Library

Be sure to code UNITNAME for each BTLS library. To ensure that the same set of devices by UNITNAME is also defined to BTLS, use the Library DEVICES command.

In HCD definition, if you specify control unit type as 3490 for the IBM 3591-A01 and define four tape drives for the IBM 3590-B11s, HCD issues warning message "CBDA890I Number of specified unit addresses below minimum number 16 for control unit" but you can use this definition. To avoid this HCD warning message, control unit type specification of HCD can be specify one of the IBM 3490 C model number such as 3490-C22, 3490-C11, 3490-C10, 3490-C2A, or 3490-C1A. Note that APAR OW16279 must be applied for defining 3490-Cxx. For HCD definition specifications and panels follow the same rules and refer to Chapter 4, "Software Implementation" on page 81 for more details.

For multihost sharing and during processing, each physical IBM 3590 can be assigned for exclusive use by a single host at a given time, with I/O occurring concurrently for all IBM 3590 machines with the hosts to which the drives are assigned. The VARY ONLINE/OFFLINE commands for MVS and the ATTACH/DETACH commands for VM work as they are defined.

10.4.2 SCSI Host Connection

SCSI cables and interposers that connect an IBM 3590 tape subsystem to SCSI-attached host processors must be ordered separately. SCSI cables used to connect the IBM 3590-B11 tape drives inside the rack can be ordered with the IBM 3591 configurator.

Cabling the IBM 3590-B11 tape drives and defining the tape drive addresses can be different for SCSI-attached hosts and the IBM 3591-A01. It is strongly

recommended to use the same style of connection and the same tape drive addresses to minimize operational actions.

To install and configure the IBM 3591 tape subsystem shared with SCSI-attached host processor, refer to Chapter 3, "Hardware Implementation" on page 37 attaching to RISC System/6000 and IBM RS/6000 Scalable POWERparallel Systems.

When sharing an IBM 3590 tape drive between ESCON-attached and SCSI-attached host processors, be sure that the drive is not used by both platforms at the same time.
On RISC/6000 or SP2 processor, to prevent another system using a drive, the SCSI host must issue RESERVE UNIT SCSI I/O command. This command is identical to the ASSIGN CCW that is performed on VARY ONLINE for MVS or VM systems. To free the device, the SCSI host sends a RELEASE UNIT SCSI I/O command. This command is also identical to the UNASSIGN CCW that is performed on VARY OFFLINE command. See "Tape Drive Assignment" section of Chapter 4 "Multisystem Access" in a redbook *Guide to Sharing and Partitioning IBM Tape Library Dataserver*. Sharing drives on AS/400 follows the same general rules. Allocation and Deallocation commands are issued to reserve the drive for exclusive use by only one host at a time.

10.5 Environmentals

Below we present specifications for the machine dimensions and operating environment, list the power requirements and heat output, and compare the floor space and power requirements of the IBM 3591, IBM 3480, and IBM 3490E tape subsystems.

10.5.1 Machine Dimensions and Operating Environment

IBM 3591 Tape Subsystem Dimensions

Note: Machine dimensions and service clearances for the IBM 3591 tape subsystem are the same as for the IBM 3590 tape subsystem in a rack for SCSI connection.

Table 37 shows the dimensions and service clearances for the IBM 3591 tape subsystem.

Table 37. IBM 3591 tape subsystem Dimensions and Service Clearances			
	Unit	**Rack Dimension**	**Service Clearance**
Front	mm (in.)	650 (25.60)	1524 (60)
Side	mm (in.)	921 (36.30)	0 (0)
Height	mm (in.)	1578 (62.10)	-
Rear	mm (in.)	-	760 (300)

IBM 3591-A01 Control UnitPhysical Specifications

Within the rack, the IBM 3591-A01 control unit has the following physical specifications:

```
EIA Units:    8
Width:        445 mm (17.5 in.)
Depth:        432 mm (17.0 in.)
Height:       330 mm (13.0 in.)
Weight:       40.8 kg (90 lb 0 oz)
```

IBM 3591-A01 Control Unit Environmental Specifications

The following specifications apply only to an IBM 3591-A01 control unit:

```
Ambient Temperature:
      15 to 40 degrees C (50 to 104 degrees F)
Relative Humidity:
      5% to 80%
Capacity of Exhaust:
      2.3 cubic meter/mn
```

See Table 14 on page 40 for the environmental specifications for the IBM 3590 tape subsystem.

10.5.2 Power Requirements and Heat Output

The IBM 3591-A01 includes a power supply that operates from 200 to 240 volts AC at 47 to 63 Hertz with 1 phase. A power cord from the IBM 3591 to the rack is supplied. Special ordering is not required.

Note: For maintenance purposes, the front and rear panels of the IBM 3591 have indicators and switches.

Table 38 shows the heat output and power requirements for the IBM 3591 tape subsystem.

Table 38. IBM 3591 Heat Output and Power Requirements				
	Unit	3590 Model B11	3591 Model A01	9309 7202 7215 Rack
Heat Output	kW (kBtu/hr)	0.3 (1.02)	0.24 (0.80)	0.1 (0.34)
Power Requirement	kVA (max) (phases)	0.3 (1)	0.7 (1)	0.1 (1)

For more detailed information refer to:

* *IBM 3590 High Performance Tape Subsystem Introduction and Planning Guide*
* *IBM Rack Enclosure General Information and Site Preparation Guide*
* *IBM 3591 Tape Control Unit Model A01 Introduction, Planning, and User's Guide*

Remote Power Control

The IBM 3591-A01 control unit does not support the remote power control function. To take advantage of this function, the IBM 3591-A01 control unit power cord must be plugged to the rack power which contains a remote power control interface.

10.5.3 IBM 3591 Tape Subsystem

Table 39 gives you a good idea of what the benefit would be if an IBM 3480 or IBM 3490E tape subsystems were replaced with an IBM 3591 tape subsystem.

The four tape drives configuration is as follows:

- One IBM 3480-A22 control unit with two IBM 3480-B22 tape drive units
- One IBM 3490-A10 control unit with one IBM 3490-B40 tape drive unit
- Two IBM 3490-C22s
- One IBM 3591-A01 control unit four IBM 3590-B11 tape drives.

Table 39. Environmental and Power Comparison				
Description	**3480**	**3490-Axx**	**3490-C22**	**3591**
Floor space (m2)●	1.262	1.271	1.170	0.585
Difference/3591 (%)	53.6	54	50	-
Power (kVA)●	2.7	2.0	1.8	1.1
Difference/3591 (%)	60.3	45	38.8	-
● Floor space without service clearance ● Without heat output				

When compared with other tape subsystems, the IBM 3591 tape subsystem appears a lot more economical on each specification. Fifty percent is the average (38.8 to 60.3) of what you may get for environmental benefit when replacing an IBM 3480 or IBM 3490E tape subsystem with an IBM 3591 tape subsystem.

Chapter 11. IBM 3591 Software Implementation

Support for the IBM 3591-A01 control unit is provided in OS/390, MVS/ESA, VM/ESA, and VSE/ESA system operating environments on ES/9000 and ES/3090 systems or System/390 Parallel Transaction and Enterprise Servers. This support applies to the release of the operating systems that support IBM 3490E tape subsystems. The IBM 3591 control unit allows the operating system to communicate with the IBM 3590 tape drives as if they are IBM 3490E tape drives.

The following operational constraints may be encountered:

- A native IBM 3490E tape unit and an IBM 3591-attached IBM 3590 emulating a IBM 3490E use unique media types that cannot be interchanged on the two types of tape devices. When emulated IBM 3490E drives are defined on a host, special mechanisms must be established to direct allocation to the desired drives.

- When the application software handles the IBM 3590 as an IBM 3490E, the capacity of the tape cartridge may be perceived as an IBM 3490E media type. Thus, with some applications or products, special customization may be required to exploit the full capacity of the IBM 3590 media.

- Catalogs and inventories that associate volumes and data sets with IBM 3591-attached drives reflect IBM 3490E media type. A future migration from IBM 3591 control units to a unit that presents drives to the host as 3590 device type may entail updates to the catalogs and/or inventories maintained on the host.

Specific issues related to the topics of capacity utilization, drive allocation, and transition to native IBM 3590 vary among program products. We will discuss the first two topics in this chapter and address the third in Chapter 12, "Migration from IBM 3591 to IBM 3590" on page 213

Figure 78 on page 188 depicts the operational environment of native and emulated 3490E drives.
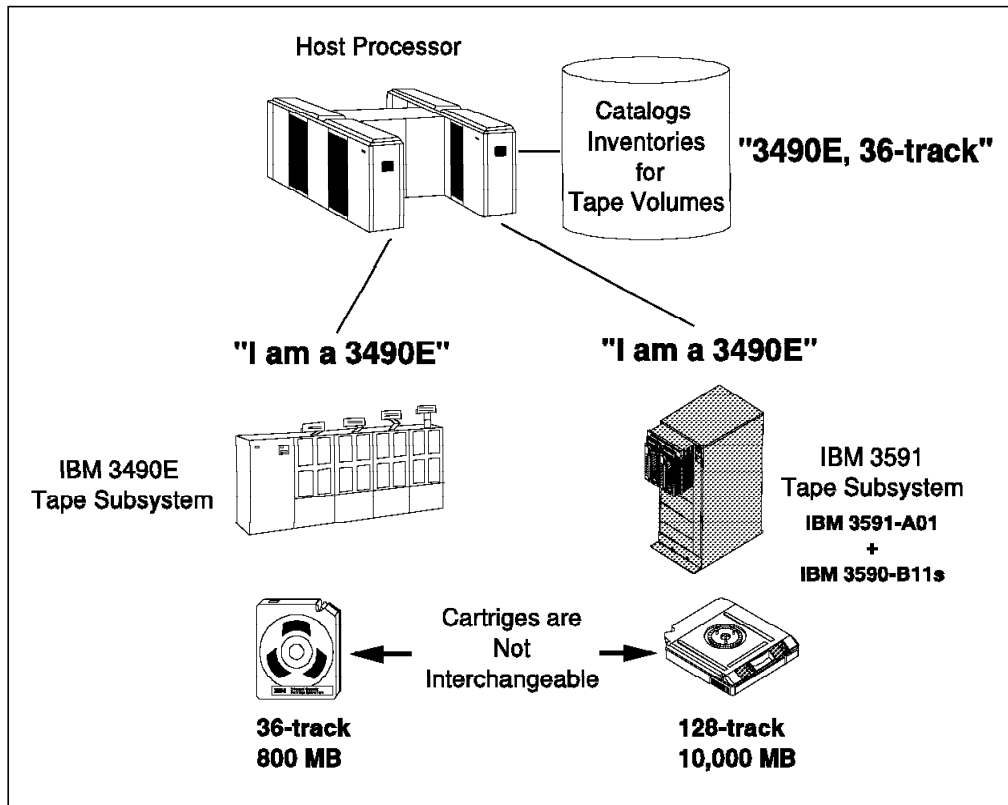
Figure 78. Operational Environment with IBM 3490E and IBM 3591 Tape Subsystem.

11.1 Operating Software Requirements

Table 40 summarizes the MVS operating software levels that support IBM 3490E drives and thus IBM 3590 drives attached through an IBM 3591-A01 control unit. Also shown are the levels that support IBM 3590 Magstar drives attached through an IBM 3590-A00 control unit.

MVS/SP	DFP					DFSMS		
	3.1.1	3.2.0	3.2.1	3.3.0	3.3.2	1.1.0	1.2.0	1.3.0
2.2.3	E							
3.1.3	E	E	E					
4.1.0		E	E					
4.2.0		E	E	E	E			
4.2.2		E	E	E	E			
4.3.0		E	E	E	E	E	E M	E M
5.1.0				E	E	E	E M	E M
5.2.0						E	E M	E M
5.2.2						E	E M	E M

Table 40. MVS Operating Software Support of IBM 3490E and IBM 3590 Drives

Note:

E indicates IBM 3490E is supported
M indicates IBM 3590 is supported

Table 41 on page 189 summarizes the operating software levels that support IBM 3490E and IBM 3590 drives in VM, VSE, and TPF environments.

Table 41. VM, VSE, and TPF Support of IBM 3490E and IBM 3590		
Environment	Minimum Software Required to Support	
	IBM 3490E	IBM 3590
VM/ESA (and quests)	VM/ESA 1.1.1	VM/ESA 2.1
VSE/ESA	VSE/ESA 1.2	VSE/ESA 2.2
TPF	TPF 3.1 [1]	TPF 4.1
Note:		
[1] No statement of support for IBM 3591 tape subsystem		

11.2 General Considerations

In this section we highlight considerations you need to be aware of when using emulated 3490E drives.

11.2.1 Device Allocation

An native IBM 3490E tape unit and an IBM 3591-attached IBM 3590 emulating an IBM 3490E use unique media types that cannot be used interchangeably on the two types of tape devices. Thus, both native and emulated 3490Es are defined on a host, you must establish special mechanisms to direct allocation to the desired type of 3490E. Allocation considerations may require attention, even if true 3490E tape drives are not present but other types of stand-alone cartridge tapes are defined on the host. For example, IBM 3490E drives can read both IBM 3480 and IBM 3490 cartridges; thus, action may be required to ensure that IBM 3591-attached drives are not allocated for use by applications using CST or ECCST cartridges.

11.2.2 Media Capacity

As part of 3490E emulation, the media type of the 3590 cartridge is presented to the host as that of 3490E enhanced capacity media. The capacity of the 3590 media is 10 GB uncompacted, approximately 12 times that of 3490E media. When the host software handles the IBM 3590 as an IBM 3490E, the capacity of the tape cartridge on a 3591-attached drive may be perceived as a 3490E media type. For certain products and applications, special actions may be required to exploit the full capacity of the 3590 media.

The extent to which the full capacity of 3590 media is exploited on emulated 3490E drives is dependent on how the software determines end-of-volume. Software products can use several methods to detect end-of-volume:

- Write to physical end of tape
- Use wrap and segment values to determine that end of tape is approaching
- Count the amount of data written on tape

Depending on the method used, different products may or may not be able to utilize the full capacity of the 3590 media.

Some products may require that dedicated tape volumes be used to store data sets, that is, you cannot stack the data sets on a volume with other data sets. If

the size of the data set does not warrant the use of high capacity 3590 media, you may consider allocating these data sets on lower capacity media.

11.2.3 Media Compatibility and Migration Considerations

The IBM 3591-attached drives write tapes in 3590 media format and present 3590-format block identifiers (block IDs) to requesting programs. Thus, tapes written by IBM 3591-attached drives are compatible with IBM 3590 ESCON and/or SCSI attachment hardware offerings. Catalogs and inventories reflect 3490E media type, not 3590 media, because the emulated device type is 3490E. A future migration from IBM 3591 control units to a unit that presents drives to the host as 3590 device types may entail updates to the catalogs and/or inventories maintained on the host. With MVS/ESA, volumes must be recataloged as 3590 media. For certain applications inventories may also require updates to volume entries.

To minimize the complexity of future migration steps, we recommend that you dedicate an explicit volume serial range to 3591-created cartridges.

11.2.4 Block ID Format

A block ID returned from an IBM 3490E device to the host in connection with a Read Block ID CCW is made up of 32 bits as follows:

Bits	Used for
0	Wrap
1-7	Segment number
8-9	Format
10-31	Logical block number

The IBM 3590 tape drive uses all 32 bits for block numbering. The wrap and segment notations in 3490E media format cannot be presented in a meaningful context for 3590 media. Furthermore, a nonzero value in any of these bits is interpreted by the IBM 3590 drive as part of the 32-bit logical block number. To ensure that tapes written on drives attached to an IBM 3591 can be read in the future by IBM 3590 drives attached as 3590 device type, the wrap, segment, and format mode bits are presented by the IBM 3591 to the host as zeros. Thus, using wrap and segment fields to determine that physical end-of-tape is approaching is not effective. Applications and products with dependencies on wrap, segment, and/or format mode bit settings as returned from the IBM 3591 tape subsystem may experience unpredictable results.

With the Locate Block ID command, bits 0-9 of the block ID, if set by host applications, are ignored by the IBM 3591. With the IBM 3591, only the logical block number itself is required for high-speed locate.

Information returned to the host by the Read Buffered Log command is presented in 3490E device type format.

11.2.5 Block Size Considerations

The 22-bit logical block number limits the number of blocks that can be written or read on a cartridge to 4,194,303. A tape written on a SCSI or IBM 3590-A00 attached IBM 3590 tape drive is readable with the IBM 3591, only up to this maximum number of blocks. Furthermore, larger block sizes are required to utilize the full cartridge capacity with an IBM 3591. The minimum block size to fully utilize a cartridge is approximately 8 KB, assuming a 3:1 compaction ratio (30 GB / 4,194,303 = 7.2 KB).

11.2.6 Tape Device Naming Conventions

We make frequent reference to tape device names in this document. Table 42 shows the hardware (marketing device name) and software (MVS generic unit name) names for cartridge tape devices. The MVS generic unit names are the names used by the MVS job control language (JCL) to communicate with the MVS operating system. Use the MVS generic unit name for any JCL statements or other commands that specify device names, for example DFSMShsm commands and IDCAMS commands.

Table 42. Cartridge Tape Device Naming Conventions			
Device Description	Hardware Name	Generic Unit Name	Recording Format
3480 device without IDRC capability	3480	3480	18 track
3480 device with IDRC capability	3480	3480X	18 track
3490 device	3490	3480X	18 track
3490E device	3490E	3490	36 track
3590 attached through 3591-A01	3591/3590	3490	128 track
3590 attached through 3590-A00	3590	3590-1	128 track

11.3 MVS/ESA Environments

Use of esoteric names to dependably influence allocation between native and emulated IBM 3490E machines has the potential to require comprehensive updates to JCL but is an option for managing device allocation. You have to define unique esoteric names for your native and emulated IBM 3490E drives and change your jobs accordingly. All tape jobs may require JCL modifications if generic unit names are currently in use.

Basic Tape Library Support (BTLS) is a program offering that provides support for IBM Automated Tape Library Dataservers in MVS/ESA environments where system-managed tape is not available. BTLS provides a means of controlling allocation with minimum updates to JCL. BTLS influences allocation by associating a group of drives with a group of volumes as a logical library and provides tools for directing allocation to the desired logical library.

If you have both native and emulated nonlibrary IBM 3490E devices, you have to use either esoteric names or BTLS to direct allocation to the desired type of 3490E. Depending on your current environment, you might consider the following:

- **System-managed tape in use**

  Recent enhancements to BTLS enable you to use BTLS in system-managed tape environment to control allocations to non-library tape drives. The BTLS LIBRARY command can be used to create "logical" libraries by associating a group of volumes with a group of nonlibrary drives. We recommend that you install BTLS to manage the media-to-drive relationship for your native and emulated IBM 3490E drives outside tape library.

  To use BTLS in a system-managed tape environment, PTFs for APARs OW03323 and OW18860 must be applied.

- **BTLS in use**

If you are currently using BTLS to manage your tape allocations, you can simply define IBM 3591-attached drives as a new BTLS library. The enhancements introduced by APARs OW18860 and OW19261 will assist you in directing device allocation to the desired 3490E drive.

• **Neither system-managed tape nor BTLS in use**

If you currently use neither system-managed tape nor BTLS, you have to define appropriate esoteric names to differentiate the native and emulated IBM 3490Es. As an alternative, we recommend that you install BTLS to manage the media-to-drive relationship.

No action is required to modify applications using drives in IBM 3494 and 3495 Automated Tape Library Dataservers when you install the IBM 3591 because allocation of library drives is done under control of system-managed tape or BTLS. However, you have to review your ACS routines to ensure that allocations for emulated IBM 3490E drives are not assigned a storage class, thus directing them outside the library.

Even if you do not have native IBM 3490E tape drives, but other types of stand-alone cartridge tapes are defined on the host, you must ensure that a desired type of drive is allocated. We address specific cases in the sections that follow.

First, we discuss recent enhancements to BTLS and describe how to use BTLS with the IBM 3591. We then go on to discuss major tape users in an MVS environment.

11.3.1 BTLS Enhancements

BTLS has been changed by the addition of new functions that will help you control allocation of tape drives. The APAR numbers for these changes are:

OW18860   for BTLS for DFSMS/MVS V1 (5655-056)
OW19261   for BTLS for MVS/DFP V3 (5655-057)

They provide you with the following enhancements (because MVS/DFP does not support system-managed tape, the first of these enhancements is not applicable with OW19261):

• **BTLS coexistence with system-managed tape**

Previously, BTLS could not be used in a system-managed tape environment; if installed, the Library Control Function of BTLS was disabled by BTLS APAR OW03323, which enables system-managed tape support for the IBM 3494 and 3495 Automated Tape Library Dataservers. New APAR OW18860 enables a subset of BTLS support to function after OW03323 has been installed, thus allowing some of the BTLS functions to be used in a system-managed tape environment. The BTLS LIBRARY command can be used to create logical libraries by associating a group of volumes with a group of nonlibrary drives.

With OW03323 and OW18860 installed, the BTLS LIBRARY commands that result in communication with a IBM 3494 or 3495 Automated Tape Library Dataserver are disabled, but the following LIBRARY commands can be used to describe the logical libraries for directing device allocation:

DEFINE   Define a volume or range of volumes in a BTLS library
DELETE   Delete a volume or range of volumes from a BTLS library
DEVICES   Define the devices in a BTLS library
JOBNAMES   Define the job names that should use a BTLS library

LISTVOL   List the volumes defined in a BTLS library
OPTIONS   Define the BTLS operating options

- **Volume range specification**

  The BTLS LIBRARY command is enhanced to allow the VOLUME parameter
  to identify either a single volume or a range of volumes. For example:

  ```
  LIBRARY DEFINE VOLUME(ABC000-ABC025)
  LIBRARY DELETE VOLUME(ABC000)
  LIBRARY AUDIT  VOLUME(ABC010-ABC020)
  ```

  To specify a range of volume serial numbers, the following rules apply:

  - Specify six-character volsers, separated by a dash (-).
  - The first three characters of each volser must be the same.
  - The last three characters of each volser must be numeric, 000 to 999.
  - The second volser must be numerically greater than the first.

  The range type volser specification is valid with the following BTLS
  commands:

  AUDIT   Verify that a volume is present in an ATL
  DEFINE   Define a volume or range of volumes in a BTLS library
  DELETE   Delete a volume or range of volumes from a BTLS library
  SETCATEGORY Assign a volume to a category

  Note: AUDIT and SETCATEGORY are valid only if the PTFs for APAR
       OW03323 have not been installed.

- **Allocation based on esoteric name**

  The LIBRARY OPTIONS command supports a new allocation option
  character, *E*. Option *E* enables you to direct scratch allocations to a library
  using special BTLS esoteric names. To use the new option, specify the
  OPTIONS command as follows:

  ```
  LIBRARY OPTIONS (EEE)
  ```

  The first of the option characters specifies the allocation rule. The second
  character enables BTLS allocation support, and the third enables BTLS DDR
  support.

  Allocation option *E* causes BTLS to direct scratch allocations into or away
  from a BTLS library based on esoteric unit names. The following esoteric
  names are supported:

  ```
  BTLSLIB1   BTLSLIB2   BTLSLIB3   BTLSLIB4
  BTLSLIB5   BTLSLIB6   BTLSLIB7   BTLSLIB8
  ```

  When option *E* is used, BTLS allocation uses EDTINFO to determine whether
  the set of eligible devices match one of the new BTLS esoteric names. If an
  allocation uses these special esoteric names, BTLS allows the allocation to
  be directed to the BTLS library devices. However, if the allocation does not
  use one of the special esoteric names, BTLS ensures that none of the library
  drives is allocated.

A current user of BTLS to control an IBM 3494 or 3495 Automated Tape Library
Dataserver or a non-IBM 3494 or non-IBM 3495 user who requires the allocation
control functions should install the PTF for APAR OW18860 or OW19261 to take
advantage of the added function for specifying ranges of volsers with the
LIBRARY command and for exploiting the BTLS special esoteric names.

Table 43 on page 194 summarizes the operating software levels that support BTLS and APARs OW18860 and OW19261.

MVS/SP	DFP			DFSMS/MVS		
	3.1.1	3.2	3.3	1.1	1.2	1.3
2.2.3	S					
3.1.3	S	S				
4.1.0		S				
4.2.0		S	S +			
4.2.2			S +			
4.3.0			S +	S +	M S +	M S +
5.1.0			S +	S +	M S +	M S +
5.2.0			S +	S +	M S +	M S +
5.2.2				S +	M S +	M S +

Table 43. MVS Operating Software Support of BTLS

Note:

S indicates BTLS is supported
M indicates BTLS supports 3590-A00 attached Magstar drives
+ indicates that enhancements provided by OW18860 (DFSMS/MVS) or OW19261 (DFP) are available

11.3.2 Device Allocation with BTLS

With the enhancements described above, BTLS can be used in an operational environment with or without IBM 3494 and 3495 Automated Tape Library Dataservers and can coexist with IBM 3494 and 3495 Automated Tape Library Dataservers that are SMS managed. In the rest of this section we assume that the PTFs for APAR 0W18860 (DFSMS/MVS) or OW19261 (DFP) have been applied.

11.3.2.1 Defining the IBM 3591 Logical Library

During the setup of BTLS, you must define the IBM 3591-attached tape drives and the 3590 volsers to a BTLS-managed logical library:

1. Use the LIBRARY DEVICES command to describe the IBM 3591-attached emulated IBM 3490E drives to BTLS.

2. Use the LIBRARY DEFINE command to describe the 3590 volumes to the BTLS volume catalog. The library name referenced is the same as that used to describe the IBM 3591-attached drives with LIBRARY DEVICES.

An alternative would be to define your native IBM 3490E drives as a BTLS logical library (and either define IBM 3591-attached drives as a separate BTLS library or treat them as nonlibrary drives). However, this would require that you describe your existing 3490E volumes to the BTLS volume catalog with the LIBRARY DEFINE command. In addition, if you used allocation option *E* you would have to define an esoteric for the native IBM 3490E drives and change your existing JCL to use the new esoteric. Obviously, more work is involved with this approach, and we do not recommend it.

11.3.2.2 Specific Volume-Serial Mounts

Tape drive allocation for specific volsers is handled through the association of volumes and tape drives in the logical library. For a volser defined in the BTLS volume catalog as part of the IBM 3591 logical library, an IBM 3590 drive attached to the IBM 3591 is allocated. For a volser not defined for this library, a drive outside the IBM 3591 logical library is allocated.

11.3.2.3 Scratch Mounts

When a specific volume is required, allocation control is simple for BTLS. If there is a BTLS volume record in the catalog, BTLS directs allocation to the library named in the volume record. If there is no BTLS volume record in the catalog, BTLS directs allocation to nonlibrary tape drives.

For scratch requests, you must tell BTLS when to allocate to the IBM 3591 logical library. To direct allocation to an IBM 3591-attached drive for scratch mounts, we recommend either of the following techniques:

Using Job Names: With this technique, BTLS directs allocation to or away from the IBM 3591 logical library according to job name. To accomplish this:

- Use the LIBRARY JOBNAMES command to list up to 50 job names or wildcards per library for which drive allocation is to be steered to the IBM 3591 logical library.

- Use the LIBRARY OPTIONS command to specify the *J* allocation option, which orders BTLS to base scratch allocation on job name.

Using Special BTLS Esoteric Names: BTLS provides eight special esoteric names that enable BTLS to ensure that only scratch allocations associated with an IBM 3591 logical library (through a special esoteric name) are directed to an IBM 3591-attached drive. The supported esoteric names are:

```
BTLSLIB1    BTLSLIB2    BTLSLIB3    BTLSLIB4
BTLSLIB5    BTLSLIB6    BTLSLIB7    BTLSLIB8
```

To use this technique:

- Create the BTLS esoteric name, for example, BTLSLIB1, for the IBM 3591-attached devices, using MVSCP or HCD.

- Change the JCL in the appropriate jobs to specify UNIT=BTLSLIB1.

- Use the LIBRARY OPTIONS command to specify the *E* allocation option that orders BTLS to base scratch allocation on the esoteric name.

With allocation option *E*, there is no need to modify jobs that use existing IBM 3490E drives. Allocations that use generic unit names or non-BTLS esoteric names will continue to be directed to nonlibrary drives. With the *E* option, BTLS recognizes that a BTLS esoteric name was not used and excludes all of the library drives from allocation.

Note: BTLS also supports allocation option *I* which assumes that the esoteric name is being used to control scratch allocations. BTLS allocation assist does not influence scratch allocations when the *I* option is used. You would not be able to use generic unit name 3490 for your native IBM 3490E devices if you installed the IBM 3591, whereas with option *E* you can continue to use the generic name for the native IBM 3490E drives.

11.3.2.4 Implementation Tasks

Follow these steps to control allocation to IBM 3591-attached devices with BTLS:

1. **Define 3591 Devices to the Operating System**

   Define 3591 devices to the operating system by using either MVSCP or HCD.
   The following example uses MVSCP to define 3591 devices that are installed
   in two different locations as two BTLS libraries, and native 3490E devices
   that are not managed by BTLS.

   ```
   * 3591 subsystem
    IODEVICE  UNIT=3490,ADDRESS=(180,4)
    UNITNAME  NAME=BTLSLIB1,UNIT=(180,4)

   * Two 3591 subsystems
    IODEVICE  UNIT=3490,ADDRESS=(190,4)
    IODEVICE  UNIT=3490,ADDRESS=(194,4)
    UNITNAME  NAME=BTLSLIB2,UNIT=((190,4),(194,4))

   * 3490E subsystem
    IODEVICE  UNIT=3490,ADDRESS=(1A0,16)
   ```

   Be sure to code UNITNAME for each new BTLS library, and be sure that the
   same set of devices defined by UNITNAME is also defined to BTLS through
   the LIBRARY DEVICES command. The esoteric must include only the drives
   in the corresponding BTLS Library. You do not necessarily have to define an
   esoteric name for the IBM 3490E drives, as they can be identified by their
   generic unit name 3490.

2. **Define 3591 Devices to BTLS**

   Define the 3591 devices to BTLS by using the LIBRARY DEVICES command:

   ```
   LIBRARY DEVICES (180183) LIBNAME(LIB1)
   LIBRARY DEVICES (190193 194197) LIBNAME(LIB2)
   ```

   You can execute the LIBRARY command either as a TSO command or by
   running a job that executes IDCAMS:

   ```
   //LIBJOB   JOB
   //         EXEC PGM=IDCAMS
   //SYSPRINT DD   SYSOUT=*
   //SYSIN    DD   *
     LIBRARY DEVICES (180183) LIBNAME(LIB1)
     LIBRARY DEVICES (190193 194197) LIBNAME(LIB2)
   ```

3. **Create the BTLS Volume Catalog Records**

   Create the BTLS volume catalog records by using the LIBRARY DEFINE
   command. For specific volume requests, BTLS allocation uses BTLS volume
   records to control allocation. If a BTLS volume record is found, BTLS directs
   allocation into the library that was named by the LIBRARY DEFINE command.
   If a BTLS volume record is not found, BTLS directs allocation to a nonlibrary
   device.

   In this example, volumes ABC000 – ABC999 will be defined to library LIB1
   and volumes XYZ000 – XYZ999 will be defined to library LIB2. LISTVOL will
   produce a SYSPRINT listing of the cataloged volumes.

   ```
   LIBRARY DEFINE  VOLSER(ABC000-ABC999) LIBNAME(LIB1)
   LIBRARY DEFINE  VOLSER(XYZ000-XYZ999) LIBNAME(LIB2)
   LIBRARY LISTVOL LIBNAME(LIB1)
   LIBRARY LISTVOL LIBNAME(LIB2)
   ```

4. **Control the Scratch Allocation**

   BTLS provides two methods for directing scratch allocation to a BTLS library:

   - You tell BTLS the **job names** that should use a BTLS library for scratch. To use job names, specify:

     ```
     LIBRARY OPTIONS (JEE)
     ```

   - You change the JCL to identify with a special BTLS **esoteric name** the BTLS library that should be used for scratch. To use esoterics, specify:

     ```
     LIBRARY OPTIONS (EEE)
     ```

   If you decide to route scratch allocations to a 3591 according to job name, you must identify the jobs to BTLS. In the example below, job name TAPELIB1 will use 3591 devices in LIB1 for scratch allocation, as well as any job name that begins with the name AUTO or HSM. Jobs that begin with LIB2 will use the 3591 devices in LIB2 for scratch allocation. All other jobs will be allocated to nonlibrary drives according to the unit name specified in the JCL.

   ```
   LIBRARY JOBNAMES (TAPELIB1 AUTO HSM) LIBNAME(LIB1)
   LIBRARY JOBNAMES (LIB2)              LIBNAME(LIB2)
   ```

   Note: Job names that are shorter than eight characters will be used as wildcards.

   If you decide to route scratch allocation to a 3591 by using the special BTLS esoteric names, code your JCL as indicated below. In the example, TAPEDD1 will allocate a 3591 in LIB1, TAPEDD2 will allocate a 3591 in LIB2, and TAPEDD3 will allocate a nonlibrary 3490E for scratch.

   ```
   //YOURJOB  JOB
   //         EXEC PGM=XXXXXX
   //SYSPRINT DD   SYSOUT=*
   //TAPEDD1  DD   DISP=(NEW,KEEP),UNIT=BTLSLIB1,
   //         LABEL=(1,SL),DSN=DATASET1
   //TAPEDD2  DD   DISP=(NEW,KEEP),UNIT=BTLSLIB2,
   //         LABEL=(1,SL),DSN=DATASET2
   //TAPEDD3  DD   DISP=(NEW,KEEP),UNIT=3490,
   //         LABEL=(1,SL),DSN=DATASET3
   ```

   After a scratch allocation has been made, and the tape data set has been created and cataloged in the BTLS catalog, the next reference to that data set will be a specific request for the volume. The specific allocation for the volume will be determined by the BTLS volume catalog records.

11.3.2.5 BTLS with JES3

BTLS support is provided with JES3 as follows:

- The tape subsystems that are managed by BTLS must not be defined in the JES3 initialization deck and therefore are not managed by JES3.

- MVS performs all tape device allocations for BTLS-managed drives with the allocation assist function of BTLS.

- BTLS functions in the JES3 environment are identical to the BTLS functions provided in the JES2 environment.

- There is no support for JES3 tape DSPs or JES3 tape commands for 3490 drives managed by BTLS.

JES3 can manage tape devices outside BTLS libraries as long as those devices do not belong to the same generic or esoteric unit types as tape devices

managed by BTLS. Therefore, you must not have JES3-managed 3490E devices while you use BTLS to manage IBM 3591-attached drives.

If you have both native and emulated 3490E drives, you cannot manage them with JES3 as JES3 cannot differentiate between the two types of drives. We recommend that you use BTLS to manage the drive-to-media relationship.

11.3.2.6 Summary

Table 44 summarizes our recommendations for setting up allocation control when you install the IBM 3591 tape subsystem.

Table 44. Recommendations for Allocation Control when Installing the IBM 3591					
Current Environment		Recommendation			
Stan-dalone 3490E Installed	IBM 3494/3495	BTLS	Apply OW18860/ OW19261	Apply OW03323	Comments
Yes	Not installed	Install	Yes	No	
Yes	SMS managed	Install	Yes	Yes	1
Yes	BTLS managed	Use	Yes	No	
No	Not installed	No	No	No	2
No	SMS managed	No	No	No	1, 2
No	BTLS managed	Use	Yes	No	
Note:					
1. Check that ACS routines do not assign 3591 allocations a storage class. 2. As native 3490Es are not installed, generic unit name 3490 correctly directs allocations to 3591 drives.					

For additional information about BTLS, refer to the *Basic Tape Library Support User's Guide and Reference* or *Guide to Sharing and Partitioning IBM Automated Tape Library Dataservers*.

11.3.3 Batch Jobs

Note: The following applies only if you are not using BTLS. With BTLS, you can control tape allocations without having to modify your existing JCL when you install the IBM 3591. We recommend that you use BTLS.

If you have both emulated and native nonlibrary 3490E drives, you should not code UNIT=3490 on your JCL because either type of device could be allocated. You have to define esoteric unit names for both the emulated 3490E devices and the native 3490E devices, and modify your JCL accordingly. Define the esoteric names to contain only native 3490E drives or only emulated 3490E drives; do not use esoteric names with mixed device types.

When a data set is cataloged through JCL, the catalog entry contains the generic device type, in this case 3490. When you later reference the data set either type of device could be allocated unless you use the UNIT parameter on the DD statement to specify the appropriate esoteric name. The UNIT parameter is honored as it specifies a subset of the device type retrieved from the catalog.

Regardless of whether you do or do not have native 3490E drives but have any type of stand-alone cartridge tapes defined on your system, together with IBM 3591 drives, you must ensure that you do not use the special system-defined

esoteric names SYS3480R and SYS348XR on your JCL. These esoteric names make the following device types eligible for allocation:

SYS3480R   Makes 3490, 3480X, and 3480 device types eligible for allocation
SYS348XR   Makes 3490 and 3480X device types eligible for allocation

SYS3480R and SYS348XR are intended to allow CST cartridges to be read on any compatible device. With 3591s and any other cartridge tape drives defined on your system, SYS3480R and SYS348XR essentially become esoteric groups that contain incompatible devices. The special read esoterics override 3480 and 3480X device types in the system catalog, practically guaranteeing that 3591-attached drives will be allocated. (If multiple devices can be allocated, the default preference order is 3490, 3480X, and 3480.)

If you are installing IBM 3591s now and later plan to replace them all with IBM 3590-A00 control units, you can use the same esoteric name for the emulated 3490Es and the native IBM 3590s. This way you only have to modify your JCL once. The move to native IBM 3590s requires no additional JCL changes.

11.3.4 DFSMShsm and DFHSM

The setup presented below is required when you install IBM 3591-attached tape drives and start using them with DFSMShsm or DFHSM. Hereafter we use a word HSM as a name of DFSMShsm and DFHSM. The examples illustrate actions for a public HSM scratch pool environment. The commands will differ when a private HSM scratch pool is used.

It is critical to apply PTFs for the following APARs before using IBM 3591-attached tape drives if an IBM 3591 tape subsystem is used for migration or backup when the tape utilization option is not NOLIMIT.

OW20192   for DFSMShsm with DFSMS/MVS V1 (5695-DF1)
OW20500   for DFHSM V2.6 (5665-329)

1. **Specify HSM output restricters to direct the output to 3591-attached devices.**

   Specify which HSM functions should use 3591 devices. HSM has an option for each of several output categories. Major categories are backup, migration to tape, spill, recycle, and dump output. In this example, all HSM functions will be directed to 3591-attached devices. TAPE3591 is an example of an esoteric unit name for the new 3591 drives, and ESO3480 refers to existing IBM 3480 tape drives. The esoteric that you use must be defined to MVS and then identified to HSM with SETSYS USERUNITTABLE before it can be used on other HSM commands.

   ```
   SETSYS USERUNITTABLE(ESO3480:ESO3480, TAPE3591:TAPE3591)

   SETSYS BACKUP(TAPE(TAPE3591)) -
       TAPEMIGRATION(ML2TAPE(TAPE(TAPE3591))) -
       SPILL(TAPE(TAPE3591)) -
       RECYCLEOUTPUT(BACKUP(TAPE3591) MIGRATION(TAPE3591))

   DEFINE DUMPCLASS(classname UNIT(TAPE3591))
   ```

   Note that you have to specify your existing esoteric ESO3480 on the SETSYS USERUNITTABLE command, even if it is no longer used for output to allow your 3480 volumes associated with that esoteric name to be used for input.

2. **Avoid attempts to extend the native 3490E cartridges on 3591 devices.**

Existing cartridges previously used for the same HSM functions for which 3591 cartridges will be used must be excluded from selection by HSM as a cartridge that could be directed to a 3591-attached drive for output.

HSM can select any of the following for output on a 3490E drive:

- An empty or a partially filled ECCST cartridge
- An empty CST cartridge
- A partially filled CST cartridge in 36-track format

You have to mark full all partially filled 36-track backup and migration volumes and delete all empty CST and ECCST cartridges to prevent their selection by HSM. Note that dump volumes are always automatically marked full by HSM.

HSM can select a partially filled cartridge for output on a 3591-attached drive even if the cartridge was previously written to another device type. The esoteric name on which a tape was first written does not have to be the same when the tape is later used. The unit name associated with a volume does not prevent the volume from being selected for output if it is different from the unit name specified for the HSM function. HSM extracts the common technology such as from the esoteric name set of drives that is used for the output function, and, if a writeable tape fits that technology, it can be selected for output.

If the MARKFULL option is currently in use in a public scratch pool environment, there would be very few or no tapes that have to be marked full. Be aware, however, that there may be partially filled tapes even if you have specified SETSYS PARTIALTAPE(MARKFULL). Data set migration (MIGRATE command) does not mark the output tape volume full.

Use the LIST command to create a list of volsers that are partially full or available, and for each volser on the list, submit a DELVOL command to mark it full or delete it.

```
LIST TTOC SELECT(BACKUP NOTFULL) ODS(dsn)        /* Obtain list of */
LIST TTOC SELECT(ML2 NOTFULL) ODS(dsn)           /* volumes that   */
LIST DUMPVOLUME SELECT(AVAILABLE) ODS(dsn)       /* require action */

DELVOL volser BACKUP(MARKFULL)       /* Mark partial backup and   */
DELVOL volser MIGRATION(MARKFULL)    /* migration volumes as full */

DELVOL volser BACKUP(PURGE)      /* Delete empty backup and       */
DELVOL volser MIGRATION(PURGE)   /*          migration volumes    */
DELVOL volser DUMP(PURGE)        /* Delete available dump volumes */
```

Note: DELVOL MARKFULL does not delete the volume from HSM's control.

Although HSM will not select partially filled 18-track cartridges for output because they are not in an acceptable format to be written on a 3490E, you should mark them as full anyway. If you do not, they will never be selected and will not become eligible for recycling.

3. **Retain read access to existing HSM cartridges.**

Note: This step is not required if BTLS is used to direct all input allocations appropriately. Otherwise, this step is required, even when no native IBM 3490E drives are installed, if esoteric unit names were not used when HSM tapes were created. The situation can arise even for IBM 3480 tapes because IBM 3480 tapes can be mounted for read on IBM 3490E drives. This step is required before you take any emulated

3490E devices online, even if the tape drives are not defined for any HSM function.

For each volume that HSM uses it records a unit name that will be used for subsequent allocations of the tape for input. Even if an esoteric name is used for selecting the output device, or was specified when the volume was defined using the ADDVOL command, a generic unit name may be recorded for the volume once it has been used. As an example, assume A3490 and B3490 are two esoterics for 3490E devices and you have specified SETSYS USERUNITTABLE(A3490, B3490:B3490). For volumes that are allocated to A3490 units for output, the corresponding generic unit name 3490 is recorded and used for subsequent input allocations. Volumes allocated to B3490 units for output will have their subsequent input allocations made to units associated with B3490.

When generic unit name 3480 or 3480X is associated with a cartridge, HSM substitutes it with the special read esoteric name SYS3480R or SYS348XR at allocation time. Because the read esoterics make 3490 an eligible device, a 3591-attached device could be allocated. Thus, if a generic name is currently stored, you may have to update your HSM volume inventory with an esoteric unit name for non-3591-attached drives to influence allocation when existing HSM tapes are requested for input.

The priority should be given to ML2 tapes because they are needed for recalls that occur automatically and frequently. The need to influence their mounting occurs as soon as the 3591-attached units are added to the configuration. You do not have to be directing new HSM output to the 3591-attached drives for this problem to surface. Similar problems will occur for backup and dump tapes, but mounting of those tapes normally results only from explicit commands requesting recovery of lost data.

To change the inventory records, first identify the volumes requiring change by using an appropriate LIST command. Look for volumes that show device type 3480, 3480X, or 3490. In addition, if you have redefined an existing esoteric to point to the new 3591-attached drives, you have to change those as well. Then enter an ADDVOL command to make each change. The esoteric that you use must be defined to MVS and then identified to HSM before it can be used in an ADDVOL command. In this example, ESO3480 is used as an example of an esoteric for existing 3480 drives, and TAPE3591 is used for the 3591-attached drives:

```
LIST ML2(TAPE) ODS(dsn)
LIST BVOL ODS(dsn)
LIST DVOL ODS(dsn)

SETSYS USERUNITTABLE(ESO3480:ESO3480, TAPE3591:TAPE3591)

ADDVOL volser UNIT(ESO3480) MIG(ML2)
ADDVOL volser UNIT(ESO3480) BACKUP(DAILY)
ADDVOL volser UNIT(ESO3480) BACKUP(SPILL)
ADDVOL volser UNIT(ESO3480) DUMP
```

The ADDVOL command changes the type of unit on which the given volume can be allocated for input, in this case to ESO3480.

Be sure to specify the esoteric as a pair, TAPE3591:TAPE3591. If you specify SETSYS USERUNITTABLE(TAPE3591), the corresponding generic unit name 3490 is used for subsequent allocations of the tape for input, potentially causing the tape to be directed to a native 3490E device.

4. **Set the percentage of fullness, that is, establish how much data HSM should write on a migration or backup volume.**

When HSM backs up and migrates data to tape, it keeps track of the actual amount of data written on tape by requesting this information from the tape control unit using the Read Buffered Log command. HSM keeps writing until the tape volume has reached the desired level of utilization (fullness), which has been specified with the SETSYS TAPEUTILIZATION(PERCENTFULL(pct)) command. HSM then forces an end-of-volume.

The value specified with PERCENTFULL can be greater than 100, allowing HSM to write more than the assumed capacity of the media.

The capacity of a 3590 cartridge is approximately 12 times that of an ECCST cartridge. By specifying that 1175% of 3490E tape capacity is to be used for HSM backup and migration volumes, you will effectively use close to 97% of the 3590 media capacity, which is HSM's default for PERCENTFULL. This leaves a small margin to cope with the minor inconsistencies that can exist in the length of cartridge-type tapes to ensure that a tape can be copied to another with the TAPECOPY command even if the length of the target tape is shorter than the source tape.

You may want to calculate a value that corresponds to your current installation standard for PERCENTFULL.

The HSM functions for volume dump, ABACKUP, and CDS Version Backup will use the 3590 media capacity. The physical end of volume is the indication that the volume is full.

Use the SETSYS command to change the percentage full of emulated 3490E cartridges:

```
SETSYS TAPEUTILIZATION(UNIT(TAPE3591) PERCENTFULL(1175))
```

Issuing the SETSYS USERUNITTABLE command will reset the TAPEUTILIZATION for all esoteric devices to the DFSMShsm default of 97 percent. For the command to be effective, you must enter the SETSYS USERUNITTABLE before the SETSYS TAPEUTILIZATION command.

Note that the TAPEUTILIZATION option of using NOLIMIT is available, but it is not recommended even if you do not copy tapes because no action is taken to reduce data set tape volume spanning. NOLIMIT ties tapes together originally and can result in the recycling of long chains of tapes and a need for mounting two tapes when recalling the small data set spanning a pair of tapes.

Note: You must apply PTFs for the above mentioned APARs if a TAPEUTILIZATION option other than NOLIMIT is used.

HSM uses a 16 KB block size, which enables you to fully utilize the capacity of a 3590 cartridge written on 3591-attached drives.

5. **Recycle.**

Once your HSM environment is up and running using 3591-attached drives, you may want to run RECYCLE to move ML2 data to 3590 cartridges. You may consider doing this earlier than your normal percentage of valid data trigger would indicate, to free the old CST or ECCST type ML2 volumes and gain the performance and space benefits of the IBM 3590. To do this, either issue command

```
RECYCLE ALL EXECUTE PERCENTVALID(pct)
```

with a high pct value, or use command

```
RECYCLE VOLUME(volser) EXECUTE
```

which recycles volumes regardless of the percent of valid data.

Note: The recycle function was changed in DFSMShsm 1.2.0. The following applies to 1.2.0 and later releases.

Recycle function will work with emulated 3490E tapes with the following precautions:

- If all 3490E ML2 tapes are emulated 3490Es and either they are all written with NOLIMIT or an acceptable TAPEUTILIZATION percentage, recycle will calculate a reuse capacity based on the average of all fully-written tapes which will accurately allow percentages to be calculated for selection.

- If some 3490E ML2 tapes are native 3490Es and some are emulated 3490Es with either NOLIMIT or TAPEUTILIZATION in excess of 100%, the reuse capacity will be a weighted average of all fully-written tapes. Thus the tapes in the minority will have percentages off significantly, and the tapes in the majority will have percentages off slightly.

- If you intend to replace all native 3490E ML2 tapes with emulated 3490E tapes, create all new ML2 tapes to emulated 3490Es, and recycle will automatically cause the reuse capacity to slowly rise, causing native 3490E tapes to "appear" emptier and emptier over time, and therefore will be favored for recycle selection.

The above applies to incremental backup tapes in the same manner. Since reuse capacity for recycle is calculated independently between ML2 and backup tapes, you can have ML2 tapes be all emulated 3490E and backup tapes be all native 3490E without any special implications to recycle.

6. **CDS backups**

For control data set (CDS) backup, if you backup to tape PARALLEL, each CDS will write to a separate drive. If you currently spill over several tapes for your BCDS, for example, you might use emulated 3490E to contain the entire backup to a single cartridge. If you specify NOPARALLEL, all CDS backups are written to a single stream of tapes and would make good use of an emulated 3490E cartridge.

7. **Full volume dumps**

HSM full volume dump, both automatic dump and command dump with BACKVOL DUMP command will always start each DASD dump to an empty tape volume. As it stands, the full volume dump function will not be able to fully utilize a 3590 cartridge.

However, dumps of large DASD volumes would still be good candidates for emulated 3490Es. An IBM 3390-9 might take up three times as many tapes as an IBM 3390-3 device. With DEFINE DUMPCLASS, you can dump some DASD volumes to emulated 3490E and others to smaller capacity cartridges. Since most full volume dumps of L0 and ML1 DASD exceed a single ECCST cartridge, we recommend use of emulated 3490E for this function.

As with any new tape device, if you plan to take cartridges to a disaster recovery location, please ensure that similar tape devices exist to read the new cartridges in their new format.

For more details, refer to the *DFSMS/MVS Version 1 Release 3, DFSMShsm Storage Administration Reference*, *DFSMS/MVS Version 1 Release 3, DFSMShsm Storage Administration Guide*, and *DFSMS/MVS Version 1 Release 3, DFSMShsm Implementation and Customization Guide*.

11.3.5 ABARS

ABARS (DFSMShsm Aggregate Backup And Recovery Support) is a function that you can use to back up a user-defined group of data sets and recover them at the same or another computer site.

The aggregate backup function of ABARS creates the following files on tape volumes, which can then be transported to the recovery site:

- Data file
- Control file
- Instruction/activity log file (optional)

The output files are physical sequential data sets. Each of these files must be written to a separate physical tape volume (or volumes, as the files may extend several volumes). The size of the data file can be very large, making it a good candidate for 3590 cartridges. The control and instruction files tend to be much smaller, so you may want to write them on smaller capacity media. However, ABARS does not allow you to specify the output unit individually for these files. The unit name specified in the ABACKUP command applies to all three files.

If you are using an IBM 3494 or 3495 Automated Tape Library Dataserver with system-managed tape, you can use ACS routines to override the ABACKUP unit specification and direct the output files to different media.

Figure 79 on page 205 shows an ACS storage class code fragment selecting ABARS output data set names, as per the FILTLIST, and directing the control and instruction files to system-managed tape volumes in the IBM Automated Tape Library Dataserver by assigning them storage class SCABARS. The data file is assigned a null storage class, that is, it is not to be system managed and will be allocated to nonlibrary tape units according to the unit specification on the ABACKUP command.

To create the aggregate backup and direct data file allocation to 3591-attached drives, issue this command:

```
ABACKUP aggregatename EXECUTE UNIT(TAPE3591)
```

TAPE3591 is the esoteric unit name for your IBM 3591 tape subsystem.

```
PROC STORCLAS

/**********************************************************************/
FILTLIST AB_DATA  INCLUDE(prefix.D.C%%V%%%%,        /* L0 Data file    */
                          prefix.O.C%%V%%%%)        /* Other Data file */
FILTLIST AB_CNTL  INCLUDE(prefix.C.C%%V%%%%,        /* Control file    */
                          prefix.I.C%%V%%%%)        /* Instruction file */
FILTLIST AB_UNIT  INCLUDE(¢TAPE3591¢)
/**********************************************************************/
.
.
.
SELECT
  WHEN (&DSN = &AB_CNTL && &UNIT = &AB_UNIT)      /* Direct control and */
    DO                                            /* instruction files  */
      SET &STORCLAS = ¢SCABARS¢                   /* to storage class    */
      EXIT                                        /* SCABARS              */
    END

  WHEN (&DSN = &AB_DATA && &UNIT = &AB_UNIT)      /* Direct data file    */
    DO                                            /* to outside drive    */
      SET &STORCLAS = ¢¢                          /* unit                */
      EXIT
    END
END
.
.
.
END /* OF STORAGE CLASS ROUTINE PROC */
```

Figure 79. Storage Class ACS Routine for ABARS Tape Data Sets

In Figure 79, substitute *prefix* with the output data set prefix that you have specified in your aggregate group definition.

The data class ACS routine must assign a data class with the desired media type to the control and instruction files. The storage group ACS routine must directly assign an appropriate tape storage group to the tape volumes and indirectly a system-managed tape library and tape device pool.

You have to eject the control and instruction volumes from the IBM Automated Tape Library Dataservers and transport them to the recovery site together with the data volumes.

Note: The preceding consideration is not exclusively a 3591 issue, it equally applies to native IBM 3590 devices.

For more details on ABARS, see the *DFSMS/MVS Version 1 Release 3, DFSMShsm Storage Administration Guide*.

11.3.6 ADSM for MVS Servers

Note: ADSM for MVS Version 1 cannot fill 3590 cartridge. Therefore, you should install ADSM for MVS Version 2 if you plan to use 3591-attached drives with ADSM.

Consider the following when using 3591-attached drives with ADSM:

11.3.6.1 Allocation Control

In ADSM, all tape volumes belong to some storage group, and each storage group is associated with a defined set of tape drives, called a *device class*. A mount request for a tape volume is satisfied by allocating a device from the corresponding device class. By defining a device class for 3591-attached drives using an appropriate esoteric unit name, you can fully control the drive-to-media relationship in ADSM.

If any of your existing device classes has been defined by using generic device type 3490, you have to modify the device class definition to specify an esoteric unit name for your native 3490E drives. Otherwise emulated 3490E drives become eligible for allocation. The modification is necessary even if you do not use the 3591 itself with ADSM.

Note: This task is not required if you are using BTLS to control allocation as we have recommended. (See 11.3.2, "Device Allocation with BTLS" on page 194.)

11.3.6.2 Capacity Considerations

With ADSM for MVS Version 2, full capacity exploitation is possible by defining a unique device class for 3591-attached devices. The MAXCAPACITY parameter of the DEFINE DEVCLASS command is set to extend the default capacity of 3490E drives.

MAXCAPACITY specifies the maximum amount of data ADSM can store in the volumes categorized by the device class. The value you specify for this parameter (other than 0) is used to determine maximum capacity of the volumes. You must specify this value as an integer followed by a scale factor. The following are possible scale factors:

K   Kilobyte
M   Megabyte
G   Gigabyte

Special attention is required to ensure that the maximum capacity specified is correlated with the compaction practices. For example, if data is already compacted by ADSM, maximum capacity specified should be approximately 10 GB. However, if compaction is performed by the tape subsystem, a maximum capacity of 30 GB or greater should be specified according to the compaction ratio for this data.

ADSM database backup, both automatic and command backup (DEFINE DBBACKUPTRIGGER and BACKUP DB commands), when directed to a cartridge type device class, can store only one backup per volume. Because the capacity of 3590 tapes in most cases far exceeds the size required for database backups, you may prefer not to use 3590 cartridges for this purpose. We recommend that you either direct your database backups to DASD on a *file* type device class volume and use HSM to migrate the *file* data sets to tape, or use lower capacity tape media for database backups, if available at your installation.

ADSM for MVS uses a 32 KB block size when writing to tape. Thus you can use the full capacity of a cartridge on 3591-attached drives.

11.3.6.3 Example

The following example shows how to set up a 3591 tape pool in ADSM. First, we define device class DEVC3591 for 3591-attached tape drives using the DEFINE DEVCLASS command. Esoteric unit name TAPE3591 must be defined to MVS. Parameter a COMP=YES specifies that data is compacted by the tape subsystem. Assuming a 3:1 compaction ratio, we set maximum capacity to 30 GB. We then define storage pool POOL3591 and assign it to device class DEVC3591 with the DEFINE STGPOOL command. Finally, we assign 3590 cartridge volume VOL001 to storage pool POOL3591. When ADSM uses volume VOL001, it will be allocated to a device associated with esoteric name TAPE3591.

```
DEFINE DEVCLASS DEVC3591 DEVTYPE=CART UNIT=TAPE3591 MAXCAP=30G COMP=YES
DEFINE STGPOOL POOL3591 DEVC3591
DEFINE VOLUME POOL3591 VOL001
```

Note that the parameters mentioned above are relevant to our scenario, they are not the only parameters you might require.

Instead of preassigning volumes to a storage pool, you can also have ADSM dynamically acquire scratch tape volumes, as needed. Once a scratch volume has been used, it becomes a member of that storage pool.

For more information about how to use ADSM commands, refer to *ADSTAR Distributed Storage Manager for MVS Administrator's Reference Version 2*.

11.3.7 DFSMSdss and DFDSS

DFSMSdss and DFDSS can use the full capacity of the 3590 media.

When you are using the 3590 media capacity to stack multiple dump data sets (including multiple full-volume DASD dumps) on a single tape volume, recommend that the Stand-alone Services SPE be installed. The APAR numbers for DFDSS V2.5 (FMID HAE2502, for DFP releases) are PN74583 and PN77830. For DFSMSdss 1.1.0, 1.2.0. 1.3.0 (FMID JDZ1120, HDZ11B0, HDZ11C0), the APAR numbers are OW14835 and OW16802. When using DFSMSdss or DFDSS stand-alone program to restore from a file that is not the first file on the tape, the Stand-alone Services SPE **must** be installed.

Note: If you decide to stack multiple full volume dumps on a 3590 cartridge, consideration for the order of restoring those volumes should be reviewed. Your disaster recovery plan dictates the order to restore system, critical and application data within a certain time frame. Since restoring stacked dumps for a 3590 cartridge is a serial process, dumps should be stacked in such a way to not impact this time frame.

DFSMSdss and DFDSS use 64 KB block size when writing to tape. Thus you can use the full capacity of a cartridge on IBM 3591-attached drives.

See 4.1.6, "DFSMSdss" on page 90 for an example on how to create a DFSMSdss stand-alone tape.

11.3.8 OAM

The following considerations apply to OAM users who install the IBM 3591.

11.3.8.1 Allocation

When you install the IBM 3591 tape subsystem you must ensure that OAM tape allocations are managed correctly even if you do not use IBM 3591-attached drives for storing OAM objects. Planning is required when you use native or emulated nonlibrary IBM 3490E drives with OAM.

The drive selected for use with a stand-alone OAM tape depends on the TAPEUNITNAME associated with that tape in the TAPEVOL table of the OAM optical configuration database. For nonlibrary drives, the UNITNAME field contains the generic or esoteric unit name used to mount the tape volume when it was first added to the storage group. This unit name is used for subsequent allocations of the tape volume. Any online device that corresponds to the unit name could be allocated.

Because native and emulated IBM 3490E devices have the same generic unit name, 3490, an OAM tape can be allocated on an incompatible device unless you use esoterics to direct input allocations appropriately.

We recommend that you use BTLS to control the drive-to-media relationship if you have both native and emulated stand-alone IBM 3490E drives and use either of them with OAM. With BTLS, you can accomplish the necessary level of control by defining your IBM 3591 subsystems as BTLS libraries as described in 11.3.2, "Device Allocation with BTLS" on page 194.

11.3.8.2 Capacity Exploitation

OAM cannot use the full capacity of 3590 media with IBM 3591-attached drives. When writing to tape, OAM keeps track of the kilobytes of data written to the tape and will only fill the tape to what it considers will fit on the used media. Tapes on IBM 3591-attached drives are filled as if they are 3490E enhanced capacity cartridges, that is, OAM will write up to 800 MB of uncompacted data on them.

Note that although the TAPEVOL table has a CAPACITY column, you cannot modify that column for 3591-created volumes hoping to increase the cartridge size as seen by OAM. OAM checks the capacity for 3490 or 3480 tape cartridges and will fail during initialization for cartridges that do not have a specific value in the CAPACITY column.

11.3.9 DFSMSrmm

Define a new volume pool for your Magstar cartridges by adding the following definition in the PARMLIB member EGDRMMxx:

```
VLPOOL PREFIX(M*) TYPE(SCRATCH) MEDIANAME(3590) -
       DESCRIPTION(¢3590 SCRATCH POOL¢) RACF(N) EXPDTCHECK(N)
```

Then, use RMM subcommands ADDRACK and ADDVOLUME to define the new volumes in your system.

```
RMM ADDRACK M00000 COUNT(100)

RMM ADDVOLUME M00000 COUNT(100) POOL(M*) -
    STATUS(SCRATCH) INIT(Y) MEDIANAME(3590)
```

11.3.10 DEVSERV QTAPE MVS Operator Command

The QTAPE option of the DEVSERV MVS operator command has been designed to assist system operators, systems programmers, configuration administrators, and customer service personnel in acquiring physical identification, status, and diagnostic information about tape devices in large, complex MVS/390 configurations.

The DEVSERV QTAPE command has been enhanced with new function and supports the IBM 3591 control unit. The enhancements are provided by APAR OW18995. See Appendix J, "QTAPE Option of the DEVSERV MVS Operator Command" on page 293 for more details on the DEVSERV QTAPE command.

11.3.11 Other Considerations

There are some other considerations below:

- The recommended missing interrupt handler (MIH) value for the IBM 3591-attached drives is eight (8) minutes. See Figure 29 on page 86 and Figure 30 on page 86 for an example on how to specify the MIH value.

- The IBM 3591 cannot be used in the IBM 3494 or 3495 Automated Tape Library Dataserver. When you define IBM 3591-attached drives to the system in the HCD as IBM 3490E, it is critical that LIBRARY=NO be specified (or taken as the default.)

11.4 VM/ESA Environments

In this section we describe VM/ESA support for drive allocation, drive capability, and media capacity for the IBM 3591 control unit.

11.4.1 Device Allocation

The operating system does not allocate the tape drives. Local procedures and EXECs are modified to direct specific tape-processing work to IBM 3591-attached drives by example or by using the capabilities of a tape management product to select or request a desired device type.

11.4.2 Drive Capability and Media Capacity

Specifying the largest possible block size when issuing CMS commands that write to tape will provide the best exploitation of IBM 3591 performance capability.

When using a utility such as DDR to dump files to tape, specifying the LEAVE option maintains the tape position at the end of the current dump for starting another dump to the same tape volume.

The commands and functions in VM/ESA for writing to tape can fully use the 3590 media capacity.

11.5 VSE/ESA Environments

In this section we describe VSE/ESA support for drive allocation, drive capability, and media capacity for the IBM 3591 control unit.

11.5.1 Drive Allocation

Review both JCL and your tape management product to ensure that drives are allocated correctly.

11.5.1.1 JCL

Customers who use 3490E as a device-type parameter in JCL ASSGN statements cannot dependably have the desired type of device assigned when both native and emulated IBM 3490E drives are added to the system.

Customers who rely on JCL for drive selection must use a specific device number or a list of suitable addresses to steer assignment to the correct physical unit type. Customers who currently use device-type of 3490E extensively in JCL must modify all instances of this usage to direct allocation to either a native IBM 3490E subset or an IBM 3590 subset, depending on which type of media is desired.

Customers who do not have an native 3490E installed or defined have no immediate problem or workload, beyond what is typically required to introduce a new device or media type. However, if a later migration is planned to the native 3590 device type, a future set of JCL modifications will be required for this migration. Thus, it may be a good idea to target only a few space-intensive applications (backups, for example) for this offering to diminish rework for 3590 migration.

11.5.1.2 Tape Management Products

Tape management products typically issue an operator message when a tape mount is required, and an operator selects the actual unit to be used. Tape management product catalog entries enable associations to be made between data sets and either drive subsets or media subsets. Thus, an operator can be informed of the desired media or drive type when scratch mounts are required.

When IBM 3591-attached drives are introduced, new device classes or media subsets may require that definition and catalog entries for IBM 3591-targeted data sets be modified. The specific actions required depend upon the tape management product installed.

11.5.2 Drive Capability and Media Capacity

The capacity of IBM 3590 cartridges used in IBM 3490E emulation mode is best exploited by applications and program products that determine maximum volume capacity by the physical end-of-tape rather than by a drive or media-type characteristic.

When data sets are stacked or multiple backup or dump files are written on a single physical cartridge, a software product that records and uses the logical block IDs for data sets can provide rapid access to data that is not at the beginning of the media.

11.6 TPF Environments

TPF does not support IBM 3591 attachment of IBM 3590-B11 drives. TPF Version 4.1 will support native IBM 3590 drives.

11.7 Recovering Data beyond Logical End of Data

Sometimes unusual circumstances create a need to recover data located beyond the logical end-of-data (EOD) mark of an IBM 3590 cartridge. For example, a volume has been scratched for reuse, and subsequently a need arises to read old data from an area not yet rewritten on the tape. In such situations, some differences in technique and error handling will be experienced as compared to performing a comparable operation on an native IBM 3490E. The essential distinction lies in the respective format characteristics of 3490E and 3590 media. With the IBM 3490E, it is possible to reference a physical location on tape through wrap and segment designations, whereas with the IBM 3590, only logical reference (to block ID) is possible in specifying relative locations on the media.

Spacing or reading beyond the logical EOD mark on an IBM 3590 cartridge results in a record sequence error when the first out-of-sequence block ID is encountered. This error may recur as additional EOD marks and subsequent old data fragments are encountered.

The native IBM 3590 command interfaces provide options that allow sequence errors to be ignored. Thus, recovery of data can be accomplished without encountering record sequence errors with SCSI or ESCON attachment of drives as IBM 3590 device type.

Chapter 12. Migration from IBM 3591 to IBM 3590

In Chapter 11, "IBM 3591 Software Implementation" on page 187 we discuss how to implement and successfully use emulated IBM 3490E drives attached through the IBM 3591 control unit. In this chapter we go a step further and discuss what you have to consider when you plan to move from an IBM 3591 environment and start using native IBM 3590 tape drives attached through the IBM 3590-A00 control unit.

12.1 Cartridge Compatibility

Tape written on a IBM 3591-attached drive is written in 3590 media format on an IBM 3590 High Performance Tape Cartridge. In addition, any program that records block IDs in association with the location of files on a cartridge will have been presented with a 3590-format block ID by the IBM 3591 control unit. Thus, tapes themselves are compatible with IBM 3590 ESCON or SCSI attachment hardware offerings.

12.2 Inventory Management

With IBM 3591, inventories and catalogs describe IBM 3590 cartridges as 3490E media because they are written on a device type known to the system as IBM 3490E.

On all operating platforms, it is desirable to update product inventories, catalogs, and control data sets that describe device or media types associated with data sets or files. However, in some cases, the inaccurate media type descriptions in a catalog may be cosmetic rather than functional discrepancies, as long as volumes are correctly described in the system catalog.

12.3 Migration Strategies

When moving from emulated IBM 3490E drives to native IBM 3590 drives, you have three options for migrating your data and applications:

- Leave existing tape data sets on the cartridges where they currently reside and let them age there while at the same time you start writing new data on native IBM 3590 drives.

- Move data sets currently residing on cartridges written on emulated IBM 3490E drives by rewriting them on native IBM 3590 drives.

- Leave data sets on the IBM 3590 cartridge where they reside and convert the cartridges for use on native IBM 3590 drives by updating product inventories and catalogs to indicate that the data sets now reside on IBM 3590 volumes.

The first option provides the simplest migration but may not be appropriate for you as it requires the two subsystems to exist until data sets on the old cartridges have aged or have been moved. For a quick migration, you have to consider the two other options.

The second option, moving data from IBM 3590 cartridges to identical cartridges, seems like a waste of time and resources. However, the way in which a

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software product implements its support for IBM 3490E and IBM 3590 devices may differ in such a way that this option becomes a necessity.

The third option is unique to migration from emulated IBM 3490E to native IBM 3590 devices. Because the underlying media and recording format for the two devices are the same, a tape written on an emulated IBM 3490E drive can be read on a native IBM 3590 drive. You do not have to move the data, provided that you can modify product inventories and catalogs to indicate that the volumes and the data sets on them reside on 3590 media instead of 3490E media, as was assumed at the time of writing. Modification may include changing the device name, media type, and other relevant information recorded for the volumes and data sets.

The management and details of a 3591-to-3590 migration scenario are dependent on whether or not there is a period of time during which IBM 3591 hardware remains installed in parallel with IBM 3590 hardware. If a catalog or inventory update capability is not available, retaining IBM 3591 hardware during a transition period enables recall or restore activity for data on cartridges described in an inventory as 3490E media. When data on IBM 3591-created cartridges has expired, the IBM 3591 is no longer needed. Meanwhile, new data has been written on 3590-type devices.

The first two migration options are not specific to a 3591-to-3590 migration but apply generally to migration from a non-3590 to 3590 (see Chapter 5, "Migration in an MVS/ESA Environment" on page 115 and in Chapter 6, "Migration in Non-MVS Environments" on page 129). In this chapter we mainly concentrate on the third migration option for major tape users.

Note: To simplify conversion to a 3590 device type, we recommend that you use an exclusive range of VOLSERs for the media mounted on IBM 3591-attached drives.

Figure 80 on page 215 depicts the operational environment of IBM 3490E and IBM 3590 tape drives.
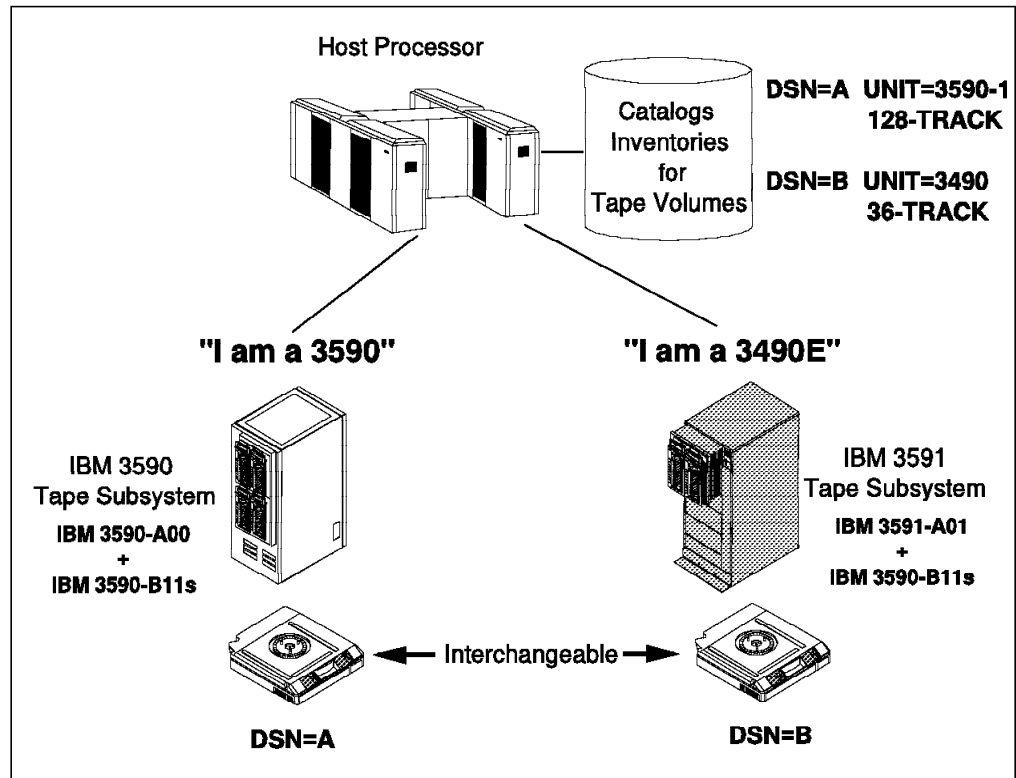
Figure 80. Operational Environment: with IBM 3591-attached and native IBM 3590

12.4 MVS System Catalog

Data sets written on IBM 3591-attached drives, if cataloged, are described as device type 3490 in the MVS system catalog and must be recataloged as device type 3590-1, as part of a 3591-to-3590 migration.

To update a catalog entry, first uncatalog and then recatalog the data set using the following IDCAMS commands:

```
//          EXEC  PGM=IDCAMS
//SYSPRINT DD   SYSOUT=*
//SYSIN     DD   *
  DELETE datasetname –              /* Delete catalog entry    */
         NOSCRATCH                  /* for a non-VSAM data set */

  DEFINE NONVSAM           –        /* Define a catalog entry  */
         (NAME(datasetname)  –      /* for a non-VSAM data set */
         DEVICETYPES(3590–1) –
         VOLUMES(volser)     –
         FILESEQUENCENUMBERS(number) )
  /*
```

In the example above, replace *datasetname* with the name of the data set and *volser* with the volume serial where the data set resides.

Be aware, that if you do not update the catalog entry then even if you modified your JCL to specify UNIT=3590-1 (without specifying the volume parameter), a 3490E device would be allocated because the catalog entry would take precedence over the UNIT parameter on the DD statement.

Note: You can use the tape data set recatalog program called TPCATCV2 to make a mass change to the catalog entries of tape data sets. The program is in assembler code format. It generates the DELETE and DEFINE commands for tape data sets and saves them in a file which can then be used as input to an IDCAMS job. TPCATCV2 is a new version of TPCATCVT which has been used for many years. TPCATCVT selected entries with device types 3480 and 348X, and converted these to 3490 to allow 3490E devices to be allocated to read these old datasets. TPCATCV2 is a modified version that looks for entries with device type 3490 and converts them to 3590-1. It will also allow filtering on a VOLSER range. This is one reason why it is important for the customer to select a unique VOLSER range to be used with IBM 3591 and IBM 3590 tape subsystems. TPCATCVT is on MKTTOOLS in the package TAPEMIG. TPCATCV2 will be on MKTTOOLS in the package TAPEMIG2, at the GA date for the IBM 3590-A00 tape control unit. MKTTOOLS is an IBM internal repository.

12.5 BTLS

In a BTLS-managed environment, you have to define the IBM 3591-created volumes as residing in a library associated with the native IBM 3590 drives before you can start using them on the native IBM 3590 drives. First, define the BTLS logical library for the IBM 3590 drives as described in 11.3.2, "Device Allocation with BTLS" on page 194. Then run the following job (we assume that LIB1 is the BTLS logical library of IBM 3591-attached drives and LIB2 is the new logical library of IBM 3590 drives):

```
//LIBJOB    JOB
//          EXEC PGM=IDCAMS
//SYSPRINT DD  SYSOUT=*
//LIBOUT    DD  DSN=VOLUME.LIST,DISP=(NEW,KEEP),VOL=SER=DAS001,
//              DCB=(RECFM=FB,LRECL=80),SPACE=(CYL,(1,1)),
//              UNIT=3390
//LIBIN     DD  DSN=VOLUME.LIST,DISP=OLD,VOL=SER=DAS001,
//              UNIT=3390
//SYSIN     DD  *
  LIBRARY LISTVOL LIBNAME(LIB1)   /* List volumes in 3591-library */
  LIBRARY DELETE                  /* Delete volumes from LIB1     */
  LIBRARY DEFINE  LIBNAME(LIB2)   /* Add volumes to 3590-library  */
/*
```

The LIBRARY LISTVOL command lists all of the volumes that are cataloged for LIB1. Data set VOLUME.LIST will contain a sequential list of the volumes. The LIBRARY DELETE command will cause the volumes in VOLUME.LIST to be deleted from the catalog. Finally, all volumes in the VOLUME.LIST data set will be defined in the catalog as residing in LIB2.

If you want to move only part of your cartridges to the IBM 3590 logical library, you should run two jobs. First, create the volume list with LISTVOL, then edit the VOLUME.LIST data set before issuing the DELETE and DEFINE commands.

If you stop using the IBM 3591 logical library at the same time you introduce the native IBM 3590 drives, you can simply redefine the BTLS library with the new IBM 3590 device addresses without having to delete and define the volumes.

```
  LIBRARY DEVICES (180183) LIBNAME(LIB1)     /* Redefine LIB1 */
```

In the example, assume 180-183 are the addresses of the new IBM 3590 drives. The LIBRARY DEVICES command first deletes the old library definition and then creates the new one. It does not delete the volume records or job names associated with the library.

12.6 DFSMShsm or DFHSM

You can convert IBM 3591-generated DFSMShsm or DFHSM cartridges for use on true IBM 3590 drives by changing the 4-byte device type and cartridge type in each HSM volume record which currently indicate they are 36-track IBM 3490E ECCST. To effect the change, issue a LIST command and look for volumes with the unit name you have used for the IBM 3591-attached drives. Depending on your environment, this may be an esoteric unit name or generic unit name 3490 in case no native IBM 3490E drives are installed. For each of these volumes, issue a FIXCDS command to modify the device type (to X′83′). For migration and backup tapes, issue a FIXCDS command to change the cartridge type from enhanced to standard. Then issue an ADDVOL command to change the unit name to 3590-1.

```
LIST ML2(TAPE) ODS(dsn)
LIST BVOL ODS(dsn)
LIST DVOL ODS(dsn)

FIXCDS V volser PATCH(X¢1C¢ X¢optn8083¢)      {ML2s}
FIXCDS V volser PATCH(X¢46¢ BITS(...10...))   /* ML2 tape to std */
FIXCDS X volser PATCH(X¢48¢ X¢optn8083¢)      {backups}
FIXCDS X volser PATCH(X¢12¢ BITS(.....10.))   /* backup tape to std */
FIXCDS Y volser PATCH(X¢0C¢ X¢optn8083¢)      {dumps}
                                              ¢optn¢ are the options bytes

ADDVOL volser UNIT(3590-1) MIGRATION(ML2)
ADDVOL volser UNIT(3590-1) BACKUP(DAILY)
ADDVOL volser UNIT(3590-1) BACKUP(SPILL)
```

You must use the FIXCDS first, otherwise the ADDVOL will fail because HSM would see the inconsistency of the new unit name of 3590-1 and the device type of 3490 which is associated with the cartridge. HSM only allows re-ADDVOLs when the old and new device types are compatible, which they are not in this case. The ADDVOLs are in fact only required to extend partially filled 3591 tapes on a native 3590 drive, which explains why no ADDVOL is needed for DUMP tapes. A 3591 tape can be used for input (recall, restore) without the ADDVOL.

After you have completed the above modifications direct HSM functions to native 3590 drives as follows:

```
SETSYS TAPEMIGRATION(ML2TAPE(TAPE(3590-1))) -
       BACKUP(TAPE(3590-1)) -
       SPILL(TAPE(3590-1)) -
       RECYCLEOUTPUT(BACKUP(3590-1) MIGRATION(3590-1))

DEFINE DUMPCLASS(classname UNIT(3590-1))
```

For more details, refer to *DFSMS/MVS Version 1 Release 3, DFSMShsm Storage Administration Reference*, and *DFSMS/MVS Version 1 Release 3, DFSMShsm Diagnosis Guide*.

12.7 ADSM for MVS

ADSM support for native IBM 3590 devices is implemented in such a way that, although the underlying media and recording format are the same, a tape volume written on an IBM 3591-attached drive **cannot be read logically by ADSM on a native IBM 3590 drive.** The only way for you to migrate from an IBM 3591 environment to native IBM 3590 environment is to physically move the data.

But ADSM provides a read compatibility enhancement to allow ADSM 3590 cartridge tapes written on 3591-A01-attached drives to be read on 3590-A00-attached drives. This is a one directional read-only solution. ADSM 3590 cartridge tapes written on 3590-A00-attached drives **cannot be read** on 3591-A01-attached drives.

This enhancement will only apply ADSM MVS and VM servers and it is scheduled to be available by the end of 1996 with ADSM PTF 12 in MVS environment. The read compatibility enhancement for ADSM for VM is scheduled to be available by first quarter 1997.

The ADSM read compatibility enhancement provides easy migration from 3591-A01-attachment to 3590-A00-attachment, and it enables expanded offsite recovery scenarios.

- ADSM migration from 3591-A01-attached devices to 3590-A00-attached devices will no longer require that a 3591-A01 be available, or that all data on 3591-A01-written volumes be moved to new 3590-A00-written volumes. This new enhancement allows use of a 3590-A00-attached drive to read tapes written by a 3591-A01, as well as to read/write new 3590 tapes.

- An ADSM server that uses 3591-A01-attached drives can now be recovered at an alternate location that only has 3590-A00-attached drives available. Note that the 3591-written volumes can only be read accessible on the 3590-A00-attached drive. In effect, with this configuration you will have a read-only ADSM server. For an alternate site to provide full production ADSM services, it is required that the alternate site have the same devices available as the primary. If the primary site uses IBM 3590 drives that emulate 3490E, the alternate site should have 3490E emulation drives as well.

There are restrictions associated with this ADSM read compatibility enhancement that must be understood before implementing a solution.

- ADSM tapes written on 3590-A00-attached drives can NOT be read on 3591-A01-attached drives.

- 3591-A01-written volumes that will be read on a 3590-A00-attached drive must be marked read-only to ADSM.

- You cannot perform ADSM reclamation processing between 3591-written volumes and 3590-A00-written volumes. ADSM views these volumes as different formats and they must be in different storage pools. The only way to migrate data from 3591-written volumes to new 3590-written volumes is to perform a Move Data on each 3591-written volume.

- 3591-written volumes **cannot** be subsequently written to on a 3590-A00-attached drive until they are emptied (through expiration, Move Data, or Delete Volume processing). When using scratch processing, the volume returns to scratch when empty and can then be reused as a 3590

format volume. If you are not using scratch, you must delete the volume after it's empty and then redefine the volume to the ADSM 3590 storage pool.

- If you are using a 3590-A00-attached drive to both read 3591-written volumes and also write new 3590 tapes, you must have 2 ADSM device class definitions. One device class would be defined like a 3490E to read the 3591-written tapes. The other device class would be defined as a 3590. 3591-A01-written tapes would need to be in a different storage pool than the 3590-A00-written tapes. On MVS, the esoteric unit name for a 3590-A00-attached drive could be used for both device classes.

- 3591-A01-attachment to 3590-A00-attachment read compatibility only applies to the MVS and VM ADSM servers. Therefore, you cannot do ADSM exports from a 3591-A01-attached device on MVS or VM and import to IBM 3590 tape devices on other platforms such as AIX and OS/400.

If you have a requirement to keep the old device export, backup, dump, or copypool tapes (for legal reasons, or to restore the server to some older date) you will have to have access to one of the old device drives.

If you are storing 3591-created ADSM tapes for disaster recovery purposes you need to make sure that your recovery site has 3591-attached drives available for reading the tapes.

There are several ways in ADSM to move the storage pool data from one device type to another. Note that the following techniques are not specific to migrating from an IBM 3591 to an IBM 3590. They apply generally for moving storage pool data from one device type to another.

- Primary storage pools

  Create a device class for the native 3590 device and create storage pools with the new device class. Change your copygroups and management classes to use the new storage pools. Then, move the data, using one of the following methods:

  – "Natural migration." Allow expiration and reclamation to empty the volumes in your old storage pools. When the more active data on your system has been deleted from the old storage pool, manually move the rest with the MOVE DATA command or by using migration. This process assumes that a relatively limited number of backup versions exist and data that is modified frequently will expire off the old storage pool, and be backed up on the new storage pool. A similar process would occur for migrated data that is recalled and migrated again. Archived data and most migrated data would have to be moved manually.

  – Use ADSM storage pool migration. Set the NEXT parameter for your old storage pools to your new storage pools, and set the HIGHMIG to 1, LOWMIG to 0. After migration is complete, if there are any nonempty volumes, issue the MOVE DATA command for them.

  – Use the MOVE DATA command to move data from a storage pool volume to other available storage pool volumes. You have to issue the command for all volumes in the old storage pools.

- Copy storage pools

  Copy storage pools cannot be moved. You must create a new copy storage pool in the new device class and issue the BACKUP STGPOOL command. After you have backed up all of the primary copy storage pools to the new

copy storage pool, you can delete volumes in the old copy storage pool, using the DISCARDDATA=YES parameter, and the copy storage pool itself.

Database backup, database dump, and export tapes cannot be moved. You have to do new backups, dumps, and exports, using the new device class.

12.8 OAM

You can convert OAM tapes written on IBM 3591-attached drives for use on a native IBM 3590 by modifying the following columns of the TAPEVOL table of the OAM optical configuration database:

MEDIATYP Media type
  04 Enhanced Capacity Cartridge System Tape
  05 IBM 3590 High Performance Tape Cartridge
UNITNAME Unit name
  3490 IBM 3490E tape device
  3590-1 IBM 3590 tape device
CAPACITY Approximate capacity of tape
  600000 Represents the approximate number of millimeters of tape for an ECCST
  9765888 Represents the approximate number of kilobytes of data of an IBM 3590 cartridge
FRESPACE Free space remaining on tape volume in kilobytes

The list shows the relevant values for IBM 3490E and IBM 3590 devices.

You can modify the columns, using for example SPUFI. The following is a sample SQL statement for updating the values for two volumes, VOL001 and VOL002.

```
UPDATE TAPEVOL
SET MEDIATYP=¢05¢,UNITNAME=¢3590-1¢,CAPACITY=9765888,FRESPACE=9765888
WHERE VOLSER IN (¢VOL001¢,¢VOL002¢)
```

When modifying the table, set a value of 9765888 into both the CAPACITY and the FRESPACE columns. OAM will update the free space to be correct after the next object is written.

For more information about how to use OAM with the IBM 3590 tape subsystem, see 4.1.5, "DFSMSdfp Component Object Access Method (OAM)" on page 89.

12.9 DFSMSrmm

DFDSMrmm records in its control data set the media type and recording format of the tape volumes it manages. If the cartridge is not a system-managed tape volume, this information is not validated. It is recorded simply to provide information about the cartridge. When native IBM 3590 drives become available, existing IBM 3590 cartridges known to DFSMSrmm as enhanced capacity cartridges can be reused by just mounting them for use. DFSMSrmm will record the correct media type and recording format.

You can use media name, rack number, or VOLSER as a way of keeping IBM 3590 cartridges segregated in the library if you have to know that information while using them on IBM 3591-attached drives.

Chapter 13. Operational Considerations for IBM 3591

In this chapter we describe operational considerations related to only the IBM 3591 tape subsystem. See also Chapter 7, "Operational Considerations for IBM 3590" on page 141 and *IBM 3590 High Performance Tape Subsystem User's Guide*.

13.1 Performance

The IBM 3591-A01 control unit enables customers to attach the IBM 3590 tape drives which can provide a higher level of performance for tape subsystems. The drive data rate of the IBM 3590 tape drive at 9 MB/sec is three times faster than previous IBM 3480, IBM 3490, or IBM 3490E tape drives allowing tape applications to read or write data more quickly.

Thus, although the IBM 3590 tape drive is capable of a 9 MB/sec sustained data rate and the ESCON channel is capable of an instantaneous data rate of up to 17MB/sec, other system considerations may limit effective data rate of the IBM 3591 tape subsystem.

Note: The actual throughput a customer may achieve is a function of many components, such as system processor, ESCON tape controller and its associated drive configuration, data block size, data compressibility, dependencies on other I/O such as DASD, and the system or application software used.

13.1.1 IBM 3591 MVS QSAM Write Performance

The theoretical data rate figures are put into perspective by actual measurements of maximum effective data rates achieved. Such a measurement study was conducted at the IBM SSD Laboratory at Tucson where one IBM 3591-A01 control unit and four IBM 3590-B11 units were used for the measurements. The 3591-A01 has only one ESCON channel path to the host and only one SCSI interface to the IBM 3590 drives. It means that the host has a single path to the tape drives. The measurement program uses standard MVS QSAM access method for writing date onto the IBM 3590 tape drives but did not perform any processing of the data blocks written to tape. The data transferred from memory to tape. Two data patterns were used in this study to provide compaction ratio of approximately 3:1 and 1:1.

Table 45 on page 222 shows the effective data rate of the IBM 3591 tape subsystem with 3:1 compaction ratio data pattern in this measurements. The default value of MVS QSAM buffer number is five and 30 buffer is the maximum MVS supported value. The figures of both 32 KB and 16 KB block sizes are shown.

Table 45. IBM 3591 Data Rates for MVS QSAM write - 3:1 compaction ration						
Buffer Number	**Block Size**	**IBM 3591 Data Transfer Rate (MB/sec)**				
		Number of Tape Drives Attached to IBM 3591				
		1	**2**	**3**	**4**	
5	32 KB	7.9	8.8	8.8	8.8	
5	16 KB	5.6	6.5	6.6	6.6	
30	32 KB	8.4	9.2	9.5	9.6	
30	16 KB	6.2	7.0	7.2	7.2	

Table 46 also shows the effective data rates where the transferred data has a compaction ratio of 1:1.

Table 46. IBM 3591 Data Rates for MVS QSAM write - 1:1 compaction ratio						
Buffer Number	**Block Size**	**IBM 3591 Data Transfer Rate (MB/sec)**				
		Number of Tape Drives Attached to IBM 3591				
		1	**2**	**3**	**4**	
5	32 KB	7.7	8.8	8.8	8.8	
5	16 KB	5.6	6.5	6.5	6.5	
30	32 KB	8.0	9.1	9.6	9.6	
30	16 KB	5.7	7.1	7.1	7.2	

You can see that the results achieved with a 3:1 compaction ratio are not significantly different from those achieved with 1:1 (that is no) compaction. This indicates that the tape drive speed is not the limiting factor in the IBM 3591 tape subsystem performance in this configuration. However the effect of blocksize, and the resulting effective channel data rate, are clearly demonstrated by these figures. Large block size will always improve the effective data rate provided that the overall tape subsystem is not limited elsewhere for example by the tape drive speed.

13.2 Time Value of Missing Interruption Handler

The recommended Missing Interruption Handler value for the IBM 3591-attached IBM 3590 tape drive is eight (8) minutes.

13.3 Error Log (ERA)

Error recovery actions (ERAs), which are defined for 3490E tape subsystems, are also used to report errors encountered by the IBM 3591 tape subsystem with its IBM 3590-B11 tape drives.
There are no new ERA codes introduced with the IBM 3591 tape subsystem. However, three IBM 3490E ERA codes have an expanded context in an IBM 3591 environment or can be used for error conditions not compatible with IBM 3490E subsystems.

See also the *IBM 3490 Magnetic Tape Subsystem Models A01, A02, A10, A20, B02, B04, B20, B40 Hardware Reference*,, and *IBM 3490 Magnetic Tape Subsystem Models C10, C11, C22, C1A, and C2A Hardware Reference*.

13.3.1 ERA Code 2C, Permanent Equipment Check

ERA Code 2C, Permanent Equipment Check is issued when data is lost in connection with a Manual Unload operation.

13.3.2 ERA Code 2E, Not Capable

ERA code 2E, Not capable is reported when attempt is made to load a cartridge type other than IBM 3590 cartridge.

13.3.3 ERA Code 48, Unsolicited Informational Data

ERA code 48, Unsolicited Informational Data, is generated to report an error encountered in the IBM 3591 control unit or that an IBM 3590 service information message (SIM) or IBM 3590 media information message (MIM) has been logged.

13.4 Remote Support Facility

Remote Support Facility is available on the IBM 3591 tape subsystem. Remote Support Facility is mandatory for IBM 3591 control unit and IBM 3590-B11 tape drives service.

Appendix A. Enterprise Systems Connection (ESCON) Tutorial

Enterprise Systems Connection (ESCON) is the most significant change to the I/O area of data processing since the original parallel Original Equipment Manufacturer Interface (OEMI) was introduced nearly 30 years ago.

In this chapter we describe ESCON terminology, fiber-optic technology, ESCON architecture and standards.

A.1 Overview

The following is a summary of ESCON announcements since September 5, 1990.

- New ESA/390 and new I/O interface
  ESCON is an integral part of the IBM Enterprise Systems Architecture /390 (ESA/390). ESCON replaces the previous S/360 and S/370 parallel OEMI with the ESCON I/O interface supporting new media, providing new interface protocols, and replacing the previous bus-and-tag cables and their multiple data and control lines.

- Fiber optics
  ESCON cables are a hundred times lighter than bus-and-tag copper cables. ESCON cables are more reliable, have less distortion, and are free from signal skew.

- Topology
  ESCON control units and channels are attached in a switched point-to-point arrangement. The switching capabilities allow multiple connections between channels and control units without requiring permanent physical connections.

- ESCON directors
  A new class of devices, called directors, was introduced that connect the channels and control units only for the duration of an I/O operation. ESCON directors are nonblocking and can switch millions of connections per second. Apart from dynamic switching, the ESCON directors can be used for static switching of a single control unit among different system images.

- ESCON repeater/converter
  These devices give the common carrier the ability to monitor the usage on the fiber link and to collect error statistics. Repeater/converters can be used in place of directors when only a few fiber links are required.

- ESCON manager
  The ESCON Manager is a software product that provides an easy-to-use interface that can be automated. It offers protection against disruptive changes and is available for both MVS/ESA and VM/ESA.

- ESCON channel to channel (CTC)
  The ESCON CTC allows processors to communicate at channel speeds, without the need for extra hardware.

- Distance
  Extended attachment distances, up to 60 km, are possible with ESCON. The
  IBM 3590 tape subsystem can be attached at up to 43 km from a host, using
  ESCON channels.

- ESCON capable processors
  All IBM ES/9000 and S/390 processors support and exploit the facilities of,
  ESCON. Some older IBM processor models can be enhanced to support
  ESCON, (ES/3090-9000 model T) or can have the support retrofitted, such as
  the ES/3090 model J range. RISC/6000 and IBM RS/6000 Scalable
  POWERparallel Systems (RS/6000 SP) also support ESCON.

  ESCON software support is provided in the appropriate levels of MVS/ESA,
  VM/ESA, VSE/ESA and TPF.

- ESCON control units
  Many control units and devices, such as the IBM 3590 tape subsystem,
  support ESCON.

- Converters
  Two protocol converters are available to ease the migration from parallel
  OEMI to ESCON. One device converts parallel OEMI protocol to ESCON
  protocol, and the other converter does the reverse. These converters are
  migration devices and cannot exploit the full functions of ESCON.

A.2 Terminology

In this section we describe ESCON fiber-optic terms. These elements are used
to physically realize the connections in an ESCON configuration:

- Transmitter
  There is a transmitter in the channel and the control unit, which converts
  electrical signals into light pulses. These light pulses are sent by a light
  emitting diode (LED) or laser.

- Jumper cable
  The jumper cable has the same function as the pair of cables that make up a
  parallel channel cable. There are two fibers, one to carry data in one
  direction and the other to carry data in the opposite direction.

  Jumper cables for IBM devices are supplied by IBM in standard lengths up
  to 122 meters (400 feet) at no charge. The number of jumper cables supplied
  at no charge by IBM depends on the IBM ESCON device.

- Distribution panel
  The distribution panel is a "junction box" to connect ESCON cables. The aim
  is to simplify reconfiguration and allow the addition of extra channels without
  disruption.

- Trunk cable
  A trunk cable is a single cable containing many optical fibers. Typically a
  trunk cable will contain 144 working fibers; this is equivalent to 72
  bus-and-tag copper channel cables. Trunk cable is used instead of multiple
  jumper cables when many connections are required between two locations.

- Splice

  Fiber cables may be joined by splicing. Every splice causes light loss, and this may restrict the length of fiber that can be used.

- Connector

  Fiber cables are connected to panels, control units and so on, with IBM duplex connectors. Many connector types are available, but an IBM duplex connector is required for attachment to any IBM ESCON device.

- Receiver

  There is a receiver in the channel and control unit, to detect the light pulses, demodulate them, and change the optical signal to an electrical one.

A.3 Fiber Optic Technology

In this section we describe the major advantages of optical fiber technology over copper cable technology and discuss some basic principles of fiber-optic communication.

A.3.1 Advantages of Optical Fiber

Optical fibers have several important advantages when compared to traditional copper cables. The advantages include the following:

- Larger bandwidth

  A fiber-optic cable can sustain a much higher data rate than a copper cable. Typical bandwidths are 500 MHz to 100 GHz over a 1 km distance.

- Physical characteristics

  A fiber-optic cable is very flexible. It is small and light, and consequently it is much easier to install than copper cable. It is also highly resistant to environmental conditions such as temperature, water, light and radiation .

- No electromagnetic interference

  A signal transmitted in a fiber-optic cable:

  − Does not generate electromagnetic interference (EMI).

  − Does not have radiated electromagnetic susceptibility (RES).

  − Is not affected by radio frequency interference (RFI).

- Low loss

  The light travelling in a fiber-optic cable will lose energy at a very slow rate, usually at less than 1 dB/km.

- Small crosstalk and high security

  Since there is no electrical radiation from fiber-optic cables, they offer a higher degree of security than copper cables. Although fiber-optic cables are not easy to tap, it is possible. Transmitted light is converted to electrical signals at ESCON repeaters, and data may be exposed at these points.

- No common ground

  Fiber-optic cables are not affected by electrical disturbances to ground.

A.3.2 Propagation of Light in an Optical Fiber

Because of attenuation (signal loss), only certain wavelengths of light are suitable for use in optical fibers. The wavelengths of 850 nanometers and 1300 nanometers are used. The power of the light transmitted is relatively small, 10 to 50 milliwatts. However, all safety precautions should be followed, as the light used may cause harm to human tissue and even cause blindness if aimed at the human eye.

Several aspects are significant:

- Transmission modes
  There are two modes of transmitting light signals through an optical fiber, single-mode or multimode. Thus the optical fibers used are referred to as single-mode or multimode fibers.

- Multimode fiber
  When the cable core has a comparatively large diameter, the light rays enter at different angles. The light now travels in different modes, called multimode transmission.

  Multimode fiber carries several modes concurrently. The 62.5/125 μm or 50/125 μm optical fiber cables are supported by IBM. A light-emitting diode is used as the light source and the maximum distance for a multimode optical fiber link is 3 km, using a 62.5/125 μm fiber.

- Single-mode fiber
  When the cable core has a comparatively small diameter, the light rays travel almost parallel to the central axis. The light now travels in one mode, called single-mode transmission.

  Single-mode fiber usually has a core diameter of 8 to 10 μm and a cladding of 125 μm. A laser is used as the light source and the maximum distance for a single-mode optical fiber link is 20 km.

A.4 I/O Architecture

In this section we describe the general concepts of the ESA/390 ESCON I/O interface.

A.4.1 Overview

These are the significant I/O architecture aspects:

- Channel
  To execute the commands presented by the software through the standard ESA/390 I/O instructions, the channel manages its associated link interface to control bit transmission and reception.

- Link
  The transmission medium of the ESCON I/O interface is a fiber-optic cable.

- Link-level facility
  The link-level facility performs link-level protocols and functions, such as initialization, offline processing and error recovery, and manages the logical paths and attached links.

- Device-level protocol
  Device-level protocol defines the rules for exchanging information between the program and the device, and consists of commands, data, status and control information.

- Link-level and device-level frames
  Apart from encoding, characters are packaged into frames with a specific format. The ESCON I/O interface defines two types of frames, one to control the link and associated elements, and the other to control device operations. The former are called "link-level" frames, and the latter, "device-level" frames.

- Logical paths
  A logical path is the relationship between a channel and a control-unit image that designates the physical path to be used for device-level communication between both link-level facilities. An ESCON channel can currently support up to 120 logical paths.

A.4.2 ESCON Director

The ESCON Director temporarily connects ports for transmission. The connection can remain in effect while several frames are exchanged between ports. The switching function of the ESCON Director provides a way of connecting multiple channels and control units without requiring permanent connections.

A link address is associated with each ESCON Director port number by a mapping scheme. Data arriving at a port carries a link address that the switching function of the ESCON Director uses to determine the outbound port to send the data to.

Ports in an ESCON Director can be in several states, namely:

Inactive A port can accept or initiate a connect request.

Busy The port cannot accept a connect request.

Connection The port has a valid connection.

Static The port has a dedicated connection with another port.

Offline The port is transmitting an offline sequence. This state can be caused by:

- Issuing a *BLOCK* command
- Performing diagnostics (wrap test).

Link failure This is usually the result of a loss of light at the receiver end of the port.

A.5 ESCON I/O Architecture Implementation

In this section, we describe how the ESCON architecture is implemented in IBM′s ESCON products.

A.5.1 Channels

There are two types of ESCON channel:

LED This ESCON channel uses multimode fiber with a Light Emitting Diode source. The maximum single-link distance (without repeating) is up to 2 km (using 50 micron fiber) or 3 km (using 62.5 micron fiber). These channels can attach directly to processor channels, control units, and directors.

XDF This ESCON channel uses single-mode fiber with a laser light source. The maximum single-link distance (without repeating) is up to 20 km. These channels can attach directly to processor channels and directors. An XDF channel cannot be directly attached to a control unit. This channel can be accessed only by a control unit by means of an ESCON director or Repeater/Converter.

A.5.2 Capable Processors

Table 47 summarizes the maximum data rate of ESCON channels on each processor type.

Table 47. Maximum Data Rate for ESCON Channels		
Processor Type	**ESCON LED MB/sec**	**ESCON XDF MB/sec•**
ES/3090-J	10	N/A
ES/3090-9000T	10	N/A
ES/9000 9221	10	10
ES/9000 9121	10	10
ES/9000 9021 (340 based models)	10	10
ES/9000 9021 (520 and 711 based models)	17	17
S/390 Parallel Server E/P/R1 models	17	17
S/390 Parallel Server R2/R3 models	17	N/A•
RISC/6000	10	N/A
IBM RS/6000 Scalable POWERparallel Systems	10	N/A
Notes:		
• The figures in the table represent maximum data rates and extended distances will reduce the data rates.		
• XDF is only available when upgrade from a E/P/R1 model.		

At initial micro program load (IMPL) time the operator can select one of three modes of operation for the processor:

S/370 mode In this mode of operation, ESCON channels cannot be used.

> **Note:** S/370 mode is not a native mode for most ES/9000 or any S/390 processors.

ESA/390 mode In this mode of operation, ESCON channels can be used if the required software levels are installed.

LPAR mode If ESA/390 mode is selected for a partition, ESCON channels can be used. If S/370 mode is selected for a partition, ESCON channels cannot be used.

A.5.3 ESCON Multiple-Image Facility

The ESCON Multiple-Image Facility (EMIF) enables channel sharing among Processor Resource/Systems Manager (PR/SM) logical partitions, running on any IBM ES/9000 model 520, 511, or 711 based processors and S/390 Parallel Servers. With EMIF, the processor channel subsystem provides physical path sharing by extending the logical addressing capability of the ESCON architecture to host images (PR/SM logical partitions).

Each partition has its own logical channel subsystem, and its own view of each shared channel (logical channel path image) and each control unit connected to the shared channel (subsystem image).

On processors that do not have EMIF installed, the available channel paths must be dedicated to a single partition. In this environment, ESCON channel paths need to be varied offline from the owning host and then online to the target host.

On processors which do have EMIF installed, the channels are managed such that each partition can have access to all ESCON channels. The channel subsystem manages the arbitration between the partitions requesting channel service and the physical channel resources. Typically, this means that many fewer ESCON channels are required for a given configuration.

A.6 ESCON-Attached IBM 3590 High Performance Tape Subsystem

An IBM 3590 tape subsystem can be connected to an ESCON LED channel in one of two ways:

- **Point to Point**. The channel path consists of a single link interconnecting one channel with one control unit. ESCON is a point-to-point channel architecture and therefore does not support channel daisy-chaining. Figure 81 shows an IBM 3590 model A00 connected to ESCON channels.
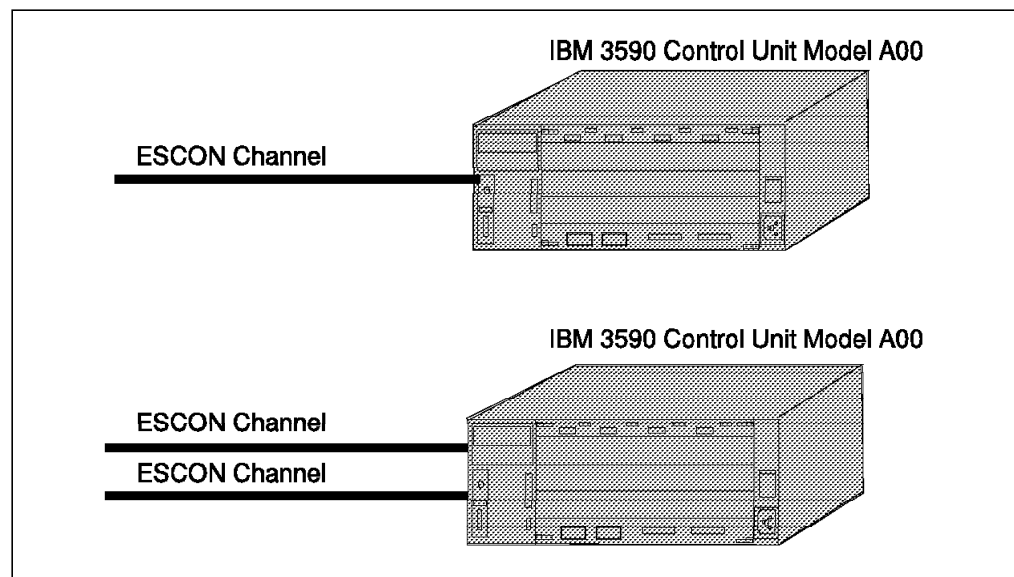
Figure 81. ESCON Point-to-Point Connections

In Figure 81 the upper example shows a IBM 3590 tape subsystem with a single ESCON point-to-point connection. The lower example shows a IBM 3590 tape subsystem connected to two ESCON channels. These two

channels can either be connected to the same system image, to different system images on the same host, or to two or more hosts with the use of ESCON directors. The IBM 3590 tape subsystem can be attached to 64 system images on each of its two ESCON ports. Thus the IBM 3590 tape subsystem can support up to 128 logical ESCON paths.

Some devices support both ESCON and parallel attachment, such as the IBM 3490 tape subsystem. In this case, a single IBM 3490 tape subsystem control unit can connect to a host with both a parallel and an ESCON channel. Under no circumstances should a parallel path and an ESCON path be defined for the same control unit to a *single* system image. If this is done, channel problems occur, such as missing interrupt errors. The general rule is that you cannot mix different path types for a control unit to a single system image.

• **Switched Point to Point**. A very fast dynamic switch (ESCON director) provides the capability to interconnect multiple links and control units to ESCON channels dynamically. These connections are typically of such short duration, that multiplexing of the links is possible. Such a connection is referred to as a dynamic connection. In Figure 82, two ESCON directors supporting various links are shown.
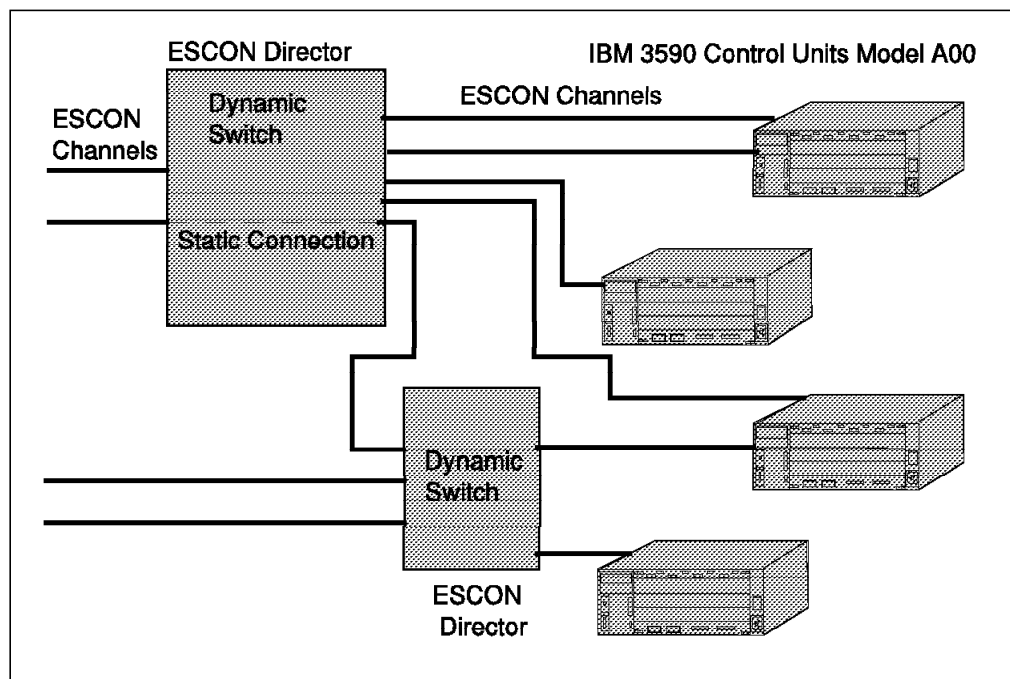
Figure 82. ESCON Switched Point-to-Point Connections

Directors perform the channel multiplexing function, connecting control units to multiple systems. Some connections in an ESCON director cannot be switched: these are referred to as *static* connections. Links between ESCON channels and control units, defined in this way are dedicated and cannot be dynamically switched. In Figure 82, the connection between the two directors is a static connection.

A.7 Fiber Optic Standards

In addition to the ESCON architecture, there are other standards based on fiber optics. In this section we provide information on some of the standards that are either available or being designed:

- Fiber Channel Standard
  Fiber Channel Standard (FCS) is ANSI standard X3T9.3. This standard has not yet been finalized, it became available for the first public review late in 1992.

  The base of FCS is laser technology with a bandwidth of 1 GHz. It will first be used by numerically intensive computing and scientific applications providing a high performance parallel interface (HIPPI). In FCS, switching is not an architectural design, only the ends are defined. Switching in the network is based on the destination and source address. There may be several switches in a network. It may become possible to use FCS as a high-speed backbone network. It may also be used as a general transfer vehicle for upper level protocols, such as TCP/IP, HIPPI and SBCC. These upper-level protocols may be intermixed on a link.

- Synchronous Optical Network
  Synchronous Optical Network (SONET) is a U.S. standard for the international operations of optical networks. It is closely related to a system called Synchronous Digital Hierarchy, that is a Comite Consultatif International Telegraphique et Telephonique (CCITT) recommendation for the internal operations of optical networks.

  SONET can mix packages, or frames, from different sources and carry them over a network. It uses a family of rates of 51.84 Mb/sec. Using multiples of these rates, SONET is capable of reaching rates of gigabits per second. Within SONET, several bandwidths can be transported simultaneously.

- Integrated Services Digital Network
  Integrated Services Digital Network (ISDN) describes and specifies a digital interface to a public communication network. It does not specify the internal operations of a network, but rather the interfaces to it and the service it provides.

  There are three generic types of ISDN:

  1. Narrowband ISDN can utilize 64 Kb/s copper links primarily on a switched services basis.

  2. Wideband ISDN is a form of ISDN where a user can access a wider synchronous data channel utilizing several 64 Kb/s copper links.

  3. Broadband ISDN is a cell-based packet-switching system. It does not offer synchronous links as do narrowband and wideband ISDN, but Asynchronous Transfer Mode (ATM) cell switching.

  ISDN is already in use for carrying speech and data simultaneously over a channel. It is aimed at many applications, not only for computing, but also for consumer services at offices, homes and so on.

- Asynchronous Transfer Mode
  Asynchronous Transfer Mode (ATM) is a protocol that has been accepted as the basis for broadband ISDN service. It is aimed at high-speed cell-switching systems. ATM is suitable for all types of traffic, including voice, data, image, and video. Information is transferred in cells that contain

a header defining the route through a network. Each cell may contain 48 bytes of data, or payload.

- Fiber Distributed Date Interface

  The Fiber Distributed Date Interface (FDDI) standard was developed by ANSI. It was originally proposed as a standard for fiber-optical computer channels, but has become a generalized standard for operation of a LAN at 100 Mb/sec. The FDDI standard was approved in 1991, and many FDDI devices are available on the market.

  FDDI is primarily intended for operation over optical fiber networks, but was recently proposed for operation over standard copper wire (shielded twisted pair). Using multimode optical fiber, a FDDI ring may be up to 200 km in length with a maximum of 500 stations. Data transfer takes place in frames or packets. The maximum frame size is 4500 bytes and contains a header with the physical destination address of a FDDI station. The ring protocol of FDDI is conceptually similar to that of the token-ring LAN (IEE 802.5), but differs significantly in detail.

  FDDI was approved quite early, and so it has been implemented and accepted by many enterprises.

For more information on please refer to *Enterprise Systems Connection (ESCON) Implementation Guide*.

Appendix B. Small Computer Systems Interface Tutorial

Small Computer Systems Interface (SCSI) is fully documented in ANSI standard
X3.131-1986. Following the creation of the first SCSI standard, now referred to as
SCSI-1, emerging technologies required the expansion of the standard. An
enhanced version of the standard was produced in 1994, and is called SCSI-2.
Today SCSI-3 standards are under development by the X3T10 committee;
however most of the significant changes have already been defined.

The SCSI architecture is device independent, allowing the attachment of any
form of device that conforms to the ANSI SCSI standard. With this standard
interface, hosts can communicate with intelligent peripheral devices such as
fixed disks and tape drives.

The devices are connected by means of a flat multiconductor cable, called the
SCSI bus. A twisted-pair cable can also be used, which reduces crosstalk
between adjacent signals. A large number of devices of different types can be
connected to a host by means of a single SCSI bus cable and a single SCSI
attachment feature. This SCSI attachment can be either an external, or
integrated adapter and is connected to the host system bus.

Up to a maximum of seven devices can be directly attached to the SCSI bus
cable and each of these devices can support up to eight more. This means that
it is possible for one SCSI-2 attachment feature to support 56 devices. All
devices and the attachment features must conform to the ANSI standard, which
specifies their mechanical, electrical, and functional requirements, as well as the
command set they must support.

SCSI allows several different devices to operate concurrently on a single bus
and to share the SCSI bus efficiently. This is done by performing arbitration
between any devices that want to use the bus at the same time and managing
device disconnect and reconnect. High data transfer rates can be achieved, but
distances are greatly restricted when compared with those possible with ESCON.
For example the maximum distance that a 3590 tape drive can be from the host
(or SCSI attachment feature) is 25 m, compared with up to 43 km available with
an ESCON connection.

B.1 Interfaces

Four interfaces are available:

• Intelligent Interface

   SCSI is an intelligent interface that masks:

   – The physical format of the device. The host is concerned only with what
     type of device is attached, for example disk or tape.

   – The physical configuration of the device. Using logical block addressing
     the host requests a file in the form of a logical address that is in the
     range from zero to the maximum address that is available on the device.

   – The recovery procedures of the device. The device will attempt to
     resolve errors without host intervention.

   – The commands used to communicate with the device. The SCSI
     interface provides generic commands which support many device types,

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for example the READ command for a disk device is very similar to the READ command for a tape device. The host requires software that can properly format these commands for each specific device type attached to the SCSI bus. This host software is known as the Device Driver.

- Peripheral Interface

  - Up to eight (for SCSI-2) or 16 (in the case of SCSI-3) devices can be attached to a single bus cable. In SCSI-3 an additional cable, called the *Q-Cable*, can be added to allow the attachment of up to 32 devices. These devices can be any combination of hosts adapters or peripheral controllers

  - The standard protocol is device independent. The host can attach disk, tape or optical drives and other devices such as printers or scanners to the same bus

  - All SCSI devices are plug compatible.

- Buffered Interface

  - All components can handshake, so that slow or fast devices can properly communicate with slow or fast hosts

  - All transfers consist of real data; data correction, mapping, and caching is done in a buffer.

- Peer to Peer

  - Communication can take the form of:

    Host to host
    Host to peripheral device
    Peripheral device to peripheral device.

  - Each communication (I/O process) is between two devices and each device assumes an operational role. For each communication, one device assumes the role of:

    An Initiator, which is responsible for starting the I/O process, for example *READ*
    A Target, which is responsible for controlling the I/O process.

B.2 Data Transfer

The SCSI bus can transfer data in one of two ways, either in synchronous or asynchronous mode. The mode determines how the data is actually transferred.

- Synchronous

  In this mode of operation, each byte of data sent between the initiator and the target must be requested and acknowledged. The series of handshakes entailed makes this the slower of the two modes of data transfer.

- Asynchronous

  In this mode of operation, multiple bytes of data can be transferred before acknowledgments are received. Acknowledgments are received, but not at regular intervals, as in the synchronous mode. At the end of the total transfer operation the acknowledgments are checked. If the total number of acknowledgments is as expected, the transfer operation is considered successful.

B.3 Configurations

In a SCSI environment, many different configuration options are possible. The SCSI standard defines three bus configuration options:

- Single initiator and single target

- Single initiator and multiple targets

- Multiple initiators and multiple targets.

The third type of configuration is illustrated in Figure 83. Here, multiple targets are connected to multiple hosts. Although Figure 83 shows all the targets sharing the same bus, you may want to restrict the number of devices to one or two per bus for performance reasons.

In Figure 83, the first two *targets* could each be an IBM 3490-C2A, and the last four *targets* could each be IBM 3590-B11s. The number of logical units is device dependent; an IBM 3490-C2A can have up to two, and an IBM 3590-B11 can have only one. The SCSI-2 standard supports up to eight logical devices for each target peripheral controller.
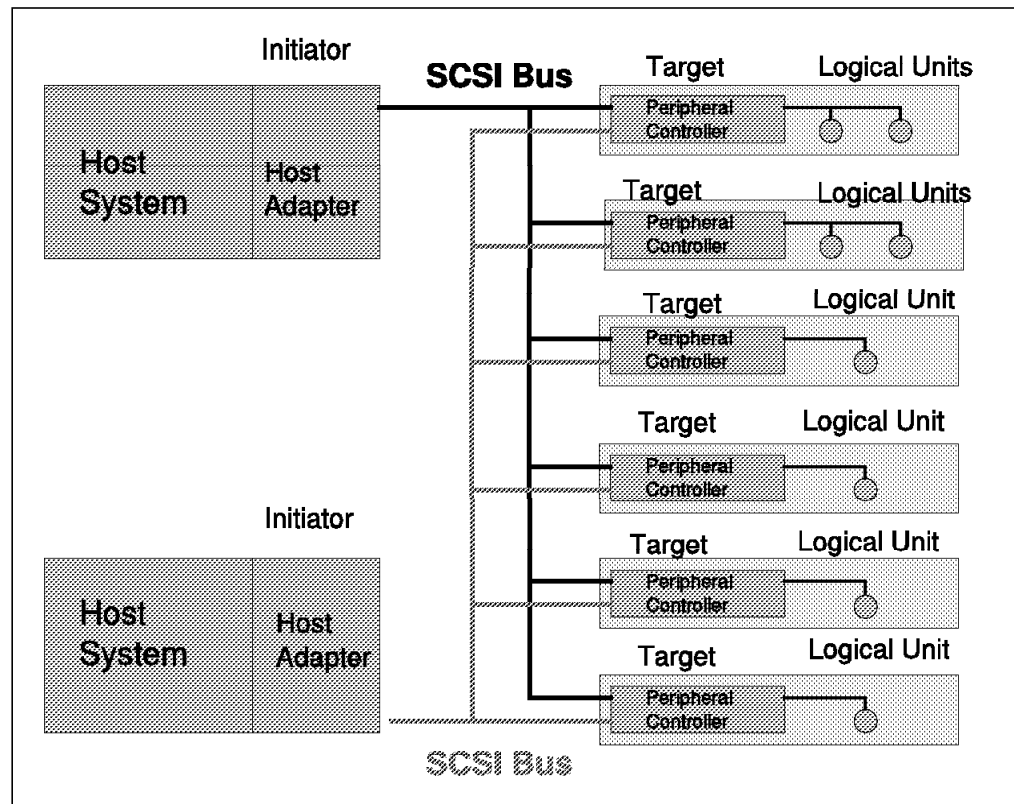
Figure 83. SCSI Multiple Initiators and Multiple Targets

The components shown in Figure 83 are defined as follows:

Host Adapter A device that connects the host bus to the SCSI bus. This is also referred to as the SCSI attachment or SCSI adapter

Initiator The mode of operation within a device that determines what task needs to be executed and which target will perform the desired task

Target   The mode of operation within a device that controls the entire process, after being successfully selected by an initiator

Logical Unit   A physical or virtual peripheral device, addressable through a target or peripheral controller

I/O Process   An operation with an input/output device.

B.4 I/O Process

In a SCSI I/O process, three protocol layers may occur:

- COMMAND. This is the transfer operation
- DATA. This is the information to be transferred
- STATUS. This updates the initiator that the I/O process has completed.

Figure 84 illustrates the I/O operation protocol layers. These layers are also referred to as *SCSI Bus Phases*. The SCSI bus can only be in one phase at any given time.
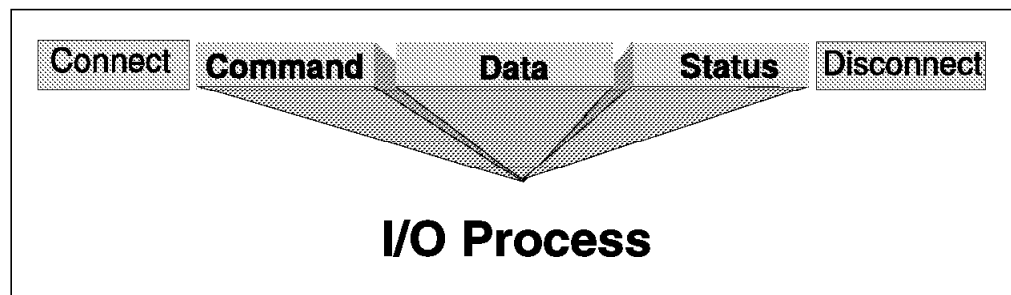
Figure 84. SCSI I/O Operation

An I/O process (data transfer operation) is initiated after a decision has been made within the host to store or retrieve information to or from an I/O device. Once the host SCSI adapter has the required information, it starts the operation. The total operation includes the initial bus connection and the final bus disconnection. The I/O process comprises the three intervening protocols. Of the three protocols layers defined for an I/O process, at least two—the COMMAND and the STATUS—must be present. The DATA protocol is optional because some SCSI commands have no data to transfer.

B.5 Addressing

In a SCSI configuration, the following components are addressed with SCSI ID numbers:

- Attachment Features

    The value of the SCSI ID number is used during *arbitration*. If more than one device requests the use of the bus at the same time, the one with the highest SCSI ID number is selected. The SCSI attachment feature has a unique SCSI ID number from zero to seven assigned. Typically a SCSI ID of seven is assigned to the attachment feature, since seven is the highest priority ID on the bus

- Devices

    Each device attached to the SCSI bus is known as a SCSI device. It is assigned a SCSI ID number which is unique on the bus. This ID is set by

means of hardware switches or jumpers located in the device. Most devices have a single SCSI ID; however device may have more than one SCSI unit. For example an automated tape library will have one SCSI ID for the accessor (or robot) and one for each of the attached tape drives.

- Logical Units

The logical units are not attached directly to the bus, but to the SCSI device. The controllers can be considered SCSI devices and the actual device itself, for example a disk drive or a tape units can be thought of as the *logical unit*. These logical units can be assigned a SCSI ID number in the range zero to seven (for SCSI-2) and zero to 31 (for SCSI-3). For example, if an IBM 3490-C2A has a SCSI ID of five, then typically the first tape unit has the SCSI ID set to zero and the second tape unit has its SCSI ID set to one.

The SCSI address takes the form "00-**ad**-00-**xy**," where **ad** is the host adapter number, **x** is the SCSI ID, and **y** is the logical unit number (LUN).

The SCSI attachment feature can support up to seven SCSI devices and each device can support up to eight logical control units (with SCSI-2). This means that each SCSI-2 attachment feature can support up to 56 devices.

B.6 Tape I/O Commands

The SCSI standard specifies that commands are either optional or mandatory. A device must implement all mandatory commands to conform to the SCSI standard. Below are some typical tape (Sequential-Access Devices) commands:

Mandatory: READ, WRITE, REWIND

Optional: LOCATE, WRITE BUFFER, PREVENT MEDIA REMOVAL, ALLOW MEDIA REMOVAL.

Note: For a complete list of tape commands please refer to Table 50 on page 247.

Some SCSI tape devices, such as the IBM 3590 tape subsystem, are also termed *Medium Changer Devices*. Thus in addition to the normal tape commands, these device also support medium changer commands. Below are listed some typical medium changer commands:

Mandatory: INQUIRY, MOVE MEDIUM, TEST UNIT READY

Optional: EXCHANGE MEDIUM, POSITION TO ELEMENT, READ ELEMENT STATUS.

Note: For a complete list of medium changer commands, please refer to Table 51 on page 248.

B.7 Bus Options

- Bus Width

The number of bytes that a SCSI bus can transfer in a single I/O operation is termed the *width* of the bus.

Narrow Bus   A narrow bus can transfer one byte in a data transfer.

Half-Wide Bus   A half-wide bus can support one or two bytes in a data transfer.

Full-Wide Bus   A full-wide bus can support one, two or four bytes in a data transfer.

It is common practice to refer to a bus as *wide* when it is in fact only half-wide. As an added complication, when the SCSI-3 standard is finalized it may refer to a 4-byte-wide capability as *Double-Wide*, this would mean that the 2-byte capability would be termed *Wide*.

Both devices and host adapters are termed *Full-Wide, Half-Wide or Narrow*, meaning that they transfer four, two or one byte in a single transfer. Both wide and narrow devices can be mixed on the same SCSI bus.

- **Interposer**

  Typically, not all adapter, device, and cable connectors in a SCSI environment are compatible. To facilitate the connection of the various connector designs an interposer connector is used. An interposer is a connector that allows the target (device control unit) to attach to the initiator (host adapter).

  It is possible to attach a device to a host adapter where both device and adapter support a different width for data transfer. Thus for attachment of a 2-byte-wide device to a 1-byte-wide SCSI attachment, a 2-byte-wide interposer is required.

- Normal Speed SCSI Bus

  This bus can transfer data at 4 million transfers per second, which is the SCSI-1 limit.

- **Fast SCSI Bus**

  This bus can transfer data at 10 million transfers per second, which is the maximum speed of a SCSI-2 bus. A SCSI-3 bus can operate at 20 million transfers per second.

  To obtain the effective data rate, multiply the maximum transfer rate by the bus width. For example,

  10 million transfers per second X 2 bytes per transfer = 20 million bytes per second

- Transceiver Alternatives

  There are two types of bus transceiver (driver and receiver) and they are mutually exclusive:

  - Single-Ended

    With a single-ended implementation the maximum cumulative cable length is 6 m. The distance from the device to the bus can be no greater than 0.1 m, with minimum cable length between the devices of 0.3 m. The single-ended cable option is primarily designed for use within a cabinet.

  - Differential

    With a differential implementation, the maximum cable length is 25 m, with a minimum cable length between the devices of 0.3 m. The distance from the device to the bus cannot exceed 0.3 m. The differential cable option is primarily designed for use outside a cabinet.

  - Cable Options

    A-Cable   This is a 50-pin bus cable, which transfers 1 byte per transfer.

B-Cable This is a 68-pin bus cable, which transfers 2 bytes per transfer. The B-Cable is used in addition to the A-Cable.

P-Cable This is a 68-pin bus cable, which is a *Half Wide* 16-bit bus option. This cable can be used as a SCSI1 or SCSI2 bus, but is always required for a SCSI-3 bus.

Q-Cable This is a 68-pin *Full Wide* 32-bit cable. If the Q-Cable is used, then the P-Cable is also required. The P-Cable with the Q-Cable provides a four byte wide bus.

Figure 85 shows typical SCSI bus connections, using various types of bus cable.
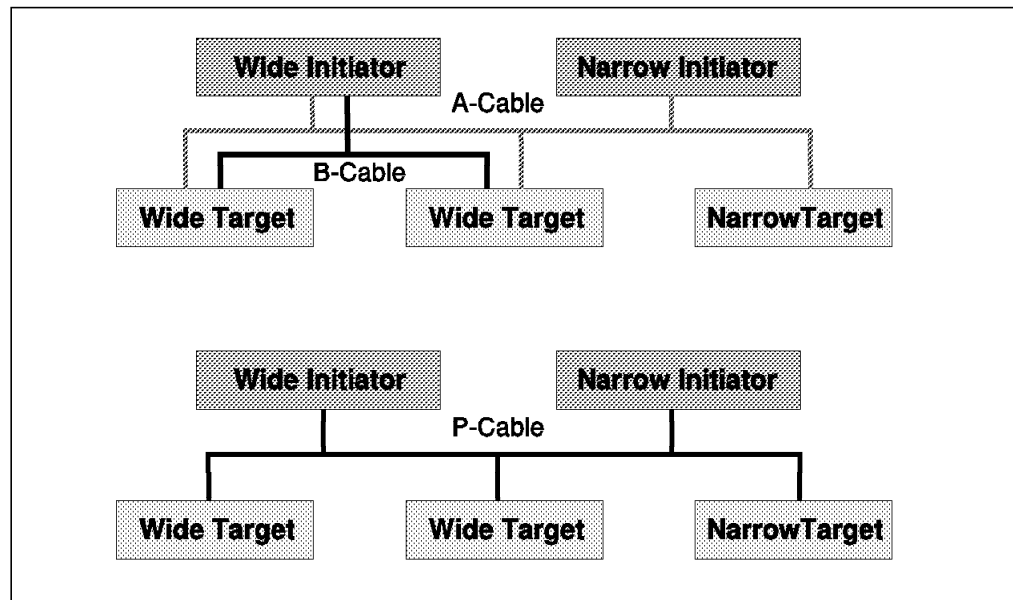
Figure 85. SCSI Bus Cable Alternatives

Both wide and narrow initiators and targets and shown in the two cabling arrangements in Figure 85. In the upper configuration, the devices are daisy chained together using a common 50-pin A-Cable. All signals are common between all devices. Additionally, the wide devices are also connected together by a second 68-pin B-Cable, to conform to the SCSI-2 standard.

In the lower configuration, the functionality of both the A-Cable and the B-Cable is replaced by a P-Cable. Here, only one cable is required while the bandwidth is effectively doubled to devices that support wide transfers.

B.8 Other Facilities

- As we have seen, more than one initiator can be attached to a single SCSI bus. If one device was a disk and the other a tape, the SCSI attachment could send a command to a tape drive to copy information to the disk device. Once the tape device had read the data it would become an initiator and send a write command to the disk, without further involvement of the SCSI attachment or host.

- More than one host can initiate requests on the same bus. Care needs to be exercised when using this arrangement. ADSM for AIX and some target devices do not support this environment.

B.9 Performance

The performance achieved with the SCSI bus, in terms of I/Os per second, depends on many factors, including the number of devices attached to the bus, effective use of caching,and the effectiveness of the SCSI attachment feature. An important consideration is the type of operation being performed:

- Disk to tape

- Tape to tape

- Memory to tape.

Data transfer rates in disk-to-tape operations will typically be constrained by the transfer rate of the disk system. Both memory-to-tape and tape-to-tape operations should be able to exploit the potential of the SCSI bus speed more fully.

SCSI implements a bus release feature, disconnection which maintains a logical connection between the devices executing a command but releases the bus when one device encounters a delay, such as buffer full or mechanical seek.

SCSI is a very low overhead architecture, with a protocol time of approximately 17 µs. Actual implementations may vary between 0.5 to 1.5 ms. Very high data transfer rates are possible, up to 40 MB/sec, if both 32-bit wide and fast SCSI are implemented. Typical implementations vary between 5 MB/sec and 20 MB/sec.

B.10 Connecting SCSI Devices

Steps to follow:

1. Plan how you should connect the device in advance. Ensure that disks and tape drives use their own dedicated SCSI attachments and do not share their individual buses with other device types.

2. Determine which SCSI ID (or IDs) the device should have. Make sure you do not use a SCSI ID that is already defined for that bus.

3. Obey the bus cable-length restrictions

4. Draw a map of the bus showing:

   - Every device
   - All SCSI IDs
   - Where terminators are connected.

5. You need to install terminators at the extreme ends of the bus. You need to consider the following items when dealing with terminators:

   - The last device connected to the bus (not necessarily the last SCSI ID) must be terminated

   - Some devices come with internal terminators, which may need to be removed before connection to the SCSI bus

   - Terminators should get their power from the closest device and must have power to operate. Typically, the SCSI attachment feature provides

power to one of the terminators. Lack of power to a terminator will cause failures on the SCSI bus.

- SCSI attachment fuses provide terminator power. These fuses blow if SCSI cables are connected and disconnected without shutting down the host. The result will be faults on the bus and devices not powering-on properly.

6. Check all device SCSI IDs on the bus.

7. Check that the SCSI ID of the attachment feature is set to seven, that is the highest priority on the bus.

8. Make sure that you use the correct type of SCSI bus cable or cables.

9. If you need to customize the SCSI bus, be sure to insert the daisy chain sockets in the correct position.

10. Power down the host before connecting devices.

11. Remove the host SCSI adapter port terminator.

12. Connect the SCSI cable to the host adapter port. Use a twisted pair cable to reduce crosstalk between adjacent signals.

13. Verify all the connections at this point. For AIX platforms, this can be done by issuing the AIX command DIAG. You must have ROOT authority to execute the DIAG command. The sequence is as follows:

- Execute the DIAG command
- Select **Service Aid**
- Select **SCSI bus**
- Select the parent adapter, or bus
- Finally select the SCSI ID of the device you want to verify.

14. Check every SCSI device by selecting its SCSI ID. This will send a Test Unit Ready (TUR) command to that address. If the device is powered on and properly connected, it will reply with a valid response, in which case the connection is okay. You may receive a valid response to a TUR with a CHECK-CONDITION from the device. This may not necessarily indicate a problem; for example it could mean that a tape drive does not have a cartridge loaded.

Connection Problems:

Most problems will occur at installation, reconfiguration, and the addition of new devices. However, if you follow the above procedure many of the usual errors will be eliminated.

When a problem occurs on a SCSI connection, it pinpoints the exact source, for example hardware or software. A trace of the SCSI bus is typically required for a vendor to perform problem determination.

The Device Driver provides logging to the system error log for a variety of errors. For AIX platforms, view the error log by using the system management interface tool (SMIT) or use the ERRPT command.

B.11 Differences between SCSI-1 and SCSI-2

Table 48 summarizes the difference between SCSI-1 and SCSI-2 commands, advanced functions and protocol characteristics.

Table 48. Differences between SCSI-1 and SCSI-2		
Device Type	**SCSI-1**	**SCSI-2**
All command types	8/1•	17/4•
CD-ROM commands	15/2	52/8
Communication commands	NONE	20/6
Direct access commands	30/4	45/12
Medium changer commands	NONE	25/5
Optical memory commands	NONE	58/5
Printer commands	16/2	25/7
Processor commands	8/2	15/5
Scanner commands	NONE	26/8
Sequential commands	23/5	33/15
WORM commands	29/3	50/9
Three-Level defect model	NO	YES
Extended inquiry	NO	YES
Extended sense data	OPTIONAL	YES
Log commands	NO	YES
Page mode select/sense	NO	YES
Paged mode select/sense command	NO	YES
Read defect command	NO	YES
Arbitration delay specification	2.2 µs	2.4 µs
ARBITRATION	OPTIONAL	REQUIRED
Single initiator selection	YES	NO
Extended messages	3	4
IDENTIFY message	OPTIONAL	REQUIRED
LUN specified in command	OPTIONAL	NO
Number of messages/mandatory	14/1	22/8
Number of timing specifications	15	23
Parity	OPTIONAL	REQUIRED
• For the SCSI commands the number following the '/' represents the number of *mandatory* commands for the SCSI standard.		

B.12 Differences between SCSI-2 and SCSI-3

The SCSI-3 standards are still under development by the X3T10 committee. However, most of the significant changes have now been defined. Table 49 on page 245 is a list of what has significantly changed in SCSI-3.

Table 49. Differences between SCSI-2 and SCSI-3

CHARACTERISTIC	SCSI-2	SCSI-3
Devices attached to bus	Up to 8	Up to 16, or up to 32 (requires two cables)
Number of logical units	Up to 8	Up to 32
IDENTIFY messages	LIUNTAR	NO - Target routines removed
16 byte command	NO	Group 4 commands
Automatic Contingent Allegiance•	NO	Can replace SCSI-2 Contingent Allegiance
Automatic Sense Capability	NO	Allows Target to automatically return Sense data when Contingent Allegiance condition occurs
LUN in CDB	Ignored if IDENTIFY message was sent	Reserved in all CDB's
INQUIRY command	YES	Enhanced to define new SCSI-3 features
Control byte	YES	Enhanced to handle Auto Contingent Allegiance
FAST-20	NO	Doubles the rate of the SCSI bus to 20 million transfers per second
CLEAR ACA message	NO	Is used to clear the Auto Contingent Allegiance condition
• Contingent Allegiance preserves the logical connection to the device following an abnormal condition. The logical connection is preserved until the abnormal condition is cleared. Contingent Allegiance may exist after the following: • The return of CHECK CONDITION status • The return of COMMAND TERMINATED status • An unexpected disconnect, which is optional, not mandatory.		

For a summary of the differences between the SCSI-1 and SCSI-2 please refer to Table 48 on page 244.

B.13 Command Codes for Tape and Medium Changer Devices

B.13.1 Command Codes for Sequential-Access Devices

The commands for Sequential-Access devices, such as tape drives, can be seen in Table 50 on page 247.

Table 50. SCSI Commands for Sequential-Access Devices		
Command	**Operation Code**	**Type•**
CHANGE DEFINITION	40h	O
COMPARE	39h	O
COPY	18h	O
COPY AND VERIFY	3Ah	O
ERASE	19h	M
INQUIRY	12h	M
LOAD UNLOAD	1Bh	O
LOCATE	1Bh	O
LOG SELECT	4Ch	O
LOG SENSE	4Dh	O
MODE SELECT(6)	15h	M
MODE SELECT(10)	55h	O
MODE SENSE(6)	1Ah	M
MODE SENSE(10)	5Ah	O
PREVENT ALLOW MEDIUM REMOVAL	1Eh	O
READ	08h	M
READ BLOCK LIMITS	05h	M
READ BUFFER	3Ch	O
READ POSITION	34h	O
READ REVERSE	0Fh	O
RECEIVE DIAGNOSTIC RESULTS	1Ch	O
RECOVER BUFFERED DATA	24h	O
RELEASE UNIT	17h	M
REQUEST SENSE	03h	M
RESERVE UNIT	16h	M
REWIND	01h	M
SEND DIAGNOSTIC	1Dh	M
SPACE	11h	M
TEST UNIT READY	00h	M
VERIFY	13h	O
WRITE	0Ah	M
WRITE BUFFER	38h	O
WRITE FILEMARKS	10h	O
• For sequential access command type:		
M Command implementation is mandatory		
O Command implementation is optional		
The following command codes are vendor specific: 02h, 06h, 07h, 0Ch, 0Dh and 0Eh.		
All other command codes for sequential-access devices are reserved for future standardization.		

B.13.2 Command Codes for Medium Changer Devices

The commands for *Medium Changer* devices, such as tape drives, can be seen in Table 51.

Command	Operation Code	Type•
Table 51. SCSI Commands for Medium Changer Devices		
CHANGE DEFINITION	40h	O
EXCHANGE MEDIUM	A6h	O
INITIALIZE ELEMENT STATUS	07h	O
INQUIRY	12h	M
LOG SELECT	4Ch	O
LOG SENSE	4Dh	O
MODE SELECT(6)	15h	O
MODE SELECT(10)	55h	O
MODE SENSE(6)	1Ah	O
MODE SENSE(10)	5Ah	O
MOVE MEDIUM	A5h	M
POSITION TO ELEMENT	2Bh	O
PREVENT ALLOW MEDIUM REMOVAL	1Eh	O
READ BUFFER	3Ch	O
READ ELEMENT STATUS	B8h	O
RECEIVE DIAGNOSTIC RESULTS	1Ch	O
RELEASE	17h	O
REQUEST VOLUME ELEMENT ADDRESS	B5h	O
REQUEST SENSE	03h	M
RESERVE	16h	O
REZERO UNIT	01h	O
SEND DIAGNOSTIC	1Dh	M
SEND VOLUME TAG	B6h	O
TEST UNIT READY	00h	M
WRITE BUFFER	3Bh	O

• For medium changer command type:
 	
    M Command implementation is mandatory
 	
    O Command implementation is optional
 	
  Command codes C0h through FFh are vendor specific.
 	
  All other command codes for medium changer devices are reserved.		

More information on SCSI can be found in *An In-Depth Exploration of Small Computer System Interface*, by David A. Deming, published by *ENDL Publications, Saratoga, California*.

Appendix C. Enhancements to IBM 3494 Automated Tape Library Dataserver

This appendix describes three enhancements to the IBM 3494:

- Dual Gripper
- Additional options for the high capacity output facility
- Enhanced-capacity Convenience I/O station.

C.1 Dual Gripper

The Dual Gripper feature, number 5215, adds a second gripper to the accessor mechanism. The feature was announced October 1994 and has been generally available since December 2, 1994. Figure 86 shows the barcode reader, the first gripper and the second gripper mounted below it.
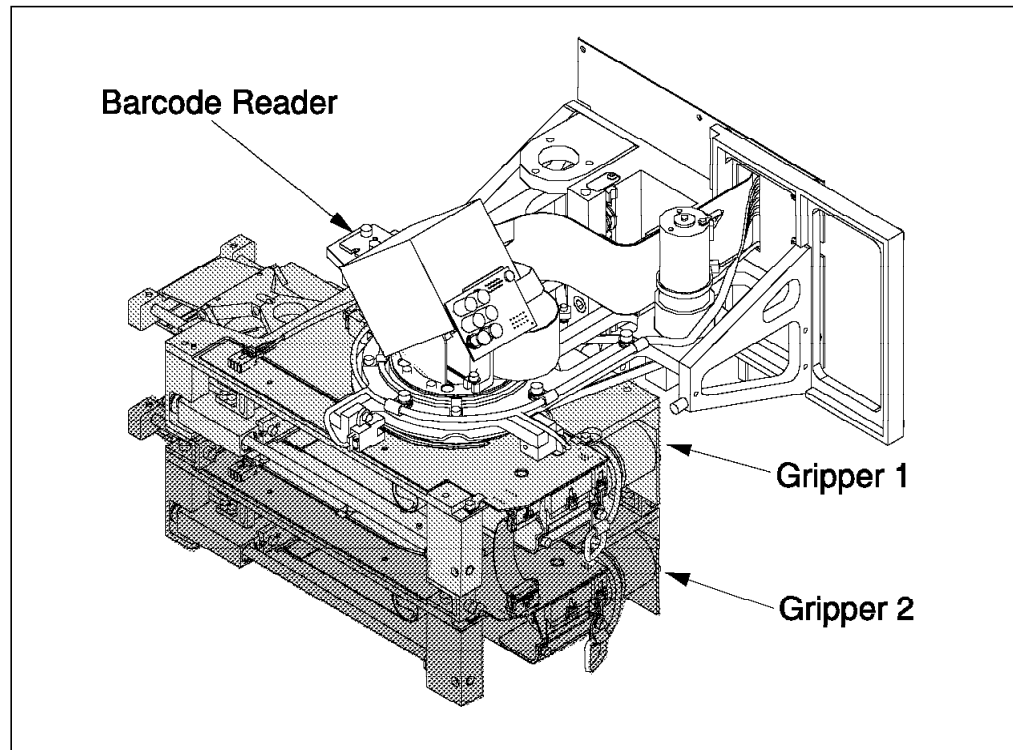
Figure 86. IBM 3494 Dual Gripper

The Dual Gripper feature improves both the availability and mount performance of the IBM 3494.

Both grippers operate simultaneously and in the unlikely event that a gripper fails, the operation of the other gripper is not affected, thus system availability is maintained.

When a mount is requested the IBM 3494 will pick the requested cartridge and deliver it to the drive. If a drive contains an unloaded cartridge, the other gripper will remove the cartridge from the drive, and the first gripper will insert the required tape. Without the Dual Gripper feature, the IBM 3494 would need to

move to the target drive, remove the unloaded tape, and return it to its storage cell, all before picking the new cartridge. The operation of the Dual Gripper thus improves the mount performance of the IBM 3494. Maximum performance is achieved by the use of the floating home cell mode, which is available only with the Dual Gripper feature. In this mode of operation the IBM 3494 accessor returns a used cartridge to the nearest cell or the cell which the next cartridge is to be mounted, rather than to the original cell (as it does in fixed home cell mode, the default). Thus, the floating home cell mode of operation reduces robotic movement and thus improves mount performance.

Table 52. IBM 3494 Performance—Exchanges Per Hour		
Frames/Drives	**With Single Gripper**	**With Dual Gripper**
1/2	265•	305•,•
2/4	235	290•
3/4	215	280•
4/4	200	260•
8/16	160•	225

Notes::

1. These numbers are theoretical and reflect accessor capability that cannot be realized because of drive constraints in a one- or two-drive system.

2. These results are produced from models, but are consistent with expectations.

Note: The installation of the Dual Gripper feature reduces the cartridge storage capacity of the IBM 3494 by 10%.

C.2 High Capacity Output Facility

The High Capacity Output Facility is a group of cells that may be defined within the Control Unit frame to provide space for the IBM 3494 to use to eject cartridges. The size of the facility is shown in Table 53 on page 251. The High Capacity Output Facility cells are dedicated to this output-only function, and you cannot use them for regular cartridge storage. When you are considering the effective capacity of your IBM 3494, you need to reduce the number of cells that you have defined for this facility.

You must not use the High Capacity Output Facility as a means to insert cartridges. The Library Manager assumes that if it finds a cartridge in the High Capacity Output Facility that it has not placed there, an error condition exists. The Library Manager then performs error recovery and eventually stores the cartridge in a cell. However, during this process an external label is not read, with the result that an Enhanced Capacity Cartridge System Tape is stored as a Cartridge System Tape. However, with the latest levels of Licensed Internal Code (LIC), the Library Manager can now leave any inserted cartridges in the High Capacity Output Facility.

Table 53. IBM 3494 High Capacity Output Facility Sizes		
Feature	**Without Dual Gripper**	**With Dual Gripper**
Without Convenience I/O Station	10, 20, 40, 80, 160	10, 20, 36, 72, 144
With 10-Slot Convenience I/O Station	10, 20, 40, 80, 130	10, 20, 36, 72, 122
With 30-Slot 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 will use cartridge storage cell 2 A 1 as a default output facility entitled Single Cell Output Facility when the Dual Gripper is not installed and 2 A 3 if it is.

If a High Capacity Output Facility is defined, the first and last cell locations depend on the size you selected and whether you have the Dual Gripper feature installed. See Table 54 for the cell locations for the various High Capacity Output Facility sizes.

Table 54. IBM 3494 High Capacity Output Facility Cell Locations		
Size	**Without Dual Gripper**	**With Dual Gripper**
10	2 A 1 – 2 A 10	2 A 3 – 2 A 13
20	2 A 1 – 2 A 20	2 A 3 – 2 A 23
36	N/A	2 A 3 – 2 A 38
40	2 A 1 – 2 A 40	N/A
72	N/A	2 A 3 – 2 A 38 2 B 3 – 2 B 38
80	2 A 1 – 2 A 40 2 B 1 – 2 B 40	N/A
122	N/A	2 A 3 – 2 A 38 2 B 3 – 2 B 38 2 C 16 – 2 C 38
130	2 A 1 – 2 A 40 2 B 1 – 2 B 40 2 C 16 – 2 C 40	N/A
144	N/A	2 A 3 – 2 A 38 2 B 3 – 2 B 38 2 C 16 – 2 C 38 2 D 16 – 2 D 38
160	2 A 1 – 2 A 40 2 B 1 – 2 B 40 2 C 16 – 2 C 40 2 D 16 – 2 D 40	N/A

C.3 Enhanced Capacity Convenience I/O 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 cartridges, depending on which feature is installed. The 30-cell Convenience I/O Station is shown in Figure 87, along with the standard 10-cell Convenience I/O Station.

The cell capacity of the Library Control unit frame is:

- 240 if no Convenience I/O station is installed
- 210 if the 10 cell Convenience I/O station is installed
- 160 if the 30 cell Convenience I/O station is installed.
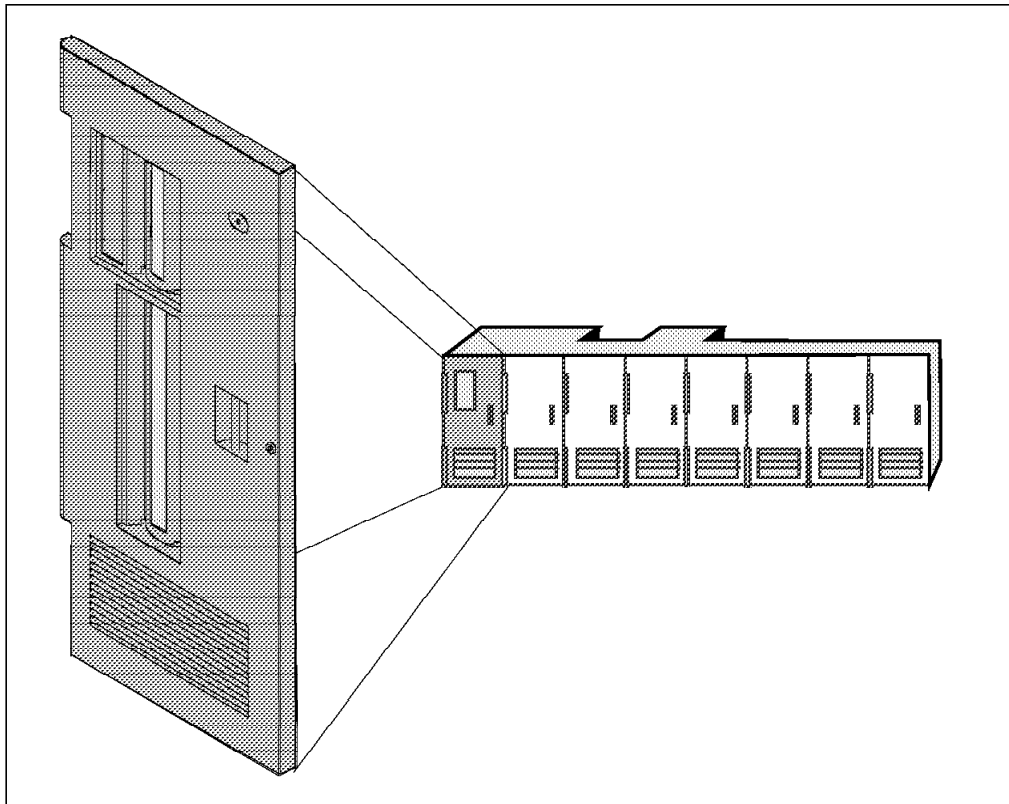
Figure 87. IBM 3494 Enhanced Capacity Convenience I/O Station

Appendix D. Library Manager Volume Categories

Table 55 lists all Library Manager volume categories and indicates on which platforms they are used and their meaning.

Table 55 (Page 1 of 7). Library Manager Volume Categories		
Category (in hex)	**Used by**	**Definition**
0000	All Hosts	Indicates to the Library Manager that the category already assigned to the volumes is to be used. Hosts cannot assign volumes to this category.
0001	DFSMS/MVS	Indicates scratch MEDIA1. Volumes in this category are mounted in the ICLs of tape drives inside an IBM 3495 that have a category of MEDIA1 assigned, or directly into any drive on request for a MEDIA1 scratch volume. MEDIA1 is a standard capacity cartridge system tape.
0002	DFSMS/MVS	Indicates scratch MEDIA2. Volumes in this category are mounted in the ICLs of tape drives inside an IBM 3495 that have a category of MEDIA2 assigned, or directly into any drive on request for a MEDIA2 scratch volume. MEDIA2 is an enhanced capacity cartridge system tape.
0003	DFSMS/MVS	Indicates scratch MEDIA3. Volumes in this category are mounted in the ACFs of tape drives inside an IBM 3495 that have a category of MEDIA3 assigned, or directly into any Magstar tape drive on request for a MEDIA3 scratch volume. 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 will be used for the partitioning user modification described in *Appendix C.* of *DFSMS/MVS Object Access Method Planning, Installation, and Storage Administration Guide for Tape Libraries*.
0080	DFSMS/VM	Indicates that the volume belongs to the VM category SCRATCH0
0081	DFSMS/VM	Indicates that the volume belongs to the VM category SCRATCH1
0082	DFSMS/VM	Indicates that the volume belongs to the VM category SCRATCH2

Table 55 (Page 2 of 7). Library Manager Volume Categories		
Category (in hex)	**Used by**	**Definition**
0083	DFSMS/VM	Indicates that the volume belongs to the VM category SCRATCH3
0084	DFSMS/VM	Indicates that the volume belongs to the VM category SCRATCH4
0085	DFSMS/VM	Indicates that the volume belongs to the VM category SCRATCH5
0086	DFSMS/VM	Indicates that the volume belongs to the VM category SCRATCH6
0087	DFSMS/VM	Indicates that the volume belongs to the VM category SCRATCH7
0088	DFSMS/VM	Indicates that the volume belongs to the VM category SCRATCH8
0089	DFSMS/VM	Indicates that the volume belongs to the VM category SCRATCH9
008A	DFSMS/VM	Indicates that the volume belongs to the VM category SCRATCHA
008B	DFSMS/VM	Indicates that the volume belongs to the VM category SCRATCHB
008C	DFSMS/VM	Indicates that the volume belongs to the VM category SCRATCHC
008D	DFSMS/VM	Indicates that the volume belongs to the VM category SCRATCHD
008E	DFSMS/VM	Indicates that the volume belongs to the VM category SCRATCHE
008F	DFSMS/VM	Indicates that the volume belongs to the VM category SCRATCHF
0090 to 009F	-	Currently not assigned
00A0	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH00
00A1	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH01
00A2	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH02
00A3	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH03
00A4	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH04
00A5	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH05
00A6	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH06
00A7	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH07
00A8	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH08

Table 55 (Page 3 of 7). Library Manager Volume Categories		
Category (in hex)	**Used by**	**Definition**
00A9	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH09
00AA	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH10
00AB	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH11
00AC	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH12
00AD	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH13
00AE	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH14
00AF	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH15
00B0	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH16
00B1	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH17
00B2	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH18
00B3	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH19
00B4	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH20
00B5	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH21
00B6	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH22
00B7	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH23
00B8	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH24
00B9	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH25
00BA	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH26
00BB	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH27
00BC	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH28
00BD	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH29
00BE	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH30
00BF	VSE/ESA	Indicates that the volume belongs to the VSE category SCRATCH31

Table 55 (Page 4 of 7). Library Manager Volume Categories		
Category (in hex)	**Used by**	**Definition**
00C0 to 00FF	-	Currently not assigned
0100	OS/400 (MLDD)	Indicates that the volume has been assigned to category *SHARE400. Volumes in this category can be shared between all attached AS/400 systems.
0101	OS/400 (MLDD)	Indicates that the volume has been assigned to category *NOSHARE. A volume in this category can be accessed only by the OS/400 system that assigned it to the category.
0102 to 012B	-	Currently not assigned
012C	ADSM/6000	Indicates a private volume. Volumes in this category are managed by ADSM/6000.
012D	ADSM/6000	Indicates an IBM 3490 scratch volume. Volumes in this category are managed by ADSM/6000.
012E	ADSM/6000	Indicates an IBM 3590 scratch volume. Volumes in this category are managed by ADSM/6000.
012F to 0FEF	-	Currently not assigned
0FF0 to 0FF1	BTLS	Reserved
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	BTLS	Reserved

Table 55 (Page 5 of 7). Library Manager Volume Categories		
Category (in hex)	**Used by**	**Definition**
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	-	Currently not assigned
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	-	Currently not assigned
FF00	All	Indicates Insert. Set when a tape volume is added to the inventory. The vision system reads the external label on the volume, and 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 to FF0F	-	Reserved
FF10	Library Manager	Indicates Convenience eject. 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	Indicates Bulk eject. 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 to FFF8	-	Reserved

Table 55 (Page 6 of 7). Library Manager Volume Categories		
Category (in hex)	**Used by**	**Definition**
FFF9	Library Manager	Indicates a service volume. Set when the Library Manager detects that a volume has a unique service cartridge volume serial. Volume serials that fit in the mask *CE xxx* (where xxx represents any valid volume serial characters) are service cartridges. Specific cell locations (defined during the teach 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. Assigned to this category if the cartridge was not found but is in the inventory.
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.
FFFD	Library Manager	Indicates a cleaner cartridge for the Magstar 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.

Table 55 (Page 7 of 7). Library Manager Volume Categories		
Category (in hex)	**Used by**	**Definition**
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 E. IBM 3590, 3494 and 3495 Special Feature Codes

The following tables list the special feature codes available for the:

- IBM 3590 High Performance Tape Subsystem

- IBM 3494 Automated Tape Library Dataserver

- IBM 3495 Automated Tape Library Dataserver.

E.1.1 IBM 3590 Special Feature Codes

Table 56 lists the special features available for the IBM 3590 High Performance Tape Subsystem.

Table 56 (Page 1 of 2). IBM 3590 Special Features Codes		
Feature Code	**Feature Code Description**	**IBM 3590 Model**
2003	Attachment to C12	B1A
2710	Remote Support Facility	A00
2711	Remote Support Switch	A00
2712	Remote Support Attachment	A00
2924	U.S. English	B11, B1A
2929	German	B11, B1A
2931	Spanish	B11, B1A
3311	First ESCON/SCSI Adapters	A00
3312	Second ESCON/SCSI Adapters	A00
4630	Field install in IBM 3494 Field install in IBM 3590 Model A14	B1A B11
4635	Field install in IBM 3494	A00
4638	Field install B1A in A14	A14
4641	Field install A00 in Rack	A00
5000	Floor Standing Package	A01
5106	0.6 meter SCSI cable (for drive to drive)	B11, B1A
5112	12 meter SCSI cable	B11, B1A
5118	18 meter SCSI cable	B11, B1A
5125	25 meter SCSI cable	B11, B1A
5128	2.8 meter SCSI cable	B11, B1A
5129	2.9 meter SCSI cable	B11, B1A
5134	3.4 meter SCSI cable (for drive to drive)	B11, B1A
5138	4.0 meter SCSI cable (for drive to drive)	B11, B1A
5145	4.5 meter SCSI cable	B11, B1A
5201	1-SCSI Bus Configuration	C12
5202	2-SCSI Bus Configuration	C12
• This feature is required for installation only in the City of Chicago. However, IBM 3590 Models B11 and B1A do not require this feature because these models use the external power cords of the rack or library frame in which they are installed.		

Table 56 (Page 2 of 2). IBM 3590 Special Features Codes		
Feature Code	**Feature Code Description**	**IBM 3590 Model**
8001	1 Magazine	B11
8002	1 Cleaning Cartridge	B11, C12
8003	30 Data Cartridges (Field)	B11
8130	30 Data Cartridges (Plant)	B11
8210	210 Data Cartridges	C12
8220	420 Data Cartridges	C12
9000	Attach to ES/3090, ES/9000, S/390	B1A, B11, A00, A14
9010	Attach to a IBM 3495-B16	A14
9012	Factory install in IBM 3495	A14
9076	Attach to IBM RS/6000 Scalable POWERparallel Systems	B1A, B11
9221	First device in rack	B11
9222	Second or fourth device in rack	B11
9223	Third device in rack	B11
9400	Attach to AS/400	B1A, B11
9410	Interposer for AS/400	B1A, B11
9590	No Data Cartridges	B11, C12
9600	Attach to RISC/6000	B1A, B11
9603	AIX device driver	B1A, B11
9630	Field install in IBM 3494 Field merge in IBM 3590 Model A14	B1A B11
9631	Factory install in IBM 3494 Factory install in IBM 3590 Model A14	B1A B11
9632	Attach to IBM 3591	B11
9636	Factory install in IBM 3494	A00
9637	Factory install in IBM 3590 Model A14	A00
9638	Factory install Model B1A in Model A14	A14, B1A
9639	Field Merge Model B1A in Model A14	A14
9701	Interposer, single-byte-wide RISC/6000 and IBM RS/6000 Scalable POWERparallel Systems	B1A, B11
9702	Interposer, double-byte-wide RISC/6000 and IBM RS/6000 Scalable POWERparallel Systems	B1A, B11
9710	Sun device driver	B1A, B11
9986	Chicago Power Cord (2 m)•	A14, C12
• This feature is required for installation only in the City of Chicago. However, IBM 3590 Models B11 and B1A do not require this feature because these models use the external power cords of the rack or library frame in which they are installed.		

E.1.2 IBM 3494 Special Feature Codes

Table 57 lists the special features available for the IBM 3494.

Table 57 (Page 1 of 2). IBM 3494 Special Features Codes		
Feature Code	**Feature Code Description**	**IBM 3494 Model**
2710	Remote Support Facility	B16
2711	Remote Support Switch	B16
2712	Remote Support Attachment	B16
2924	U.S. English	L10, L12, L14, B16
2928	French	L10, L12, L14 B16
2930	Japanese	L10, L12, L14 B16
2931	Spanish	L10, L12, L14 B16
2932	Italian	L10, L12, L14 B16
2933	French Canadian	L10, L12, L14
2935	French Canadian Nomenclature	B16
3701	Disk Storage Capacity	B16
4630	Field install IBM 3590 model B11 or B1A•	L12, L14, D12, D14
4635	Field install IBM 3590 model A00•	L14, D14
5210	Convenience Input/Output Station	L10, L12, L14
5211	AS/400 attachment (50 ft)	L10, L12, L14
5212	RISC/6000 attachment	L10, L12, L14
5213	RS-232 AS/400 attachment (400 ft)	L10, L12, L14
5214	Second disk drive for Library Manager	L10, L12, L14
5215	Dual Gripper	L10, L12, L14
5216	Remote power	L10, L12, L14
5217	50 feet RS-232 cable	L10, L12, L14
5219	Token-Ring adapter	L10, L12, L14
5220	Ethernet LAN adapter	L10, L12, L14
5224	AIX parallel channel attachment	L10, L12, L14
5226	Remote console	L10, L12, L14
5228	Tape control unit expansion	L10, L12, L14
5229	Expansion attachment card	L10, L12, L14

• Not available as new order, MES only.

Feature 5300 (drive unit frame) is no longer available.

RPQ 8B3166 delivers the third and fourth IBM 3590 Model B1A drives in an IBM 3494 Model D12.

RPQ 8B3167 delivers the fifth and sixth IBM 3590 Model B1A drives in an IBM 3494 Model D12.

RPQ 8B3168 delivers the third and fourth IBM 3590 Model B1A drives in an IBM 3494 Model D14.

• This feature is required for installation only in the City of Chicago. However, IBM 3590 Models B11 and B1A do not require this feature because these models use the external power cords of the rack or library frame in which they are installed.

Table 57 (Page 2 of 2). IBM 3494 Special Features Codes		
Feature Code	**Feature Code Description**	**IBM 3494 Model**
5230	30 cartridge convenience I/O	L10, L12, L14
5302	Upgrade F/C 5300 for IBM 3590-B1A•	L10, L12, L14
5304	Upgrade F/C 5300 for IBM 3590-B1A and A00•	L10, L12, L14
8002	1-3590 Cleaning Cartridge	ALL
8005	1-3490E Cleaning Cartridge	ALL
8410	210-3490E Data Cartridge	ALL
8420	420-3490E Data Cartridge	ALL
8510	210-3590 Data Cartridge	ALL
8520	420-3590 Data Cartridge	ALL
9002	Storage Unit Attachment	L10, L12, L14
9003	Drive Unit Attachment	L10, L12, L14
9004	Storage Unit Attach. for more than eight Frames	L10, L12, L14, S10
9005	Drive Unit Attach. for more than eight Frames	L10, L12, L14, D12, D14
9006	Virtual Tape Server Attachment	L10, L12, L14
9010	Attached to Model B16	D12
9104	AS/400 Aattachment	L10 and L12
9106	RISC/6000 Attachment	L10 and L12
9109	ES/9000 Attachment	L10, L14, B16, D12
9203	VSE LAN device driver	L10, L12, L14
9204	Sun device driver	L10, L12, L14
9540	No Data Cartridges	B16
9601	Factory install IBM 3490 model CxA	L10 and D10
9630	Field merge drive	L12, L14, D10, D12, D14
9631	Factory install IBM 3590 Model B1A	L12, L14, D12, D14
9635	Field merge IBM 3590 Model A00	L14 and D14
9636	Factory install IBM 3590 Model A00	L14 and D14
9986	Chicago power cord (6 ft)•	L10, L12, L14, B16

• Not available as new order, MES only.

Feature 5300 (drive unit frame) is no longer available.

RPQ 8B3166 delivers the third and fourth IBM 3590 Model B1A drives in an IBM 3494 Model D12.

RPQ 8B3167 delivers the fifth and sixth IBM 3590 Model B1A drives in an IBM 3494 Model D12.

RPQ 8B3168 delivers the third and fourth IBM 3590 Model B1A drives in an IBM 3494 Model D14.

• This feature is required for installation only in the City of Chicago. However, IBM 3590 Models B11 and B1A do not require this feature because these models use the external power cords of the rack or library frame in which they are installed.

E.1.3 IBM 3495 Special Feature Codes

Table 58 lists the special features available for the IBM 3495.

Table 58. IBM 3495 Special Features Codes		
Feature Code	**Feature Code Description**	**IBM 3495 Model**
2710	Remote Support Facility	B16
2711	Remote Support Switch	B16
2712	Remote Support Attachment	B16
3701	Disk Storage Capacity	B16
4012	Field install IBM 3590 Model A14	L20, L30, L40, L50
4016	Field install IBM 3495 Model B16	L20, L30, L40, L50
9012	Factory install IBM 3590 Model A14	L20, L30, L40, L50
9016	Factory install IBM 3495 Model B16	L20, L30, L40, L50
9020	Virtual Tape Server Communication	L20, L30, L40, L50
4512	Second Camera/Lamp	L20, L30, L40, L50
4514	Additional Windows	L20, L30, L40, L50
4517	Dual Library Manager	L20, L30, L40, L50
4518	External High-Capacity I/O Station	L20, L30, L40, L50
4519	Utility cover for tape control unit	L20, L30, L40, L50
4520	Utility cover for tape drive unit	L20, L30, L40, L50
4521	Token-Ring LAN attachment	L20, L30, L40, L50
4522	Ethernet LAN attachment	L20, L30, L40, L50
4523	Remote Library Manager Console	L20, L30, L40, L50

Appendix F. SCSI Cabling for Magstar and IBM 3590 Tape Subsystem

In response to many *how to* questions about cabling the IBM 3590 in the SCSI attached environment, the following supplementary information is provided. Details about host related SCSI interfaces, cables, and associated features may be found in the appropriate host documentation. Additionally, a comprehensive document on SCSI configurations titled *Adapters, Devices and Cable Information*, IBM Order Number SA23-2764, is available.

F.1 Introduction

The IBM 3590 has two independent SCSI-2 Fast Wide Differential (FWD) interfaces or ports. This allows two independent SCSI host strings to be attached to each drive concurrently. One or both IBM 3590-B11 and 3590-B1A ports may be attached to either:

- one or more RISC System/6000, POWERparallel SP2, and Sun systems

- one AS/400 system

On the same drive, one port could be attached to the RS/SP/Sun systems, and the other IBM 3590 port could be attached to an AS/400 system. One of the ports may remain unused if not needed. In this case a terminator must be attached to the unused IBM 3590 port.

When connecting IBM 3590-B11 drives through an IBM 3591-A01 High Performance Tape Control Unit for attachment to an ESCON host, the rules are slightly different.

- One, and only one, IBM 3590-B11 port can attach to an IBM 3591
- The other port may attach to any other supported SCSI host, except another IBM 3591, as described in the preceding paragraph

SCSI host to IBM 3590 device cables, IBM 3590 device to device cables (where applicable) and interposers (a component for allowing unlike physical interfaces to attach to each other) must be ordered with the IBM 3590 order. Two terminators are shipped with each IBM 3590 drive, one for each port.

F.2 AS/400 System Environment

The AS/400 attachment to an IBM 3590 is comparatively simple since neither daisy chaining of multiple AS/400 hosts (initiators) nor daisy chaining of multiple IBM 3590 devices (targets) is supported.

AS/400 (IBM 9404 or 9406) attachment to an IBM 3590 uses AS/400 feature 6501 (Tape/Disk Device Controller).

- Each feature 6501 provides two host SCSI ports.

- Each port on the 6501 can support one IBM 3590 drive for a maximum of two IBM 3590 drives per 6501 feature. (Due to the high performance provided with an IBM 3590, we recommend only one IBM 3590 per feature code 6501. The remaining 6501 port could be used by a lower speed tape device.)

- A port on the 6501 interfaces to IBM 3590 SCSI cables (IBM 3590 feature codes 51xx) through a specific interposer, IBM 3590 feature code 9410.

- No other devices can attach to the same port with an IBM 3590.

- Since an IBM 3590 has two SCSI ports, a maximum of two AS/400 systems can attach to a single IBM 3590 drive.

```
+--------+------------+                    +------+------------+
| AS/400 | Interposer |----- SCSI cable ---| 3590 | Terminator |
| FC6501 |  3590 FC   | (3590 FC 5128, 5145,| Port | (Provided  |
|  Port  |   9410     |   5112, 5118, 5125) |      |  with 3590)|
+--------+------------+                    +------+------------+
```

F.3 RISC System/6000, POWERparallel SP2, and Sun System Environment

In this environment, multiple initiators (hosts) and multiple targets (devices) can be daisy chained and intermixed on a common SCSI bus within the distance, attachment capabilities and specifications of the host's SCSI adapter. The RS/6000 and SP2 attach to the IBM 3590 only through host SCSI adapter features 2412, 2416, and 2420.

- RS/6000 and SP2 feature codes 2416 and 2412

    − SCSI-2 Differential Fast Wide Adapter

    − Supports up to 16 attachments (sum of targets and initiators)

    − Maximum end-to-end cable length is 25 meters

    − Interfaces to IBM 3590 SCSI cables (IBM 3590 feature codes 51xx) using IBM 3590 interposer feature code 9702, a 68 pin ribbon to 68 pin socket interposer

- RS/6000 and SP2 feature code 2420

    − SCSI-2 Differential High Performance I/O Controller Adapter

    − Supports up to 8 attachments (sum of targets and initiators)

    − Maximum end-to-end cable length is 19 meters

    − Interfaces to IBM 3590 SCSI cables (IBM 3590 feature codes 51xx) using IBM 3590 interposer Feature Code 9701, a one byte to two byte interposer

    − An IBM 3590 drive must be the last device on the bus.

F.4 IBM 3590 Cables (IBM 3590 feature codes 51xx)

Two basic types of 3590 cables, in a variety of lengths, are available for use with the IBM 3590 Magstar tape drives. One type, a host to device cable, has a standard SCSI wide-differential connector at one end and a **hammer-head** connector at the other end. The other IBM 3590 cable type, designed for device to device daisy chaining, has hammer-head connectors at both ends. An attempt at picturing these connectors follows.

```
      +------------------+
      |                  |
    </////////////////////' Built-in short screw.
      |                  |
 +-+                     |
 |      Normal device    |
 |        connector      |
 |                       |}}}}}}}}} Cable comes out at
 |        (top view)     |}}}}}}}}} end of connector.
 |                       |
 |                       |
 +-+                     |
      |                  |
    </////////////////////' Built-in short screw.
      |                  |
      +------------------+
```
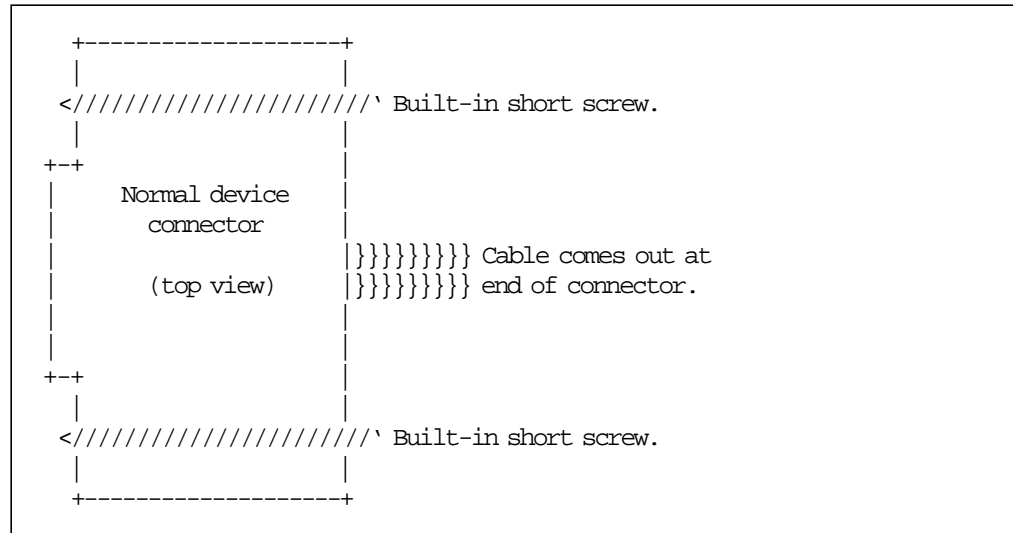
Figure 88. SCSI Wide Differential Connector

This connector normally is used to plug into a host adapter, either directly or through the appropriate interposer which in turn connects to the adapter.

```
    <///////////////////////////////////' Long screw not built into the
      +------------+                          connector.
      |            |
  +---|            |---+          One long screw is packed for each end
  |   |            |   |          of cable that has a hammer-head
  |   |            |   |          connector.
+-+   |            | +-+
  |   | Hammer-head| |            Cable comes out of the bottom of the
  |   |  connector | |            hammer-head connector.
  |   |            | |
  |   | (top view) | | <===== Daisy chained connector (or terminator)
  |   |            | |            plugs in here.
  |   |            | |            The other side of the connector plugs
+-+   |            | +-+          into the SCSI port of a 3590 or into
  |   |            | |            this side of the hammer-head connector
  |   |            | |            on the previous cable in the chain.
  +---|            |---+
      |            |
      +------------+
```

Figure 89. Hammer-Head Connector

Many SCSI devices have two connection points for each device interface, one for the incoming cable and the other to daisy chain to the next device (target) or host (initiator) on the string. The IBM 3590 has only one connection point per

device interface, or port (with two independent ports per IBM 3590 drive). The ability to daisy chain through an IBM 3590 port is enabled by the use of the hammer-head (passthru) connector.

Length (m)	Feat. Code	Part. Number	Designed Usage (Usage comment)	Hammer Head	Normal Connection
0.6	5106	05H4644	Device to device (Side by side B11s in rack)	2	0
2.8	5128	05H4647	Host to device (B11 and host in same rack)	1	1
3.4*	5134	05H4645	Device to device (Side by side B1As in 3494 frame)	2	0
4.0*	5138	05H4646	Device to device (Row to row B1As in 3494 frame)	2	0
4.5	5145	05H4649	Host to device (B1A or B11)	1	1
12	5112	05H4649	Host to device (B1A or B11)	1	1
18	5118	05H4650	Host to device (B1A or B11)	1	1
25	5125	05H4651	Host to device (B1A or B11)	1	1

Table 59. IBM 3590 Cable Description

Note: * Currently these two cables (5134 and 5138) are valid orders only with an IBM 3590-B1A. Changes are in process to make them valid with an IBM 3590-B11 also.
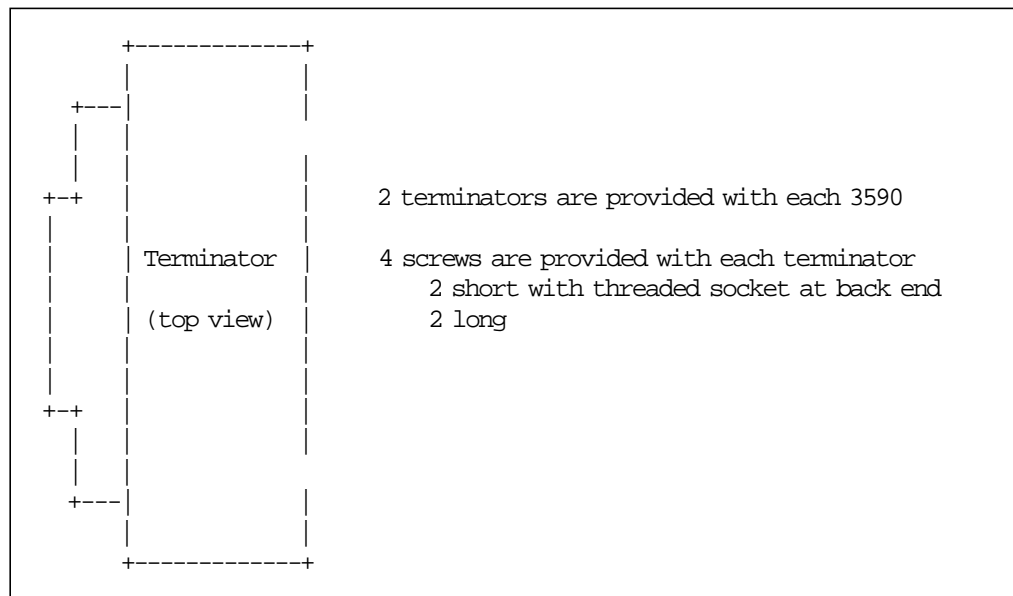
Figure 90. Terminators

F.5 Nondisruptive Connections

The primary benefit of using recommended cable types and specific screw types for daisy chain connections allows a host or device to be nondisruptively removed from the SCSI bus without affecting the continuity of the bus, thereby enabling **concurrent maintenance**. However, although termination and SCSI bus continuity is maintained during the removal of these connections, noise generated may create undetected bus errors if the bus is in use during the time of removal. To maintain data integrity, the SCSI bus should be inactive during the removal of any connection on the bus.

F.6 IBM 3590 Device Connections

If a device connection is accomplished using a hammer-head to hammer-head connection, as would be the case when attaching the IBM 3590 device to device cables (0.6, 3.4, and 4.0 (formerly 3.8) meter cables), the long screws provided should be used to secure both piggybacked connectors to the drive port as a single unit. (A terminator is NOT used behind this second hammer-head connector.) If this is the end of a bus, rather than attaching another device to device cable, a terminator would be plugged into the back of the last hammer-head connector using long screws.

In both of the above two cases (hammer-head to hammer-head or terminator to hammer-head), the long screws pass through both the piggybacked connectors concurrently. If the device required service, the screws could be removed and the piggybacked connectors could remain together while this cable assembly is carefully removed from the device without disturbing any other devices on the SCSI bus. This capability was provided to respond to the requirement for **concurrent maintenance**.

Hence the recommended host to device to device (etc.) configuration would be as follows.

1. IBM 3590 host to device cable (has a normal connector on the host end) plugs into the interposer that plugs into the host adapter

2. the drive end hammer-head connector plugs into the IBM 3590

3. plug another IBM 3590 SCSI device to device cable connector into the passthru end of the hammer-head and secure with long screws to continue the daisy chain

4. if this is the last device on the chain, plug a terminator into the passthru end of the hammer-head connector using long screws

Graphically, the sequence would look like:

```
        #1              #2,3            #4
                                        T       Key:
                            H-------------H
          N-----------H              +----P----+   A - Host SCSI adapter
          I         +---P-----+      |         |   I - Interposer
  +----A----+       |         |      |  3590   |   N - Normal SCSI connector
  |         |       |  3590   |      | Magstar |   H - Hammer-head connector
  |  Host   |       | Magstar |      +---------+   P - 3590 SCSI port
  |         |       +---------+                    T - Terminator
  +---------+
```
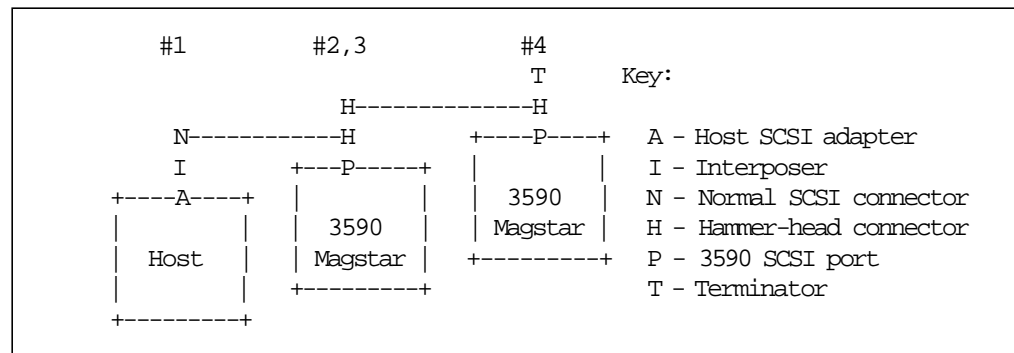
Figure 91. Recommended Connections

However, if the next cable used in step #3 above had a normal connector, the nondisruptive capability in the daisy chain would be lost. This would be the case for any of the following reasons:

• you erroneously ordered an IBM 3590 host to device cable

• you were forced to use an IBM 3590 host to device cable for daisy chaining because the physical distance to the next IBM 3590 in the daisy chain exceeded the 4 meter length capability of the longest IBM 3590 device to device cable

• an OEM cable was used as a device to device cable.

The device to device daisy chaining would now look as follows.

1. IBM 3590 host to device cable (has a normal connector on the host end) plugs into the interposer that plugs into the host adapter

2. the drive end hammer-head connector plugs into the IBM 3590 and is secured using the short screws with the threaded sockets

3. plug another SCSI host to device cable connector into the passthru end of the hammer-head and secure the built-in screws in the normal connector into the sockets of the short screws used with the hammer-head connector (step 2 above) to continue the daisy-chain   .

4. if this is the last device on the chain, plug a terminator into the passthru end of the hammer-head connector using long screws.

Graphically, the sequence would look like:

```
     #1            #2,3          #4
                                  T        Key:
                        N-------------H
        N-----------H      +----P----+    A - Host SCSI adapter
        I          +---P-----+  |       |    I - Interposer
   +----A----+     |         |  | 3590  |    N - Normal SCSI connector
   |         |     | 3590    |  | Magstar|   H - Hammer-head connector
   | Host    |     | Magstar |  +---------+   P - 3590 SCSI port
   |         |     +---------+                T - Terminator
   +---------+
```
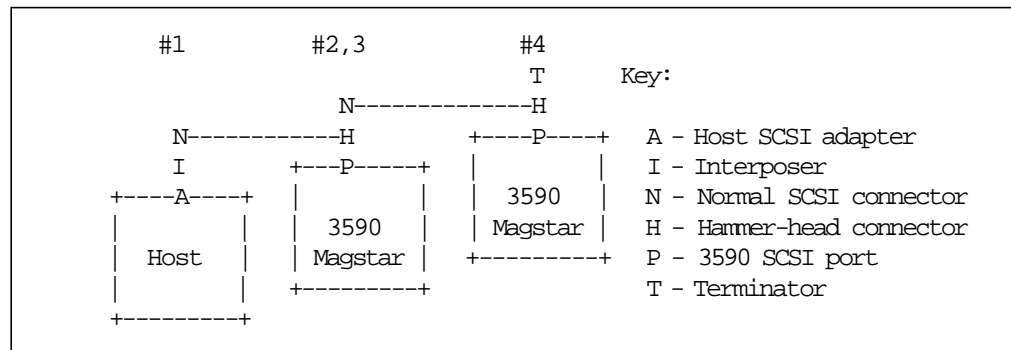
Figure 92. Possible Connections

Since the connectors in steps 2 and 3 would need to be removed individually, removing an IBM 3590 at this point would be disruptive to the SCSI bus.

F.7 Daisy Chained Host Connections

Similar to daisy chaining devices on a SCSI bus, multiple hosts can be daisy chained together using host configured Y-cables. Since a Y-cable maintains the passthru continuity of the SCSI bus when removed from the host SCSI adapter, Y-cables provide a nondisruptive host removal capability for concurrent host maintenance.

Graphically, the sequence of connections would look like:

```
                                    3590
          |<----Host cables----->|<-Cables->|


                                       T        Key:
      T/S---Y--S/N--N/S--Y--S/N---------H         A - Host SCSI adapter
       +----A----+   +---A-----+   +----P----+    I - Interposer
       |         |   |         |   |         |    N - Normal SCSI connector
       | Host #1 |   | Host #2 |   |  3590   |    H - Hammer-head connector
       |         |   |         |   | Magstar |    P - 3590 SCSI port
       +---------+   +---------+   +---------+    T - Terminator
                                                  Y - Y-cable connector
                                                  S - Socket connector on
                                                        Y-cable leg
```
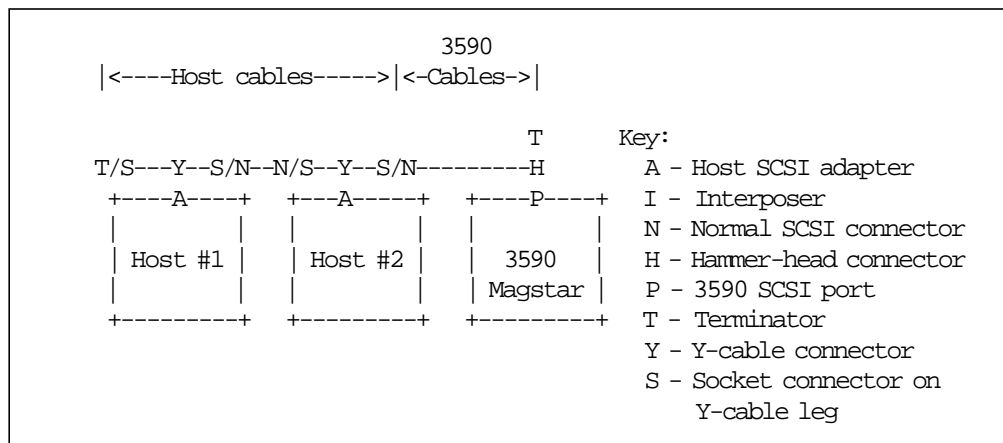
Figure 93. Daisy Chained Host Connections

F.8 IBM 3591-A01 High Performance Tape Control Unit Environment

From the perspective of an IBM 3590 drive, one can view the IBM 3591 as an RS/6000 SCSI host (which it is not). The IBM 3590-B11 to IBM 3591 configuration rules are very similar as when attaching to an RS/6000, with several exceptions.

- Daisy chaining of hosts is not supported on the SCSI bus of the IBM 3590-B11 port attaching to an IBM 3591. In other words, only one IBM 3591 can be attached to the same IBM 3590-B11.
- A maximum of four targets (IBM 3590-B11 devices) can be daisy chained to the same IBM 3591 host.
- Only IBM 3590 Model B11s can attach to the IBM 3591 host SCSI adapter.
- No interposer is needed to attach an IBM 3590-B11 SCSI cable to the IBM 3591 host SCSI adapter.
- The unused SCSI port on the IBM 3590-B11 can attach to any supported host(s) as described in the previous two environment sections. However, this second IBM 3590-B11 SCSI port may not attach to another IBM 3591.

As in the other SCSI attached environments, SCSI cables must be ordered with the IBM 3590-B11 to provide attachment to the IBM 3591, and the maximum end-to-end cable length is 25 meters.

Graphically, an IBM 3591 with two IBM 3590 drives would look as follows.

```
           |<--Host ESCON-->|      |<-------3590 cables------->|
                  cable

                                                           T
                                           N/H-----------H
                              N------------H      +----P----+
   +---------+      +----A----+   +----P----+     |         |
   |  ESCON  |      |         |   |         |     |  3590   |
   |  Host   E--------------E  3591 |   | 3590  |     |  B11    |
   |         |      |  A01    |   |  B11    |   +---------+
   +---------+      +---------+   +---------+

   Key:
        A - 3591 SCSI adapter
        E - ESCON connection
        N - Normal SCSI connector
        H - Hammer-head connector
        P - 3590 SCSI port
        T - Terminator
      N/H - Normal or hammer-head connector, depending on cable used
```
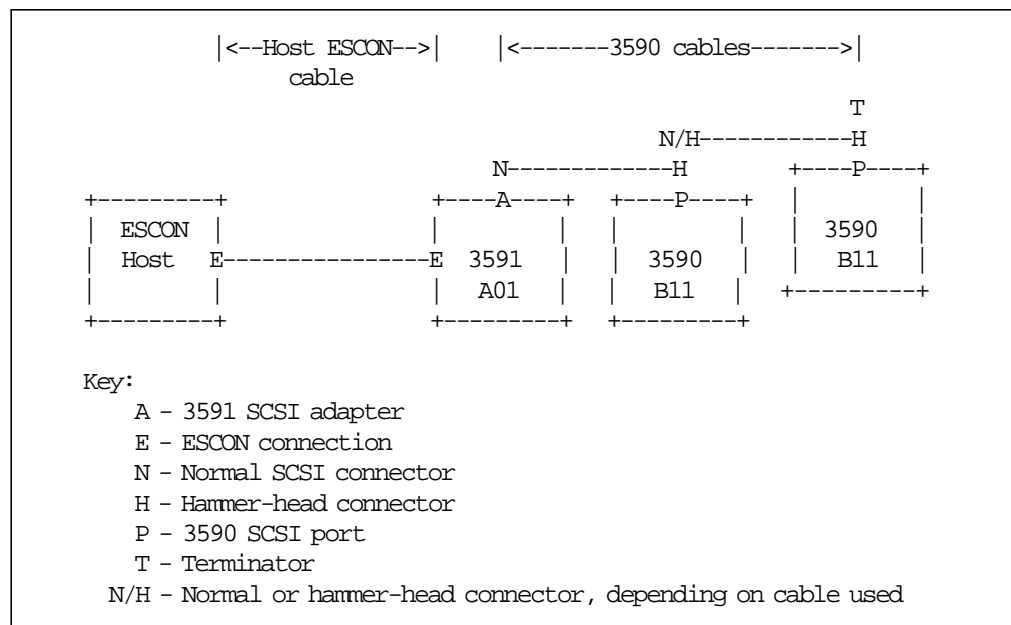
Figure 94. Connection for IBM 3591

Appendix G. IBM 3591 Tape Subsystem Presentation

This appendix provides additional material for you to use when presenting the IBM 3590 tape processing solutions.
All of the foils in this appendix can be added to the IBM Magstar 3590 tape subsystem presentation for a broader overview of the ESCON connection possibilities.

Use the chapters in this redbook, especially Chapters 8 through 12, and Appendixes G to I to complement the contents of the presentation.

Refer to the *Magstar and IBM 3590 High Performance Tape Subsystem Technical Guide* for a comprehensive foil presentation.
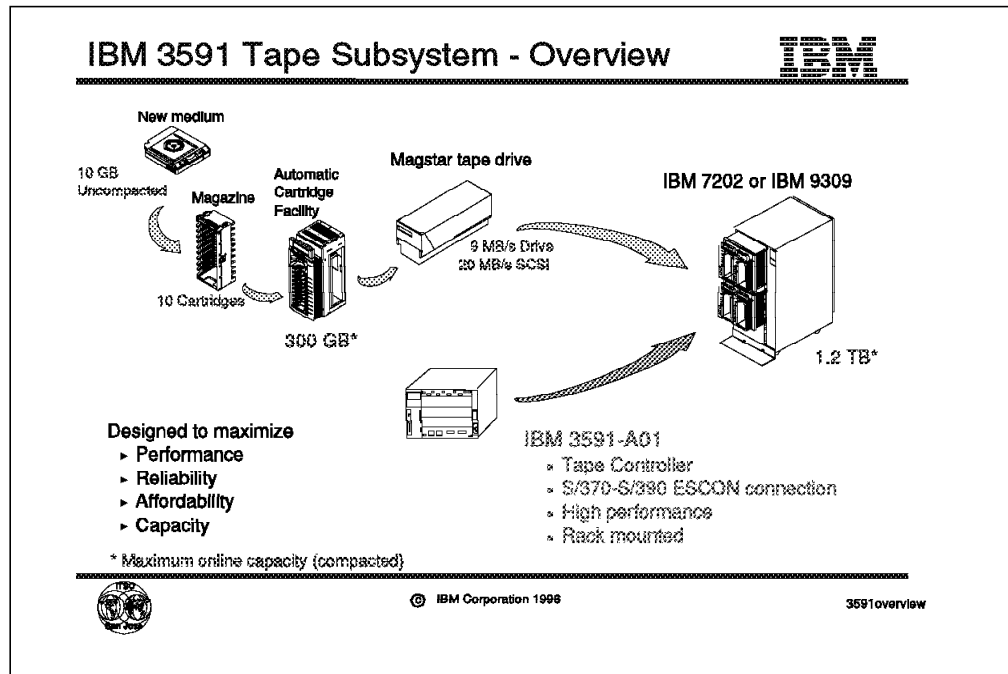
Figure 95. IBM 3591 Tape Subsystem Overview

G.1 IBM 3591 Tape Subsystem Overview

Refer to Chapter 8, "IBM 3591 Tape Subsystem Overview" on page 159 for further details.

IBM has announced the IBM 3591 High Performance Tape Control Unit. The IBM 3591 model A01 is a member of the IBM storageSmart solutions family. The IBM 3591-A01 is for attachment to ESCON channels on ES/3090 and ES/9000 systems or S/390 Parallel Transaction and Enterprise Servers. It provides attachment of the IBM 3590 high performance tape drives to those systems to provide new levels of:

- Function
- Performance
- Reliability
- Cartridge capacity

The stand-alone IBM 3591 tape subsystem, mounted in a rack, is to be supported under MVS/ESA, VM/ESA, and VSE/ESA operating systems.

This product offers an immediate tape solution at a cost per megabyte that is lower than previous alternative solutions. The IBM Magstar 3590 tape drives attached through the IBM IBM 3591-A01 control unit can be cost justified by replacing currently installed tape drives with fewer IBM 3590-B11 tape drives.

The IBM 3591 can be used to:

- Create tapes for archive files
- Back up and restore systems
- Store high capacity sequential application data sets
- Satisfy offsite data storage for disaster recovery
- Provide data interchange with other systems
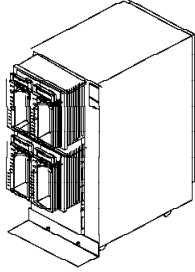
While connected to the IBM 3591-A01 control unit, the IBM 3590-B11 tape drives can also be attached to SCSI processors such as a RISC System/6000 server, SP2 parallel server, or AS/400.

The IBM 3591 tape subsystem cannot be mounted in the IBM 3590-A14 frame or IBM 3494 or IBM 3495 Automated Tape Library Dataserver.

Figure 96. IBM 3591 Characteristics

G.2 IBM 3591 Characteristics

Refer to Chapter 10, "IBM 3591 Hardware Implementation" on page 169 for more details.

Figure 96 shows the general characteristics of the IBM 3591-A01 control unit. The unit is mounted in an IBM 9309, an IBM 7202 or IBM 7215, or a customer provided standard rack. It provides control unit function for up to four IBM 3590-B11 tape drives. Tapes are written in 3590 media type format.

The IBM 3591-A01 control unit allows operating systems to communicate with the IBM 3590 tape drives as if they were IBM 3490E tape drives. As most customers already have software installed that supports the IBM 3490E, it will be easy to install the IBM 3591 tape subsystem and take advantage of the high capacity 3590 tape cartridge.

The IBM 3591-A01 control unit provides one ESCON channel attachment.

- Maximum channel data transfer rate is 10 to 17 MB per second, depending on the processor type.
- Maximum connection distance up to 43 km using appropriate IBM 9032 or IBM 9033 ESCON Directors or IBM 9036 ESCON Remote Channel Extender.
- One ESCON attachment provides 64 logical addresses for multihost, multiple-image connections.

While connected to the IBM 3591-A01 control unit, the IBM 3590 tape drives can also be shared with SCSI-attached hosts.
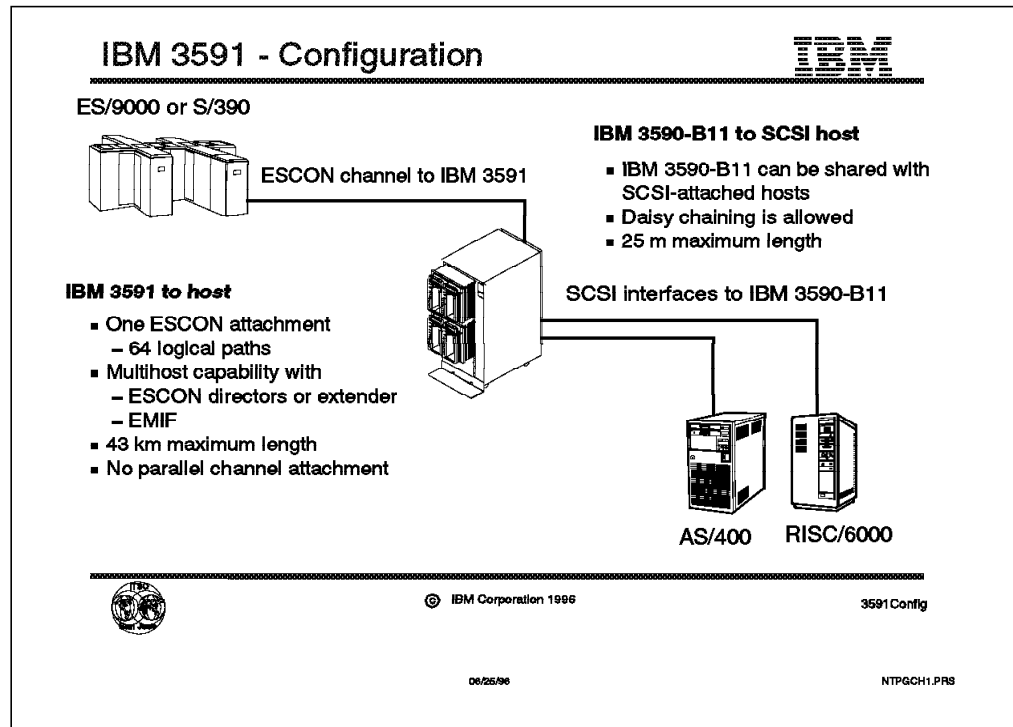
Figure 97. IBM 3591 Configuration

G.3 IBM 3591 Configuration

See Chapter 10, "IBM 3591 Hardware Implementation" on page 169 for more details.

Figure 97 is a simple view of an IBM 3591 tape subsystem configuration that shows the two ways of connecting the IBM 3591-A01 control unit and the IBM 3590-B11 tape drives.

ESCON-Attached Hosts

The prime objective of this subsystem is to connect IBM 3590-B11 tape drives to ESCON-attached hosts. This is done by providing a single ESCON attachment on the IBM 3591-A01 control unit.

64 logical addresses are available for multihost or multiple-image connections. To connect to multiple hosts or images, use:

• ESCON Multiple Image Facility (EMIF).
• IBM 9032 or 9033 ESCON Directors

Each physical IBM 3590 tape drive can be assigned for exclusive use by a single host at a given time. VARY ONLINE/OFFLINE (MVS) or ATTACH/DETACH (VM) commands work as defined. Maximum distance of 43 km from the host can be used. The following ESCON devices and components could be used:

• ESCON laser or light emitting diode (LED) cables
• IBM 9032 or 9033 ESCON Directors
• IBM 9036 ESCON Remote Channel Extender.

Neither parallel nor SCSI attachment is available on the IBM 3591-A01 control unit.

SCSI-Attached Hosts

The IBM 3590-B11 tape drives can be shared with SCSI-attached hosts such as RISC System/6000, SP2, AS/400, or Open systems. The second free 3590 SCSI adapter port is used for this purpose. Connections are similar to the those used for an IBM 3590 tape drive, and the same limitations apply.

When shared between ESCON and SCSI attached hosts, the 3590 ACF support is not identical (full functions for SCSI, limited functions for ESCON).
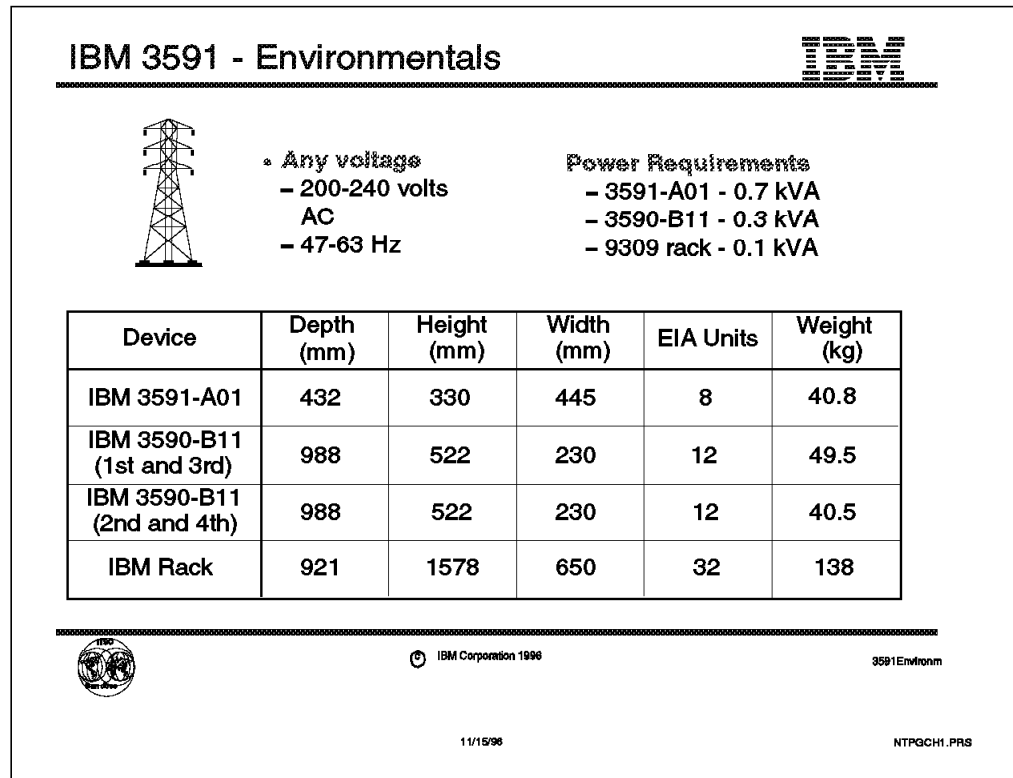
Figure 98. IBM 3591 Environmentals

G.4 IBM 3591 Environmentals

Refer to 10.5, "Environmentals" on page 183 for further more details.

- **Input Voltage**

  The IBM 3591-A01 control unit accepts any voltage in a range from 200 to 240 volts AC and from 47 to 63 Hz. The device automatically adjusts itself for proper operation. For installation, common IBM racks route 200 to 240 volts ac nominal.

- **Power Control**

  Powering up the rack enables all devices in the rack (IBM 3590 tape drives and IBM 3591-A01 control unit) to be powered up.
  The IBM 3591-A01 control unit does not support the remote power control function. The IBM 9309 or IBM 7202 rack power system should be used to take advantage of this function.

- **Dimensions**

  For installation, the total floor space of the rack is the reference to be used. For service clearance, leave enough space to service the IBM 3590 tape drives and the IBM 3591-A01 control unit from the front and to service and connect devices from the rear.

Figure 99. IBM 3591 Software Support

G.5 IBM 3591 Software Support

Refer to Chapter 11, "IBM 3591 Software Implementation" on page 187 for further details on software solution.

All operating systems (except TPF) that support IBM 3490E tape subsystems support the IBM 3591 tape subsystem. This is the opportunity to exploit the 10 GB capacity of the Magstar 3590 tape cartridge with the existing system software levels and application programs.

The software support is provided under:

- MVS/ESA
- VM/ESA
- VSE/ESA

From an operating system point of view, the operating systems only see IBM 3490E tape drives, regardless of whether the drives are native IBM 3490Es or IBM 3590 drives connected to an IBM 3591-A01 control unit. When compared with native IBM 3590 tape support, the IBM 3591 tape subsystem requires lower levels of operating systems.

- **MVS operating system**

  As detailed in Chapter 11, "IBM 3591 Software Implementation" on page 187, support is provided from MVS/XA with MVS/SP 2.2.3 and DFP 3.1.1. As a comparison, the support of 3590 drives for native IBM 3590 tape subsystems (IBM 3590-A00 and IBM 3590-B11 in IBM 3590-A14 or IBM 3590-B1A in ATLs) requires a minimum of MVS/SP 4.3.0 with DFSMS 1.2.0.

- **VM operating system**

Support is provided from VM/ESA 1.1.1. VM/ESA 2.1 is mandatory for native IBM 3590 tape subsystems.

- **VSE operation system**

  The IBM 3591 tape subsystem is supported from VSE/ESA 1.2. The IBM 3590 tape subsystems need VSE/ESA 2.2.

- **TPF operating system**

  TPF does not provide any support for the IBM 3591 tape subsystem even though it supports IBM 3490E tape subsystems.

IBM 3591 - Allocation and BTLS

- BTLS only needed when sharing stand-alone 3490E and 3591
  - BTLS enhancement - APAR OW18860 or OW19261
    - Esoteric name selection
    - Volume range specification
  - SMT and BTLS coexistence - APAR OW03323

3591	3490E standalone	3494 3495	BTLS	OW18860 OW19261	OW03323
✓	✓		✓	✓	
✓	✓	✓ SMT	✓	✓	✓
✓	✓	✓ BTLS	✓	✓	
✓					
✓		✓ SMT			
✓		✓ BTLS	✓	✓	

IBM Corporation 1996

3591BTLS

06/25/96

NTPGCH1.PRS

Figure 100. IBM 3591 Allocation

G.6 IBM 3591 Device Allocation and BTLS

Refer to Chapter 11, "IBM 3591 Software Implementation" on page 187 for further details.

In the majority of cases, allocation of the IBM 3590-B11 tape drives connected to an IBM 3591 tape subsystem does not require more than what is done with IBM 3480 or IBM 3490E tape subsystems.
Under VM and VSE operating systems, installation of the new IBM 3591 tape subsystem and sharing with other IBM 3480 or IBM 3490E drives are simple operations even though they require JCL and operational changes.
Especially for MVS operating systems, sharing the IBM 3591 tape subsystem with IBM 3490E tape drives requires the installation of BTLS.

BTLS Device Allocation

Figure 100 shows the sharing conditions that require BTLS to be installed for directing drive allocations.
BTLS is recommended when the IBM 3591 tape subsystem is to be shared with IBM 3490E tape drives in a stand-alone subsystem. An IBM 3490E installed in an IBM 3494 or 3495 or other robots (must verify with other Vendor) does not need BTLS.
When under control of BTLS, any IBM 3480, 3490, or 3591 tape subsystem is called a **logical library**.

Two new APARs have been released for BTLS:

- OW18860 for DFSMS/MVS or OW19261 for MVS/DFP V3 provides enhancements of BTLS to allow:
  - Coexistence with SMT by enabling "logical library" functions.

    – Volume range specification
    – Allocation based on esoteric names
- OW03323 enables SMS tape support for IBM 3494 or 3495 Automated Tape Library Dataservers by disabling BTLS functions on them ATLs.

If you are already using BTLS, APAR OW18860 or OW19261 may be installed to enhance the usability of BTLS. PTFs for both OW18860 and OW03323 must be installed if an IBM 3591 tape subsystem is shared with an IBM 3494 or 3495 Automated Tape Library Dataserver.

Also refer to Chapter 12, "Migration from IBM 3591 to IBM 3590" on page 213 for migration considerations.

Figure 101. Filling the Cartridge with IBM 3591

G.7 Filling the Cartridges

Refer to Chapter 11, "IBM 3591 Software Implementation" on page 187 for further details.

Even if IBM 3590-B11 tape drives are connected to an IBM 3591-A01 control unit and the Magstar tapes are written in 3590 media-type format, the operating systems perceive the drives as IBM 3490Es. Some actions may be required to exploit the full capacity of the media:

• **Block ID**

   This is the key element of the media usage. The block ID associated with the IBM 3591 operation is based on a 22-bit logical block number (3490E type). It limits the number of written blocks to approximately 4 million. Application programs that use small block sizes will never write to the end of tape. Therefore we recommend a block size greater than 8 KB be used.

   Refer to Chapter 9, "IBM 3490E Emulation" on page 163.

• **Reaching end of tape**

   Depending on the method an application program or product uses it may or may not be easy to use the full tape capacity. Different approaches can be used to detect the physical end of tape:

   – Write to physical end of tape (DFSMSdss)
   – Use wrap and segment values (ADSM)
   – Fill until a given percentage of maximum capacity is reached (DFSMShsm)
   – Write per physical length that is traversed

Most application programs or software products run the same with the IBM 3591 tape subsystem and the IBM 3490E tape subsystem. Special considerations are to be taken for:

– DFSMShsm and DFHSM: It has been enhanced to extend the PERCENTFULL parameter over the value of 999. It is recommended that a value of 1175 be used.

– ADSM: It is recommended that only ADSM/MVS Version 2 be used. ADSM/MVS Version 1 does not support IBM 3591.

Appendix H. Read Characteristic and Read Buffered Log CCWs

This appendix provides additional CCW descriptions that are unique to the IBM 3591 with 3490E emulation.

The Read Device Characteristics (RDC) and Read Buffered Log (RBL) channel commands for the IBM 3490E are now enhanced to utilize previously reserved fields for device and media emulation information. Fields now being used for emulation information are described here.

Please refer to *IBM 3490 Magnetic Tape Subsystem Models A01, A02, A10, A20, B02, B04, B20, B40 Hardware Reference*,, and *IBM 3490 Magnetic Tape Subsystem Models C10, C11, C22, C1A, and C2A Hardware Reference* for base information on these channel commands.

H.1 Read Device Characteristics (RDC, X′64′) Data

The following previously reserved bits are now used to define the IBM 3591-A01 control unit working in 3490E emulation mode.

Byte	Bit	Description
8	0	Set to B′1′ when device or media emulation is active, indicating that additional emulation information is available in RDC data and that media information is provided in RBL Format-30 data. Set to B′0′ when normal 3490E device and media characteristics are present. Always set to B′1′ with IBM 3591
8	1	Reserved. Always B′0′ for IBM 3591
8	2	Set to B′1′ to indicate that the 10 most significant bits (0-9) are B′0′ in the Block ID transferred to the channel in a Read Block ID command and transferred to the tape drive when the host has issued a Locate Block command. The IBM 3591 sets these bits to B′0′, regardless of their state as received from the channel for a Locate Block command. Set to B′0′ when the high-order 10 Block ID bits retain normal IBM 3490E interpretation: bit 0 is direction; bits 0-7 are segment number; bits 8 and 9 are format mode. Always set to B′1′ with IBM 3591
24-25		Contain the 2-byte, (four-decimal-digit) type of the underlying physical control unit. For IBM 3591 this value is ″3591.″ This field is valid only when RDC Byte 7, Bit 0 is set to B′1′.
26		Contains the 1-byte, (two-hexadecimal-digit) model code for the underlying physical control unit. For IBM 3591 Model A01, this code is X′01′. This field is valid only when RDC Byte 7, Bit 0 is set to B′1′.
27-28		Contain the 2-byte, (four-decimal-digit) type of the underlying physical device. For IBM 3590, the code value is ″3590.″ This field is valid only when RDC Byte 7, Bit 0 is set to B′1′.
29		Contains the 1-byte, (two-hexadecimal-digit) model code of the underlying physical device. For IBM 3590 Model B11 the value is X′11′. This field is valid only when Byte 7, Bit 0 is set to B′1′.

H.2 Read Buffered Log (RBL, X′24′) Format-30 Data

The following represents the description of the previously reserved bits now used to define the IBM 3591-A01 control unit working in 3490E emulation mode.

Byte	Bit	Description
56-57		Contain the media identifier of the underlying physical medium. For IBM 3590 standard media, the supplied media code is X′0130′. This field is valid only when Byte 7, Bit 0 is set to B′1′.
58		Contains the format identifier of the underlying physical medium. For 3590 standard media, the supplied value is X′23′. This field is valid only when Byte 7, Bit 0 is set to B′1′.
59	0-4	Reserved
	5-6	Wrap number of underlying physical medium
	7	Wrap direction of the underlying physical medium • B′0′ is physical forward wrap half • B′1′ is physical backward wrap half These fields are valid only when Byte 7, Bit 0 is set to B′1′.
60		Contains the fractional part of the underlying physical volume currently traversed, provided as an integer n, which represents n/255 of the physical volume. This value of the fraction represents a logical position, except during rewind when it is expressed as a physical position; for example, at the end of the first wrap half, on a write the fraction represents a number close to 1/8, but when a rewind is issued, the fraction is very close to 1. This field is set only when RDC Byte 7, Bit 0 is set to B′1′.

Appendix I. Tape Subsystem Comparison Chart

Table 60 lists the major differences among the IBM 3480, 3490E, 3591 and 3590 tape subsystems.

Table 60. Tape Subsystem Comparison				
Description	**3480**	**3490E**	**3591**	**3590**
Packaging				
Frame	Yes	Yes	No	Yes•
Rack	No	Yes•	Yes	Yes•
Host support				
ES/9000	Yes	Yes	Yes	Yes
RISC System/6000-SP2	No	Yes	No	Yes
AS/400	Yes	Yes	No	Yes
Channel attachment				
Max number	8•	2-8•	1	2
ESCON	No	Yes	Yes	Yes
Parallel	Yes	Yes	No	No
SCSI	No	Yes•	No	No
Controller				
Model	A22	Ax0-Cxx	3591-A01•	3590-A00•
Packaging	Framed	Framed	Integrated	Integrated
Performance				
Channel max (MB/s)	4.5	17	17	17
Drive max (MB/s)	3	3	9	9
Tape drive				
Type	3480	3490E	3590	3590
Max number	16	2-16•	4	4
Mode	3480	3490E	3490E	3590
Compaction	IDRC	IDRC	IBMLZ1	IBMLZ1
Cartridge				
Type	CST	CST-ECCST	3590	3590
Media format	18 track	36 track	128 track	128 track
Capacity (GB) uncomp.	0.2	0.4-0.8	10	10
Cartridge Loader				
Type	ACL•	ICL•	ACF&sup10.	ACF&sup10.
Capacity	6	6	10	10
Random mode	No	No	No	Yes-No[11]
• IBM 3590 model A14				
• IBM 3490 models C10, C11 and C22				
• IBM 3590 model B11				
• 4 per 3480-A22 or 8 when with Dual Control Unit Communication				
• for 3490-Cxx and for 3490-A20				
• Only on 3490 models C10, C11, C22				
• Only for ESCON host connection				
• Automatic Cartridge Loader (ACL)				
• Integrated Cartridge Loader (ICL)				
[10] Automatic Cartridge Facility (ACF)				
[11] Random mode available for SCSI-attached 3590-B11				

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Appendix J. QTAPE Option of the DEVSERV MVS Operator Command

The QTAPE option of the DEVSERV MVS operator command has been designed to assist system operators, systems programmers, configuration administrators, and customer service personnel in acquiring physical identification, status, and diagnostic information about tape devices in large, complex MVS/ESA configurations.

DEVSERV QTAPE is capable of displaying a broad range of information, such as identification and status information, for a specific tape device or multiple tape devices. It supports a tape device as long as the device can handle the SENSEID(x′64′) CCW. The scope of the display is controlled by selection criteria specified on the DEVSERV QTAPE command.

Basic information returned includes (see Figure 105 on page 298):

- Device number
- Device type equivalent to DTYPE from DS P command
- Device status indicating online or offline and ready or not ready
- Control unit type and model
- Control unit serial number
- Device type and model
- Device serial number
- Library ID
- Indication of whether the defined MVS unit control block (UCB) device type is inconsistent with the real device type.

Optionally, a hexadecimal display of the following device-related MVS system control blocks may be requested:

- UCB, UCB Prefix, and UCB Common Extension
- Device Class Extension (DCE)

In addition, a hexadecimal display of the following data buffers acquired directly from the device may be requested:

- Read Device Characteristics (RDC) data
- Read Configuration Data (RCD) data

Online help text is also provided.

J.1 Syntax of the DEVSERV QTAPE Command

Figure 102 on page 294 details the verbal syntax and Figure 103 on page 294 details the linear syntax of the DEVSERV QTAPE command. Refer to these figures when reading the pages that follow.

```
DEVSERV  QTAPE   ,?
DS       QT      ,?


                                            -- or --


DEVSERV  QTAPE
DS       QT
 [ [,ccuu   [ ,1 ] | ,[ [,UCB] [,DCE][ [,NOIO] | [,RDC] [,RCD] ] ] ] |
    ,ccuu,nnn |
   [,ccuu,nnn],LIB=[ALL | libid] |
             ,MACH=[serialnmbr | XXXXalnmbr] |
             ,TYPE=[ALL | type] ]
  [,ONLINE] [,OFFLINE] [,DEFINED]
```

Figure 102. Verbal Syntax of the DEVSERV QTAPE Command

Figure 103. Linear Syntax of the DEVSERV QTAPE Command

Two distinct classes of parameters are associated with the DEVSERV QTAPE command: unit selection parameters and diagnostic information selection parameters.

The unit selection parameters identify the units for which information is to be displayed. These parameters include:

- **ccuu** and **nnn**
- **LIB=**

- **MACH=**
- **TYPE=**
- **ONLINE**
- **OFFLINE**
- **DEFINED**

The diagnostic information selection parameters indicate which MVS system control blocks and/or which information acquired directly from the device are to be displayed in hexadecimal format. These parameters include:

- MVS control blocks:

  - **UCB**
  - **DCE**

  If the parameter **NOIO** is specified, the requested MVS control blocks will be displayed, but no attempt will be made to issue I/O to the selected device.

- Device information buffers:

  - **RDC**
  - **RCD**

Any hexadecimal information requested appears in the display after the basic status information (see Figure 109 on page 301).

Online help text can be viewed by entering the command in the form **DEVSERV QTAPE, ?** (see Figure 104 on page 297).

DEVSERV Invoke the DEVSERV command processor

QTAPE Invoke the **QTAPE** function of the **DEVSERV** command

The following are the unit selection parameters:

ccuu Indicates the starting, or only, tape device number to be queried.

nnn A decimal value indicating the number of sequential device numbers, starting with **ccuu**, for which information is to be displayed. **nnn** has a different meaning for **DEVSERV QTAPE** than for **DEVSERV PATHS** or **DISPLAY UNITS**. For those commands, **nnn** indicates the number of device numbers to be displayed, ignoring gaps in the device number sequence. For the **DEVSERV QTAPE** command, if gaps exist in the sequence of tape device numbers defined to the operating system, and **DEFINED** is not specified, the missing tape device numbers are listed in the form '... nnnn(01)...' where nnnn is the device number and 01 is the reason code indicating that no UCB was found for that device number. If **DEFINED** is specified, no information is displayed for missing device numbers. Valid values for **nnn** are from 1 to 256. The default is 1. The value of **nnn** must be defaulted, or a value of 1 specified, if any diagnostic information selection parameters are specified. **nnn** is valid only when **ccuu** is also specified.

LIB=libid Indicates that information is to be displayed for the devices having the specified **libid**. If **LIB=ALL** is specified, information will be displayed for all library tape devices. **LIB=** is mutually exclusive with **MACH=** and **TYPE=**.

MACH=mmpp-sssss mmpp-sssss must be the 10-character serial number of either a tape control unit or a tape device. Information will be displayed for the specific device, or for all devices on the tape control

unit, having the serial number **mmpp-sssss**. If the **mmpp** portion of **mmpp-sssss** is specified as **XXXX**, the manufacturer and plant of manufacture fields of the serial number will be ignored, and the search will be done only for the **sssss**, or sequence number, portion. **MACH=** is mutually exclusive with **LIB=** and **TYPE=**.

TYPE=type Indicates that information is to be displayed for all tape devices of the specified type. Valid values for **type** include any valid four-character numeric tape device or tape control unit type. If **TYPE=ALL** is specified, information will be displayed for all tape devices that meet any additional selection criteria, such as **ONLINE**, **OFFLINE**, and **DEFINED**. **TYPE=** is mutually exclusive with **LIB=** and **MACH=**.

ONLINE Indicates that information is to be displayed for devices that are online to this MVS host

OFFLINE Indicates that information is to be displayed for devices that are offline to this MVS host

If neither **ONLINE** nor **OFFLINE** is specified, information will be provided for both online and offline tape devices as the default. If either **ONLINE** or **OFFLINE** is specified, information will be displayed only for the devices with the specified status.

DEFINED Indicates that information is to be displayed for all tape units defined in the current I/O configuration that meet all other selection criteria, such as **ccuu** and **nnn**, or **TYPE=**, **ONLINE**, or **OFFLINE**. A specification of **DEFINED** indicates that information is to be provided based on the existence of unit addresses (UCBs) that are configured as tape devices, and not on the existence of physical devices. Therefore available information will be displayed even for unit addresses that have no accessible physical devices, or for which the accessible physical device type is inconsistent with the defined device type. **DEFINED** is ignored when specified with **LIB=** or **MACH=**, as these options require the existence of a physical device. If **DEFINED** is specified, and **TYPE=ALL** is specified, information will be displayed for all tape units defined in the configuration. If **DEFINED** is specified together with **TYPE=type**, where **type** is other than **ALL**, information will be displayed only for units of the type specified by the parameter **type**. Valid types are: **3400**, **3480**, **3490**, and **3590**.

For the 3400 device type, QTAPE supports only the devices that support the SENSEID command. If a tape device does not support the SENSEID command, QTAPE indicates that with reason code 9, "QTAPE is not supported."

The following are the diagnostic information selection parameters. These parameters are valid only when **ccuu** and **nnn** are specified, with **nnn** having a value of 1.

UCB Request UCB data to be displayed in hexadecimal format

DCE Request DCE data to be displayed in hexadecimal format

RDC Request RDC data to be displayed in hexadecimal format

RCD Request RCD data to be displayed in hexadecimal format

NOIO   Prevents DEVSERV QTAPE from issuing I/O requests to the devices. Indicates that only processor storage resident information is to be displayed. The basic display (see Figure 108 on page 301) will contain only the unit number and device type defined in MVS. **NOIO** is valid only when specified in combination with **UCB** and **DCE** and is mutually exclusive with **RDC** and **RCD**, as data associated with these parameters can be acquired only through an I/O operation with the device.

J.2 DEVSERV QTAPE Help Text

Figure 104 shows the help text provided when the **DEVSERV QTAPE,?** command is issued.

```
 DS QT,?

  IEE459I 15.27.49 DEVSERV QTAPE
      DEVSERV QTAPE COMMAND SYNTAX:
  DS QT,ccuu,n,filter1,filter2,diagnostic info
    ccuu  -- device number,  n -- number of devices (1-256)
    filter1 -- LIB=ALL or library id, or
               MACH=ALL or cu or device serial, or
               TYPE=ALL or device type or defined device type
    filter2 -- DEFINED, ONLINE, OFFLINE
               DEFINED is valid only if TYPE= is selected
    diagnostic info -- UCB, DCE, RDC, RCD, NOIO
                   valid only if n=1 is specified
  DS QT,LIB=libid,filter
       libid -- ALL or library id
       filter -- ONLINE, OFFLINE
  DS QT,MACH=serialnmbr,filter
       serialnmbr -- control unit or device serial
       filter -- ONLINE, OFFLINE
  DS QT,TYPE=type,filter
       type -- ALL or defined device type
       filter -- DEFINED, ONLINE, OFFLINE
```

Figure 104. Format of the DEVSERV QTAPE Help Text Response When '?' Is Specified

J.3 Format and Legend of DEVSERV QTAPE Display

Figure 105 is an example of the basic display generated by the **DEVSERV QTAPE** command.

```
DS QT,parms

 IEE459I 12.57.36 DEVSERV QTAPE
 UNIT DTYPE  DSTATUS CUTYPE   DEVTYPE CU-SERIAL   DEV-SERIAL ACL LIBID
 uuuu tttttt ON-RDY   ccccmmm ddddmmm mmpp-sssss mmpp-sssss I-A lllll
 uuuu tttttt ON-NRD   ccccmmm ddddmmm mmpp-sssss mmpp-sssss I   lllll
 uuuu tttttt OFFLINE ccccmmm ddddmmm mmpp-sssss mmpp-sssss I
 uuuu tttttt OFFLINE ccccmmm ddddmmm mmpp-sssss mmpp-sssss
 ****     ggg DEVICE(S) MET THE SELECTION CRITERIA

  LEGEND:

  uuuu:       external device id (unit number)
  tttttt      device type such as 3490, 3480SX, 3480X and 3480
  ccccmmm:    Control Unit Type and Model, acquired from the attachment
  ddddmmm:    Device Type and Model, acquired from the attachment
  ?:          Following device model indicates that the defined (UCB)
              device type is incompatible with the real device type.
  *:          Following device model indicates that device emulation
              is active.
  mmpp-sssss: Control Unit or Device Serial Number, acquired from the
              attachment
  I-A:        Indication of ACL status.
              I indicates installed, A indicates active.
              Blank otherwise.
  lllll:      library id for library device or blank for non-library
              device.
  ggg:        Number of unit addresses encountered which met the
              specified selection criteria
```

Figure 105 (Part 1 of 2). Format of the Basic DEVSERV QTAPE Response

The following text might appear within the display associated with a
specific unit number:

  -NO DATA-
            The device does not support Self Description commands
            so the information is not available for QTAPE to display.

The ACL field shows I for the 3490E models C1A and C2A even though
the device does not have automatic cartridge loader installed.

The following text might appear interspersed with detailed unit
information when a unit address is encountered for which no information
is available.

 **** UNLISTED DEVICE(S) AND REASON CODES :
   uuuu(rc) uuuu(rc) ... ...

  uuuu - the unit number
  (rc) - the reason code indicating why no information is presented
         display. The value of rc indicates the reason that there is
         no valid information.

  (rc)   reason code meaning:
 ____   _____
   01   Device not configured, UCB not found.
   02   UCB is not connected to a physical device
   03   Device unavailable - system routine in control
   04   Subchannel error detected
   05   Device is boxed
   06   UCB does not define a tape device
   07   I/O error accessing the device
   08   UCB is not connected to a tape device
   09   QTAPE does not support the tape device since
            the device does not support the SENSEID cmd.

 ____   _____

The following text might appear indicating the results of the DS QT
command execution:

 **** TYPE=tttt IS AN INVALID UCB TYPE
            TYPE= and DEFINED were both specified, and no tape units of
            the type tttt were found

 ****   hhh DEVICE(S) WITH INCONSISTENT UCB TYPE DEFINED
            hhh is the number of unit addresses encountered for which
            the defined device type is inconsistent with the connected
            physical device

 ****   hhh DEVICE(S) WITH DEVICE EMULATION ACTIVE
            hhh is the number of unit addresses encountered for which
            the device emulation is active

Figure 105 (Part 2 of 2). Format of the Basic DEVSERV QTAPE Response

Figure 106 shows an example of a display resulting from DEVSERV QTAPE
command without hexadecimal data.

```
DS QT,TYPE=ALL

IEE459I 12.57.36 DEVSERV QTAPE
UNIT DTYPE  DSTATUS CUTYPE  DEVTYPE  CU-SERIAL  DEV-SERIAL ACL LIBID
0930 3480SX ON-NRD  3490A02 3490B04  0112-47671 0112-47671 I
093F 3480SX OFFLINE 3490A02 3490B04  0112-47671 0112-47671 I
0990 3490   ON-RDY  3490A20 3490B40  0113-97231 0113-97231 I-A
09A0 3490   OFFLINE 3490C2A 3490C2A  0113-55565 0113-55565 I   10382
**** UNLISTED DEVICE(S) AND REASON CODES :
   093E(05) 093F(05)
****       4 DEVICE(S) MET THE SELECTION CRITERIA
**** (05) - DEVICE BOXED
```

Figure 106. Example of Basic DEVSERV QTAPE Display without Hexadecimal Data

Figure 107 is an example of a display that contains emulated devices from
DEVSERV QTAPE with **DEFINED** specified. Without **DEFINED**, the display does
not list the emulated device because its physical device type is not **3490**.

```
DS QT,TYPE=3490,DEFINED

IEE459I 12.57.36 DEVSERV QTAPE
UNIT DTYPE  DSTATUS CUTYPE  DEVTYPE  CU-SERIAL  DEV-SERIAL ACL LIBID
0990 3490   ON-RDY  3490A20 3490B40  0113-97231 0113-97231 I-A
0998 3490   ON-RDY  3591A01 3590B11* 0113-33343 0113-33343 I-A
09A0 3490   OFFLINE 3490C2A 3490C2A  0113-55565 0113-55565 I   10382
09A1 3490   OFFLINE 3490C2A 3490C2A  0113-55565 0113-55565 I   10382
09A2 3490   OFFLINE 3490C2A 3490C2A  0113-55565 0113-55565 I   10382
09A3 3490   OFFLINE 3490C2A 3490C2A  0113-55565 0113-55565 I   10382
**** UNLISTED DEVICE(S) AND REASON CODES :
   0991(07) 0992(07) 0993(07) 0994(07) 0995(07) 0996(07) 0997(07)
   0999(07) 099A(07) 099B(07) 099C(07) 099D(07) 099E(07) 099F(07)
   09A4(07) 09A5(07) 09A6(07) 09A7(07) 09A8(07) 09A9(07) 09AA(07)
   09AB(07) 09AC(07) 09AD(07) 09AE(07) 09AF(07)
**** (07) - DEVICE I/O ERROR
****       6 DEVICE(S) MET THE SELECTION CRITERIA
****       1 DEVICE(S) WITH DEVICE EMULATION ACTIVE
```

Figure 107. Example of Basic DEVSERV QTAPE Display with Device Emulation Active

Figure 108 is an example of a display resulting from a **DEVSERV QTAPE** command with **NOIO** and some dumping options specified.

```
DS QT,991,NOIO,UCB,DCE

 IEE459I 11.06.30 DEVSERV QTAPE
 UNIT DTYPE  DSTATUS CUTYPE  DEVTYPE  CU-SERIAL  DEV-SERIAL ACL LIBID
 0991 3490
   UCB AT V00F1CD18
000AFF8009914000 00F1CDF000F9F9F1 7804808100F1CCC8 0000000000000000
0000800000000000
   UCB PREFIX AT V01B8AB60
0000000000000000 01AB400040000000 0000000000000000 0000000000000000
00D8004800180000
   UCB COMMON EXTENSION AT V00F1CCC8
0F00FA00200E0000 01B8AB6000000000 0000000000FCF024 00F1CD5800000000
   DCE AT V00F1CD58
E4C3C2E300480030 0000000000000000 0000000000000000 0000000000000000
0000000000000000 0000000000000000
 ****      1 DEVICE(S) MET THE SELECTION CRITERIA
```

Figure 108. Example of Basic DEVSERV QTAPE Response with NOIO Specified

Figure 109 shows an example of display resulting DEVSERV QTAPE command with hexadecimal data.

```
DS QT,991,1,RDC,UCB,DCE

 IEE459I 10.21.51 DEVSERV QTAPE
 UNIT DTYPE  DSTATUS CUTYPE  DEVTYPE  CU-SERIAL  DEV-SERIAL ACL LIBID
 0991 3490SX OFFLINE 3490A20 3490B40   0113-97231 0113-97231 I
   READ DEVICE CHARACTERISTICS
3490203490400000 0FE0808000000000 0000000000000000 0000000000000000
0000000000000000 4281000000000000 0000000000000000 0000000000000000
   UCB AT V00F1CD18
000AFF8009914000 00F1CDF000F9F9F1 7804808100F1CCC8 0000000000000000
0000800000000000
   UCB PREFIX AT V01B8AB60
0000000000000000 01AB400040000000 0000000000000000 0000000000000000
00D8004800180000
   UCB COMMON EXTENSION AT V00F1CCC8
0F00FA00200E0000 01B8AB6000000000 0000000000FCF024 00F1CD5800000000
   DCE AT V00F1CD58
E4C3C2E300480030 0000000000000000 0000000000000000 0000000000000000
0000000000000000 0000000000000000
 ****      1 DEVICE(S) MET THE SELECTION CRITERIA
```

Figure 109. Example of DEVSERV QTAPE Response with Hexadecimal Data

J.4 Use in Diagnosing Inconsistent Device Definition

Figure 110 shows the use of the DEVSERV QTAPE command to detect an error.

```
1.) VARY ONLINE Fails.

V 931,ONLINE

 IEE103I UNIT 0931    NOT BROUGHT ONLINE
 IEE763I NAME= IECDINIT CODE= 0000000800000000
 IEA435I PHYSICAL DEVICE INCONSISTENT WITH LOGICAL DEFINITION
 IEE764I END OF IEE103I    RELATED MESSAGES

2.) DEVSERV QTAPE shows inconsistent device definition.

DS QT,931,1

 IEE459I 15.28.22 DEVSERV QTAPE
 UNIT DTYPE  DSTATUS CUTYPE  DEVTYPE  CU-SERIAL  DEV-SERIAL ACL LIBID
 0931 3480X  OFFLINE 3490A20 3490B40? 0113-97231 0113-97231 I
 ****     1 DEVICE(S) MET THE SELECTION CRITERIA
```

Figure 110. Example of DEVSERV QTAPE Used to Detect an Error

Appendix K. IBM Magstar 3590 Silo-Compatible Tape Subsystem

This chapter describes how the IBM 3590 Magstar Tape Drive can be installed in a StorageTek Automated Cartridge System.

STK Trademarks

* **The following are trademarks (*) of, or terms used by, Storage Technology Corporation:**
  * 4410 Automated Cartridge System
  * NEARLINE Library System
  * 4480 Cartridge Tape Subsystem
  * 9310 PowderHorn* Automated Cartridge System
  * Host Software Component (HSC)
  * Library Control Unit (LCU)
  * Library Management Unit (LMU)
  * Library Storage Module (LSM)
  * RedWood* SD-3 Helical Cartridge Tape Subsystem
  * Silo
  * Silverton 4490 Cartridge Subsystem
  * StorageTek*
  * TimberLine* 9490 Cartridge Tape Subsystem

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Figure 111. STK Trademarks

K.1 STK Trademarks

The StorageTek Automated Cartridge System has been on the market for some years and some of the components are trademarks of the Storage Technology Corporation, marked with an asterisk (*) in Figure 111. Other parts of the system are represented by terms or definitions that are used by STK or installations having a Silo installed:

* **4410 Automated Cartridge System**

  This is the first Silo, also called Nearline, introduced by StorageTek in 1987.

* **4480 Cartridge Tape Subsystem**

  This is the StorageTek IBM 3480-compatible tape subsystem, using 18-track format standard cartridges and is able to attach to parallel channels only.

* **9310 PowderHorn Automated Cartridge System**

  This is the second version of the Silo introduced by StorageTek in 1993 and has approximately twice the robotics performance of the StorageTek 4410 Automatic Cartridge System.

* **Host Software Component (HSC)**

  The primary function of HSC is to steer allocation, mounting, and dismounting of different cartridge types. The HSC basically intercepts console messages before they are visible to the operator.

- *Library Control Unit (LCU)*

  Receives and responds to requests from the hosts and directs the function to the robotics of the Library Storage Module (LSM).

- *Library Management Unit (LMU)*

  Provides an interface between the Host Software Component (HSC), and the Library Control Units (LCUs), attached to each Library Storage Module (LSM).

- *Library Storage Module (LSM)*

  The LSM is a free-standing robotic arm within a twelve-sided cylindrical housing (the Silo), with storage capacity for approximately 6000 cartridges.

- *RedWood SD-3 Helical Cartridge Tape Subsystem*

  This is the latest tape drive announced from StorageTek; it uses helical-scan technology. Because helicalscan is a very expensive technology to use and maintain, this type of device should only be used for very special niche applications.

- *Silo*

  Some people use this term as the name of the whole subsystem and some use it as the name of the LSM. Nicknames for the Silo exist in different local languages.

- *Silverton 4490 Cartridge Subsystem*

  This is the StorageTek IBM 3490E-compatible tape subsystem, using 36-track format standard cartridges and is able to attach to parallel channels only.

- *StorageTek*

  StorageTek or STK are short versions of the company name of Storage Technology Corporation.

- *TimberLine 9490 Cartridge Tape Subsystem*

  This is the StorageTek IBM 3490E-compatible tape subsystem, using 36-track format extended cartridges and with a performance twice that of the Silverton 4490 Cartridge Subsystem.

See Section K.3, "Configuration Overview" on page 308 for an overview of a StorageTek Automated Cartridge System with IBM Magstar tape drives.

Figure 112. Why Use IBM 3590 in an STK Silo?
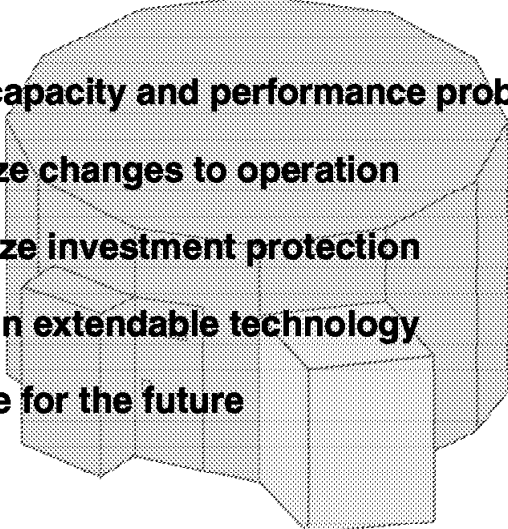
K.2 Why Use IBM 3590 Magstar in an STK Silo?

- *Solve capacity and performance problems*.

  The capacity in terabytes of a StorageTek Silo can be increased by up to 50 times by attaching IBM 3590-C12 frames. Comparing on the basis of the uncompacted storage capacity of a cartridge and recording technology, the IBM Magstar cartridge can store 50 times as much as IBM 3480 drive technologies and 12 times as much as IBM 3490E drive technologies using an Enhanced Capacity cartridge.

  The performance of the IBM Magstar tape drives may substantially improve throughput for certain tape applications. They will also have the performance to improve dump and restore times for the newly announced RAMAC-3 array disk.

- *Minimize changes to operation*.

  When installing an IBM 3590-C12 frame, no new software is required because existing 3490E tape applications also run on IBM 3590-C12. If the esoteric unit names used by existing applications are defined for the new drives, no JCL-changes are required.

- *Maximize investment protection*.

  By adding an IBM 3590-C12 frame, or installing it to replace existing tape drives, the investment in all other parts of the StorageTek Automated Cartridge System is retained at the same time as the capacity and the performance are improved.

Later, the IBM Magstar 3590 cartridges and the IBM 3590-B1A drives can be moved and installed in an IBM Automated Tape Server, such as the IBM 3494, giving you the option to use virtual tapes and drives to maximize the utilization of your investment.

- *Invest in extendable technology*.

  In 1995, IBM first announced the IBM Magstar 3590 tape subsystem and now in 1996 substantial additions have been announced in products, functions, and features. The IBM Magstar technology will be further enhanced and new products, functions, and features will be included in future announcements. By installing the IBM 3590-C12 in the StorageTek Silo, you will invest in a technology that will be extended in the future.

- *Prepare for the future*.

  As you have seen in earlier chapters of this book some functions and features of the IBM Magstar technology will be available next year and even more are expected in the future. By installing the IBM 3590-C12 now, you prepare to take full advantage of all functions and features of the IBM Magstar technology. Also by installing the IBM 3590-C12 now, you reduce the number of cartridges, and convert all your tape data to the new technology.
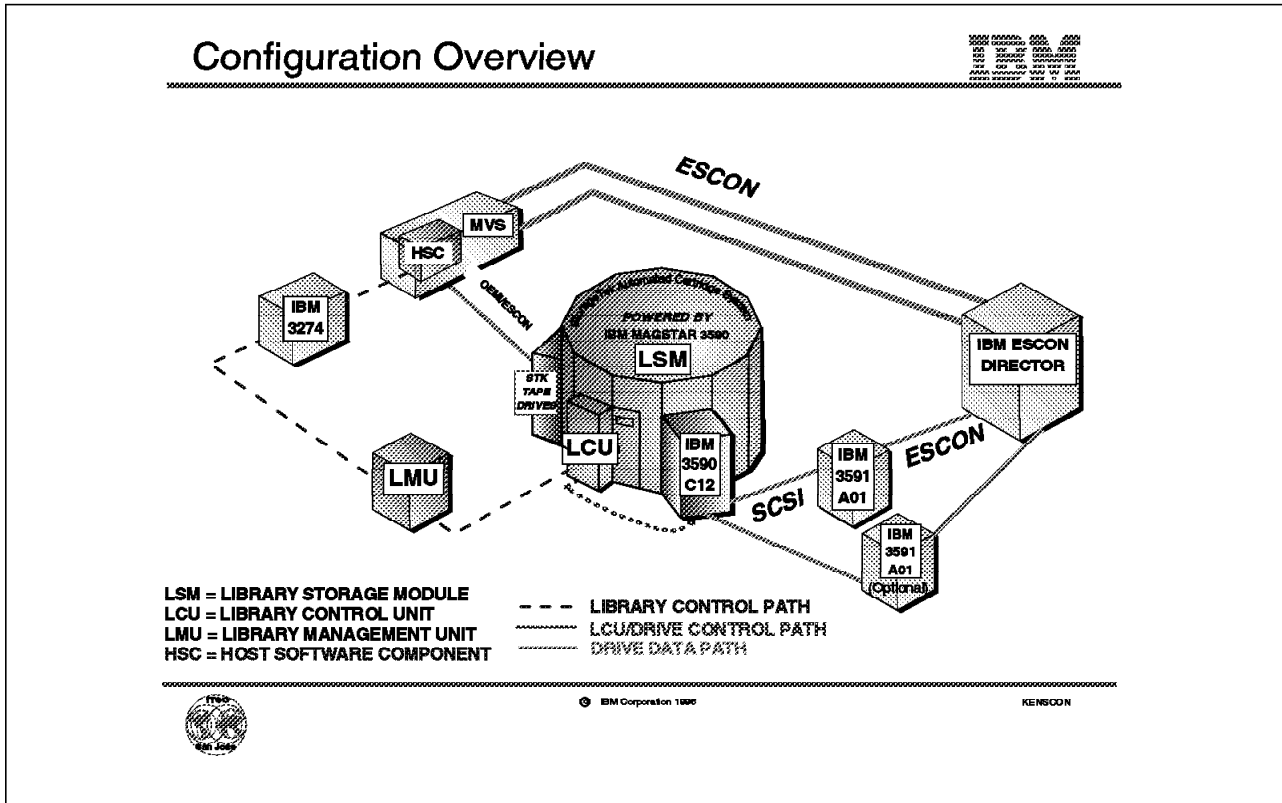
Figure 113. Configuration Overview

K.3 Configuration Overview

The components of a StorageTek Automated Cartridge System with an IBM 3590 Model C12 Silo-Compatible Frame installed (Figure 113) are as follows:

- *Library Storage Module (LSM)*

    Contains the Magstar 3590 Data Cartridges, Magstar 3590 Cleaning Cartridges, and Magstar 3590 Diagnostic Cartridges, and cartridges for STK drives, if installed, as well as storage slots and robotics.

    Up to sixteen drives can be attached to one LSM.

- *Library Control Unit (LCU)*

    Controls the robotics motion and interfaces to the drives through the LCU/DRIVE Control Path. The LCU gets orders from the Library Management Unit, see below, through the Library Control Path.

- *IBM 3590-C12 (Silo-Compatible Frame)*

    Contains four IBM 3590-B1A drives attached to StorageTek LSM and interfaces with the StorageTek LCU through the LCU/DRIVE Control Path. More information on the IBM 3590-C12 will follow in Section K.4, "IBM 3590 Model C12" on page 310.

- *StorageTek Tape Drives*

    These may be installed at the same time as the IBM 3590-C12.

- **IBM 3591-A01 (ESCON Tape Controller)**

  IBM 3591-A01 ESCON tape controller provides for ESCON attachment of the IBM 3590-B1A drives as if they are IBM 3490E drives. More information on the IBM 3591-A01 will follow in Section K.4, "IBM 3590 Model C12" on page 310.

- **IBM ESCON Director**

  The ESCON director allows the drives in the IBM 3590-C12 to be accessed from multiple hosts or logical partitions. This is optional.

- **Library Management Unit (LMU)**

  The LMU converts the mount commands from up to 16 hosts to robotic commands for up to 16 LCUs. The LMU interfaces with the LCUs and with the hosts (via a Network Controller, see below) through the Library Control Path.

- **Network Controller (for example, IBM 3274)**

  The controller allows the Host Software Component, see below, to access the LMU through the Library Control Path.

- **Host Software Component (HSC)**

  The HSC manages the cartridge-to-slot database and steers drive allocation.

IBM provides maintenance for the entire library subsystem and problem determination assistance for interoperability issues in split maintenance environments.
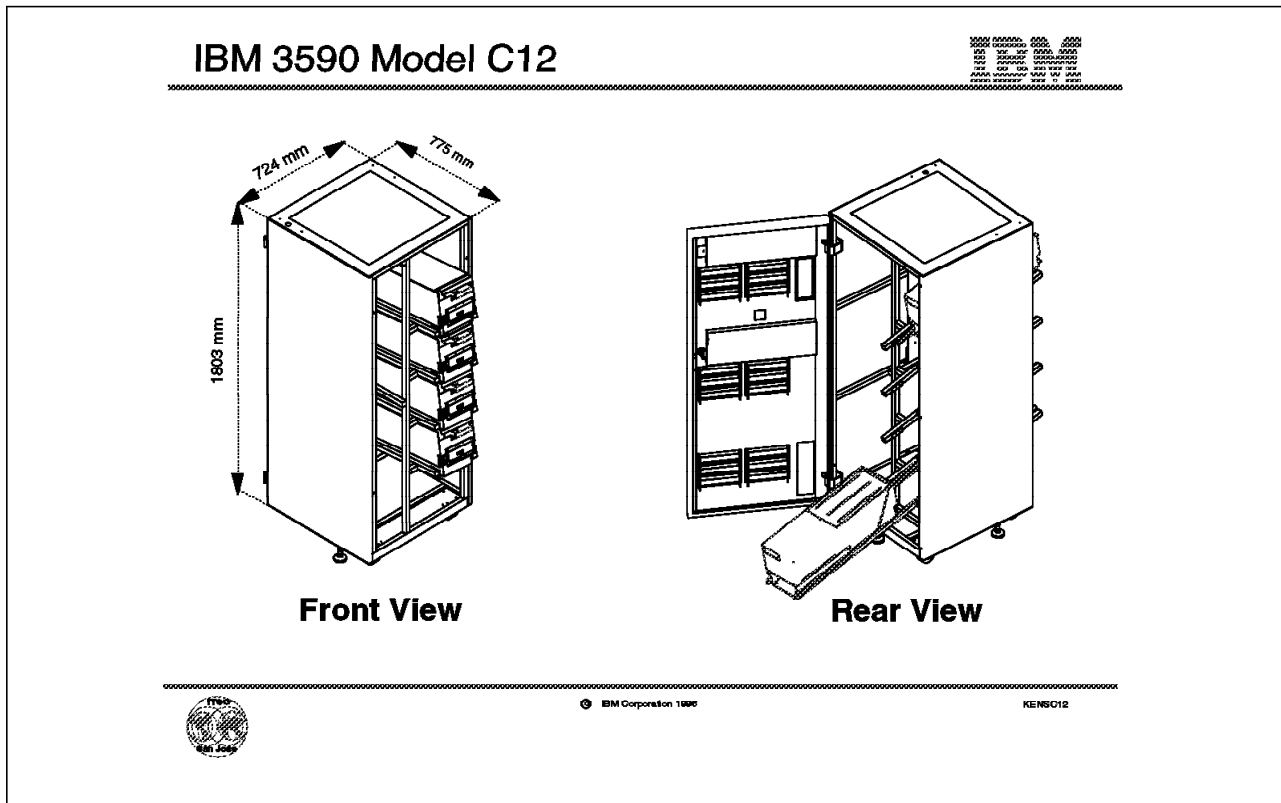
Figure 114. IBM 3590 Model C12

K.4 IBM 3590 Model C12

The IBM 3590-C12 Silo-Compatible Frame (Figure 114) is designed for attachment to a StorageTek Automated Cartridge System, often called a Silo. Four IBM 3590-B1A drives are installed in the IBM 3590-C12 frame. The SCSI bus of the IBM 3590-C12 attaches to an IBM 3591-A01 ESCON controller for 3490E emulation to the host. More information on the IBM 3591-A01 ESCON controller follows in Section K.5, "IBM 3591 Model A01" on page 314.

The drives installed in the IBM 3590-C12 frame are standard IBM 3590-B1A drives with Feature 2003 which adds a target for the STK robotics and attachment for the drive display. The drives can later be installed in another configuration, such as the IBM 3494 Virtual Tape Server (see Section K.10, "Migration Path to IBM 3494" on page 328).

The IBM 3590-B1A drives are oriented in the IBM 3590-C12 frame on slanted (15 degrees) trays, as shown in the front view in Figure 114. This is done so that the StorageTek robotic assembly can pick cartridges from and place cartridges in the IBM 3590-B1A loader mechanism. The IBM 3590 drive is designed for rear slide-out service in the IBM 3590-C12 frame (see rear view in Figure 114).

Table 61 on page 311 shows the physical specifications of the IBM 3590-C12 frame.

Four tape cartridges for diagnostics and a cleaning cartridge are supplied with each IBM 3590-C12. A three-month supply of data cartridges is recommended, along with cartridge labels to identify each cartridge's volume serial number.

See Table 62 on page 312 for ordering data cartridges with the IBM 3590-C12 Frame. For detailed information on ordering additional cartridges, see:

- *IBM 3590 Magstar High Performance Tape Subsystem Silo-Compatible Frame Model C12 Introduction, Planning, and User's Guide*.

Up to four IBM 3590-C12 units can attach to one LSM, allowing up to 16 IBM 3590-B1A drives.

Table 61. IBM 3590-C12 Physical Characteristics	
Feature	**Specification**
Height	1803 mm (71 in.)
Width	724 mm (28.5 in.)
Depth (Free-Standing)	975 mm (38.4 in.)
Depth (Installed)	775 mm (30.5 in.)[1]
Weight	400 kg (880 lb)[2]
Notes:	
1. In the service position, the maximum installed depth for Model C12 is 1635 mm (62.1 in.). 2. This is the weight of a fullyloaded C12 frame.	

For more information on environmental specifications and additional information about the IBM 3590 Model C12, see:

- *IBM 3590 Magstar High Performance Tape Subsystem Silo-Compatible Frame Model C12 Introduction, Planning, and User's Guide*.

For additional information about the IBM 3590 Magstar tape drive, see:

- *IBM 3590 High Performance Tape Subsystem Introduction and Planning Guide*

- *IBM 3590 High Performance Tape Subsystem User's Guide,*

- *IBM 3590 High Performance Tape Subsystem Hardware Reference*

- *Magstar and IBM 3590 High Performance Tape Subsystem: Multiplatform Implementation*

An optional display mounted on the top of the IBM 3494-C12 (not shown in Figure 114 on page 310) is available from Texas Digital Systems, Inc. (TDS) of College Station, Texas 77845, USA, telephone (409) 693-9378. The TDS display features an 11-color LED display that can be read from a distance up to 27 meters, and provides drive status information. The display attaches to the RS-422 interface of each IBM 3590-B1A drive through a display controller mounted in the IBM 3494-C12 frame.

K.4.1 IBM 3590-C12 Features

Table 62 shows the feature codes for the features applicable to the IBM 3590-C12 frame.

Table 62. IBM 3590-C12 Features	
Description	**Feature Code**
One 12 m (39.4 ft) SCSI cable; One SCSI bus with four drives	5201
Two 12 m (39.4 ft) SCSI cables; Two SCSI buses with two drives each	5202
One cleaning cartridge	8002
Seven 30-packs of tape cartridges (210 cartridges); without seventh character on VOLSER label	8210
Fourteen 30-packs of tape cartridges (420 cartridges); without seventh character on VOLSER label	8220
No data cartridges	9590
Chicago line cord, 2 meters	9986

- **Feature 520x**

  You must select either Feature 5201 or 5202. Installation is performed at the plant. The 12-m cable is shipped separately from the drive and is installed in the field. Approximately 10 m of the 12-m SCSI cable length is available for connection to the IBM 3591-A01 ESCON controller.

  Feature 5201 supplies one 12-m SCSI cable for attachment of a IBM 3590-B1A drive to a IBM 3591-A01 ESCON controller, and three 4-m SCSI cables for daisy-chaining to three additional IBM 3590-B1A drives in an IBM 3590-C12 frame. The SCSI cables are daisy-chained from the lowest drive in the frame to the top drive (see Figure 115 on page 314). A terminator is attached to the last connector in the top drive. The uppermost drive in the frame has SCSI address 0 and the bottom drive has SCSI address 3.

  Feature 5202 supplies two 12-m SCSI cables for attachment of two IBM 3590-B1A drives each to two IBM 3591-A01 ESCON controllers, and two 4-m SCSI cables, each of which is used to daisy-chain the two drives connected to the IBM 3591 controllers. This results in two IBM 3590-drives on each bus (Figure 115 on page 314).

- **Feature 8002**

  This feature supplies one cleaning cartridge. Up to ten Features 8002 can be specified for plant or field install.

- **Feature 8210**

  You can order no more than one Feature 8210 containing 210 IBM 3590 Data Cartridges without the "seventh character" J on the external label.

- **Feature 8220**

  You can order no more than Feature 8220 containing 420 IBM 3590 Data Cartridges without the "seventh character" J on the external label.

  Features 8210 and 8220 are plant install only.

- **_Feature 9590_**

  This feature should be specified if no data cartridges should be delivered with the IBM 3590-C12 frame.

  Note: One of Features 8210, 8220, or 9590 must be ordered with every IBM 3590-C12 frame.

- **_Feature 9986_**

  Feature 9986 is required for a IBM 3590-C12 installed in Chicago.

K.4.2 IBM 3590-B1A Features

Table 63 shows the features for the IBM 3590-B1A drive.

Table 63. IBM 3590-B1A Features	
Description	**Feature Code**
C12 Attachment	2003
ES/9000 Attachment	9000

- **_Feature 2003_**

  Feature 2003 is required on a IBM 3590-B1A to be installed in the IBM 3590-C12. This feature adds a target for the robotic vision system and a holder for the display.

- **_Feature 9000_**

  Feature 9000 should be specified when IBM 3590-B1A will be attached to a ES/3090, ES/9000, or S/390 system.
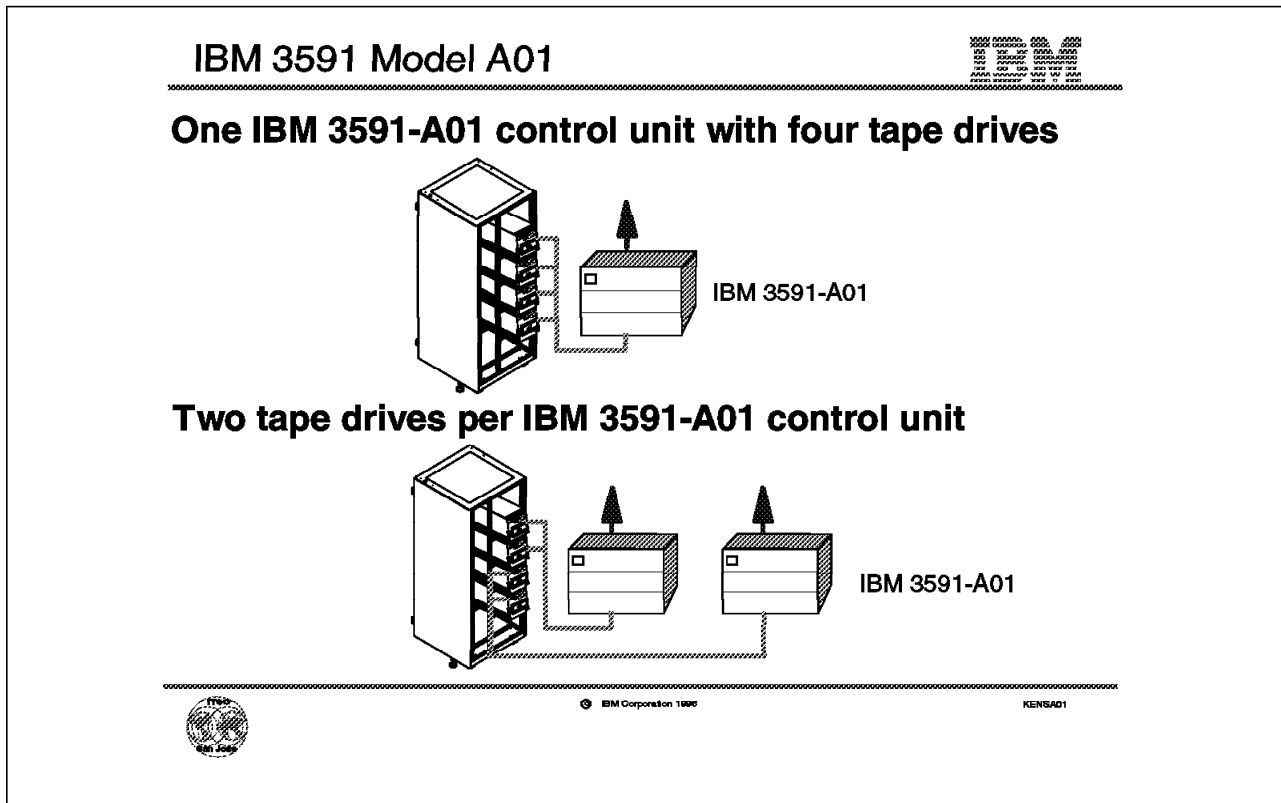
Figure 115. IBM 3591 Model A01

K.5 IBM 3591 Model A01

The primary function of the IBM 3591 Model A01 control unit (Figure 115) is to provide an interface between the SCSI-attached IBM 3590 Magstar drives and the host system ESCON channels. The IBM 3591-A01 ESCON control unit allows the operating system to communicate with the IBM 3590 Magstar drives as if they were IBM 3490E drives.

The IBM 3590-C12 supports attachment of one or two IBM 3591-A01. All four IBM 3590-B1A drives are attached through one SCSI interface to the IBM 3591-A01 in a one-control-unit configuration. Feature 5000 provides a free-standing enclosure for the IBM 3591-A01 that can be used instead of a rack.

When two IBM 3591-A01 control units are used, two IBM 3590-B1A drives are attached through one SCSI port. The first IBM 3591-A01 control unit and the other two IBM 3590-B1A drives are attached through another SCSI interface to the second IBM 3591-A01, as shown in Figure 115. The drives are not attached to both control units. The two-control-unit configuration can be used to improve throughput for certain applications, such as master-in, master-out applications.

The IBM 3591-A01 supports up to 64 logical paths and can be at a maximum channel distance of 43 km from the host.

The IBM 3591-A01 can, as previously announced, be mounted in a rack attaching up to four IBM 3590-B11/B1A drives.

Support for the IBM 3590-C12 Silo-compatible frame together with one or two IBM 3591-A01 ESCON control units is provided in the MVS/ESA operating environment. No new software is required because existing IBM 3490E tape applications also run on IBM 3590-C12.

Table 64 shows which software releases support the IBM 3590-B1A drives attached to an IBM 3591-A01 ESCON controller.

MVS Level	DFP		DFSMS		
	3.3.0	**3.3.2**	**1.1.0**	**1.2.0**	**1.3.0**
4.2.0	Yes	Yes			
4.2.2	Yes	Yes			
4.3.0	Yes	Yes	Yes	Yes	Yes
5.1.0	Yes	Yes	Yes	Yes	Yes
5.2.0			Yes	Yes	Yes
5.2.2			Yes	Yes	Yes

Table 64. IBM 3591-A01 Software Support

For more information on software support for the IBM 3591-A01 ESCON controller, see *Magstar and IBM 3590 High Performance Tape Subsystem: Multiplatform Implementation*.

Table 65 shows the physical specifications of the IBM 3591-A01 ESCON control unit.

Dimension	Specification
Height	381 mm (15.0 in.)
Width	482.6 mm (19 in.)
Depth (free-standing)	441.3 mm (17.4 in.)
Depth (installed)	533.4 (21 in.)[1]
Weight	40.8 kg (90 lb)

Table 65. IBM 3591-A01 Physical Characteristics

Notes:

 1. The installed depth includes the added length of the front cover and rear plug.

For more information on environmental specifications, see

 • *IBM 3590 Magstar High Performance Tape Subsystem Silo-Compatible Frame Model C12 Introduction, Planning, and User's Guide*.

For additional information about the IBM 3591 Model A01, see:

- *IBM 3591 Tape Control Unit Model A01 Introduction, Planning, and User′s Guide.*

K.5.1 IBM 3591-A01 Features

Table 66 shows the features for the IBM 3591-A01 ESCON control unit.

Table 66. IBM 3591-A01 Features	
Description	**Feature Code**
Remote support facility	2700
Remote support switch	2701
Remote support attachment	2702.
ESCON Adapter Card	3311
IBM 3591-A01 Floor-Standing Package	5000

- *Feature 2700*

  Feature 2700 attaches a customer-supplied modem for installation, operation, and remote diagnostic support. It should be ordered for the first IBM 3591-A01 in one location. Only one Feature 2700 should be specified for each site, because up to 14 IBM 3591-A01 units can use the same Remote Support Facility (RSF).

- *Feature 2701*

  Feature 2701 attaches to multiple IBM 3591-A01 ESCON control units to the Remote Support Facility (Feature 2700). It should be ordered for the second IBM 3591-A01 in one location. Only one Feature 2701 should be ordered for each customer site.

- *Feature 2702*

  Feature 2702 attaches to the Remote Support Facility (Feature 2700). It should be ordered for the third through fourteenth IBM 3591-A01 in one location. Only one Feature 2701 should be ordered for each site.

  Note: Each IBM 3591-A01 must specify either Feature 2700, Feature 2701, or Feature 2702. All are plant or field installable.

- *Feature 3311*

  An ESCON adapter card, Feature 3311, is required on all IBM 3591-A01 ESCON controllers; it provides an ESCON channel for attachment to a host processor ESCON channel or to a port of an IBM ESCON director. A SCSI adapter is included for attachment of IBM 3590-B1A drives on a SCSI bus. Only one Feature 3311 is needed for plant installation.

- *Feature 5000*

  Feature 5000 provides the hardware necessary to have the IBM 3591-A01 as a free-standing box, not requiring a rack.

ESCON cables are ordered with the IBM 3591-A01 ESCON control unit. For information on ordering ESCON cables, refer to:

- *IBM 3591 Tape Control Unit Model A01 Introduction, Planning, and User′s Guide.*

Allowed Device Combinations

HSC 1.2

IBM 3590	STK 4490	STK 4480
Yes	-	-
Yes	No	Yes
No	Yes	-

HSC 2.x

IBM 3590	STK SD-3	STK 9490	STK 4490	STK 4480
Yes	-	-	-	-
Yes	Yes	-	-	Yes
Yes	Yes	No	Yes	Yes
Yes	Yes	Yes	No	Yes
No	Yes	Yes	Yes	Yes

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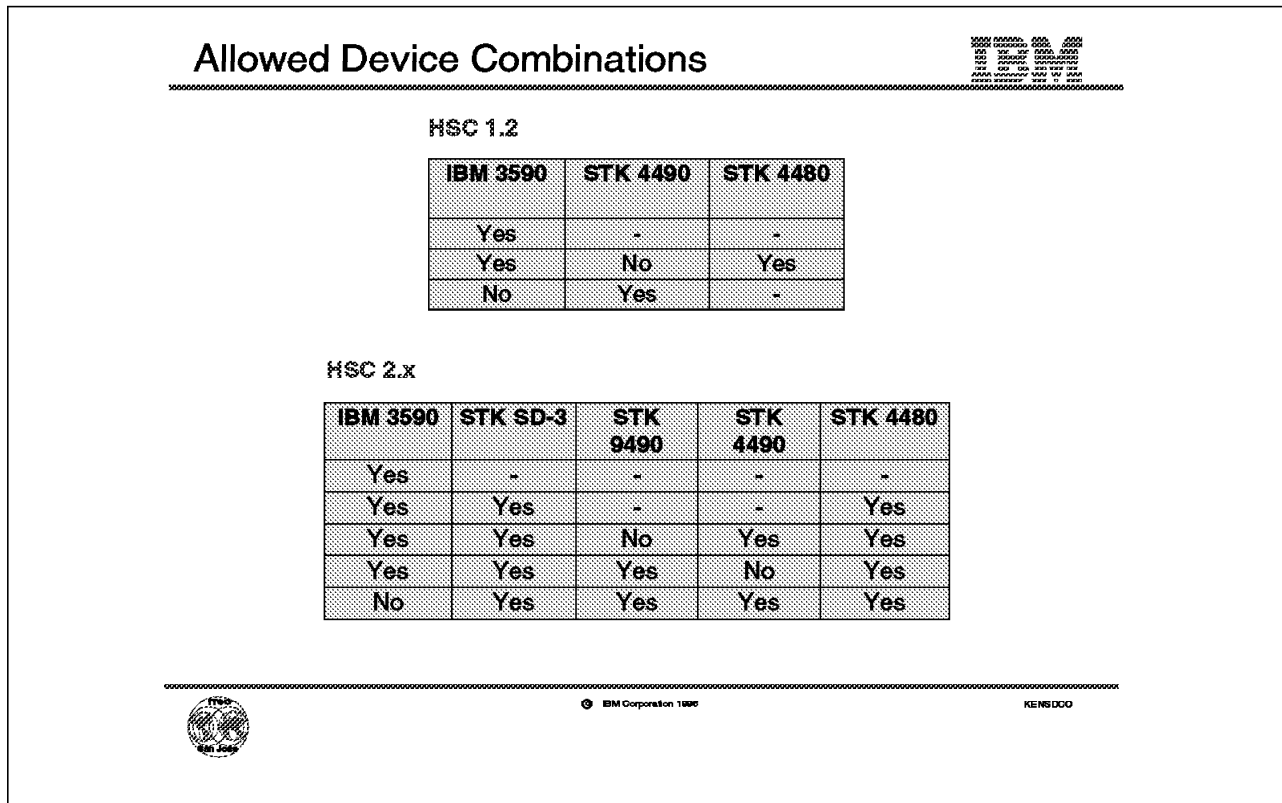
Figure 116. Allowed Device Combinations

K.6 Allowed Device Combinations

The IBM 3590-B1A drives in the IBM 3590-C12 frame are defined to the HSC as either StorageTek 4490 or StorageTek 9490 tape drives. For this reason, several requirements must be met when operating mixed devices in the StorageTek Automated Cartridge System under different StorageTek HSC levels:

- **HSC 1.2**

  The following tape device combinations are allowed when using 3590 drives in a StorageTek Automated Cartridge System under HSC 1.2:

  1. IBM 3590 only
  2. StorageTek 4480 (18-track) and IBM 3590

  Use explicit ranges of volume serial numbers for IBM 3590 media. The following volume attribute definitions are suggested to manage drive-media relationships:

  - One or more statements for IBM 3590 Data Cartridges to identify tapes as long media operated with 36-track recording technology.

  - One statement for IBM 3590 Cleaning Cartridges; the same media and recording technology attributes used for IBM 3590 Data Cartridges should be applied.

  - Additional statements as required to associate media for 4480 drives with 18-track recording technology.

  - A statement to designate a default recording technology. In a mixed configuration, do not specify the IBM 3590 media as the default.

Appendix K. IBM Magstar 3590 Silo-Compatible Tape Subsystem **317**

Esoteric unit names are used to steer allocation inside and outside the StorageTek Automated Cartridge System. More information on allocation is given in Section K.7, "Multi-ATL Scratch Tape Allocation" on page 319 and Section K.8, "Multi-ATL Specific Tape Allocation" on page 321.

- **HSC 2.x**

  The following tape device combinations are allowed when using 3590 drives in a StorageTek Automated Cartridge System under HSC 2.x:

  1. IBM 3590 only
  2. StorageTek 4480, SD-3 or both, plus and IBM 3590
  3. StorageTek 4480, SD-3 or both, plus StorageTek 4490 and IBM 3590
  4. StorageTek 4480, SD-3 or both, plus StorageTek 9490 and IBM 3590

  The IBM 3590 drives emulate StorageTek 4490 **or** 9490 drives, and cannot be introduced into the Automated Cartridge System if 4490 **and** 9490 tape drives are present.

  Use explicit ranges of VOLSERs for IBM 3590 media. The following volume attribute definitions are suggested to manage drive-media relationships:

  − One or more statements for IBM 3590 Data Cartridges to identify 3590 tapes as an unique media type associated exclusively with the recording technology of the model type they emulate (StorageTek 4490 or 9490).

  − One statement for IBM 3590 Cleaning Cartridges; the same media and recording technology attributes used for IBM 3590 Data Cartridges should be applied.

  − Additional statements as required to associate media for other drive types with their appropriate recording technology.

  − A statement to designate a default recording technology. In a mixed configuration do not specify the IBM 3590 media as the default.

  Unit attribute statements are needed to associate IBM 3590 drives with the model type they emulate. Esoteric unit names are used to steer allocation inside and outside the Automated Cartridge System. More information on allocation will be given in Section K.7, "Multi-ATL Scratch Tape Allocation" on page 319 and Section K.8, "Multi-ATL Specific Tape Allocation" on page 321.

For additional information on how to define devices and cartridges to HSC, see:

- *StorageTek Host Software Component (MVS/XA-ESA Implementation) System Programmers Guide, Release 1.2*, 4044266-2

- *StorageTek Host Software Component MVS System Programmers Guide, Release 2.0.1*, 112156401.
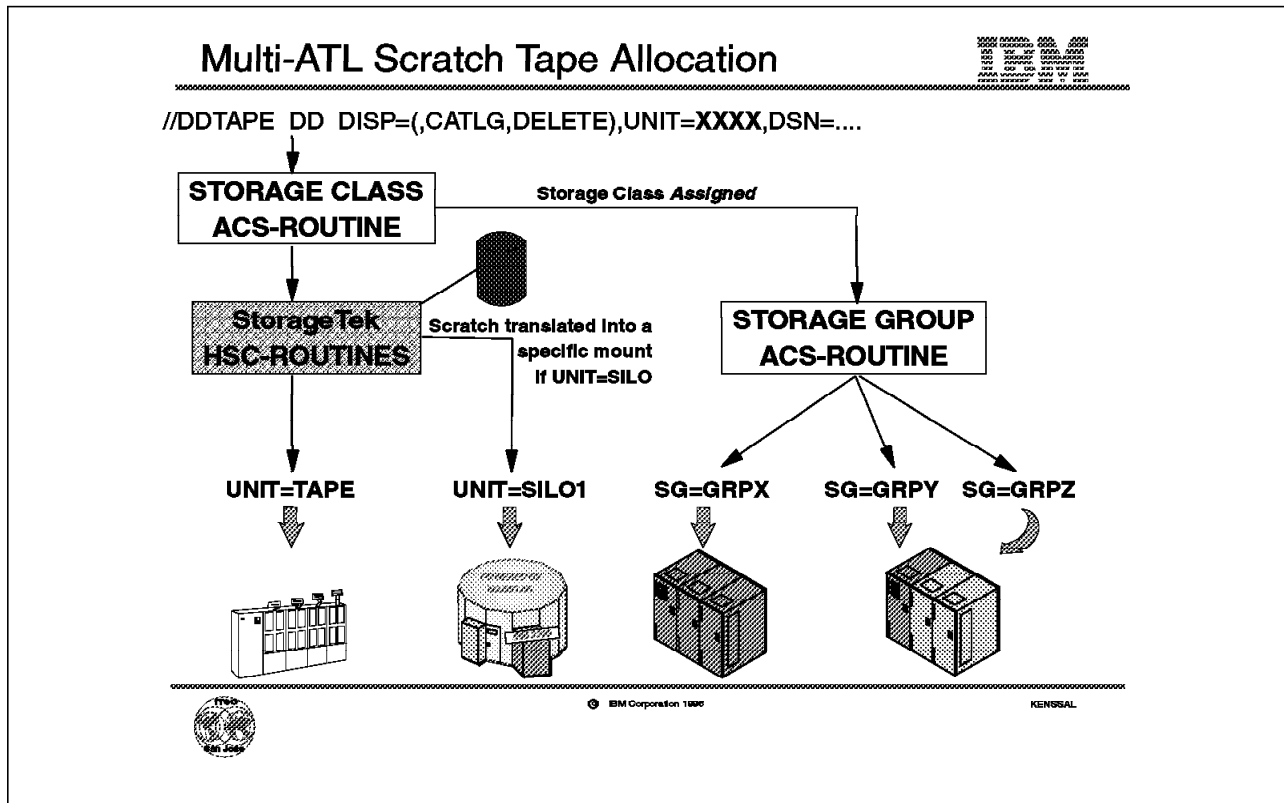
Figure 117. Multi-ATL Scratch Tape Allocation

K.7 Multi-ATL Scratch Tape Allocation

When you decide to install an IBM 3494 or IBM 3495 Automatic Tape Library Dataservers beside an already installed StorageTek Silo to make a smooth migration, you need to know which data is written on which cartridges in which library. This section describes how new tape allocations, that is scratch allocations, are handled in a multivendor tape library installation (Figure 117).

When the IBM Automatic Tape Library is installed, you define it to DFSMS/MVS and define groups for the tape volumes that will be system-managed storage groups. You also add some statements to the automatic class selection routines of DFSMS/MVS to direct new allocations to the correct tape storage groups. For more information on how to implement system managed tape, see:

 • *IBM 3495 Implementation Primer for MVS.*

When you define a JCL statement, requesting a scratch tape, the information is first passed to the DFSMS automatic class selection (ACS), routines. If the logic of the Storage Class ACS routine assigns a storage class to this request, the volume requested by this allocation will be system managed. The logic of the storage group ACS routine then assigns a storage group to this allocation. The storage group name is then used by MVS allocation to direct this scratch request to the library or libraries defined to host it. A scratch volume is selected by the Library Manager in the library selected.

If the storage class ACS routine does not assign a storage class to this request, it is not system managed, and is handled as a traditional scratch tape allocation.

After DFSMS, the StorageTek HSC routines will pick up this tape scratch allocation. If the allocation request is directed to an esoteric unit name defined for the tape drives in a Silo, the HSC software will select a scratch volume from the Control Data Set and turn this allocation into a specific allocation.

If the scratch allocation is for a unit-name not defined for a Silo, the allocation will go to some tape drive of the requested type outside the tape libraries. The operator is then requested to mount a scratch tape, if the scratch request could not be satisfied by a cartridge loader on the tape drive.
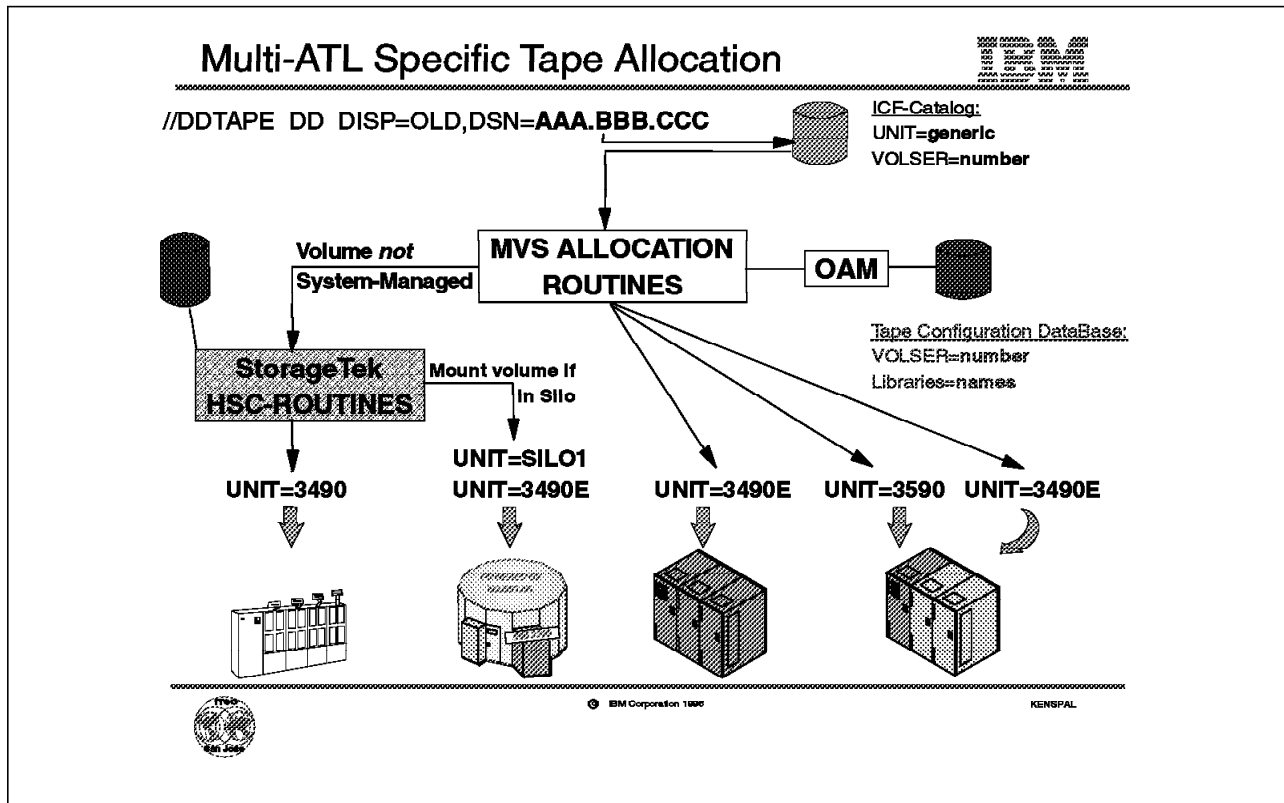
Figure 118. Multi-ATL Specific Tape Allocation

K.8 Multi-ATL Specific Tape Allocation

As described in Section K.7, "Multi-ATL Scratch Tape Allocation" on page 319 you can use system managed tape together with a StorageTek Silo for scratch requests, once data is created. This section describes how stored data can then be retrieved.

The most common request for data already stored in your system is to specify the name of the data set and specify disposition OLD or SHR, as shown in Figure 118. MVS routines extract the unit and volume information from the system catalog, if it is not specified in the allocation request.

MVS allocation together with the library support routines included in DFSMS Object Access Method (OAM) component and information in the Tape Configuration Database (TCDB), will see if this is a system-managed tape, and if so, in which library the tape is stored. For all system-managed tapes, MVS allocation directs the allocation to the drives installed in the library containing the tape.

If the tape is not system managed, the StorageTek HSC routines see the allocation request afterward. The HSC routines check the control data set to find in which Silo the tape is stored and which drives to use in order to mount the volume. The HSC routines update the allocation information and send the mount order to the robotics in the Silo.

If the tape is not system-managed, and is not defined in the HSC control data set, the allocation is directed to any stand-alone tape drive that can satisfy the

request. The operator is then requested to mount the tape on the allocated tape
drive.

Installation and Operation

Steps to install

1. Install PTFs
2. DFSMS/MVS IOGEN
3. Cleaning program
4. HSC updates
5. Hardware installation
6. Restart HSC

Operational procedures

- Manual mode
- Drive cleaning
- External labels
- Inventories and catalogs

© IBM Corporation 1996   KENSIAO
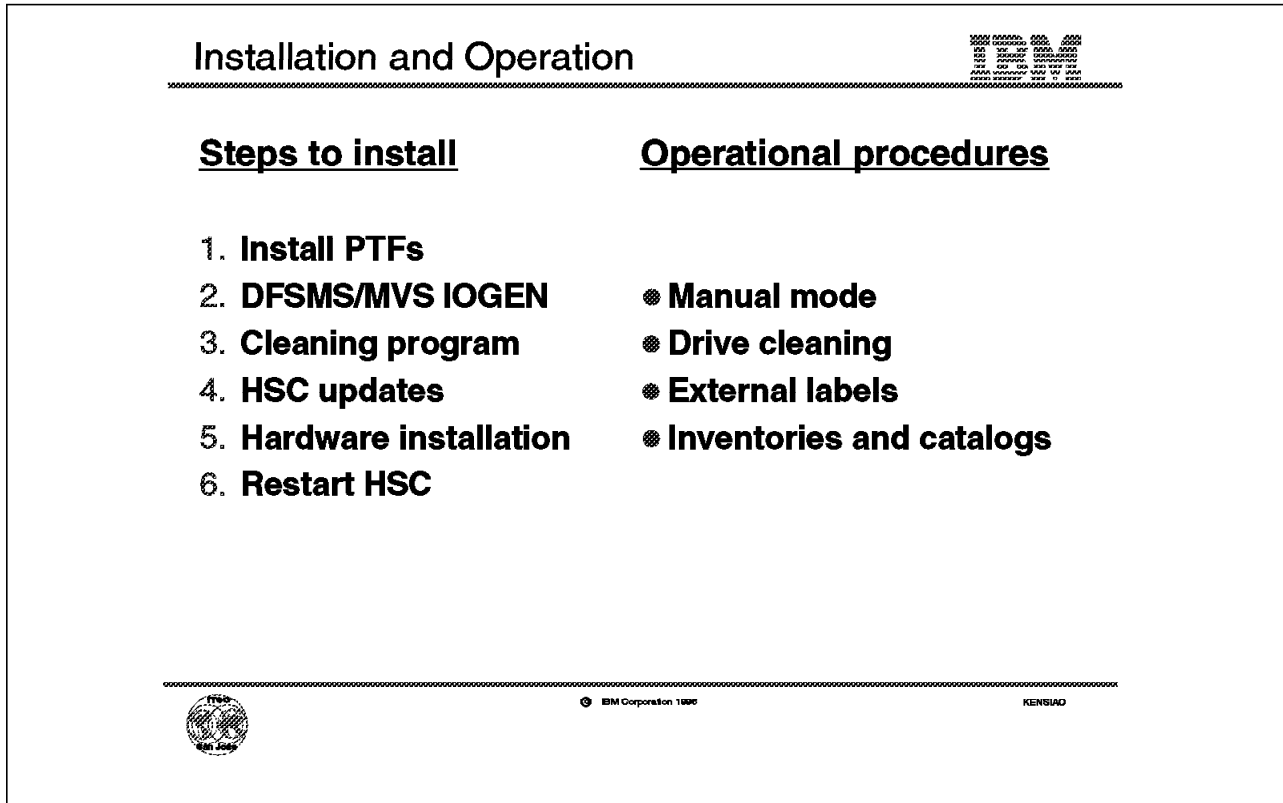
Figure 119. Installation and Operation

K.9 Installation and Operation

This section describes the installation of the IBM 3590-C12 and IBM 3591-A01 and explains operation procedures for the installation.

K.9.1 Installation

We describe six installation steps:

1. *Install PTFs*

   No new software releases are required to use the IBM 3590-C12. The IBM 3591-A01 ESCON controller emulates the IBM 3490E, and functions with existing system-level and application software. The software restrictions, limitations, and maintenance associated with IBM 3591-A01 apply to IBM 3590-C12.

   Table 67 on page 324 shows the Authorized Program Analysis Reports (APARs) that should be installed in order to exploit the full capacity of the IBM 3590 Magstar Cartridges.

Table 67. APARs	
Software Component	**APAR number**
DFHSM	OW20500
DFSMShsm	OW20192
DFDSS V2.5 (FMID HAE2502)	PN74583 PN77830
DFSMSdss 1.1.0, 1.2.0, 1.3.0 (FMID JDZ1120, HDZ11B0, HDZ11C0)	OW14835 OW16802

The APARs are described as followed:

- ***APARS OW20500 and OW20192***

  These allow the TAPE UTILIZATION to be specified with four digits, that is up to 9999. This function is needed in order to utilize the Magstar cartridge capacity if the tape utilization option is not NOLIMIT.

- ***APARS PN74583 and OW14835***

  These implement the new BUILDSA command and provide stand-alone support for restoration from a file that is not the first file on the tape.

- ***APARS PN77830 and OW16802***

  provide support for restoration from a file that is not the first file on the tape.

For more information refer to:

- *IBM 3591 Tape Control Unit Model A01 Introduction, Planning, and User's Guide*.

Your IBM installation planning representative and IBM marketing representative can determine the latest levels of software, microcode, and hardware available for your subsystem.

2. ***Install DFSMS/MVS IOGEN***

   Each IBM 3591-A01 ESCON control unit can have only one logical path specified to each host image. Specify four addresses for all IBM 3591-A01 control units, even if only two devices are attached.

   Specify the IBM 3590-B1A drives as 3490E devices.

   You also need to define an esoteric unit name for the devices as the StorageTek HSC uses it to direct the allocations.

3. ***Set Cleaning program***

   The drive cleaning mode is determined at installation; the service representative either enables or disables automatic cleaning for each IBM 3590-B1A drive. In automatic cleaning, a drive informs the Automated Cartridge System that cleaning is required; the Automated Cartridge System then delivers a cleaning cartridge to the drive. When automatic cleaning is disabled, the operator runs a job that mounts a cleaning cartridge (see Appendix L, "Sample Cleaning Program" on page 331 and Figure 121 on page 331).

   In a mixed-drive environment, automatic cleaning is performed for non-3590 drives, while cleaning jobs are scheduled at regular intervals for IBM 3590-B1A drives. If there are no mixed media in the Automated Cartridge

System and only 3590 drives are present, then automatic cleaning can be enabled.

Install the cleaning job and the cleaning program even if automatic cleaning is enabled. You find information on how to obtain the necessary MVS JCL and source code of the cleaning program in Appendix L, "Sample Cleaning Program" on page 331.

4. **Make HSC updates possible**

Define one or more statements for IBM 3590 Data Cartridges to identify tapes as:

- Long media operated with 36-track recording technology if HSC 1.2 is used

- A unique media type associated exclusively with the recording technology of the model type they emulate (4490 or 9490) if HSC 2.x is used.

Define one statement for IBM 3590 Cleaning Cartridges (prefix **MGC**); the same media and recording technology attributes used for IBM 3590 Data Cartridges should be applied.

The IBM 3590 Diagnostic Cartridges (prefix **DGC**) are not to be defined to the HSC.

Define unit attribute statements to associate IBM 3590-B1A drives with the model type they emulate.

Add statements as required to associate media for other drive types with their appropriate recording technology. Esoteric unit names are used to steer allocation inside and outside the StorageTek Automated Cartridge System.

Add one statement to designate a default recording technology. In a mixed configuration do not specify the IBM 3590 media as the default.

In an Automated Cartridge System that has only IBM 3590-B1A drive, the cleaning prefix for autocleaning can be set to **MGC**, and the drives themselves can be configured to request autocleaning. See also Section K.9.2, "Operation" on page 326.

5. **Install Hardware**

Relocate the cartridges in the LSM drive panel (top four and bottom four cartridge arrays) into which the IBM 3590-C12 is to be installed. This action is not necessary if you audit the LSM panel when the LSM is varied online.

Setup and verify the IBM 3590-C12 and IBM 3591-A01 before the LSM is taken offline. During installation, the LSM is offline for approximately 2 hours. Total installation time is 6.5 hours.

6. **Restart the Host Component Software**

After the hardware is installed:

a. Stop the HSC
b. Run the reconfiguration program.
c. Start HSC, with new LIBGEN and control statements in place.
d. Enter IBM 3590 Magstar data and cleaning cartridges into the LSM.

K.9.2 Operation

Four types of operation are described:

- *Manual mode*

  Varying the Library Storage Module (LSM) offline while the HSC is active allows you to enter the LSM and load cartridges manually into the IBM 3590-B1A drives. To load a cartridge manually, with the metal washer facing down, gently slide the cartridge into the drive′s loading slot until it stops. Then, push the cartridge into the drive; after you push the cartridge about 1.5 cm into the drive, the loading mechanism pulls the cartridge into the drive and completes the load.

  Some LSM actions can leave the drive unable to load a cartridge on the first mount after opening the LSM door. If pushing the cartridge into the drive fails to start the loader, leave the cartridge in the slot and select ALLOW LOAD on the display panel main menu. This should start the load. If it does not, remove the cartridge and repeat the manual loading procedure.

  In manual mode, the panel displays the cartridge VOLSER and LSM cell coordinates.

- *Drive cleaning*

  When IBM units are intermixed with StorageTek drives and media in an Automated Cartridge System, special measures are required to ensure that the IBM 3590 cleaning cartridges are mounted on IBM 3590-B1A drives, and StorageTek cleaning cartridges are mounted on StorageTek drives. Since a single cleaning prefix is available in support of all tape drives in an Automated Cartridge System, either IBM 3590-B1A drives or StorageTek drives, but not both, can be enabled for automatic cleaning.

  At installation, the IBM 3590-B1A drives are configured to either enable or disable autocleaning in the Automated Cartridge System environment. It is recommended that IBM 3590 drives be enabled for autocleaning only when they are in an Automated Cartridge System containing only IBM 3590 drives and media. In a mixed-drive or mixed media Automated Cartridge System, the IBM 3590 drives are configured so that they do not request cleaning. Autocleaning is enabled for the Automated Cartridge System, but will be requested only by the StorageTek drives. IBM 3590-B1A drive cleaning is accomplished through special, regularly scheduled jobs that request mounting of an IBM 3590 cleaning cartridge on a specific IBM 3590 drive. Typically, once every day is sufficient; customize your cleaning schedule based on drive usage.

  An example of a drive cleaning program and job control language can be obtained through FTP service. See Appendix L, "Sample Cleaning Program" on page 331 for more information. The cleaning program in that example receives a drive address as an input parameter. Defined constants in the program specify the cleaning prefix **MGC** and the high and low sequence numbers, 000-020, for the range of available cleaning cartridges. An additional defined constant specifies the maximum number of times that a cleaning cartridge should be used.

  The example program searches for a suitable cleaning cartridge by starting at the low end of the range and issuing an SLSXREQ QVOLUME command for the VOLSER. If a cartridge is encountered that has been mounted for the maximum number of times, it is ejected from the library by means of SLSXREQ EJECT.

The sample cleaning program and the JCL are optimized for cleaning drives successively rather than concurrently. Four job steps are used to request the cleaning of each IBM 3590 tape drive in the IBM 3590-C12 frame.

- *External labels*

Typically, J is the media identification character for the IBM Magstar 3590 High Performance Tape Cartridge and is in the seventh character position. For IBM 3590-C12, cartridges without a media identification character are recommended for the reasons listed below.

The following consequences occur when using J-labeled cartridges:

- Warning messages appear on the operator console when the library vision system encounters this unexpected J media type

- Redundant robotic movements occur during the physical mounting of J-labeled cartridges

- J-labeled cartridges cannot be entered temporarily into the Automated Cartridge System to satisfy specific mount requests.

You can use J-labeled cartridges that are already present, but be aware of the effects listed above. It is recommended that the J labels be removed.

When existing J-labeled cartridges associated with IBM automated or stand-alone libraries or drives are requested for temporary or permanent entry in an Automated Cartridge System, the J can be removed or temporarily concealed to allow the cartridge to be used without the effects listed above.

Note: IBM Magstar 3590 cartridges without J-labels can be used effectively in IBM tape libraries and distinguished from other media types.

- *Inventories and catalogs*.

Inventories and catalogs that associate 3590 datasets with emulated 3490E tape units require future modification when the 3590 device type is introduced as a native device.
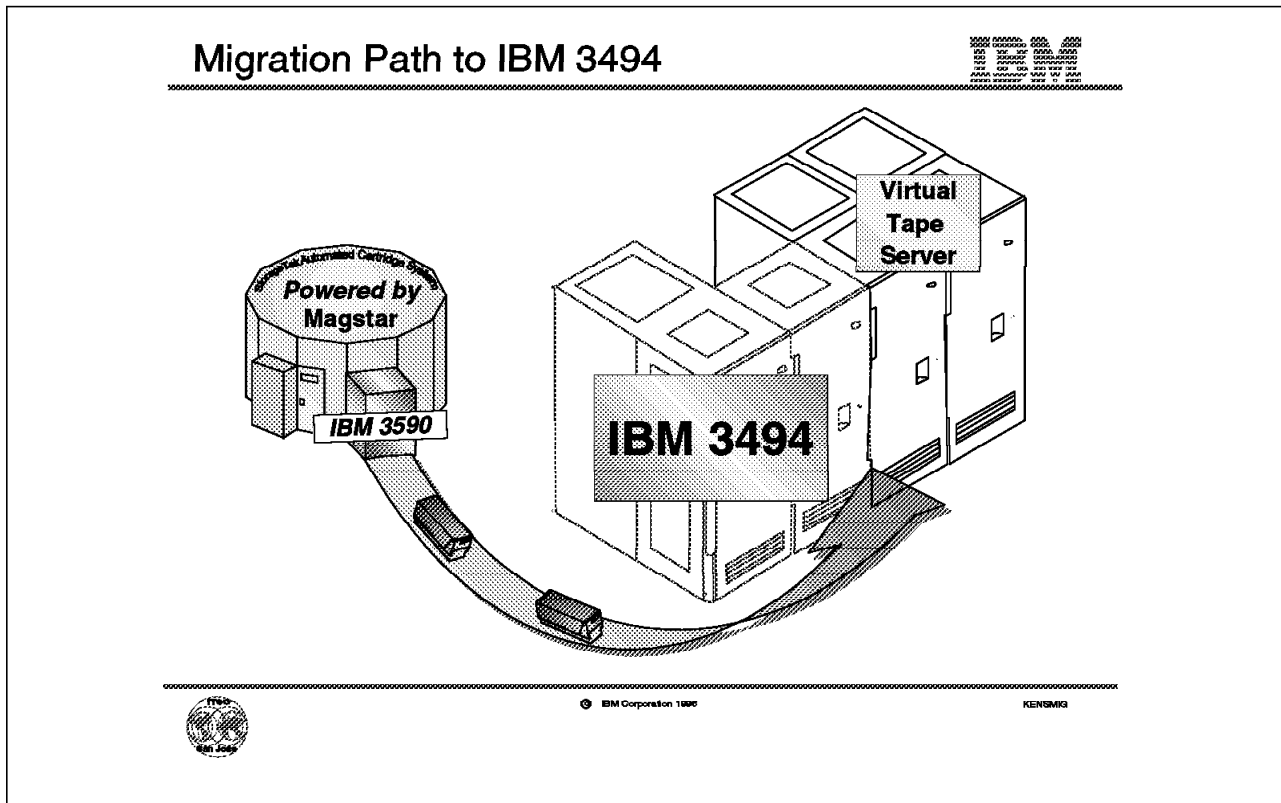
Figure 120. Migration Path to IBM 3494

K.10 Migration Path to IBM 3494

Even if attaching IBM 3590-B1A Magstar tape drives to a StorageTek Silo gives your installation many benefits, you may consider migrating to an IBM Automatic Tape Library. Such a migration will give your tape subsystem many additional functions and enhancements:

- **Investment protection**

  The investment you have already made in the IBM Magstar technology can now be further exploited by, for example, using the IBM 3590 drives and cartridges in a Virtual Tape Server to improve the utilization of already installed tape space.

- **Native IBM 3590 support**

  Moving the installed IBM 3590-B1A drives from the IBM 3590-C12 frame and installing them in an IBM 3494-L14, IBM 3494-D14, or IBM 3590-A14 frame gives you native 3590 support.

- **Reduced floor space**

  Installing the IBM 3590-C12 frame in your StorageTek Silo drastically reduces the number of cartridges needed, perhaps by as much as 50 times. For this reason, you may not need more than one or a few IBM 3494 frames to host all the cartridges in your installation.

- **System-managed tape**

  System-management of tape gives tape allocations all the benefits of system-managed dataset. DFSMS automatically stores your tape data,

application data, DFHSM/ADSM or other migrated data, interchange data, archive data, local backup copies, or disaster backups copies, in the appropriate tape library or the real or virtual tape server. It does all of this using the technology of your choice, IBM 3490, IBM 3490E (real or virtual), or IBM 3590, and selects the cartridge type defined in DFSMS without any JCL changes.

- *Virtual Tape Server*

  The IBM 3590-B1A drives can also be moved into an IBM 3494-D12 frame. Used together with an IBM 3494-B16 frame, the combination forms a IBM Virtual Tape Server. This configuration will give you all the benefits of virtual tape support described in this book.

Appendix L. Sample Cleaning Program

An example of a drive cleaning program, and job control language, can be obtained over the Internet through file transfer protocol (FTP) server. The name of the anonymous FTP server is **index.storsys.ibm.com**. Access the FTP server as you would an anonymous service. The driver and documentation are in directory **/devdrvr**.

In summary:

FTP site:	index.storsys.ibm.com
URL:	ftp://index.storsys.ibm.com/devdrvr
User:	anonymous
Password:	< e m a i l >
Files:	/devdrvr/3590_C12/README
	/devdrvr/3590_C12/clean_asm /* 370 assembler source example */

```
//CLEANMAG JOB 000,MSGLEVEL=(1,1)
//*
//CLNMAG   PROC DEVNO=
//CLNDRV   EXEC PGM=CLEANDRV,PARM=¢&DEVNO¢
//STEPLIB  DD   DISP=SHR,DSN=YOUR.LINKLIB * LIBRARY CONTAINING PROGRAM
//         DD   DISP=SHR,DSN=SLS.SLSLINK  * LIBRARY CONTAINING STK-CODE
//DUMDD    DD   UNIT=(&DEVNO,,DEFER)      * STOP OTHERS USING DRIVE
//         PEND
//*
//CLNE50   EXEC CLNMAG,DEVNO=E50
//CLNE51   EXEC CLNMAG,DEVNO=E51
//CLNE52   EXEC CLNMAG,DEVNO=E52
//CLNE53   EXEC CLNMAG,DEVNO=E53
//
```

Figure 121. JCL for Sample Cleaning Program

The sample program requires the device number of the tape drive to be cleaned as a parameter. The device number may be specified with three or four characters.

The return code from this program is:

104	Invalid input
108	Cleaner cartridge not available
R15 after SLSXREQ call	HSC not active
Value of SLXCMDRC	Mount of cleaner cartridge failed

Appendix M. Special Notices

This publication is intended to help customers and IBM technical professionals understand the IBM 3590 High Performance Tape Subsystem, IBM 3591 control unit, and its Magstar tape drive. The information in this publication is not intended as the specification for any programming interfaces that are provided by IBM 3590 High Performance Tape Subsystem and IBM 3591 control unit. See the PUBLICATIONS section for information about publications considered to be product documentation.

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RAMAC	RISC System/6000
RS/6000	S/370
S/390	S/390 Parallel Enterprise Server
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Appendix N. Related Publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this redbook.

N.1 International Technical Support Organization Publications

For information on ordering these ITSO publications see "How to Get ITSO Redbooks" on page 339.

- *Magstar and IBM 3590 High Performance Tape Subsystem Technical Guide*, GG24-2506

- *IBM Magstar Virtual Tape Server and Enhancements to Magstar: New Era in Tape*, SG24-4917

- *DFSMS/MVS Version 1 Release 3.0 Presentation Guide*, GG24-4391

- *Guide to Sharing and Partitioning IBM Automated Tape Library Dataservers*, SG24-4409

- *IBM 3495 Implementation Primer for MVS*, GG24-3987

N.2 Redbooks on CD-ROMs

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N.3 Other Publications

These publications are also relevant as further information sources:

- *IBM 3590 High Performance Tape Subsystem Introduction and Planning Guide*, GA32-0329

- *IBM 3590 High Performance Tape Subsystem User′s Guide*, GA32-0330

- *IBM 3590 High Performance Tape Subsystem Hardware Reference*, GA32-0331

- *IBM 3590 Magstar High Performance Tape Subsystem Silo-Compatible Frame Model C12 Introduction, Planning, and User's Guide*, GA32-0366.

- *IBM 3591 Tape Control Unit Model A01 Introduction, Planning, and User′s Guide*, GA32-0358

- *IBM 3490 Magnetic Tape Subsystem Models A01, A02, A10, A20, B02, B04, B20, B40 Hardware Reference,*, GA32-0127

- *IBM 3490 Magnetic Tape Subsystem Models C10, C11, C22, C1A, and C2A Hardware Reference*. GA32-0219

- *IBM 3494 Automated Tape Library Dataserver Introduction and Planning Guide*, GA32-0279

- *IBM 3494 Automated Tape Library Dataserver User's Guide: Media Library Device Driver for Application System/400*, GC35-0153

- *IBM 3495 Automated Tape Library Dataserver Introduction and Planning Guide*, GA32-0234

- *IBM SCSI Tape Drive, Medium Changer, and Library Device Drivers Installation and User's Guide*, GC35-0154

- *Adapters, Devices, and Cable Information*, SA23-2764

- *Enterprise Systems Connection (ESCON) Implementation Guide*, SG24-4662

- *IBM 9309 Rack Enclosure General Information and Site Preparation Guide*, GA24-4103.

- *Planning for Fiber Optic Channel Links*, GA23-0367

- *AS/400 Automated Tape Library Planning and Management Version 3*, SC41-3309

- *DFSMS/MVS Version 1 Release 3 Object Access Method Planning, Installation, and Administration Guide for Tape Libraries*, SC26-3051

- *ADSTAR Distributed Storage Manager Administrator's Guide*, SH35-0117

- *Basic Tape Library Support Version 1 Release 1 User's Guide and Reference*, SC26-7016

- *DFSMS/MVS Version 1 Release 3, DFSMShsm Storage Administration Reference*, SH21-1075

- *DFSMS/MVS Version 1 Release 3, DFSMShsm Storage Administration Guide*, SH21-1076

- *DFSMS/MVS Version 1 Release 3, DFSMShsm Implementation and Customization Guide*, SH21-1078

- *DFSMS/MVS Version 1 Release 3, DFSMShsm Diagnosis Guide*, LY27-9607

- *DFSMS/MVS Version 1 Release 3, DFSMSdss Storage Administration Guide*, SC26-4930

- *DFSMS/MVS Version 1 Release 2, Using the Volume Mount Analyzer*, SC26-4925

- *DFSMS/MVS Version 1 Release 3, Utilities*, SC26-4926

- *VM/ESA: CMS Application Development Guide*, SC24-5761

- *VM/ESA: CMS Command Reference*, SC24-5776

- *ADSTAR Distributed Storage Manager for MVS Administrator's Reference Version 2*, SH26-4040

- *ADSTAR Distributed Storage Manager for AIX Administrator's Guide Version 2*, SH35-0134

- *IBM Client Input Output/Sockets Version 2 Release 1 General Information*, GC23-3879

- *Backup Recovery Media Services/400 Version 3 Release 2*, SC41-3345

- *Backup Recovery Media Services/400 Version 3 Release 6*, SC41-4345

- *IBM Report/Data Archive and Retrieval System for OS/400, Version 3 Release 1 Installation and User's Guide*, SC26-7073

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