



IBM 3480 Magnetic Tape Subsystem Planning and Migration Guide

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GC35-0098-5

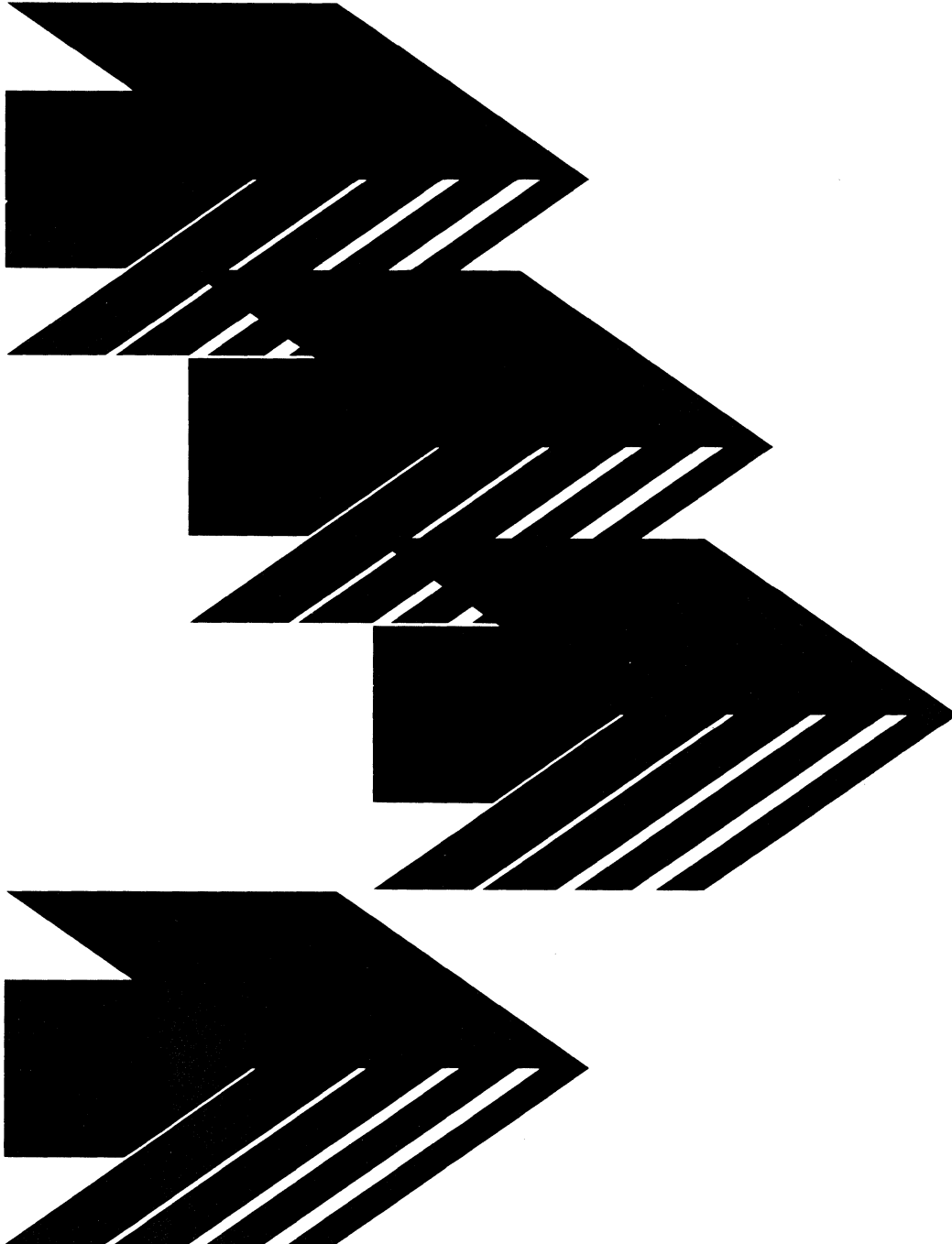




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| Sixth Edition (November 1987)

| This is a revision of and makes obsolete GC35-0098-4.

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Preface

This manual provides planning, installation, and migration information for the IBM 3480 Magnetic Tape Subsystem including: configurations, software support, application considerations, migration, and operations changes.

The manual can be used as a reference to:

- Understand the features of the 3480 subsystem
- Understand the prerequisites for a successful installation of the 3480 subsystem
- Educate planners, programmers, and users of the 3480 subsystem
- Develop each component of the 3480 migration plan
- Identify documentation and other resources pertinent to the 3480 installation.

This manual contains the following chapters:

- “Chapter 1. Introduction to the IBM 3480 Magnetic Tape Subsystem” is an overview of the 3480 subsystem including a brief description of the tape drives and control units, optional features, tape cartridge, and cartridge library.
- “Chapter 2. Planning for Installation” describes hardware migration such as control unit and tape drive configurations, channel attachments, and environmental considerations.
- “Chapter 3. Planning for Software Support” gives system software information, describes the various software environments in which the 3480 is supported, and includes SYSGEN and IOCP generation information. This chapter also explains the differences between full function support and 3420 compatibility mode.
- “Chapter 4. Planning for Application Changes” describes application-related topics, application software capabilities, and elements of the 3480 architecture, including precautions that may apply to some environments.
- “Chapter 5. Planning for Operations” describes the effect of the 3480 subsystem in the operations environment including: operational characteristics of the 3480 subsystem, the cartridge system tape, tape

drive message display, the cartridge library, and switching considerations.

- “Chapter 6. Performance Characteristics” describes the relationship of block sizes, channel speed, tape motion, and type of processor on the performance of the 3480. This chapter also describes the performance characteristics of a Data Facility Data Set Services (DFDSS) volume dump using the 3480.
- “Chapter 7. Data Migration” gives guidance for planning data migration from tape reels to the tape cartridge. It includes a description of tape library composition, library inventory and turnover, JCL conversion, and special tape file handling. Also included is a migration strategy with an example that lists the many components of a migration plan.
- “Appendix A. Checklist of General Installation Tasks” contains a sample checklist of installation tasks.
- “Appendix B. Interpreting Message Displays” explains the different types of messages that appear on the message display of the 3480 tape drive.

The last section of chapters 2 through 7 contains a planning checklist arranged according to the subject material of the chapter.

Related Publications

You may want to refer to the information presented in the publications listed below.

IBM 3480 Magnetic Tape Subsystem

- *IBM 3480 Magnetic Tape Subsystem Introduction*, GA32-0041
- *IBM 3480 Magnetic Tape Subsystem User's Reference*, GC35-0099
- *IBM 3480 Magnetic Tape Subsystem Reference: Channel Commands, Status and Sense Bytes, and Error Recovery Procedures*, GA32-0042
- *IBM 3480 Magnetic Tape Subsystem Operator's Guide*, GA32-0066
- *Care and Handling of the IBM Magnetic Tape Cartridge*, GA32-0047
- *IBM Input/Output Equipment: Installation Manual—Physical Planning for System/360, System/370, and 4300 Processors*, TNL GN22-2317 to GC22-7064
- *Tape and Cartridge Requirements for IBM Magnetic Tape Cartridge Drives*, GA32-0048.

MVS/Extended Architecture

- *MVS/Extended Architecture Checkpoint/Restart User's Guide*, GC26-4139
- *MVS/Extended Architecture System-Data Administration*, GC26-4149
- *MVS/Extended Architecture Data Administration Guide*, GC26-4140
- *MVS/Extended Architecture Data Administration: Macro Instruction Reference*, GC26-4141
- *MVS/Extended Architecture Magnetic Tape Labels and File Structure Administration*, GC26-4145
- *MVS/Extended Architecture Message Library: System Messages*, Volumes 1 and 2, GC28-1376, GC28-1377
- *MVS/Extended Architecture Message Library: System Codes*, GC28-1157
- *MVS/Extended Architecture MVS/System Product - JES 3 Version 2, MVS/System Product JES-2 Version 2, License Program 5665-291, 5740-XC6, Routing and Descriptor Codes*, GC28-1194
- *MVS/Extended Architecture Installation: System Generation*, GC26-4009
- *MVS/Extended Architecture Data Facility Product: General Information*, GC26-4142
- *MVS/Extended Architecture Conversion Notebook: MVS/System Product JES 2, License Program 5740-SC6; MVS/System Product JES 3, License Program 5665-291*, GC28-1143
- *MVS/Extended Architecture, MVS/System Product-JES 3 Version 2, MVS System Product-JES 2 Version 2, License Program 5665-291, 5740-SC6, Job Control Language*, GC28-1148
- *MVS/Extended Architecture MVS/System Product Version 2 5665-291, 5740-XC6, Initialization and Tuning*, GC28-1149
- *MVS/Extended Architecture, MVS/System Product Version 2—JES3, MVS/System Product Version 2—JES2, License Program 5665-291 5740-XC6, Supervisor Services and Macro Instructions*, GC28-1154
- *MVS/Extended Architecture MVS/System Product—JES3 Version 2 MVS/System Product—JES2 Version 2, License Program 5665-291, 5740-XC6, System Macros and Facilities*, Volumes 1 and 2, GC28-1150, GC28-1151
- *MVS/Extended Architecture, License Program 5665-291, 5740-XC6, System Modifications*, GC28-1152
- *MVS/Extended Architecture, MVS/System Product—JES3 Version 2, MVS/System Product—JES2 Version 2, 5665-291, 5740-XC6, System Management Facility*, GC28-1153

- *MVS/Extended Architecture, MVS/System Product—JES2 Version 2 5740-XC6 Operations: JES2 Commands*, SC23-0064
- *MVS/Extended Architecture, MVS/System Product JES2 Version 2, License Program 5740-XC6, Initialization and Tuning*, SC23-0065
- *MVS/Extended Architecture, MVS/System Product—JES3 Version 2, License Program 5665-291, Operations: JES3 Commands*, SC23-0063
- *MVS/Extended Architecture, MVS/System Product—JES3 Version 2, License Program 5665-291, Initialization and Tuning*, SC23-0059
- *MVS/Extended Architecture Debugging, MVS/System Product—JES3 Version 2, MVS/System Product—JES2 Version 2, 5665-291, 5740-XC6, Handbook*, Volumes 1 through 5, LC28-1164¹, LC28-1165, LC28-1166, LC28-1167, LC28-1168.

MVS/370

- *MVS/370 Data Facility Product, 5665-295, Checkpoint/Restart*, GC26-4054
- *MVS/370 Data Facility Product, 5665-295, System Generation Reference*, GC26-4063
- *MVS/370 Data Facility Product, 5665-295 Data Management Macro Instructions*, GC26-4057
- *MVS/370 Data Management Services, Data Facility Product 5665-295*, GC26-4058
- *MVS/370 Data Facility Product, 5665-295, Data Management*, GC26-4056
- *MVS/370 Magnetic Tape Labels and File Structure, 5665-295*, GC26-4064
- *MVS/370 Message Library: System Messages*, Volumes 1 and 2, GC28-1374, GC28-1375
- *OS/VS Message Library: VS2 System Codes*, GC38-1008
- *OS/VS Message Library: VS2 Routing and Descriptor Codes*, GC38-1102
- *MVS/370 Installation: System Generation*, GC26-4166
- *MVS JCL MVS/System Product—JES2 Release 3.3, MVS/System Product—JES3 Release 3.1, License Program 5740-XYX, -XYN*, GC28-1300
- *MVS/370 Data Facility Product: General Information*, GC26-4160

¹ All five volumes may be ordered under one order number, LBOF-1015.

- *OS/VS2 System Programming Library: Debugging Handbook, MVS/System Products, License Program 5740-XYN, -XYS Volumes 1 through 3*, GC28-1047, GC28-1048, GC28-1049
- *OS/VS2 MVS Supervisor Services and Macro Instructions*, GC28-0683
- *OS/VS2 MVS System Programming Library: Initialization and Tuning Guide*, GC28-0681
- *OS/VS2 MVS System Programming Library: Supervisor*, GC28-0628
- *OS/VS2 MVS System Programming Library: System Management Facilities*, GC28-1030.

VM/SP and VM/HPO

- *Virtual Machine/System Product Planning Guide and Reference*, SC19-6201
- *Virtual Machine/System Product High Performance Option Planning Guide and Reference*, SC19-6223.

VSE/SP

- *IBM Virtual Storage Extended/System Package Hardware and Software Support Extensions, Version 2 Release 1*, SC33-6184.

Other Related Publications

- *OS/VS Sort/Merge Programmer's Guide Program Product 5740-SM1*, SC33-4035
- *Data Facility Hierarchical Storage Manager: Version 2 Release 3.0 Installation and Customization Guide*, SH35-0084
- *Data Facility Hierarchical Storage Manager: Version 2 Release 3.0 System Programmer's Guide*, SH35-0085
- *Data Facility Hierarchical Storage Manager: Version 2 Release 3.0 System Programmer's Reference*, SH35-0083
- *OS/VS2 MVS and Stand-Alone Versions: Input/Output Configuration Program, License Program 5740-XYN, -XYS, User's Guide and Reference*, GC28-1027
- *4381 I/O Configuration Program User's Guide*, GC24-3964
- *Environmental Recording Editing and Printing (EREP) Program*, GC28-1178

- *Data Facility/Data Set Services, License Program 5740-UT3, User Guide and Reference, SC26-3949*
- *IBM Input/Output Equipment: Installation Manual—Physical Planning for System/360, System/370, and 4300 Processors, GC22-7064*
- *IBM System/370 Installation Manual: Physical Planning, GC22-7004.*

Contents

Chapter 1. Introduction to the IBM 3480 Magnetic Tape Subsystem	1
Tape Subsystem Overview	1
Control Unit	2
Tape Unit	2
Tape Cartridge	3
Abilities of the IBM 3480 Magnetic Tape Subsystem	4
Read/Write Buffering	5
Assigning the 3480 to a Processor	5
Message Display	6
Automatic Tape Threading	6
Integrated File Protector	6
High-Speed Search	6
Tape Write Immediate Mode	6
Tape Synchronous Mode	6
Software Support Compatibility with Most 3420 Programs	7
Special Features	8
Additional Channel Adapters	8
Dual Control Unit Communications Coupler Feature	9
Dual Communications	9
Automatic Cartridge Loader Feature	9
Library Storage Units	10
Chapter 2. Planning for Installation	11
Attaching the 3480 to a Processor	11
3480 Tape Subsystem Configurations	11
Single Control Unit	11
Dual Control Units	12
Configuration Examples	12
Attaching Channels	14
Determining Channel Cable Lengths	14
Sharing a Channel Between the 3480 and a Direct Access Device	15
Automatic Cartridge Loader	15
Environmental Considerations	16
Attaching Early-Level Machines to Newer-Level Machines	17
Configuration/Physical Planning Tasks	17
Chapter 3. Planning for Software Support	19
3480 MVS Software Support Modes	19
Full Function Mode	19
3420 Compatibility Mode	20
Full Function vs 3420 Compatibility	20
Selecting System Software Combinations	21
Requirements for MVS/Extended Architecture Users	22
Requirements for MVS/370 Users	22

JES/BCP Combinations	23
Requirements for Other IBM MVS Products	23
Software Support for the Automatic Cartridge Loader Feature	24
Generating and Initializing an MVS System	27
Performing an I/O Generation	27
IOCP Generation	32
JES Initialization	34
Automatic Cartridge Loader Feature Considerations	36
Catalog Considerations	40
Adding the 3480 Magnetic Tape Subsystem to DFHSM	40
Converting from Compatibility Mode to Full Function Mode	41
Sharing the 3480 in a Multisystem Environment	42
3420 Compatibility Mode	42
Full Function Mode	43
Mixed Mode	43
Planning for VM Software Support	44
Planning for VSE/SP Software Support	44
Checklist of Software Planning Tasks	44
Chapter 4. Planning for Application Changes	47
Verifying That the Data Migrated	47
Coding an Application in MVS Full Function Mode	48
Special Application Considerations	49
Sense Bytes	49
Data Chaining	49
Update in Place	49
Checkpoint/Restart	49
Write Validity Check	50
Tape Synchronous Mode	50
Device-Type Dependencies	50
Tape IPL	51
Generation Data Groups	51
Forward Space File	51
Data Security Erase	51
Execute Channel Program (EXCP) Programming	51
Checklist of Application Planning Tasks	52
Chapter 5. Planning for Operations	53
New Architecture Features	53
Maintenance and Drive Cleaning Operations	53
File Protect Selector	54
Care and Handling of Cartridges	55
Message Displays	55
3480 Partitioning	59
Switching Considerations	59
Checklist of Operations Planning Tasks	60
Chapter 6. Performance Characteristics	61
Effect of Simultaneous Drive Operations	61
The Effects of Buffering	62
Buffered Write Mode	62
Buffered Read Mode	63
Effect of the Block Size	63
Comparison of the Cartridge and Reel Capacities	63

Tape Subsystem Performance Comparison	64
Chapter 7. Data Migration	69
Analyzing Existing Library Characteristics	70
Determining the Library Composition	70
Taking a Library Inventory	72
Determining the Rate of the Library Turnover	73
Selecting Alternative Conversion Methods	76
Developing a Data Migration Strategy	76
Planning for the Requirements for Tape Drives	77
Scheduling the Migration	78
Determining Data Dependencies	79
Moving Data as Part of Regularly Scheduled Work	80
Migrating Unscheduled Work	81
Special Considerations	81
Generation Data Group (GDG)	81
Multifile Volumes	81
Multivolume Files	81
Block Sizes	81
Sample Migration Plan	81
Data Migration Planning Tasks	87
Appendix A. Checklist of Installation Tasks	89
Configuration/Physical Planning Tasks	89
Software Planning Tasks	90
Application Planning Tasks	91
Operations Planning Tasks	91
Data Migration Planning Tasks	92
Appendix B. Interpreting the Message Displays	93
Software Created Messages	93
Mount and Demount Messages	93
Application Program Message	95
Messages during OPEN/CLOSE/EOV and Checkpoint/Restart	95
Hardware-Created Messages	97
Hardware Error Messages	98
Example of the Message Display when Processing a Job	99
Glossary	101
Index	105



Figures

1.	Tape Cartridge	4
2.	3480 Tape Drive with the Automatic Cartridge Loader Feature	10
3.	Minimum 3480 Subsystem Configuration	12
4.	Typical 3480 Subsystem Configuration	12
5.	Maximum 3480 Subsystem Configuration	13
6.	Example of How to Define an Esoteric Name	28
7.	IODEVICE Macro Parameter Values—Magnetic Tape Units	30
8.	IODEVICE Macro FEATURE Parameter Values	30
9.	System Generation Parameters	31
10.	IOCP Generation for MVS/SP	33
11.	IOCP Generation for MVS/XA	34
12.	JES3 Initialization Statements for Full Function	35
13.	JES3 Initialization Statements for 3420 Compatibility Mode	36
14.	Partitioning between Systems	43
15.	File Protect Selector	55
16.	Tape Drive Message Display	57
17.	Message Display Example	58
18.	Comparison of Reel and Cartridge Capacities	64
19.	3480 Model A22 Subsystem Effective Data Rate Comparison	66
20.	3480 Model A11 Subsystem Effective Data Rate Comparison	67
21.	Tape Media Classifications	70
22.	Common Tape Categories and Their Characteristics	71
23.	Library Composition Example	73
24.	Cumulative Tape Turnover in Normal Processing	74
25.	Library Migration Schedule	75
26.	JCL Analysis	79
27.	Sample Worksheet of Scheduled Workload Analysis	80
28.	Cartridge Requirements for Tape Categories	82
29.	Cartridge Migration vs Actual Library Turnover	83
30.	Configuration Capability	85
31.	Example of Equipment Install/Removal Schedule	86
32.	Example of Cartridge Migration Schedule	86
33.	Message Display Sequence during Tape Processing.	99



Summary of Amendments

IBM 3480 Magnetic Tape Subsystem Planning and Migration Guide

Release GC35-0098-5, November 1987

This edition adds information about changes to:

- MVS/BCP Scheduler Allocation
- JES3
- Automatic Cartridge Loader operations
- Operating system support.

This edition includes changes to correct errors or omissions in the previous edition.

Release GC35-0098-4, January 1987

This edition adds information on the 1-megabyte buffer, changes the maximum data block size that can be processed in buffered mode, and adds VM/SP and VM/HPO software support information.

There are also miscellaneous changes to correct errors or omissions in the previous edition.

Release GC35-0098-3, September 1986

This edition adds information on the 3480 Model A11 Control Unit and Model B11 Tape Unit, including:

- The Model B11 nominal data rate
- Field upgrading from Model A11 to A22 and B11 to B22

- The Dual Communications feature to enable dual-control-unit communications between Model A11 control units
- Subsystem configurations
- The effective data rate for 3480 Models A11/B11 compared to 3480 Models A22/B22, 3420-6, and 3420-8.

There are also miscellaneous changes to correct errors or omissions in the previous edition.

Release GC35-0098-2, June 1986

This edition adds information on the Automatic Cartridge Loader feature, including:

- A description of the loader and its three operating modes
- Software support for the loader
- Information on volume allocation in JES3 and non-JES3 environments.

There are also miscellaneous changes to correct errors or omissions in the previous edition.

Release GC35-0099-1, October 1985

This edition adds information about attaching early-level machines to newer-level machines.

There are also miscellaneous changes to correct errors or omissions in the previous edition.



IBM 3480 Magnetic Tape Subsystem



Chapter 1. Introduction to the IBM 3480 Magnetic Tape Subsystem

Tape Subsystem Overview

The IBM 3480 Magnetic Tape Subsystem consists of a buffered, microprocessor-driven control unit, Model A11 or A22, and a compact tape unit, Model B11 or B22. Each tape unit contains two microprocessor-controlled tape drives that use a cartridge-enclosed magnetic tape. It is enhanced by a specially designed cartridge storage system.

The 3480 subsystem has the following characteristics:

- A compact design with front loading for easy operation.
- A 1/2-inch, 18-track, high-density tape that is enclosed in a compact cartridge for greater protection and automatic threading.
- A tape drive that moves the tape with precision under microprocessor control without the need for capstans or vacuum columns.
- A high-speed search capability that allows a program to position a tape to a specific block at high speed and without constant processor or control unit supervision.
- A message display on each tape drive to present MVS software-generated messages and subsystem status information to the operator.
- A microprocessor-driven control unit, containing a data buffer that allows data transfer of up to 3 megabytes per second. The data buffer operates simultaneous with and independent of tape data flow.
- Reduced physical complexity. The 3480 subsystem is simple to operate and easy to load and unload.
- Equipment that permits the use of advanced service tools and techniques to increase availability.
- Expanded error correction and state-of-the-art recording technology to improve the reliability of the recorded data.

- A substantial reduction in power and cooling requirements compared to previous IBM tape subsystems.

Control Unit

The IBM 3480 Model A11 and A22 Control Units contain the logic for interpreting channel commands, controlling tape drives, and managing buffer operations. Each control unit contains a buffer that helps maintain data rates by masking mechanical motion. The buffer space is distributed among the attached active drives under internal buffer management control. The subsystem operator panel, containing the subsystem power on/off switch and channel attachment controls, is located in the IBM 3480 control unit.

During normal operations, data is transferred at channel rates directly into or out of the buffer, and the data flow is managed by a microprocessor within the control unit. Because the processor does not have to wait for the tape drive to respond to read or write commands, the use of the channel can be improved.

The dimensions of the control unit are:

Height 98.8 cm (39.5 in)
Width 65.0 cm (26 in)
Depth 73.8 cm (29.5 in).

Model A11 control units can be field upgraded to a Model A22 control units.

Selecting a Language Option

You can select a language option other than English when the 3480 Control Unit is ordered. The language you choose is only for hardware-generated messages on the 3480 message display. If you want the messages generated by the software to be in a language other than English, see *IBM 3480 Magnetic Tape Subsystem User's Reference*, "Modifying MSGDISP for Other Languages" for further information.

Tape Unit

The IBM 3480 Model B11 and B22 Tape Units contain two compact, self-threading, reel-to-reel tape drives that use a tape cartridge. The tape unit contains the mechanical and electronic parts required to support the tape drives. A mechanical assembly within each drive moves and threads the tape. A microprocessor within each tape drive controls reading, writing, and tape motion. No capstans or vacuum columns are used. A thin film read/write head records data on 18 tracks.

The characteristics of the tape unit are:

- An instantaneous data rate of 1.5 megabytes per second for Model B11
- An instantaneous data rate of 3.0 megabytes per second for Model B22

as before

- A data density of approximately 38,000 bytes per inch
- A load/unload time of 5 to 10 seconds

The load/unload time on a drive with the Automatic Cartridge Loader, including one index cycle, is approximately 15 seconds.

- A rewind time of 48 seconds (full cartridge)
- Dimensions of the tape unit are:

Height 98.8 cm (39.5 in)
 Width 50.0 cm (20 in) (2 drives)
 Depth 73.8 cm (29.5 in).

A message display that can be rotated is mounted on top of each tape drive. The message display shows drive status, mount messages, error information, and other action information sent by the drive, the control unit, a system control program, or an application program.

Model B11 tape units can be field upgraded to Model B22 tape units.

Tape Cartridge

The subsystem uses a chromium dioxide, particle-based, 1/2-inch tape. The chromium dioxide coating permits higher bit densities and better signal output than the iron oxide coatings used in the past. This results in greater data capacity and improved data reliability. The 1/2-inch tape is contained in a plastic cartridge (approximately 100 mm by 125 mm by 25 mm (4 inches by 5 inches by 1 inch)) for ease of use, reduced contamination, and protection from physical damage (see Figure 1 on page 4). The tape is threaded automatically when loaded, reducing handling and saving operator time. A plastic leader block is attached to the beginning of the tape for tape drive loading.

There are no reflective markers on the tape. Beginning-of-tape (BOT) and end-of-tape (EOT) positions are defined as specific length relationships between the feed and take-up spools.

The file-protect mechanism for the tape is a thumbwheel selector integrated as part of the rear of the cartridge.

The cartridge has two recessed areas for external labels: one on the front edge or spine (for the volume serial number) and one on the top.

The approximate capacity of the 3480 cartridge, written in 24K byte (K = 1,024) blocks, is 200 megabytes. A standard 3420-type, 262.5 mm (10.5 inch), 727 meter (2400 feet) reel at 6250 bpi with 24K byte blocks, has a capacity of approximately 165 megabytes.

see p. 64

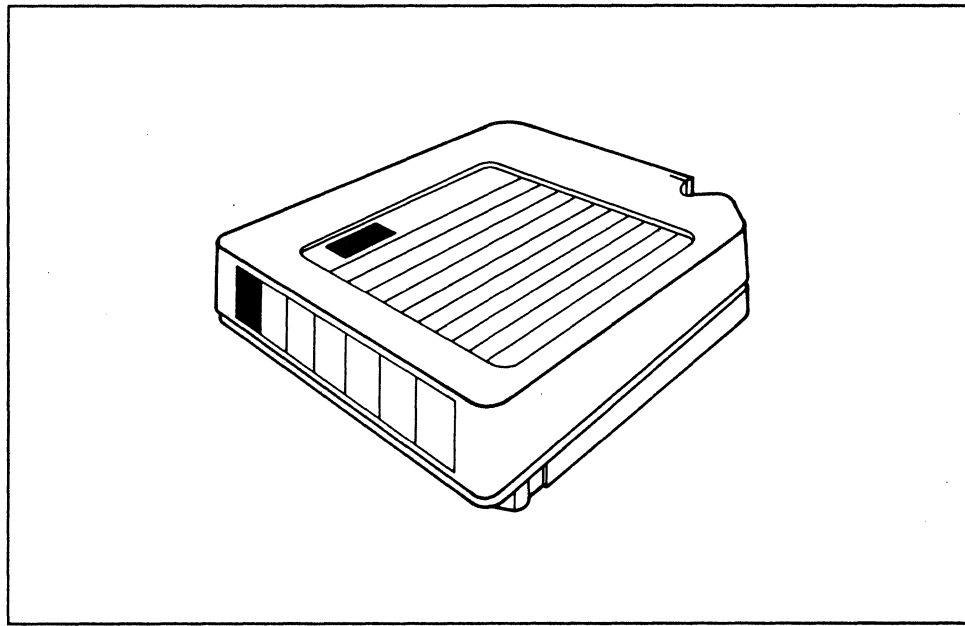


Figure 1. Tape Cartridge

Abilities of the IBM 3480 Magnetic Tape Subsystem

The 3480 subsystem includes the following abilities:

- Buffered read and write operations
- Drive assignment to a processor
- Message display on each tape drive
- Automatic tape threading
- Integrated file protector
- High-speed search
- Tape write immediate (start and stop) mode
- Tape synchronous mode (for data blocks over 102,417 bytes)
- Software support compatibility with most 3420 programs.

Read/Write Buffering

The control unit contains a storage area, shared by all drives, to temporarily store read and write data as it moves to or from the processor and to mask many of the effects of tape motion from the channel. With the 3420, tape motion started and stopped before and after every I/O request. The 3480 control unit buffer allows a drive to read or write blocks for several I/O requests in a single tape motion cycle.

With buffer storage, the subsystem processes data without requiring the full-time connection to a channel path. Data transfer between the buffer and a channel can occur at the same time with data transfer between the buffer and a drive.

The control unit manages the buffer, which is divided into eight segments. The control unit can give up to two buffer segments to each addressed drive. Whether a drive is given one or two buffer segments depends on I/O activity and data block size. The control unit does not give buffer segments to a drive until the drive has been addressed by a channel program.

If the control unit must control more than eight tape drives (for example, if there are two interconnected control units in the subsystem and one is offline), buffer segments can be taken away from one or more tape drives and given to those tape drives that have none. The choice of segments to take away depends on the level of tape drive activity using a least-recently-used algorithm. Some tape drives may not get any buffer segments until a buffer segment becomes available.

Assigning the 3480 to a Processor

The 3480 subsystem can be attached to more than one processor. See "Additional Channel Adapters" on page 8. Assign and Unassign commands control the sharing (partitioning) of individual tape drives among processors under the VM/SP Release 4 (and later) and MVS software.

On earlier tape subsystems, assignment of tape drives to a processor was performed by manually operated switches in conjunction with operator commands. Manual switches are not used in the 3480 subsystem because of the large number of switches that would be required to accommodate all the possible combinations of eight drives and four channels.

With the 3480 subsystem, a tape drive can be assigned to or unassigned from a specific processor by issuing a channel command. Under MVS/SP or MVS/XA non-JES3-managed systems, the operator uses the VARY command to assign or unassign a tape drive; under JES3-managed systems, the operator uses the *VARY command.

Message Display

The message display is an 8-character LED (light emitting diode) electronic display that is part of each tape drive operator panel. Display messages can be initiated by the drive microprocessor, the control unit, application programs, or the processor operating system.

Automatic Tape Threading

The cartridge is a compact container that holds the 1/2-inch tape and prevents operator and other external contact with the tape. A plastic leader block is attached to the end of the tape. When the cartridge is inserted into the drive, the drive takes up the leader block and the tape is automatically wound onto the take-up reel.

Integrated File Protector

The cartridge contains an integrated thumbwheel selector on the rear edge that can be set in either a file protected or unprotected position. The integrated file protector prevents loss or drop-out of a write-enable ring.

High-Speed Search

Under MVS software, high-speed search allows the drive to find a specific tape block quickly. During processing of a Locate Block command, the control unit can disconnect from the channel while the tape drive searches at twice the speed of a normal Read or Write command until it nears the requested location. Then the tape drive, control unit, and channel are connected again and the Locate Block command completes at normal speed. High-speed search allows the channel to service other I/O requests while the Locate Block command is processing.

Tape Write Immediate Mode

Tape Write Immediate Mode is used for those applications that require data verification each time a block is physically written to tape. System connection is maintained until the data has been physically written to tape and a read-back-check has been performed by the microprogram in the control unit. Tape Write Immediate is specified by the write validity check option in JCL. This mode of operation reduces subsystem performance.

Tape Synchronous Mode

Prior to Release 24 of the microprogram, the 3480 subsystem does not support tape synchronous mode.

The largest data block size that can be contained in the control unit buffer in all models of the 3480 family is 102,417 bytes when reading or writing.

The following table defines the specific capacity that can be held in the buffer before invoking Tape Synchronous mode in each control unit.

Control Unit (Buffer Size)	Maximum Bytes Buffered Write	Maximum Bytes Buffered Read
A11 (512K-bytes)	102,426	102,417
A22 (1-megabyte)	204,826	204,813

When the control unit receives a block of data that is too large for normal control unit error recovery to take place, the control unit selects the tape synchronous mode of operation, which passes error recovery responsibility to the controlling computer. In tape synchronous mode, the buffer is used only as a conduit between the tape drive and the channel. Because the data is read or written at the tape drive without buffering, the channel should have a data rate at least as fast as the tape drive data rate to prevent overrun errors. Note that a control unit attached to a channel with a data rate slower than the drive can write slightly larger data blocks in buffered mode than it can read without invoking tape synchronous mode.

Software Support Compatibility with Most 3420 Programs

Under certain levels of MVS/SP and MVS/XA, programming to support the 3480 subsystem is provided in two modes. Both modes are designed to be compatible with application programming for IBM 3420 tape drives, and the differences are based on the level of processor support chosen. The way the devices are defined during system generation determines the mode of operation. The two modes are:

- 3420 compatibility mode is a minimum device support level for the 3480 and excludes some of the abilities of the 3480 because their support is either not installed or not called by a user.
- Full function mode supports all of the abilities of the subsystem. This mode requires that the programming enhancements contained in all processor support components have been installed and are called.

Changes to JCL are required to access the device type and need be performed only once if code compatibility is chosen as the support mode. "Chapter 3. Planning for Software Support" on page 19 describes reasons for selecting one support level over another.

Other operating systems support only some of the 3480 functions. The following table summarizes those functions that are supported.

3480 Functions Supported	Operating System
<ul style="list-style-type: none"> • 3420-related CCWs • Error recovery using 32 sense bytes 	<ul style="list-style-type: none"> • Certain levels of MVS/SP and MVS/XA • VSE/SP 2.1.3 and above • VM/SP releases prior to Release 4 (see Note 1) • VM/SP Release 4 and above • VM/XA SF Release 1 (see Note 2) • VM/XA SF Release 2
Processor assignment	<ul style="list-style-type: none"> • VM/SP Release 4 and above • VM/XA SF Release 2
<ul style="list-style-type: none"> • High-speed search • MSGDISP macro • Automatic Cartridge Loader in System mode 	Certain levels of MVS/SP and MVS/XA

Notes:

1. *VM/SP releases prior to Release 4 provide no support, but the 3480 can be defined in DMKRIO as an unsupported device and used by a guest that does support these two functions.*
2. *VM/XA SF Release 1 provides no support, but the 3480 can be defined in HCPRIO as an unsupported device and used by a guest that does support these two functions.*

Special Features

The following special features are available for the 3480 subsystem and can be ordered separately through an IBM marketing representative.

Additional Channel Adapters

Each 3480 subsystem comes with one channel adapter. From one to three additional channel adapters can be ordered as special features. Each channel adapter attaches the subsystem to a processor on a channel path that operates in one of the following modes:

- 1.5 megabytes-per-second interlock (non-data-streaming)
- 2 megabytes-per-second data-streaming
- 3 megabytes-per-second data-streaming.

Dual Control Unit Communications Coupler Feature

If a subsystem contains two control units, they can be attached to processors through two to eight channel adapters. The Dual Control Unit Communications Coupler feature allows connection of the two control units so that all channel paths are available to all devices in the subsystem, and either control unit can access any of the tape drives. Microprocessors in the control units balance the workload between the two control units to improve the amount of work the subsystem can do. Input and output operations can be handled on either control unit as required by the subsystem workload. For example, often only some of the tape drives are active at the same time. Those drives, in a dual control unit communications environment, can use the internal data paths and buffers of either control unit, without regard to control unit attachment.

The 3480 Model A11 control unit requires the Dual Communications feature in addition to this feature before dual control unit communications can be established.

Dual Communications

The Dual Communications feature is for 3480 Model A11 control units only. This feature adds the internal cabling and logic necessary to support the Dual Control Unit Communications Coupler feature, and is required only if you want that feature. 3480 Model A22 control units support the Dual Control Unit Communications Coupler feature without any additional requirements.

Automatic Cartridge Loader Feature

This feature attaches to the front of a 3480 tape drive and allows both the automatic loading of premounted tape cartridges, and the manual loading of single tape cartridges. It can be ordered along with the tape drive and come factory installed, or it can be ordered separately and be field installed. For a more detailed description of the feature, see "Automatic Cartridge Loader" on page 15.

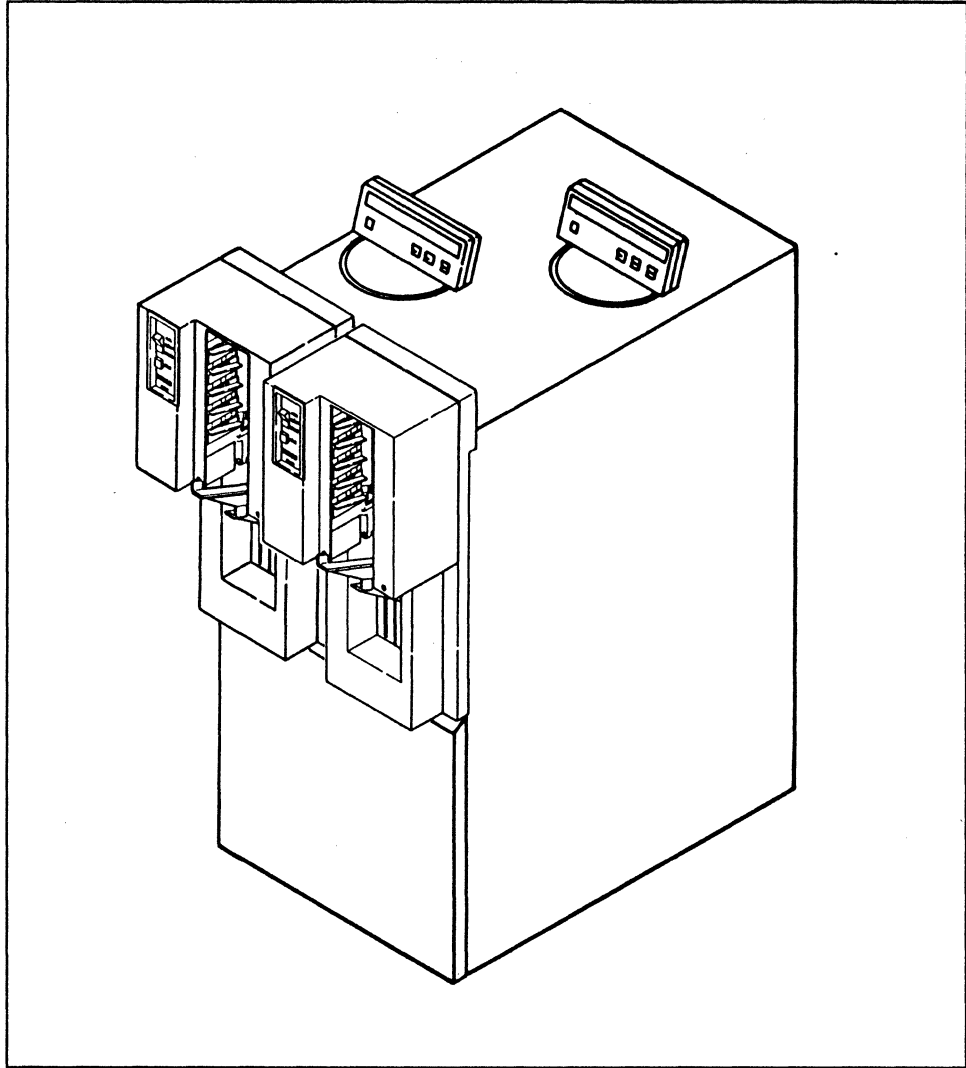


Figure 2. 3480 Tape Drive with the Automatic Cartridge Loader Feature

Library Storage Units

Although the 3480 subsystem requires no additional furniture or equipment, some provision must be made for storing the tape cartridges in a library and for moving them from the library to the subsystem. Your IBM National Distribution Division (NDD) representative can help you to identify what storage furniture is available from IBM.

Chapter 2. Planning for Installation

Installing a 3480 subsystem includes the physical planning for machine configuration, processor attachment, and environmental considerations. Appendix A, “Checklist of Installation Tasks” on page 89 has an overall checklist of installation tasks for the 3480 subsystem.

Attaching the 3480 to a Processor

The 3480 subsystem can be attached to 4341, 4361, 4381, 303x, 308x, and 3090 processors. Channel attachment is made with block multiplexer channels. The 3480 subsystem can be attached up to 120 meters (400 feet) from a processor on block multiplexer channels operating in data streaming or interlock mode. Subsystems attached to block multiplexer channels operating in interlock mode incur data rate degradation if the channel length exceeds 24 meters (80 feet). The channel unit control words (UCWs) must be set to unshared status by the console configuration capability or by input output configuration program (IOCP) generation.

3480 Tape Subsystem Configurations

The 3480 subsystem can be configured with a minimum of one control unit (which includes one standard channel attachment) and one tape unit (two drives). The maximum subsystem configuration contains two control units (each with three additional channel attach features), eight tape units (16 drives), and one Dual Control Unit Communications Coupler feature. In a Model A11/B11 subsystem, a Dual Communications feature is also required for a maximum configuration. Tape Unit Model B11 can attach only to Control Unit Model A11, and Tape Unit Model B22 can attach only to Control Unit Model A22. In a dual-control-unit subsystem, both control units must be the same model, and all tape units must be the same model.

Single Control Unit

A single control unit can attach from one to four tape units (two to eight tape drives) and from one to four channels. A typical arrangement on a single processor might include an additional channel attach feature for an alternate channel. The control unit needs all three additional channel attach features if two processors are connected with two channels each.

A single control unit can be accessed by up to four different processors.

Dual Control Units

In a dual 3480 control unit configuration, the subsystem can have a minimum of two channel attach features up to a maximum of eight channel attach features, and a minimum of two tape drives (one tape unit attached to either control unit) up to a maximum of sixteen tape drives. The electronics that support the dual control unit configuration are built into each Model A22 control unit, but must be ordered as the Dual Communications feature, number 3201, for Model A11 control units. The Dual Control Unit Communications Coupler feature (a cable connection) is required for dual control unit communications in configurations with two 3480 control units sharing the same drives.

Configuration Examples

The minimum 3480 subsystem configuration contains one 3480 Control Unit that has one channel attachment and one 3480 Tape Unit containing two tape drives (see Figure 3).

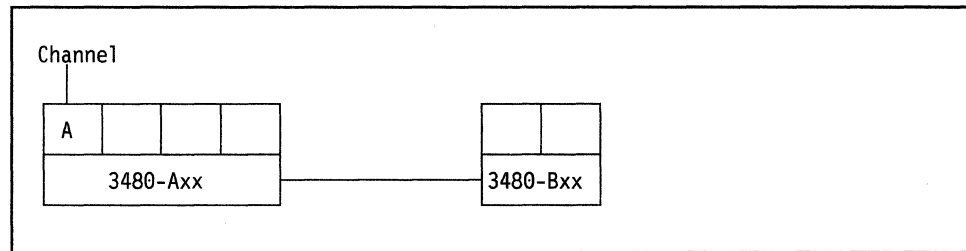


Figure 3. Minimum 3480 Subsystem Configuration

A typical 3480 subsystem configuration contains one 3480 Control Unit with two channel attachments and four 3480 Tape Units for a total of eight tape drives (see Figure 4).

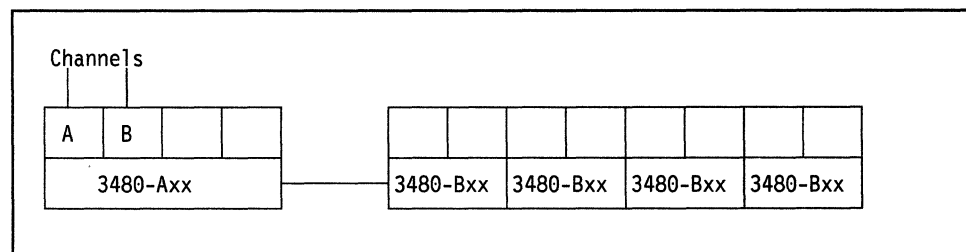


Figure 4. Typical 3480 Subsystem Configuration

The maximum 3480 configuration contains two 3480 Control Units, each with four channel attachments, and each with four 3480 Tape Units for a total of sixteen tape drives. The two Control Units are connected by the Dual Control Unit Communications Coupler feature, allowing each control unit access to every tape drive (see Figure 5).

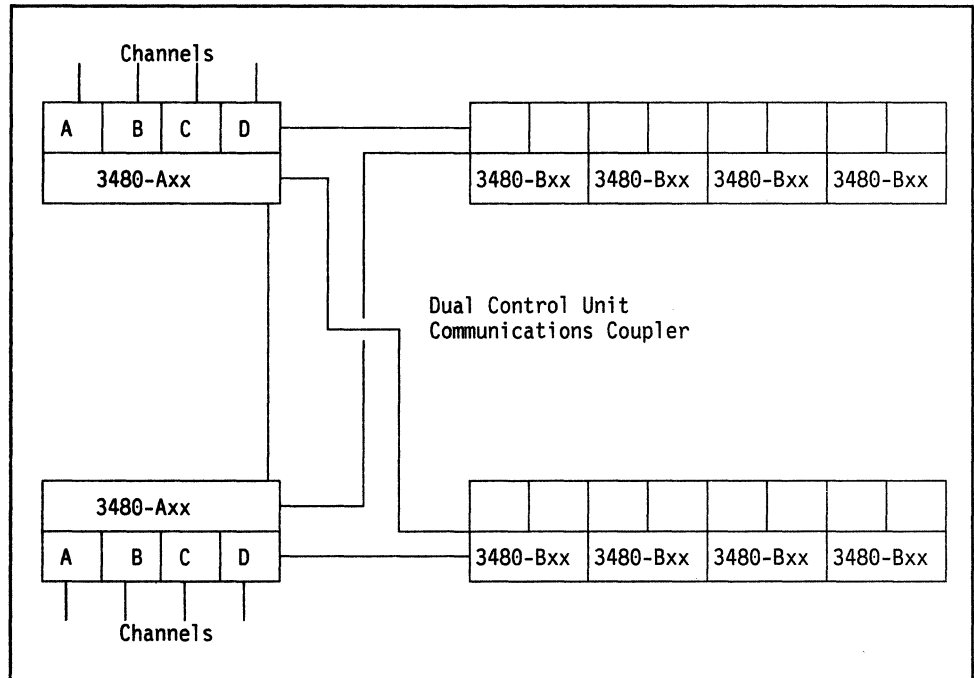


Figure 5. Maximum 3480 Subsystem Configuration

Before ordering the 3480 subsystem, you must determine which configurations you want and order the appropriate units. The following is a list of ordering options.

- First Additional Channel Attach feature, number 1511
- Second Additional Channel Attach feature, number 1512
- Third Additional Channel Attach feature, number 1513
- Dual Control Unit Communications Coupler feature, number 3211
- Dual Communications feature, number 3201 (Model A11 only)
- Automatic Cartridge Loader feature, number 2511.

Attaching Channels

You must determine what type of channels you want for the 3480 tape subsystem. The three types of block multiplexing channels to select from include:

- Interlock (non-data-streaming), up to 1.5 megabytes-per-second nominal data rate
- 2 megabytes-per-second data streaming
- 3 megabytes-per-second data streaming.

The 3480 subsystem performs best when it is attached to 3-megabytes-per-second data-streaming channels. Having more than one channel attachment improves read and write overlap.

Attachment to streaming channels that operate at less than 3 megabytes-per-second causes decreased amounts of data to be transferred.

Attaching interlock channels (non-data-streaming) significantly limits the performance capabilities of the subsystem. Interlock channels have a data rate of up to 1.5 megabytes-per-second. It is possible to attach the same subsystem to both streaming and interlock channels. This attachment could, for example, provide backup in an environment that lacks enough streaming channels to the subsystem.

You should analyze your performance requirements carefully when you are creating a plan for the channels. Backup procedures for the operator should be prepared, particularly in complex sharing or switching configurations.

Determining Channel Cable Lengths

The maximum cable length for any channel is 120 meters (400 feet). However, when the 3480 subsystem is used on a 1.5 megabyte-per-second interlock channel, some performance degradation occurs if the cable length from the processor to the 3480 control unit exceeds 24 meters (80 feet), but the buffer still allows the 3480 to continue. If the maximum data rate is required on interlock channels, the total length between the processor and the 3480 control unit must not exceed 24 meters (80 feet), minus 4.8 meters (16 feet) for every other control unit between the processor and the subsystem.

Each 3480 subsystem must have an available control unit position on the channel to which it is attached.

Sharing a Channel Between the 3480 and a Direct Access Device

Because of channel contention, sharing a channel between tape devices and direct-access storage devices (DASD) is normally not recommended. Tape devices usually use large block sizes and high effective data rates. The high channel usage by tape devices can cause DASD performance to degrade because of frequent rotational position sensing (RPS) misses. Also, channel contention can cause missing interrupts that are indicated by messages from MVS. If you are mixing device types on the same channel, for example, 3380 DASD and 3480 tape, you should evaluate the performance requirements to determine the effect on the channel and subsystems.

A processor that has channels of different capacities might present a problem when you are trying to design a configuration for optimum performance throughout a production day. Daytime operation may favor having DASD on the highest speed channels, but evening production may favor having tape on these channels. Running DASD backup favors both on the highest speed channels. You can balance these requirements by assigning a high-speed channel to each device type and assigning the slower channel to each device as the alternate.

Automatic Cartridge Loader

The tape cartridges used on the 3480 tape drives are inserted, one tape cartridge at a time. By attaching the Automatic Cartridge Loader feature (loader) to the front of a 3480 tape drive, an operator can either insert one tape cartridge at a time manually or premount tape cartridges to be inserted automatically.

The Loader Operator Panel on the front of the Automatic Cartridge Loader allows the operator to switch between the following modes:

- **Auto**, for feeding and loading premounted tape cartridges from the loader to the drive without operator action. This mode can be used for specific volume requests when multiple-volume data sets are run and the order in which the volumes will be requested is known. Scratch or blank cartridges can also be premounted in this mode. Auto mode is most efficient when specific volume requests are *not* randomly intermixed with non-specific volume requests.

Auto mode can be used for JES3 utilities or applications when the operator knows which cartridges are required and in what order; for example, when running the JES3 tape labeling utility.

- **System**, for MVS system-controlled feeding and loading of premounted scratch tape cartridges. In this mode, scratch tape cartridges are fed and loaded automatically in response to non-specific volume requests, while specific volume requests require operator insertion of the requested tape cartridge.

In normal MVS-system operating environments with 3480 full function support, non-specific volume requests are intermixed with specific volume requests. System mode is the recommended mode for this

environment. Operators can put scratch cartridges in the loader in System mode and the loader (1) will automatically mount cartridges in response to mount “SCRATCH” and “PRIVAT” mount messages, and (2) will NOT automatically mount cartridges in response to mount messages for specific volumes. System mode allows the operator to insert scratch cartridges, as needed to keep the input stack full. In Auto mode, a request for a specific cartridge via a mount message results in every cartridge being loaded and unloaded until the requested volume is found or the input stack is emptied.

Note: An MVS operating system with 3480 full function support is required to use this mode.

- **Manual**, for a single tape cartridge feed performed by the operator.

Manual mode should be selected when using JES3 utilities or applications that require only one cartridge.

The MVS demount/mount and mount messages that appear on the drive message display vary depending on whether the loader intends to automatically feed the next cartridge or not.

- If the loader intends to automatically feed the next cartridge to satisfy a demount/mount or mount request, a mount message appears on the message display. The mount message is not blinking and there are no attention bars, meaning that the message is just informational and no operator action is required.
- If the loader does not intend to automatically feed the next cartridge (for whatever reason) a blinking mount message appears on the message display and the attention bars flash (the same as on a 3480 drive without the loader feature). This indicates that operator action is required.

The Automatic Cartridge Loader *feature* is actually two loaders, intended for installation on the same tape unit.

Environmental Considerations

With its abilities, features, and proper physical planning, the 3480 tape subsystem can significantly change the environment in your computer room. Savings can occur because of:

- Reduced floor space (up to 61% less than the 3420)
- Reduced power (up to 60% less than 3420-8)
- Reduced air-conditioning requirements (up to 61% less than 3420-8)
- Longer (120-meter (400-feet)) cable attachment limits

- Fewer 3480 control units to accommodate existing channel connections (in some configurations).

The tape library can also be redesigned or relocated as part of the operations installation plan. “Chapter 5. Planning for Operations” on page 53 has further information about library storage systems. For further physical planning information, see *IBM I/O Equipment Installation Manual - Physical Planning*, and *IBM System/370 Installation Manual - Physical Planning*.

Attaching Early-Level Machines to Newer-Level Machines

Note: This section applies only to 3480 Models A22 and B22.

Attaching early-level machines to newer-level machines requires a special adapter cable.

The adapter cable required to attach a newer-level machine to the immediate right of an early-level machine is different from the adapter cable required to attach an early-level machine to the immediate right of a newer-level machine. The cables can be ordered with the following bill of material (BM) numbers:

- If you are attaching a **newer-level** tape unit to the immediate right of an early-level control unit or tape unit, you need BM 8576623.
- If you are attaching an **early-level** tape unit to the immediate right of a newer-level control unit or tape unit, you need BM 8576624.

You can distinguish early-level from newer-level machines by the following BM numbers:

- The newer-level control units have ship group BM 6460460, and the early-level control units do not.
- The newer-level tape units have ship group BM 6460006, and the early-level tape units do not.

Configuration/Physical Planning Tasks

This chapter has described the following tasks from the checklist in Appendix A, “Checklist of Installation Tasks” on page 89.

Configuration Planning

- Determine control unit configuration
- Determine tape unit quantities.

Physical Site Planning

- Determine appropriate power and air-conditioning
- Determine equipment location or relocation
- Identify space for spare parts and documentation
- Determine the number and length of required cables
- Determine channel attachments
- Identify device addresses
- Determine number and type of cartridge storage units
- Prepare for library rearrangement.

Ordering Equipment

- Order machines and features
- Order cartridges and storage units
- Order cables
- Order documentation
- Schedule facility changes.

Chapter 3. Planning for Software Support

Combinations of program products are necessary for the the MVS/SP and MVS/XA operating-systems that support the 3480 tape subsystem. Also described are system generation (SYSGEN), Input/Output Configuration Program (IOCP) generation, initialization, catalog considerations, converting from 3420 compatibility mode to full function mode, and subsystem sharing.

3480 MVS Software Support Modes

The benefits of improved performance, data reliability, and application compatibility of the subsystem are available with full function mode and 3420 compatibility mode.

A single system generation does not support both modes at the same time. All 3480 drives in a software system must be defined as either full function mode or 3420 compatibility mode devices. Full function and 3420 compatibility modes can coexist in a loosely coupled processor installation and can share common catalogs.

For information about sharing and switching in multiprocessor installations, see “Sharing the 3480 in a Multisystem Environment” on page 42 or “Switching Considerations” on page 59.

Full Function Mode

Full function mode uses new or changed support in the following areas:

- System generation
- Write validity check option (OPTCD = W) for tape write immediate operations
- New UNIT JCL parameter
- New SYNCDEV macro instruction
- New MSGDISP macro instruction
- New ABS parameter for the NOTE and POINT macro instructions (high speed search)

- Message display for MVS mount and demount messages, volume serial display, action messages, and user-generated messages
- Assignment of devices online at initialization time and ability to vary them online and offline
- Compatible catalog entries with those created in 3420 compatibility mode
- Error recovery procedures (ERP) and dynamic device reconfiguration (DDR)
- Input/output error recording, such as SYS1.LOGREC, and Environmental Recording, Editing, and Printing Program (EREP) support.

Full function mode support is provided in MVS/370 and MVS/XA with either JES2 or JES3 and an appropriate release of the Data Facility Product. For specific release level requirements, see “Selecting System Software Combinations” on page 21.

3420 Compatibility Mode

3420 compatibility mode supports 3480 read and write buffering, write validity check option, and hardware-initiated message display. Support is not included for:

- Software-initiated message display
- Processor assignment
- High-speed search
- User-requested synchronization (SYNCDEV)
- Dynamic device reconfiguration (DDR)

Note: DDR remains operable for 3420 tape drives.

- Automatic Cartridge Loader in System mode.

Full Function vs 3420 Compatibility

You must decide whether to use full function mode or 3420 compatibility mode. Some factors that may influence your decision include:

- 3420 compatibility mode is the only way you can use the 3480 for JES3-managed devices if the JES3 release level is below 1.3.4.
- Much of the software developed by manufacturers other than IBM (OEM), such as tape library management systems, can continue to run in 3420 compatibility mode without any changes. Contact your OEM representative. Changes may be necessary in full function mode.

- Some device-dependent user programs may need to be changed depending on the mode you select.

3420 compatibility mode is identical or compatible with full function mode in the following areas:

- Performance
- Recording density
- Recording format
- Catalog entry layout
- Tape label layout
- Reliability.

If full function mode is selected, you may need to modify modules that contain other vendor or user alterations in the areas of:

- Open/Close/End of Volume modules
- Accounting routines
- System Management Facilities (SMF) routines.

Programs that involve dynamic allocation, the DEVTYPE macro to examine the UCBTYP field, or JCL inspection routines may also need to be modified. For further discussion of special application considerations, see “Chapter 4. Planning for Application Changes” on page 47.

Requirements discussed in “Sharing the 3480 in a Multisystem Environment” on page 42 or checkpoint/restart requirements may also influence your decision to select a particular mode.

Selecting System Software Combinations

Operating system and related program product software releases in each version of MVS for full function mode and 3420 compatibility mode are shown in the following tables.

Requirements for MVS/Extended Architecture Users

The 3480 in compatibility mode or full function mode requires:

JES2	JES3
MVS/System Product – JES2 Version 2.1.2 (5740-XC6) with MVS/XA Data Facility Product Release 1.2 (5665-284). JES2 level may be 1.3.0 or later ¹ .	MVS/System Product – JES3 Version 2.1.2 (5665-291) with MVS/XA Data Facility Product Release 1.2 (5665-284). JES3 level may be 1.3.1 ² or 1.3.4.

- ¹ Only with JES2 1.3.3 and 1.3.4, can Assign commands be performed for 3480 devices online during JES2 initialization time.
- ² This level does not provide JES3 management of the 3480 subsystem.

Requirements for MVS/370 Users

The 3480 in compatibility mode requires:

JES2	JES3
MVS/System Product – JES2 Version 1.3.0 through 1.3.4 (5740-XYS) with MVS/370 Data Facility Product Release 1.1 (5665-295). JES2 level may be SU25 or 1.3.0 or later.	MVS/System Product – JES3 Version 1.3.0 through 1.3.4 (5740-XYN) with MVS/370 Data Facility Product Release 1.1 (5665-295). JES3 level may be SU26 or 1.3.0 or later.

The 3480 in full function mode requires:

JES2	JES3
MVS/System Product – JES2 Version 1.3.3 or later (5740-XYS) with MVS/370 Data Facility Product Release 1.0 or later (5665-295). JES2 level may be SU25 or 1.3.0 or later. ¹	MVS/System Product – JES3 Version 1.3.4 (5740-XYN) with MVS/370 Data Facility Product Release 1.0 or later (5665-295). JES3 level may be SU26 ² or 1.3.4 or later.

- ¹ Only with JES2 1.3.3 and 1.3.4, can Assign commands be performed for 3480 devices online during JES2 initialization time.
- ² This level does not provide JES3 management of the 3480 subsystem.

JES/BCP Combinations

Acceptable JES/BCP combinations can be found in recent MVS/SP announcement letters.

Requirements for Other IBM MVS Products

The following table lists the additional program products that incorporate special code for 3480 support. Programs that use Queued Sequential Access Method (QSAM) and Basic Sequential Access Method (BSAM) can run without change except for the required JCL changes.

Minimum Product Level Required	Program Number
DFHSM Version 2	5665-329
DFSORT Release 6	5740-SM1
DFDSS Release 2.1	5740-UT3
EREP Release 3.2	Feature 1, 5658-260

Data Facility Hierarchical Storage Manager

Data Facility Hierarchical Storage Manager (DFHSM) Version 2 (5665-329) extends productivity when operated with the 3480. DFHSM supports the drives as migrate/recall and backup/recover devices. The migrate/recall function moves least-active DASD data sets to 3480 multfile volumes in a compressed and compacted format by using the automatic space manager.

Data Facility Sort

Data Facility Sort (DFSORT) Release 6.0 (5740-SM1) supports the 3480. This support uses the drives as sort-in/sort-out devices. The Sort program prior to Release 7.0 does not accept 3480 devices for the SORTWKnn files. SORTOUT ignores any request for a write validity check.

Data Facility Data Set Services

Data Facility Data Set Services (DFDSS) Release 2.1 (5740-UT3) supports the 3480 as a dump/restore device.

Environmental Recording, Editing, and Printing Program (EREP)

EREP Release 3.2, Feature 5344 or 5345 of 5752-VS2, provides for collecting error environment data about the 3480 subsystem.

Software Support for the Automatic Cartridge Loader Feature

The Automatic Cartridge Loader feature requires some changes in operator procedures in MVS/XA and MVS/370 environments. Systems programmers may decide to make system initializations changes, such as defining an esoteric device type, when installing the feature. An IOGEN may be required.

The following component releases support the Automatic Cartridge Loader feature. Some releases require no changes from 3480 support, while others require changes that will be provided in the form of program temporary fixes (PTFs).

MVS/370 Programming

Release		Requirements
DFDSS	2.1	No changes from 3480
MVS/SP	1.3.3 BCP	PTF
MVS/SP	1.3.5 BCP	PTF
MVS/SP	1.3.3 JES2	No change from 3480
MVS/SP	1.3.4 JES3	PTF
DFP/370	1.1	PTF
EREP	3.2	No change from 3480
DFHSM	2.2.0	PTF

MVS/XA Programming

Release		Requirements
DFDSS	2.1	No change from 3480
MVS/SP	2.1.2 BCP	PTF
MVS/SP	2.1.3 BCP	PTF
MVS/SP	2.1.2 JES2	No change from 3480
MVS/SP	1.3.4 JES3	PTF
MVS/SP	2.1.5 JES3	PTF
DFP/XA	1.2	PTF
DFP/XA	1.1.2	PTF

DFP/XA	2.1.0	PTF
EREP	3.2	No change from 3480
DFHSM	2.2.0	PTF

VM Support

Release	Requirements
VM/370 4.0	No change from 3480
VM/XA Migration Aid 2.2	No change from 3480
VM/XA System Facility	No change from 3480
VM/370 SP 4.0	No change from 3480

VSE Support

Release	Requirements
VSE/SP 2.2	No change from 3480
VSE/SP 2.1.3	No change from 3480

Other Programming Support

Release	Requirements
DFSORT 1.7	No change from 3480
SA DUMP 1.3.5 (370)	No change from 3480
SA DUMP 2.1.2 (XA)	No change from 3480
MVS OLTEP/370	No change from 3480
OLSEP/370	No change from 3480
OLT/370	No change from 3480
MVS OLTEP/XA	No change from 3480
OLT/XA	No change from 3480

Summary of MVS/SP Support for the Automatic Cartridge Loader Feature

- MVS/SP support allows premounting of cartridges on drives with the Automatic Cartridge Loader feature (loader).
- For allocation of “SCRATCH” and “PRIVATE” requests, Scheduler Allocation prefers drives in the following order:
 1. With the loader active
 2. With the loader inactive
 3. Without a loader.
- For allocation of specific and public volume requests, Scheduler Allocation prefers drives in the following order:
 1. Without a loader
 2. With the loader inactive
 3. With the loader active.
 - A 3480 whose loader contains cartridges is not preferred for device selection until a cartridge has been demounted from the drive.
 - A specific volume request issued to a loader in Auto mode results in the loader searching the entire input stack until the volume is found or the input stack is emptied.
 - System mode is the preferred mode for normal MVS system processing with 3480 full function support.
 - In Auto mode, putting multiple volumes (which will be specifically requested) into the loader should not be done until the first of the volumes has been requested, because the volumes will all be loaded and unloaded if the drive is selected for a non-specific volume request. Additionally, putting such volumes into a loader will make the drive more likely to be selected for a non-specific volume request if the drive is active.
- Scheduler allocation will not demount a drive with the loader active, during device allocation processing, if the drive was allocated to a non-specific, private tape request, and the volume on the unit has no USE attribute.
- With the PTF for APAR OY07692 applied, JES3 prefers drives with loaders for scratch requests and, optionally, allocates scratch tape volume requests to different drives from those allocated to specific tape volume requests for jobs using High-Watermark-Setup (HWS). JES3 does not distinguish between loaders containing cartridges and those not containing cartridges.
- During setup, JES3 will not demount a drive premounted by the loader hardware.

- In response to a DISPLAY UNITS or DEVSERV command, MVS/SP support displays the presence of the Automatic Cartridge Loader being installed on a drive.

Note: Without the PTF for APAR OY07692 applied, no device selection preference is provided for JES3-managed drives containing the loader feature.

- It is possible for a combination of SYSGEN or EDTGEN changes and JES3 initialization deck changes to achieve the user requirement for device selection preference. JES3 selection can be changed during an exit procedure by substituting an esoteric name that represents Automatic Cartridge Loaders in place of the generic 3480.
- In JES3 complexes, the PTFs to support the loader feature must be applied to the global and any locals that have the loader feature attached to any of the 3480 drives.
- DFHSM support for the loader allows you to specify an esoteric name for certain functions.

Generating and Initializing an MVS System

When adding 3480 to your system, you should consider the following:

- IODEVICE macro for I/O generation
- Channel selection algorithm
- JES2 and JES3 initialization
- Shared catalogs
- DFHSM tape support.

Performing an I/O Generation

The IODEVICE macro instruction describes the characteristics of an I/O device and its system requirements. Each uniquely addressable I/O device in the machine configuration must be specified in an IODEVICE macro instruction.

For an I/O generation, all I/O devices that are to be in the new system must be specified. Except for the system residence device specification, there can be additions, deletions, changes, or the same specifications as those in the last complete system generation. For further information about system generation, see *MVS/370 Data Facility Product, 5665-295, System Generation Reference*.

Defining the IODEVICE Macro for Full Function Mode

The IODEVICE macro to describe how the UCB is to be constructed for full function:

[symbol]	IODEVICE	ADDRESS = (yx0,16) ,UNIT = 3480 [,OFFLINE = YES NO] [,OPTCHAN = number] [,FEATURE = SHARABLE ALTCTRL (SHARABLE,ALTCTRL)]
----------	----------	--

UNIT = 3480 identifies the 3480 subsystem in full function. The generic name is 3480. The UCBTYPED generated is '78008080'.

Defining the IODEVICE Macro for 3420 Compatibility Mode

The IODEVICE macro to describe how the UCB is to be constructed for 3420 compatibility mode:

[symbol]	IODEVICE	ADDRESS = (yx0,16) ,UNIT = 3420C [,OFFLINE = YES NO] [,OPTCHAN = number] [,FEATURE = SHARABLE ALTCTRL (SHARABLE,ALTCTRL)]
----------	----------	---

UNIT = 3420C identifies the 3480 in 3420 compatibility mode. The generic name is 3400-9. The UCBTYPED generated is '33008003'.

Defining an Esoteric Name

Defining esoteric unit names at system generation eases migration to future device types. Figure 6 is an example that generates sixteen 3480 devices in 3420 compatibility mode and defines the esoteric name CTAPE for them:

<pre>IODEVICE ADDRESS=(180,16),UNIT=3420C UNITNAME NAME=CTAPE,UNIT=((180,16))</pre>

Figure 6. Example of How to Define an Esoteric Name

If a system uses the definition shown in Figure 6, the UNIT parameter of a JCL statement can refer to a drive as 3400-9, 3480, or CTAPE.

The same esoteric name can be used for the 3480 (in full function or 3420 compatibility mode) and conventional tape devices. However, using a common name may not be best for every installation. In some cases, the use of the same esoteric name for two devices could cause the system to attempt to mount a volume on the wrong device type.

An installation with 3480 drives having the Automatic Cartridge Loader feature (loader) installed may want to create an esoteric unit name for those drives. See “Automatic Cartridge Loader Feature Considerations” on page 36.

Selecting IODEVICE Macro Parameters

ADDRESS = (*address, number of units*)

specify the unit address of one or more devices. For each unit address assigned, a unit control block (UCB) is created.

address

specify the unit address for the device. Specify three hexadecimal digits, 000 through FFF. The high-order digit is the address of the channel (specified in a CHANNEL macro), the second digit specifies the control unit, and the low-order digit is a value from 0 – F. (See *Input/Output Configuration Program User's Guide and Reference* for more information on coding these digits.)

number of units

specify the number of unit addresses that are to be assembled for that device. You can specify a 1-, 2-, or 3-digit decimal value. For example, if ADDRESS = (130,5) is specified, unit addresses 130, 131, 132, 133, and 134 would be assembled. The unit addresses generated are sequential and consecutive.

UNIT = *device*|DUMMY

device

specify 3480 (full function mode) or 3420C (compatibility mode).

DUMMY

specify a device that is not supported. Refer to *OS/VS2 System Programming Library: System Generation Reference* (for MVS/370) or *MVS/Extended Architecture Information: System Generation* (for MVS/XA).

OFFLINE = {YES|NO}

specify whether the device is to be considered online or offline at initial program load (IPL) time. If YES is specified, the device is considered offline at IPL time. If NO is specified or if this operand is not coded, the device is considered online at IPL time. **Do not specify YES for any device that the system needs during IPL.**

Note: If FEATURE = SHARABLE is specified for the 3420C or 3480 devices, OFFLINE = YES is forced if not already specified.

OPTCHAN = *number*

is a one- or two-digit hexadecimal number that indicates the alternate channel or subchannel, respectively, through which the device specified in this macro can be addressed. Only one alternate channel or subchannel can be specified for a device. The value specified must

be greater than the channel number of the device (the high-order digit of the primary address is the channel number).

For the 3031, 3032, and 3033 Processors, channels are attached to the processor in groups. It is possible for a hardware error to occur that leaves a group of channels unusable. For increased availability of the 3033 Processor, the alternate channel should be in a different group from the primary channel.

FEATURE = *feature*

specifies the optional features of a device. These values can be written in any order.

If **FEATURE** = SHARABLE parameter is specified for the 3480, **OFFLINE** = YES is forced if not already specified.

Unit	Feature (Optional)	Other Parameters	Notes
3420C	ALTCTRL SHARABLE	OPTCHAN	3480 Magnetic Tape Subsystem in 3420 compatibility mode. 3480/3420 compatibility mode and 3480 full function support cannot coexist in the same SYSGEN.
3480	ALTCTRL SHARABLE	OPTCHAN	3480 Magnetic Tape Subsystem in full function.

Figure 7. IODEVICE Macro Parameter Values—Magnetic Tape Units

Feature	Device	Description
ALTCTRL	3420C 3480	ALTCTRL should only be coded when there is a separate physical control unit path to the device.
SHARABLE	3420C 3480	It is your responsibility to partition shared tape drives between processor units. Ensure that a shared tape drive is not allocated and/or unloaded. When the SHARABLE feature is used, OFFLINE = YES is forced if it is not specified.

Figure 8. IODEVICE Macro FEATURE Parameter Values

Sample SYSGEN Statements

The parameters for a system generation to define the 3480 are shown in Figure 9. The OFFLINE parameters remain the same as in 3420 compatibility mode for both JES2 and JES3. Only the UNIT = parameter changes.

IODEVICE	ADDRESS=(380,16), UNIT=3480, OFFLINE=YES, OPTCHAN=4	(see note 1) (see note 2) (see note 3)	X X X
UNITNAME	NAME=CTAPE UNIT=(380,16)		X

Figure 9. System Generation Parameters

Notes:

1. *A full string of 16 addresses must be generated, even if fewer than 16 real drives are installed.*
2. *Specify:*

UNIT = 3420C for 3420 code compatibility mode
UNIT = 3480 for full function mode.
3. *For drives shared among JES2 systems, specify OFFLINE= YES; for JES3 systems, specify OFFLINE= NO.*

UNIT=3420C and UNIT=3480 cannot be used for different devices within the same SYSGEN. An attempt to mix both unit types generates an error message and ends the stage 1 system generation process.

Generic Names

A generic name is automatically assigned during the SYSGEN process to each collection of devices having similar allocation characteristics. The allocation characteristics are determined by the values specified in the UNIT, MODEL, and FEATURE parameters of the IODEVICE macro.

Generic Name Description

3400-9	3480 Magnetic Tape Subsystem in 3420 9-track compatibility mode.
3480	3480 Magnetic Tape Subsystem in full function mode.

Installation Device Preference Table

3480 or 3400-9 can be specified to create a device preference table during system generation. Refer to *OS/VS2 System Programming Library: System Generation Reference* (for MVS/370) or *MVS/Extended Architecture Installation: System Generation* (for MVS/XA).

IOCP Generation

For processors that require an IOCP generation, the IOCP generation must be performed following the rules specified for a system generation. The specifications in the CNTLUNIT macro instruction are *identical* for full function and compatibility mode. The CNTLUNIT macro defines how the UCWs are to be constructed:

[symbol]	CNTLUNIT	CUNUMBER = (number) ,PATH = [(chpid[,chpid])...] ,SHARED = N ,UNIT = 3480 [,PROTOCOL = D S] [,UNITADD = [(x0,16)...]]
----------	----------	--

Note: SHARED = N must be specified for the 3480. The 3480 uses block multiplexing that is not consistent with shared UCWs.

For the 3480 subsystem, specify the PROTOCOL parameter as **S** for data streaming mode or **D** for interlock (non-data-streaming) mode. Whether you select the **S** option or the **D** option, it should match the channel type established for the 3480 and set by the control unit configuration thumbwheel switches. For further information about an IOCP generation, see *OS/VS2 MVS and Stand-Alone Versions: Input/Output Configuration Program, License Program 5740-XYN, -XYS User's Guide and Reference*, or *4381 I/O Configuration Program User's Guide*.

Sample IOCP Statements

Figure 10 is an example of IOCP generation parameters for a dual control unit configuration with eight tape drives attached to each control unit. This 2 X 16 configuration has primary channel 5 and alternate channel B.

CNTL1	CNTLUNIT	CUNUMBR=5A0,	X
	PATH=05,		X
	PROTOCL=S,		X
	SHARED=N,		X
	UNIT=3480,		X
	UNITADD=((A0,16))		
CNTL2	CNTLUNIT	CUNUMBR=5A1,	X
	PATH=15,		X
	PROTOCL=S,		X
	SHARED=N,		X
	UNIT=3480,		X
	UNITADD=((A0,16))		
* * *	* * *	* * *	
3480	IODEVICE	UNIT=3480,	X
	ADDRESS=(5A0,16),		X
	OPTCHAN=B,		X
	CUNUMBR=(5A0,5A1)		
UNITNAME	NAME=CTAPE		X
	UNIT=(5A0,16)		

Figure 10. IOCP Generation for MVS/SP

Channel Selection Algorithm: A channel selection algorithm is specified in system generation for MVS/370 and in IOCP generation for MVS/XA. The choice of a channel algorithm depends on the configuration of the channel (device types) and performance requirements. For example, a channel that contains 3480 tape drives shared with other devices might provide better overall performance with a different choice than the algorithm that is shown in the example below. You should analyze your performance requirements to select the algorithm that best suits your environment. The following algorithm is a suggestion for initial installation, and applies to the path parameter in Figure 11 on page 34.

For MVS/370 specify 'last-channel-used' (LCU).

For MVS/XA specify 'preferred path'.

For MVS/SP, the channel selection algorithm is specified by modifying the IECIOSXX member of the SYS1. PARMLIB, as specified in the *OS/VS2 MVS System Programming Library: Initialization and Tuning Guide*.

Figure 11 is an example of IOCP generation parameters for MVS/XA (preferred path only) for a dual control unit configuration with eight tape drives attached to each control unit. This 2 X 16 configuration has primary channel 5 and alternate channel 26. A recommended technique for coding the IOCP is to use an "odd/even" path preference on the IODEVICE macro. The path should alternate between 05, 26 for all 16 devices. In a dual control unit configuration, ALTCTLR should be specified as a feature.

CNTL1	CNTLUNIT CUNUMBR=050, PATH=05, PROTOCL=S, SHARED=N, UNIT=3480, UNITADD=((050,16))	X X X X X
CNTL2	CNTLUNIT CUNUMBR=260, PATH=26, PROTOCL=S, SHARED=N, UNIT=3480, UNITADD=((050,16))	X X X X X
* * * * *		
1st device	IODEVICE UNIT=3480,PATH=05, ADDRESS=(550,1), FEATURE=(SHARABLE,ALTCTLR), CUNUMBR=(050,260)	X X
2nd device	IODEVICE UNIT=3480,PATH=26 ADDRESS=(551,1), FEATURE=(SHARABLE,ALTCTLR), CUNUMBR=(050,260)	X X
UNITNAME	NAME=CTAPE UNIT=(550,16)	X

Figure 11. IOCP Generation for MVS/XA

JES Initialization

When initializing a 3480 subsystem in a JES2 or JES3 environment, consider the following information about full-function mode or compatibility mode.

Full Function

In full function mode on JES2, the Vary command can call Assign/Unassign at system initialization to assign tapes to the various systems as required to share tapes among systems. JES2 Release 1.3.3 and above automatically attempts to assign any tape drives that are ONLINE at JES2 initialization time.

However, if the 3480 is managed by JES3 and defined as a global device (JUNIT), the DTYPE=TA03480 keyword is used in the DEVICE initialization statement.

For processing devices, the CA subparameter of the XTYPE keyword is used to identify the device as a 3480 tape device (cartridge tape device) as opposed to TA (conventional tape device). This subparameter is used by JES3 to make FETCH, MOUNT, and DEMOUNT messages to distinguish between 3480 cartridges and 3420 reels.

Drives with the Automatic Cartridge Loader feature installed must have full function support to use the System Mode function of the device. Auto and Manual Modes of the device can operate without full function support. See "Automatic Cartridge Loader Feature Considerations" on page 36 for additional information.

Figure 12 is an example of the SETNAME and DEVICE initialization statements:

```
SETNAME,XTYPE=NEWTAPE,NAMES=(3480,esoteric1,esoteric2,...)
DEVICE,DTYPE=TA03480,JNAME=name, X
JUNIT=(addr1,procname1,,addr2,procname2,,...), X
XTYPE=(NEWTAPE,CA), X
XUNIT=(addr1,procname1,,addr2,procname2,,...)
```

Figure 12. JES3 Initialization Statements for Full Function

3420 Compatibility Mode

In JES2 systems where the tape drives are shared between processors, the systems would normally be generated with OFFLINE = YES in the IODEVICE macro. The operator can then selectively set them online by issuing the Vary command.

In JES3 systems, the tape drives are normally generated with OFFLINE = NO specified in the IODEVICE macro. They are then selectively set online automatically by JES3 during subsystem initialization. Initialization parameters for JES3 must contain the 3420 compatibility mode device type to have proper processing in a shared catalog environment.

The 3480 in compatibility mode is defined as any 3420 device. The DTYPE = TA93400 keyword is used in the DEVICE initialization statement.

Drives with the Automatic Cartridge Loader feature installed may be used in Auto and Manual modes. Full function support is required to use System mode. See "Automatic Cartridge Loader Feature Considerations" on page 36 for additional information.

Figure 13 is an example of the SETNAME and DEVICE initialization statements:

```
SETNAME, XTYPE=NEWTAPE, NAMES=(3400-9, esoteric1, esoteric2, ...)
DEVICE, DTYPE=TA93400, JNAME=name, X
JUNIT=(addr1, procname1, , addr2, procname2, , ...), X
XTYPE=(NEWTAPE, TA), X
XUNIT=(addr1, procname1, , addr2, procname2, , ...)
```

Figure 13. JES3 Initialization Statements for 3420 Compatibility Mode

For further information about JES initialization, see the appropriate JES initialization and tuning manual.

Automatic Cartridge Loader Feature Considerations

Manual mode should be selected when using JES3 utilities or applications that require only a single volume. Auto mode can be used for JES3 utilities and applications where multiple volumes are required, and the operator knows which volumes will be required and in what order. Auto mode, for example, could be used with the JES3 tape labelling utility. Any volume which is not unloaded by a JES3 utility should be manually unloaded by the operator before returning the drive to use by the JES3 main device scheduler (MDS) and to Auto or System modes on the loader.

An installation can gain more control over which volumes are allocated to drives with the Automatic Cartridge Loader feature (loader) by performing some of the following changes. The changes are different for non-JES3-managed environments (JES2 environments and JES3 environments with non-JES3-managed devices) and JES3-managed environments.

Non-JES3-Managed Environments

In a non-JES3-managed environment, when non-specific private volumes are requested, drives are preferred in the following order:

1. With the loader active
2. With the loader inactive
3. Without a loader.

The following statement is an example of such a request:

```
//OUTPUT DD DSN=MASTER(+1), DISP=(NEW, CATLG), UNIT=3480
```

When drives with loaders are the only drives available at the time of a specific volume request, drives with loaders can be allocated rather than having the job wait. The following statement is an example of such a request:

```
//OLDMAST DD DSN=MASTER(0), DISP=OLD (cataloged as UNIT=3480)
```

When APAR OY07692 is applied, Allocation will always choose a drive with a loader that is active before choosing a drive without a loader for a non-specific, private volume request. This change should make it unnecessary for the creation of user unit names and JCL changes to gain absolute control over allocation of drives with loaders. User unit names may be created as described in the section, "Absolute Allocation Control," but the **WARNING** at the end of that section should be considered before creating such names.

Absolute Allocation Control: The creation of esoteric unit names for drives with loaders and drives without loaders during SYSGEN or EDTGEN and the modification of the unit name in the JCL, allows control over the allocation of volume requests. For example:

1. During system generation, create an esoteric unit name for drives with the loader, such as STACK, and another esoteric unit name for drives without the loader, such as NOSTACK. See "Defining an Esoteric Name" on page 28.
2. In JCL specify STACK for non-specific volume requests for permanent datasets and NOSTACK for other requests. For example:

```
//OUTPUT DD DSN=MASTER(+1),DISP=(NEW,CATLG),UNIT=STACK
```

```
//OLDMAST DD DSN=MASTER(0),DISP=OLD,UNIT=NOSTACK
```

Note: The statement immediately above (//OLDMAST...) is cataloged as 3480, but the NOSTACK specification is used since it is a subset of 3480.

Warning: If STACK and NOSTACK unit names (or any other names) are created as indicated, they form two subsets of the 3480 device type: a drives-with-loaders subset and a drives-without-loaders subset. If you form these subsets by creating the names STACK and NOSTACK, then use STACK and NOSTACK on all volume requests because if a DD statement or dynamic allocation request for a specific volume request specifies the 3480 device-type, one of the subsets will be chosen, then a drive from that subset will be chosen. The system does not choose the drive based on the presence/absence/state of a loader. This means that, if the drive-with-loader subset is chosen, then a drive with a loader will be allocated even though there may be many drives without loaders available.

JES3-Managed Environments

Background: Without APAR OY07692 applied, JES3:

- Does not recognize the presence or absence of a loader on a drive
- Randomly intermixes mounts of scratch volume requests and specific volume requests on a single drive when High-Watermark-Setup (HWS) is used.

These actions by JES3 allocation can combine to cause scratch volume requests to be allocated to drives without a loader and specific volume requests to be allocated to drives with loaders.

New Functions: With APAR OY07692 applied, JES3:

- Recognizes the presence or absence of a loader on a drive
- Chooses drives with loaders for scratch volume requests when such drive are available
- Chooses drives without loaders for specific volume requests when such drive are available
- Provides the option to separate scratch-volume requests from specific volume requests with High-Watermark-Setup (HWS).

APAR OY07692 introduces a new JES3 tape HWS separation (THWSSEP) option. This option must be used to cause JES3 tape HWS to allocate scratch volume requests to different drives from those allocated to specific volume requests. When THWSSEP is specified, it applies to all tape volume requests, regardless of the device types to which those requests are eligible.

Using the THWSSEP Option: THWSSEP is a keyword that can be specified on the STANDARDS initialization statement, the *MAIN JECL statement, and the MODIFY and INQUIRY JES3 operator commands. With STANDARDS, *MAIN, and MODIFY, THWSSEP has three options: REQUIRE, PREFER, and IGNORE.

THWSSEP=REQUIRE requests that JES3 allocate all specific tape volume requests to different units from those allocated to all scratch tape volume requests. For an individual job, the REQUIRE may result in more units being allocated.

THWSSEP=PREFER requests that JES3 allocate all specific tape volume requests to different units from those allocated to all scratch tape volume requests, unless this would result in the allocation of more units for an individual job. Whether total separation of scratch requests from specific requests occurs depends on a job's mix of specific and scratch tape volume requests because the PREFER option does not cause an increase in the number of drives allocated to a job.

THWSSEP=IGNORE causes no change in JES3 allocation. This option is the default.

An installation can create a JES3 preference for drives with loaders by assigning esoteric unit names for drives with loaders and drives without loaders during SYSGEN or EDTGEN, changing the SETNAME initialization statement, and changing the unit name in the JCL. For example:

Assumptions:

- All drives are JES3-managed
- All non-specific volume requests specify TAPE in the unit parameter, for example:

```
//OUTPUT DD DSN=MASTER(+1),DISP=(NEW,CATLG),UNIT=TAPE
```

- The name TAPE includes all 3480s
- All existing data sets are cataloged as residing on 3480, for example:

```
//OLDMAST DD DSN=MASTER(0),DISP=OLD
```

- All allocation requests for existing data sets use the catalog to obtain unit information
- The customer installs some loader features on a subset of the 3480 drives.

To cause JES3 to prefer the drives **with** loaders for non-specific volume requests, and to prefer drives **without** loaders for specific volume requests, the customer needs to do the following:

1. Change the initialization deck DEVICE statements for all drives with loaders to the following:

```
DEVICE,XTYPE=(STACK),XUNIT=()
```

For drives without loaders, change the initialization deck DEVICE statements to:

```
DEVICE,XTYPE=(NOSTACK),XUNIT=()
```

2. Change the JES3 initialization deck SETNAME statements for TAPE and 3480 to the following:

```
SETNAME,XTYPE=STACK,NAMES=(TAPE)  
SETNAME,XTYPE=NOSTACK,NAMES=(TAPE,3480)  
SETNAME,XTYPE=STACK,NAMES=(3480)
```

With the above initialization setup:

- JES3 will try to allocate the following request to drives **with** loaders, but will allocate drives without loaders if no drives with loaders are available:

```
//OUTPUT DD DSN=MASTER(+1),DISP=(NEW,CATLG),UNIT=TAPE
```

- JES3 will try to allocate the following request to drives **without** loaders, but will allocate drives with loaders if no drives without loaders are available.

```
//OLDMAST DD DSN=MASTER(0),DISP=OLD
```

Catalog Considerations

The 3480 cannot coexist in the same processor as both a full function and a 3420 compatibility subsystem because of the device type specified in the system generation. The different device type; however, does not affect tape files cataloged in one mode and later referred to by a system in the other mode.

The catalog contains a 3400-9 device type for 3420 compatibility entries and 3480 for full function entries. Program support for each mode recognizes both entries as 3480. The catalog can be shared by many systems at different levels with different modes.

Adding the 3480 Magnetic Tape Subsystem to DFHSM

To use the 3480 subsystem, you must first install DFHSM Version 2 and apply any program temporary fixes (PTFs).

If you have never used DFHSM tape support and you want to use the 3480 subsystem, you can add tape cartridge volumes to your computing system by doing one of the following:

- Use the ADDVOL command to add a tape cartridge volume to the list of backup volumes managed by DFHSM.
- Use the SETSYS UNITNAME(3400-9|3480) command to define the default unit name as the 3480 device. Do not use the ADDVOL command to add any tape backup volumes to those backup volumes owned by DFHSM. When DFHSM needs the first tape backup volume, it issues a mount request for a scratch tape on a 3480 tape drive.

If you want to use both the 3420 Magnetic Tape Unit and the 3480 Magnetic Tape Subsystem, you must do one of the following:

- Use the MAXBACKUPTASKS parameter of the SETSYS command to increase the number of concurrent volume backup tasks and then use the ADDVOL(*valid*) UNIT(3400-9|3480) BACKUP(DAILY(*day*)) command to add 3480 tape volumes to the list of volumes managed by DFHSM.
- Issue a QUERY BACKUP(ALL) command to determine which 3420 tape volumes are available to receive backup versions. An A indicates which volumes are available. Then use the DELVOL(*valid*) BACKUP(UNASSIGN) command to unassign some available daily backup volumes. Finally, use the ADDVOL command to add 3480 tape volumes to the list of volumes managed by DFHSM.

If you are using 3420 Magnetic Tape Units and you want to convert to using only the 3480 Magnetic Tape Subsystem, you must move all backup versions from the 3420 units to the 3480 subsystem. To do this, follow these steps:

- Issue a `QUERY BACKUP(ALL)` command to determine which 3420 tape volumes are available to receive backup versions. An A indicates which volumes are available.
- Be sure you have specified the `SETSYS TAPEDELETION(SCRATCHTAPE)` command. Issue the `ADDVOL(valid) UNIT(3400-9|3480) BACKUP(SPILL)` command so the recycled backup versions are placed on a 3480 tape volume. Issue a `RECYCLE EXECUTE VOLUME(valid)` command for each volume. When the volume is recycled, it is deleted from the list of those managed by DFHSM.
- Use the `ADDVOL` command to add a 3480 tape volume to the list of backup volumes managed by DFHSM or use the `SETSYS UNITNAME(3400-9|3480)` command to define the default unit name as the 3480 device.

If you want to leave existing backup versions on the 3420 Magnetic Tape Unit and start using only the 3480 Magnetic Tape Subsystem, do the following:

- Use the `DELVOL(valid) BACKUP(UNASSIGN)` command to unassign the currently available 3420 tape daily backup volumes.
- Next, use the `ADDVOL` command to add 3480 tape volumes to the list of volumes managed by DFHSM.

Converting from Compatibility Mode to Full Function Mode

You can convert from 3420 compatibility mode to full function mode at any time. The catalog is not a factor because the catalog entries of 3420 compatibility and full function may coexist. After you have converted to full function, it is not necessary to recatalog any data sets that have already migrated to a 3480 device in 3420 compatibility mode.

The following steps must be taken to convert to full function:

1. Install all program product software at the appropriate release levels to obtain full function support.
2. Perform an I/O generation to change the unit number in the I/O device macro from `UNIT = 3420C` to `UNIT = 3480`.

Sharing the 3480 in a Multisystem Environment

You can use the 3480 subsystem shared (partitioned) across many processors in MVS and VM/SP Release 4 operating systems. There is more than one data path from different processors to the same string of tape units allowing different tape drives within that string to be used by different processors at the same time. For information about sharing the 3480 in a VM/SP operating system, see the appropriate VM/SP publication listed in "VM/SP and VM/HPO" on page vii.

At any one time, a single tape device is used by only one processor. The Assign/Unassign commands permit the 3480 tape subsystem to interact with the connected processors and coordinate the use of the 3480 in the multiprocessor environment. A set of channel commands is available to perform the following tasks:

- Set a path group ID to identify all channels from a specific processor leading to a specific tape drive. This is usually done at system initialization and Vary Online processing.
- Assign a tape drive to a processor to allow access from a tape drive to that processor. As soon as a processor is assigned a tape drive, no other processor can access it. A tape drive assigned to only one processor is called single-system-assigned.

If more than one processor needs access to a tape drive at the same time, an assignment with a common access password can be made by a different processor.

- Enter an access password for a currently assigned device. The password is determined by the first processor that assigns the tape drive and is repeated by all processors that subsequently need assignment. A tape drive assigned to more than one processor is called multi-system-assigned.

Note: A response of -R to a DISPLAY UNIT command indicates single-system assigned, while a response of -M indicates multi-system assigned.

- Release the 3480 assigned to a processor to allow a different processor to assign the device and, optionally, disband an existing path group.

See *IBM 3480 Magnetic Tape Subsystem Reference*, for complete descriptions of the 3480 channel commands.

3420 Compatibility Mode

In 3420 compatibility mode, the operator can switch a drive from one processor to another by issuing a Vary Offline command to the current system. When the offline status is confirmed, the operator then makes the drive available to the other system. The operator issues a Vary Online command from the new system to place the drive online to the new system. The operator must be careful to avoid errors when performing this

operation. The operators on different shifts should be aware of the status of the drives.

Full Function Mode

In full function mode, sending a Vary Online/Offline command to the processor invokes the Assign/Unassign command. When the Vary Online command is issued from the new system, the Assign command is invoked. Therefore, if the drive has not been unassigned (Vary Offline) from the current system, the Vary Online is rejected and the operator is notified that the drive is already assigned to another full function system.

Mixed Mode

Sharing 3480 tape drives in a mixed environment, where both 3420 compatibility and full function modes are installed, requires additional operator control. Figure 14 describes tape pool partitioning restrictions applicable to JES2. It applies to an environment where both 3420 compatibility (CC) and full function (FF) program support coexist in the same environment. The matrix includes the cases where both systems are running in the same mode.

The matrix shows a JES2 environment with two processors and the three possible combinations of software support modes between them. Letters a-g apply to the paragraphs following Figure 14.

		PROCESSOR TO	
		FF	CC
PROCESSOR FROM	CC	Notes a b d	Notes a b c
	FF	Notes a f g	Notes a b d e

Sharing Guidelines for JES2 Systems

Figure 14. Partitioning between Systems

- a) All drives should be system generated with `FEATURE=SHARABLE` (which forces `OFFLINE=YES`).
- b) Operator should vary devices offline/online so that a drive is not online to more than one system at the same time.
- c) For access to the same drive by more than one system, the drive should be system generated without specifying `OFFLINE=YES` or the operator can vary the drive online to more than one processor.

- d) A drive cannot be online to a full function system at the same time that it is online to a 3420 compatibility system. An attempt to do so causes the drive to be accessible only to the full function system.
- e) An attempt in a 3420 compatibility system to use Vary Online for a drive that has already been assigned to a system running full function causes an I/O error message with ASE (assigned elsewhere) status to be displayed on the 3420 compatibility system console.
- f) For access to the same drive by more than one full-function system, the operator can use Vary Online for the drive and specify the SHR parameter.
- g) In a full function system, an attempt to use Vary Online for a drive that has already been assigned to another full function system causes the message VARY REJECTED, ASSIGNED TO ANOTHER SYSTEM.

Note: More than one system should not have access to the same drive at the same time because unpredictable results can occur unless the applications in both processors take care to synchronize their I/O requests to the device.

Planning for VM Software Support

VM/SP and VM/HPO support the 3480 subsystem. This software support is documented in the respective VM libraries. See “VM/SP and VM/HPO” on page vii, “VM/SP and VM/HPO” in the Preface.

Planning for VSE/SP Software Support

VSE/SP Release 2.1.3 supports the 3480 subsystem in a mode similar to that available with MVS 3420 code compatibility support. This software is documented in the VSE/SP library. See “VSE/SP” on page vii in the Preface.

Checklist of Software Planning Tasks

This chapter described the following tasks from the checklist in Appendix A, “Checklist of Installation Tasks” on page 89.

Planning

1. Select full function or 3420 compatibility mode
2. Identify software releases and maintenance required
3. Identify changes or user modifications required
4. Identify vendor software impact

5. Develop a software build and test plan
6. Identify operational impact
7. Coordinate with other project areas.

Installation

1. Collect and apply maintenance
2. Rework and apply modifications
3. Generate the system
4. Regression and stress test the system
5. Update the documentation and procedures.

Testing

1. Schedule test time
2. Do a regression test
3. Do a stress test
4. Do a performance test
5. Revise the migration plan, if necessary
6. Use 3480 subsystem for limited production
7. Use 3480 subsystem for full production
8. Use 3480 subsystem for production on all systems.



Chapter 4. Planning for Application Changes

The 3480 subsystem is compatible with currently available IBM tape subsystems. No recompile or link-edit is required for the majority of programs that use tape data. This overall compatibility is supported in both operating modes.

Verifying That the Data Migrated

Application programming personnel may need to perform several tasks when transferring data to the 3480 subsystem. Ensuring that the data is correctly transferred is the highest priority in the overall migration. Tape programming that was written at the device level, to use IBM 3420 capabilities, may require modifications to take advantage of functions available on the 3480 subsystem. Changes to JCL are required for the device type.

“Chapter 7. Data Migration” on page 69 discusses tape library migration and suggests roles for many individuals in the overall plan. Some of the activities that application personnel may need to participate in include:

1. Setting up the data test plan so project control personnel can monitor the migration.
2. Producing file copies with IEBCOPY or another utility that provides similar functions. The copies can be used in the early stages of the migration to ensure integrity before production-controlled migration begins.
3. Processing test jobs with *real* test data.
4. Verifying results with the actual production run of the same application.
5. Running a tape-compare utility.

Coding an Application in MVS Full Function Mode

Two new macros, SYNCDEV and MSGDISP, and two modified macros, NOTE and POINT, are available to the programmer who is coding for full-function mode.

SYNCDEV: This new macro, invoked in programs written with BSAM, synchronizes the tape with the application program. It ensures that any previously buffered data that was written to the control unit buffer is physically present on the tape and that the tape drive is physically positioned to write the next record to be transferred by the processor.

In full-function mode, for example, use synchronization when implementing checkpoint/restart. Also use synchronization if you are writing a device-level program to handle certain error conditions detected by the tape drive or to control the level of control unit buffering. Write Tape Mark, Locate Block, Rewind, Rewind Unload, Erase Gap and space type commands (Forward Space Block) cause synchronization automatically.

MSGDISP: This macro causes a message to display on the display area of a 3480 tape drive. The display area consists of eight character positions. The first position usually indicates an operator action. The middle six positions can be used to indicate drive status or tape volume serial numbers. The last position is used as a modifier to the specific operator action, for example, to indicate that a cartridge to be loaded must be file protected. Application programs can use the macro to provide user information to operators.

Drive activity messages that appeared on the system console in support of earlier IBM tape drives are also displayed on the 3480 message display in a format that is discussed in "Chapter 5. Planning for Operations" on page 53.

NOTE/POINT: These macros contain a new keyword, TYPE=ABS. This keyword, when used with NOTE, retrieves block ID information. It is used with POINT to start a high-speed search for a specific block. (Each block written by the 3480 has an associated block ID that is not normally transmitted to the processor with read data.)

This new keyword does not affect existing application programs that operate with 3420 tape drives. However, you may want to add the keyword to the NOTE/POINT coding to use high-speed search for better performance.

Special Application Considerations

Most of this information applies to unique tape programming subjects or items of special interest in the application area.

Sense Bytes

The 3480 subsystem operates with expanded sense bytes to support error recovery procedure programs. Many of these conditions are handled by the 3480 control unit instead of in the processor, as was necessary with the 3420. Programs that refer to sense bytes may require modification. See *IBM 3480 Magnetic Tape Subsystem Reference*, for descriptions of the status and sense bytes.

Data Chaining

Programs that perform write-data-chaining may perform at reduced speed when operating on data streaming System/370 303X processors. The data rate depends on cable length and could be as low as 650 kilobytes-per-second. Programs that read-data-chain must align their buffers on quadruple word boundaries.

Update in Place

Programs that rewrite or update in place require an MVS SYNAD routine. The 3480 does not support rewrite and this type of program is not recommended. If such programming already exists and requires modification for the 3480, the following characteristics are applicable:

- The tape control unit sequence checks the blocks during read, write, and space block operations, and these programs fail if the block sequence is altered.
- The block ID is not transferred to the system during a read operation unless explicitly requested by a NOTE macro.

Checkpoint/Restart

Checkpointing is performed to ensure that information about storage and data associated with a program is properly recorded to allow restart of the job at the checkpoint. This function is used as a protection against unexpected interruptions such as hardware or power failures. If these interruptions occur, there is a possibility of data loss.

In 3420 compatibility mode, the data in the buffer might not have been transferred to the media even though the checkpoint was completed properly in all other respects. A procedure requiring restart at an earlier checkpoint prevents this problem.

Write Validity Check

Write validity check (tape write immediate) is for applications that require a block to be placed 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 device end is not sent to the system until the read-back-check on the tape drive is complete. Write validity check is called by specifying OPTCD=W in the DCB macro or the DCB parameter of the DD statement in MVS.

Because device end is not sent to the system until the read-back-check is complete, write validity check should be used only for applications that require synchronous write verify and can tolerate lower performance. Other applications can use DASD logging as an alternative.

Tape Synchronous Mode

Prior to microprogram Release 24, the 3480 subsystem does not support tape synchronous mode.

IBM has no error recovery routines for data blocks that invoke tape synchronous mode of operation. Because the buffer does not hold the entire data block, the control unit does not assume error recovery responsibility. All data errors are sent back to the processor. To avoid an ABEND, you must provide a SYNAD or ESTAE exit routine.

Device-Type Dependencies

Programs that perform certain functions may not give the expected results when they run with the 3480 subsystem. Some of the program functions that might depend on the device type and might need alteration include:

- Dynamic allocation (SVC 99)
- Device-dependent parameters such as the DEVD parameter of the DCB macro
- JCL inspection routines
- Accounting routines (such as SMF)
- EREP log tape analyzers
- Non-IBM vendor software
- Stand-alone programs
- Interrupt routines

- Programs that call data security erase (see “Data Security Erase”)
- Use of the DEVTYPE - UCBTYP field for the 3480:

FULL FUNCTION = '78008080'

3420 COMPATIBILITY = '33008003'.

Tape IPL

Tape IPL of a standalone program sets the IPL channel to selector mode. The 3480 subsystem is designed to operate on a block multiplexer with an unshared subchannel. In MVS/370, mode bit 0 in control register 0 should be set to 1 at the outset of the program to place the channel in multiplexer mode. In MVS/XA, bit 0 should be set to 0 or off in control register zero.

Generation Data Groups

Generation data groups can contain some data sets that reside on tape reels and some that reside on tape cartridges. Multimedia generation data groups (cartridge and reel) can be processed together by concatenation.

Forward Space File

Forward space file is performed by the control unit. Applications that do skip-file processing occupy the control unit to tape drive path during the entire operation and subsystem overlaps are adversely affected during this operation.

Data Security Erase

In the 3480 subsystem, data security erase writes random data on the tape. Programs using the data security erase CCW should issue a Rewind or Rewind Unload command after the data security erase. Any command that attempts to read over the random data created by the data security erase can receive an indication of permanent error. If the tape must move to a point prior to the data security erase random data, high-speed search (Locate Block command) in combination with a Read Block ID command can be used after the Rewind command.

Execute Channel Program (EXCP) Programming

Occasionally, EXCP programs are used in tape application programs. If the program is modified for the 3480, the 3480 control unit uses channel command retry protocol in response to certain unexpected circumstances. Channel command retry repeats the channel command from the CCW that contains the command currently being processed. You should not write programs that modify tape CCWs or data areas before receiving a device end from the CCW string.

Checklist of Application Planning Tasks

This chapter has described the following tasks from the checklist in Appendix A, "Checklist of Installation Tasks" on page 89.

Education

1. Order documentation
2. Develop education.

Application Migration Plan

1. Determine high-benefit applications
2. Examine device-level dependencies
3. Select strategy
4. Assign schedule and responsibility for applications
5. Re-evaluate schedule for hardware/media delivery
6. Develop tracking system for migration.

Application Data Verification

1. Design data test plan
2. Develop test verification procedures.

Chapter 5. Planning for Operations

Most of the advantages and benefits from the 3480 subsystem are seen in the operations environment. The computer room and tape library are significantly changed during and after the transition to the 3480 subsystem.

Planning requirements include modifications in physical layout, library operations, and operator procedures. The elements of change include the architecture of the 3480 subsystem, tape cartridge, cartridge library storage, and accompanying changes to the operating system. This chapter describes operator procedures, tape drive and media differences, storage units, and switching considerations.

The operations department can participate in a significant way to accomplish 3480 migration. Operations and Production Control personnel can perform many of the tasks described in other chapters of this guide including data migration and media conversion.

New Architecture Features

Operations requirements could include equipment removal and installation, JCL changes, drive assignment schedules, cartridge external labeling, and cartridge initialization. Additional tasks include managing tape reel and tape cartridges in the computer room, developing procedures where required, and providing for training requirements.

Because you must keep a number of reel-type drives and 10.5-inch reels, you should develop and operate a multi-media library and a separate scratch pool until the reels are no longer needed.

Maintenance and Drive Cleaning Operations

The tape cartridges and use of the cleaning cartridge have a significant and positive impact on tape cleaning and tape certification procedures. The cleaning cartridge reduces the inconsistencies that occur with manual cleaning.

The drive is cleaned by using a cleaning cartridge that contains fabric tape instead of magnetic tape. A notch on the cartridge allows the drive to sense that a cleaning cartridge has been inserted. The fabric runs along the same path as the tape, cleaning as it goes.

The 3480 can signal when the device requires additional cleaning because of high use. The drive message display displays a **CLEAN** message. An initial policy of cleaning each drive once each week is recommended. The environment and the amount of use should be the guide to determine the best schedule to follow. The record of tape use is maintained for each drive in erasable memory and is lost when the subsystem is initialized again, reset, or powered off. Each control unit is shipped with one cleaning cartridge. Replacement cartridges come in packages of five. The estimated life of the cleaning cartridge is 500 cleaning cycles. You can keep track of the number of uses by marking the label provided with each cartridge. Each cleaning cycle takes less than a minute.

Cleaning procedures are contained in *IBM 3480 Magnetic Tape Subsystem Operator's Guide*.

File Protect Selector

The file protect mechanism (see Figure 15 on page 55) on the tape cartridge is a thumbwheel selector on the rear edge of the cartridge that can be set to one of two positions. When the selector is in the file-protected position, a small dot is visible in a recessed area of the thumbwheel. This dot means the cartridge is file protected and that the data can only be read. When the selector is in the unprotected position, the thumbwheel surface is raised and blank. In this position, the cartridge is unprotected, and the tape can be read, written, or erased.

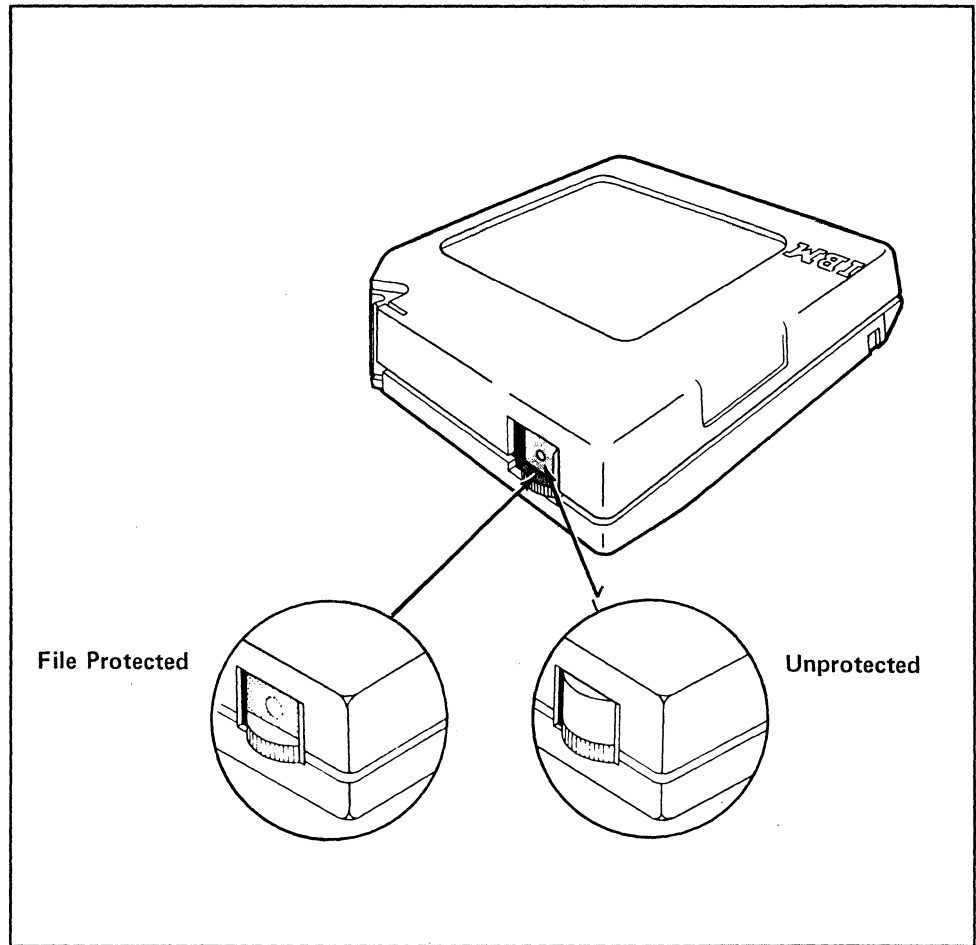


Figure 15. File Protect Selector

Care and Handling of Cartridges

Particular attention should be given to procedures regarding cartridge handling.

General handling instructions, operational and storage environment, cartridge label use, and cartridge cleaning considerations are contained in the manual *Care and Handling of the IBM Magnetic Tape Cartridge*.

Message Displays

The message display shows messages that indicate control unit and tape drive status or actions required. Four types of messages can be displayed:

- Processor messages provide information or request an operator action.
- Drive activity messages provide information about the tape drive state. These are initiated by the microcode logic within each drive.

- Application program messages are issued by an application program and provide information about the program.
- Check code messages are generated when a hardware error occurs and provide information about the nature of the error.

A 3480 subsystem operating in 3420 compatibility mode has no message display support for processor-initiated messages generated by either the operating system or application programs.

A pair of operator attention lights at the left side of the display, as shown in Figure 16, flash whenever operator action is required at the drive.

The selected light in the lower right corner of the display is on when the control unit is communicating with the drive.

The message display has eight character positions. All eight positions can be used to display a message. Some system-initiated messages use the position on each end as a qualifier and the middle six positions to display the message. Two messages can be alternately displayed.

The display can be turned to the left or right so that it can be seen from either side of the drive. An operator in proximity of the subsystem can see the message from a convenient vantage point without returning to the system console. The operating system displays the usual messages on the system console.

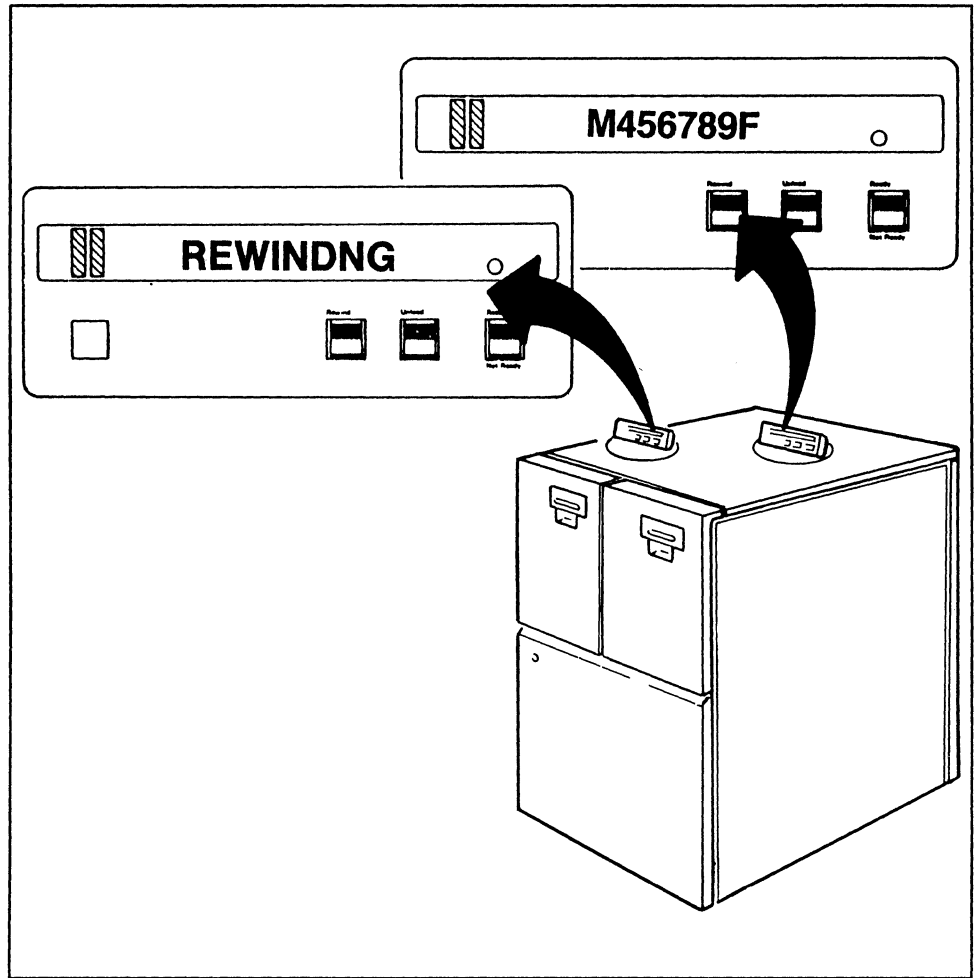


Figure 16. Tape Drive Message Display

Figure 17 on page 58 shows a typical sequence of messages as they might appear on the display.

During job processing, the volume serial number of the tape is usually displayed. This display could be interrupted by a change in state during processing of the job; for example, by an application-generated message or a check message (CHK xy) indicating a hardware error has been detected. The sequence of messages displayed in Figure 17 on page 58 is:

1. The drive is powered on and does not contain a loaded cartridge.
2. Mount request for VOLSER '123456', standard label.
3. The cartridge is loaded, ready and unprotected.
4. The volume was accepted.
5. Any application generated message.
6. Rewind is in process.
7. Unload is in process.
8. Demount requested; tape is to be kept.

Hardware-initiated messages and their use are described in detail in *IBM 3480 Magnetic Tape Subsystem Operator's Guide*. Console display message descriptions are also described in the messages manual of applicable IBM operating systems.

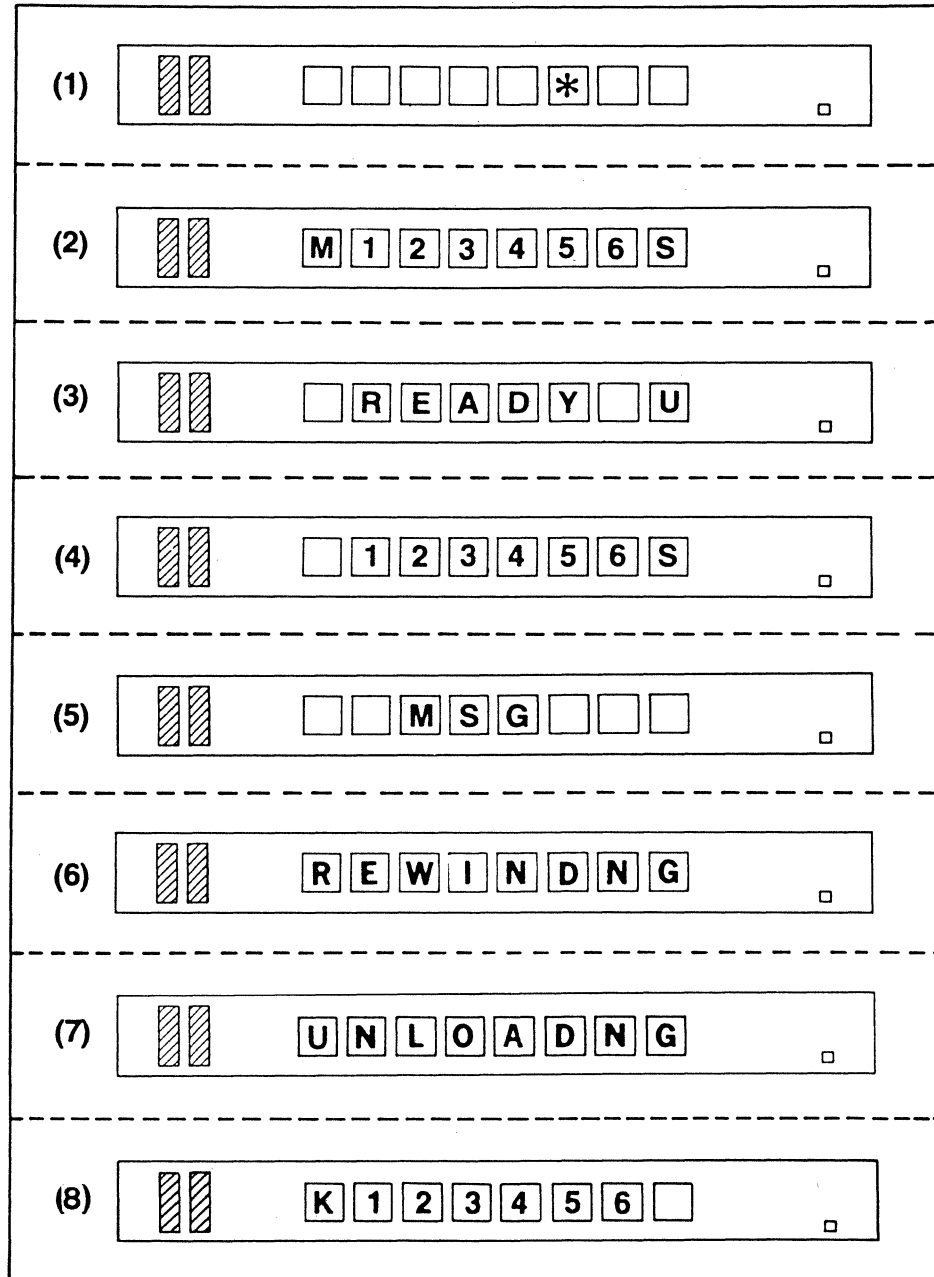


Figure 17. Message Display Example (MVS full-function system only)

3480 Partitioning

The 3480 subsystem can be configured to permit access to more than one processor in an installation with many processors. In a JES2 environment, the tape drive can be partitioned between systems with the VARY command. Partitioning is done automatically in JES3-managed systems. You must develop operator procedures for partitioning of the 3480. For guidelines, see “Chapter 3. Planning for Software Support” on page 19.

Switching Considerations

When using a 2914 or 3814 switching device, you can switch a control unit from one channel type to another; for example, from a 3 megabyte-per-second channel to another speed channel by:

1. Varying the channel path offline from the host system
2. Operating the channel adapter switch
3. Changing the control unit switch designating channel speed (otherwise interface control checks may occur)
4. Removing the path-IDs of the path being switched with a VARY command or an IPL of the system.

You can avoid these steps by using separate channel attachments from the subsystem to channels of different speeds and by varying one path off and the other one on. Setting control unit switches or initializing the subsystem again is not required if the last alternative is chosen.

If it is necessary to switch between channels of different speeds, two possible options are:

1. Set the control unit channel adapter to the lower channel speed. This avoids the need to enable or disable the channel adapter when performing a switch, but causes the channel adapter to run at the lower speed at all times.
2. For each channel, set the control unit channel address switch to the higher speed, and quiesce the subsystem before switching. Then reset the channel address switch to the other speed, and VARY the channel online.

When selecting the option, you must consider the following:

1. Before operating the 2914 or 3814 switch, VARY the subsystem offline. After operating the 2914 or 3814 switch, VARY the subsystem online.
2. Make sure that you do not create duplicate addresses on a system when switching devices.

3. Using a 2914 switching device with a 3 megabyte-per-second data-streaming channel involves significant cable restrictions. See the Washington Systems Center Technical Bulletin, GG22-9020, for details.

Checklist of Operations Planning Tasks

This chapter described the following tasks from the checklist in Appendix A, "Checklist of Installation Tasks" on page 89.

Operations Planning

- Order documentation
- Train operators
- Develop sharing and switching procedures
- Evaluate library operations
- Coordinate with other project areas.

Chapter 6. Performance Characteristics

Performance of the 3480 tape subsystem depends on:

- The number of active tape drives
- The buffering in the control units
- The size of the data set
- The block size of the data set being read or written
- The motion of the tape
- The channel speed
- The channel utilization
- The choice of processors
- The effect of write validity check (tape write immediate mode).

Each 3480 tape drive must have its own unshared unit control word (UCW) specified at the time of installation. Dedicated subchannels help prevent any single tape drive from monopolizing a data path because the channel can be disconnected. The asynchronous buffer design that permits concurrent tape use also helps improve the 3480 subsystem performance.

Effect of Simultaneous Drive Operations

Because of the buffer, the 3480 subsystem can have several tape drives active at the same time. Data transfer between a tape drive and the control unit can occur at the same time as data transfer between the buffer and the processor channel. In addition, data transfer between the control unit and a tape drive can occur at the same time with other tape drive operations that are not transferring data, for example, starting the drive or moving tape.

The Effects of Buffering

Dual control unit communications allow two control units to share control and status information for all the tape drives attached to them. In the dual control unit configuration, all channel paths to both control units can communicate with either control unit buffer at channel data rates. Each control unit establishes the internal data paths to be used between the tape drive and a channel path, independent of the processor control program. Any single tape drive is assigned to one control unit or the other during the process. Managing buffer assignments and data paths, called load balancing, is performed by logic in both control units.

The buffer in each control unit can transfer data at the same time for one channel adapter and for one tape drive. Thus, in the dual control unit communication environment, the subsystem can have four data transfers at the same time: two transfers between the buffers and the unique channels and two transfers between the buffers and the tape drives. This can be done at the same time with operations that do not transfer data, such as drive start-up and tape movement for other drives in the subsystem.

Tape write immediate and tape synchronous modes pass data through the buffer in the same way as start and stop mode (non-buffered).

The channel adapters analyze channel commands independently of the control unit buffer. If a channel command requires use of the buffer when the buffer is busy servicing another channel path, the control unit issues a channel command retry that holds the incoming CCW for retry in the channel.

Buffered Write Mode

Buffered write is the default mode and is a high-performance mode for the 3480 subsystem. When the control unit receives a Write command, data is transferred from the channel to the control unit buffer space assigned to the target tape drive. When a block of data has been transferred into the buffer, device end and channel end status is sent to the processor. Then, the processor can continue processing with the same or a different tape drive.

After the buffer for a drive is partially full, the control unit schedules the writing of data to the drive from the buffer. The time required to start the drive varies depending on how many drives are waiting for service, whether or not the tape is in position, and drive start time.

The highlights of the buffered write mode of operation are:

- Device motion can be masked from the processor. Data is accepted by the control unit while the drive is starting, moving the tape into position, or waiting for service. During these operations, data blocks are stored in the control unit buffer segment assigned to the drive.
- The processor can send several blocks of data without waiting for them to be written to tape. Once data transfer starts, the drive can write a

series of blocks. This is called data streaming and can continue as long as blocks continue to enter the buffer once the drive starts accepting data. Data streaming allows high subsystem data rates to continue without special software support.

- The control unit buffer is a common resource to all attached drives; the control unit has logic to prevent a stream of blocks to one drive from locking out service to other drives. If a lockout is detected, the stream of blocks is broken and control is given to another drive.
- Buffered data is forced to be written to tape prior to the processing of many commands. For example, when CLOSE is issued for a tape file, the data remaining in the buffer is moved to the tape before the Write Tape Mark is performed. Rewind, Rewind Unload, Locate Block, Erase Gap, space commands, or any Read command issued after a Write command operate in a similar manner. In addition, the Synchronize command can be used to force data to write to tape under program control.

Buffered Read Mode

Rapid subsystem response to the processor is achieved by putting data into the buffer for drives in read mode so that it is available to the processor upon request. Reading data into the buffer from the drive makes records available for transfer to the processor without waiting for another read command. The buffer can accept data from a drive at the same time that it provides data to the channel.

Effect of the Block Size

The block size used for tapes has a major impact on:

- Reel capacity (the amount of data that fits on a reel of tape)
- Effective data rate (the maximum speed at which a certain amount of data can be written to or read from tape).

Comparison of the Cartridge and Reel Capacities

Figure 18 on page 64 shows the relationship between capacity and block size for the cartridge and compares the nominal capacity of the cartridge with the nominal capacity of a 2400-foot tape reel recorded at 6250 bytes-per-inch.

For example, if you look at the sixth line of Figure 18 on page 64, you see that when using 24K-byte blocks the cartridge can contain approximately 200 megabytes, but a tape reel can contain approximately 165 megabytes. The cartridge has about 21% more capacity than a 3420 reel at the same block size and 6250 BPI recording density.

The recording density of the 3480 has reduced the physical reel size and increased the reel capacity.

The cartridge capacity is greater than the tape reel capacity with block sizes of 4K bytes and above. If block sizes below 4K bytes are used, the cartridge capacity can be slightly below the tape reel capacity. Small block sizes are not recommended for either 3420 or 3480 because of decreased performance.

BLOCK SIZE	CAPACITY COMPARISON (See Note)			
	2400-FOOT REEL		CARTRIDGE	
	BLOCKS	MILLION BYTES	BLOCKS	MILLION BYTES
1 024	58 842	60.3	52 388	53.6
2 048	44 085	90.3	42 430	86.9
4 096	29 358	120.3	30 804	126.2
8 192	17 600	144.2	19 874	162.8
16 384	9 772	160.1	11 633	190.6
24 576	6 772	165.2	8 223	202.1
32 760	5 171	169.4	6 359	208.4

Note: The cartridge or reel capacity can vary based on variations in tape format.

Figure 18. Comparison of Reel and Cartridge Capacities

Tape Subsystem Performance Comparison

The data rate (rate at which data can be written to or read from a subsystem) that can be achieved from any tape subsystem is dependent on many factors. Some of the factors that affect the data rate are:

- The processor requirements for the job using the subsystem
- The speed of the processor
- The load on the processor
- The contention for I/O subsystems and/or channels
- The I/O programming techniques used to access the data, for example, access methods, block sizes, number of I/O buffers.

Figure 19 on page 66 shows the results of measurements that were performed comparing the effective data rate of the 3480 Model A22, 3420-6, and 3420-8 devices at varying block sizes. The measurement environment was free of contention. The tape subsystem was a single control unit with

eight drives attached. The processor was an IBM 3081 running the MVS/XA operating system. The job wrote to a single tape drive. The job was repeated with block sizes from 1K (K = 1024 bytes) to 32K. The Queued Sequential Access Method (QSAM) with five buffers was used for the tape access method. Figure 19 on page 66 shows both the effective data rate achieved in the specified measurement environment and the relative performance improvement between the measured subsystems.

The same job was also run on an IBM 4381 processor running the MVS/370 operating system. The tape subsystems used in this environment were the 3420-6 and the 3480 Model A11. Figure 20 on page 67 shows the effective data rate achieved in the specified measurement environment and the relative performance improvement between the measured subsystems.

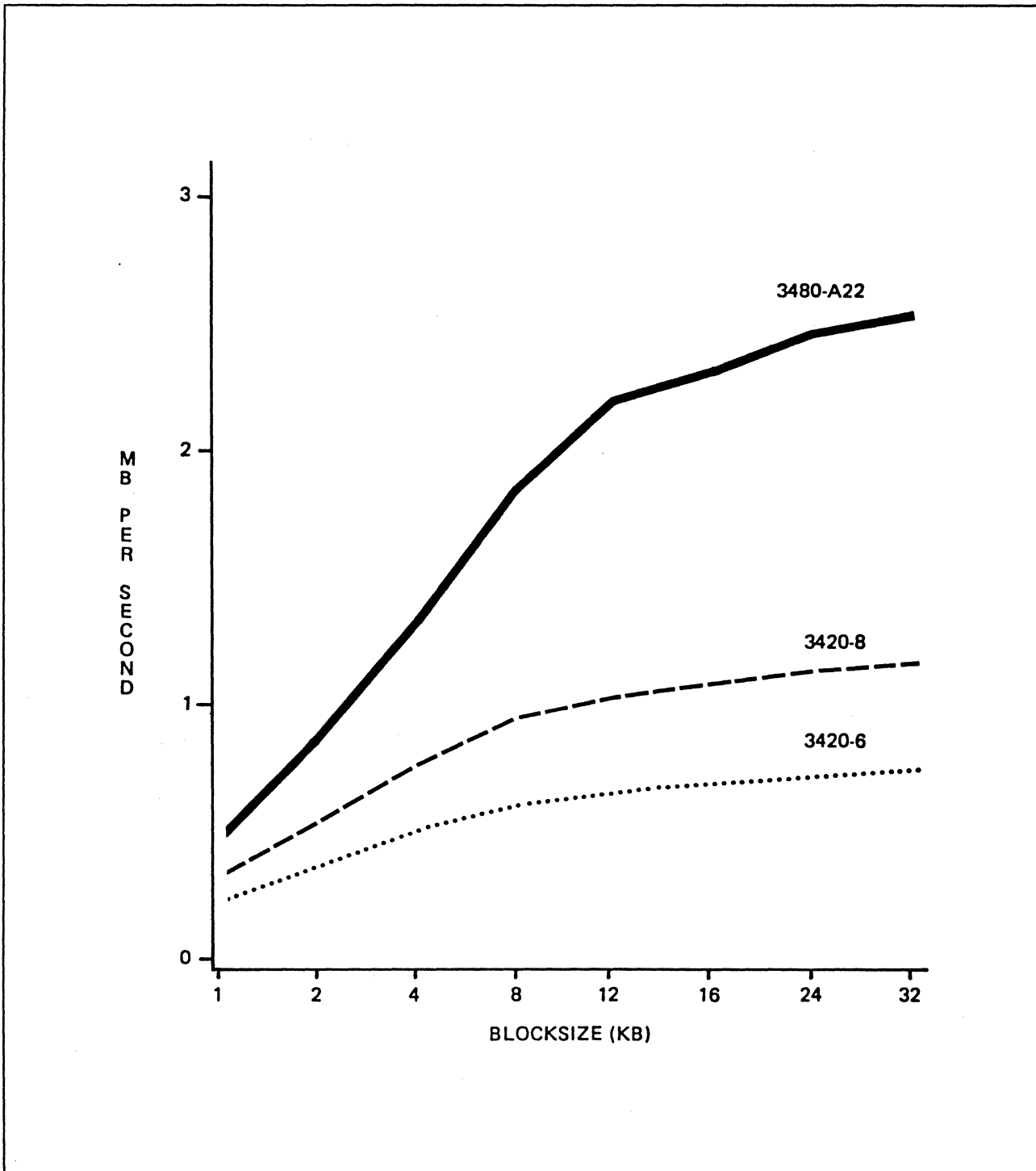


Figure 19. 3480 Model A22 Subsystem Effective Data Rate Comparison. The above data is for reference only. It was derived from measurements in a specific environment. Other environments will experience different levels of performance. Accordingly, this figure does not constitute a performance guarantee or warranty.

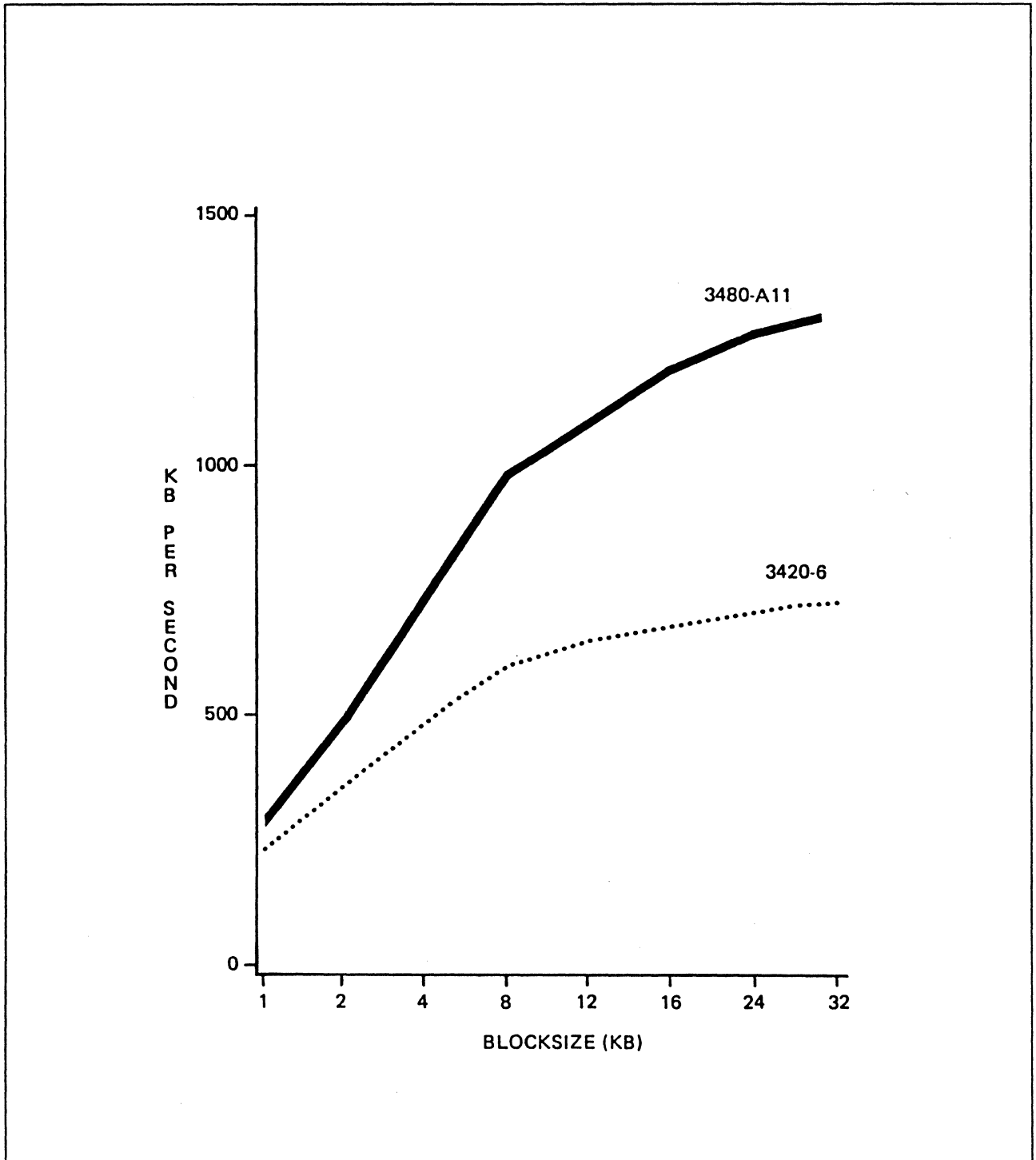


Figure 20. 3480 Model A11 Subsystem Effective Data Rate Comparison. The above data is for reference only. It was derived from measurements in a specific environment. Other environments will experience different levels of performance. Accordingly, this figure does not constitute a performance guarantee or warranty.

Chapter 7. Data Migration

Data migration is the movement of data from tape reels to tape cartridges. You must plan carefully to describe and control the steps that must be taken to complete the conversion.

Conversion to the 3480 is similar to other conversions. Common questions that you should consider are:

Which data sets should be moved first?

In what order should the movement proceed?

Which data sets can or cannot be moved?

What controls are required during the conversion?

The tape cartridge adds an extra element to the conversion, and additional questions you should consider are:

How many reel-type drives must be kept and for how long?

How many cartridges to buy and migrate to?

How many 3480 drives are needed to replace reel-type drives?

What delivery schedule of cartridges and drives can be accommodated?

How long does the conversion take?

This chapter discusses these questions and explains techniques to categorize a tape library, determine a data movement schedule, balance tape drive requirements, and explore some alternatives that can be taken in forming a general migration strategy.

For the following discussion, **data migration** is the movement of data from tape reels to tape cartridges during the normal processing of jobs, and **data conversion** is the copying of data from tape reels to tape cartridges by using special one-time utilities.

Analyzing Existing Library Characteristics

Understanding the general characteristics of a tape library is the first step you should take in planning to migrate data. To develop a library profile, you should know the library composition, the amount of inventory, and the turnover rate. The following discussion explains each of these subjects.

Determining the Library Composition

Most tape libraries are composed of common categories of tapes that are defined by the characteristics of how they are used. Determining the common categories is the first step in developing a migration strategy.

Each category is unique because of special criteria applied to its use and handling in a data-processing environment. The criteria can include life cycle, security requirements, special handling, or various application dependencies. You should understand the library composition to answer many of the questions in the migration plan. The major categories of tape in a typical computer installation are shown in Figure 21 and described in Figure 22.

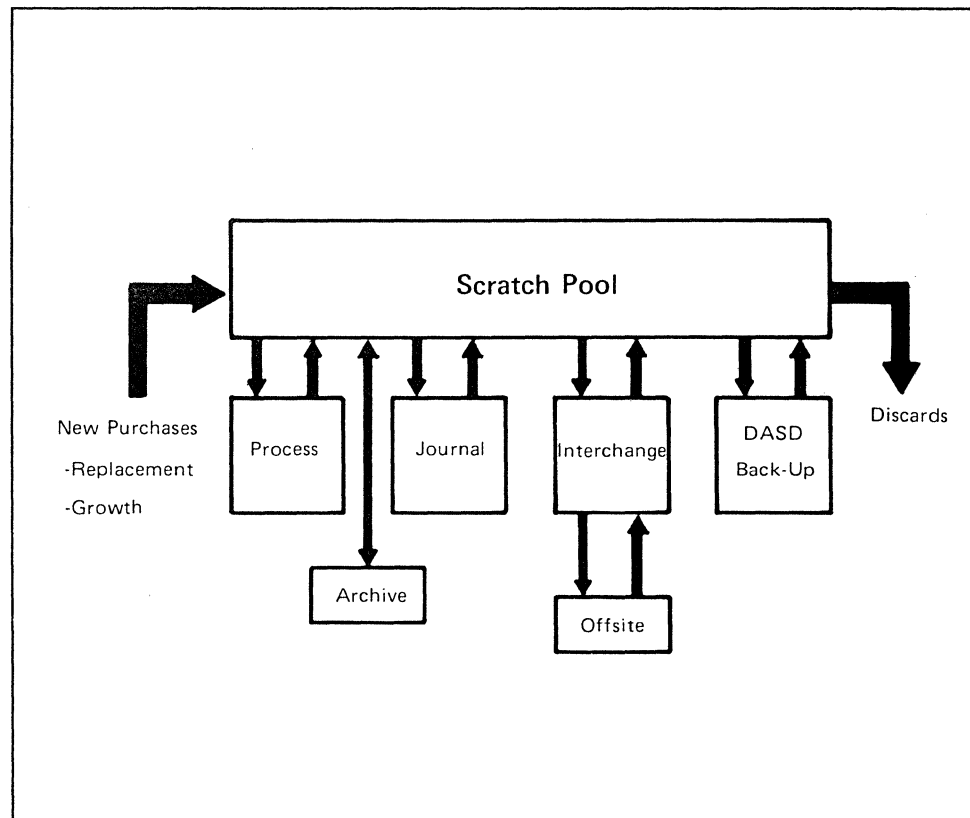


Figure 21. Tape Media Classifications

Category	Characteristics
DASD backup tapes	<ul style="list-style-type: none"> • Created in normal backup jobs for DASD devices. • Usually several generations stored in a library at any given time. • Used to recover files in the event of a program or system error or other malfunction. The restore function is seldom used, but when it is, the integrity of the copied data is usually critical. • Files usually have a high turnover rate and may require interchange with other sites.
Process tapes	<ul style="list-style-type: none"> • Created during periodic execution of an installation's application programs. • Usually represent the highest volume of files in a library. For example, multiple generations of a tape master file can be considered process tapes. • Range of criteria and time frames; most commonly is the daily, weekly, and monthly processing cycle.
Archive tapes	<ul style="list-style-type: none"> • Contain records held for historical, legal, regulatory, or disaster recovery purposes. • Retention period usually more than a year and are often stored offsite. • Some processing of these tapes can be done in locations other than the site where they were created. This offsite processing could occur as a part of a comprehensive disaster plan or for various legal or regulatory requirements.
Journal tapes	<ul style="list-style-type: none"> • Contain transactions recorded against another data set. • Allows their companion data sets to be reconstructed by applying the journaled data to a previous version of the companion data sets. • Most commonly used in data base and online systems applications.

Figure 22 (Part 1 of 2). Common Tape Categories and Their Characteristics

Category	Characteristics
Interchange tapes	<ul style="list-style-type: none"> • Prepared for use in other locations. • May be used in other computer systems or for special purposes like microfilm production. • May be tapes prepared at another location to be used on the local system, for example, tapes created on data collection equipment.
Scratch tapes	<ul style="list-style-type: none"> • Commonly referred to as the scratch pool, contain no active data. • Used for the creation of new files during normal processing when the data is to be kept at jobstep or job end • Often a regular flow of new, unused tapes entering a library to be used for growth and replacement of old tapes. This may be important in determining the number of 3480 cartridges to order.

Figure 22 (Part 2 of 2). Common Tape Categories and Their Characteristics

Taking a Library Inventory

The next step in developing a tape library profile is to determine the number of reels in each category. After you know library composition and size, you can determine the turnover rate so that you know how many cartridges to order and at what time. The following step-by-step procedure tells how to take the inventory, including possible sources of information:

1. First, obtain an estimate of the **total** number of reels in the library. The tape librarian can be a source of this information. Many tape library management programs also maintain this data.
2. Determine the number of **archive** reels in the library. An **archive** reel has a long retention period. The librarian or a tape management system can help to determine this number.
3. Determine the number of **interchange** reels in the library. Normally a log is kept of all tapes that go to other locations, go to other devices within the location, and those that arrive from other locations or devices.
4. Determine the number of reels used for **DASD backup** by counting the number required for the backup schedule and multiplying that by the number of generations of backup tapes that are kept in the library.

5. Determine the number of **journal** tapes in the library, for example, IMS or CICS log tapes. The data base administrator can be the source for this information.
6. Obtain the number of **scratch** tapes in the library. The librarian or tape management system should have a count of these reels. Be sure to account for new tapes that have not been initialized. These tapes are not known to the tape management system.
7. Subtract the total number of tapes in these five categories from the library total; the remainder is the number of **process** tapes in the library.

Figure 23 is an example of an average library inventory. The composition and distribution for your installation may be different.

AVERAGE LIBRARY DISTRIBUTION LIBRARY SIZE = 80,000 REELS		
	NUMBER OF REELS (X1000)	PERCENTAGE OF TOTAL
Process	50.4	63
Scratch	1.6	2
Journal	1.6	2
DASD backup	4.0	5
Interchange	2.4	3
Archive	20.0	25
TOTAL	<u>80.0</u>	<u>100</u>

Figure 23. Library Composition Example

Determining the Rate of the Library Turnover

In normal processing, a tape data set can be created on a given volume, held for a certain length of time, and then used again as input to a subsequent file update. The original tape volume is considered a back-level version of the file and has an expiration date associated with it. At some time after the file retention period ends, the volume is returned to the scratch pool to be used again.

Library turnover refers to the cumulative rate that active tape volumes are returned to the scratch pool.

The library turnover rate helps you to determine the how many tape drives and cartridges to order and also helps determine what delivery schedule fits your needs. It also provides an estimate of the amount of time required to complete the migration.

When determining the library turnover rate, you do not need to include all the reels in the library. If archive and interchange tapes are not expected

to return to the library or play a part in the migration, they can be excluded.

The creation and expiration date of each reel must be known or estimated and you should construct a turnover chart as shown in Figure 24. A report of the number of volumes that are expected to turnover on a monthly basis can be generated using Type 21 SMF records. This information may be available in the tape library and is kept in most tape management systems. The library turnover chart indicates the rate at which a library can be converted.

Figure 24 indicates that after three months, 80 per cent of the reels were turned over (used again). After six months, almost all of the reels have been turned over. Studies suggest that the slope of the turnover curve becomes more gradual as the size of the tape libraries increases. Archive tapes are not included in the data.

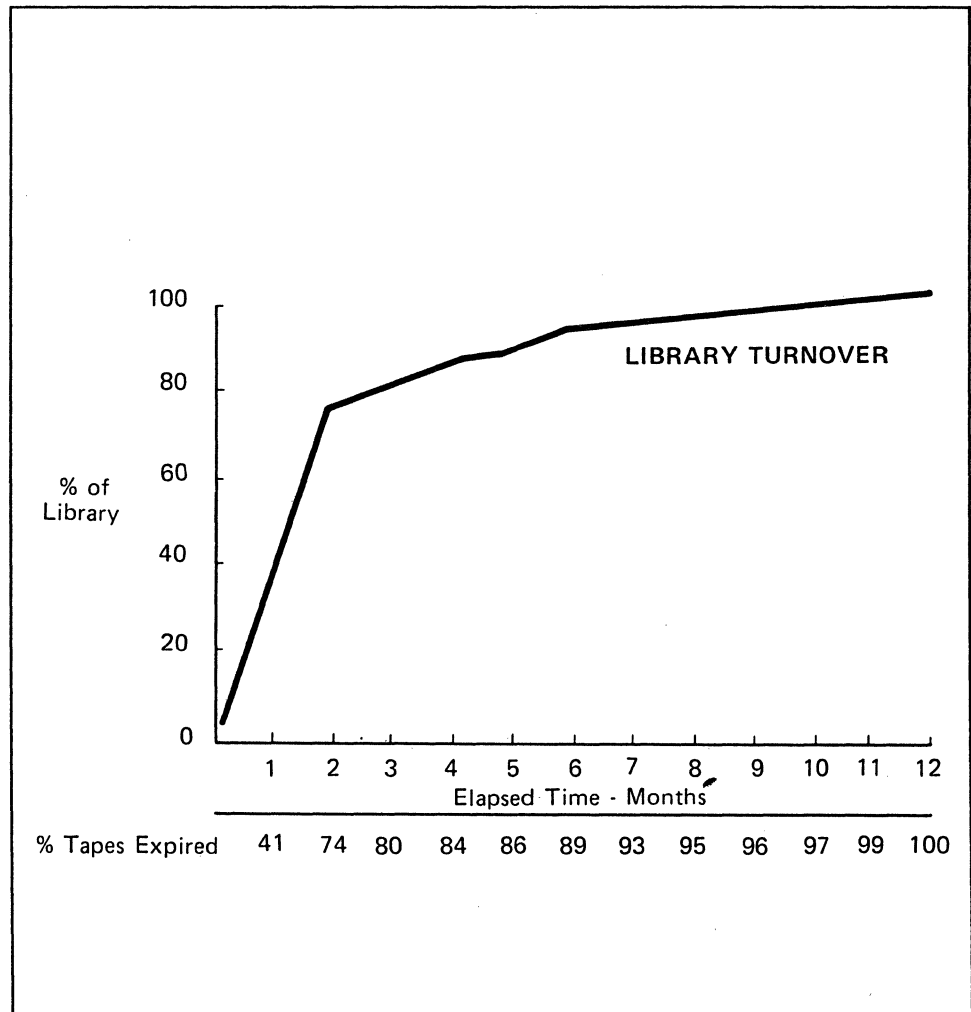


Figure 24. Cumulative Tape Turnover in Normal Processing

Accelerated vs Delayed

Figure 25 shows how library migration alternatives might be planned. The *accelerated* curve indicates that the **conversion** approach was used to complete the transition at an earlier date than generally occurs. The tape volumes to be used from the seventh month to the end of the year are copied in advance.

The *delayed* curve indicates that the migration occurs at a slower rate. Several factors in your installation can require that you use a slower rate; for example, major operational changes planned during the course of the tape migration.

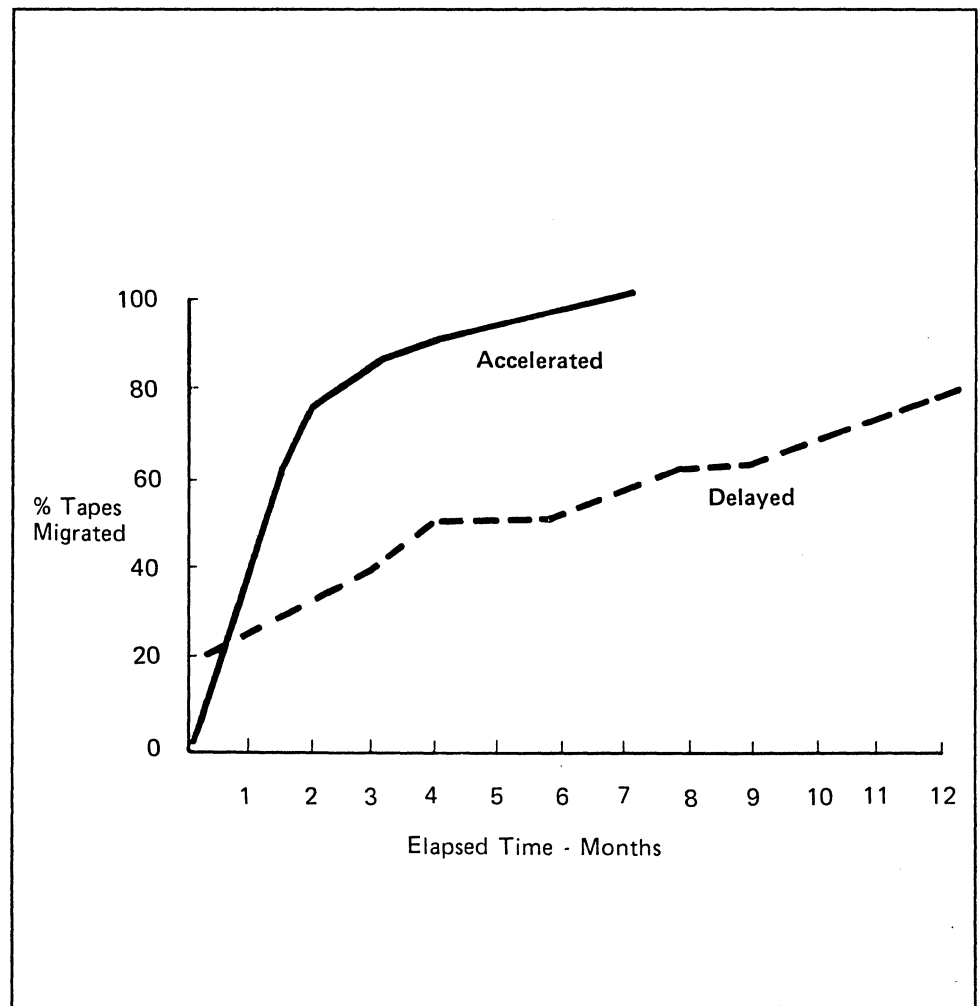


Figure 25. Library Migration Schedule

Selecting Alternative Conversion Methods

When the library profile is completed, you should investigate alternative migration approaches. You should plan the sequence and schedules in relation to all other activities planned for the transition to the 3480 subsystem.

By now you should know the major categories of files, number of reels in each category, and the turnover rate. You may know, for example, that the majority of tape files in a library are processed within a relatively short period—from two to four months. Other tape files, for example, annual or semi-annual master files, can take much longer in the normal cycle. Next you need to determine the resources required to complete the project. Methods of refining an analysis are covered in the following sections. When deciding whether to move particular categories of files in the normal process cycle or to convert them, consider the following factors:

- Choosing to move a category of files during normal processing requires no extra resources other than those required to control the new job flow, for example, JCL and monitoring. This approach, using the *reel* master-in/*cartridge* master-out occurs at the turnover rate of the files. The rate of turnover determines the number of reel-type drives that must be available.
- Choosing to convert files can speed up the transition. Converting the files from reel-type to cartridge-type can be achieved quickly with benefits in performance, data reliability, space, and other cost savings. These benefits must be evaluated against the extra resource requirements for people, schedules, and nonproductive or additional job time.

Developing a Data Migration Strategy

Another aspect of planning involves the sequence to follow during the migration/conversion. You develop your own strategy as to when to migrate or convert. Specific considerations for each category of a library determines where to begin and the preferred sequence. Some considerations are:

- **DASD backup tapes:** These tapes can be converted easily during the first phase of the plan and would quickly reduce library space requirements and improve performance. Large-scale data transfer is involved, which lends itself to device and data transfer verification with familiar utilities.
- **Process tapes:** These tapes can be converted either selectively or at the normal process rate. Application programming personnel or operations staff who normally audit application job flow might monitor the transition. This category should account for the majority of the conversion/migration workload.

- **Archive tapes:** All new archive volumes can be created on the 3480 cartridge, with the understanding that some might be recalled by a processing agency that requires a tape reel. In those instances, the cartridge would have to be copied onto a tape reel before shipment. The existing archive tapes can be converted to take advantage of space and data integrity improvements with the same understanding.
- **Journal tapes:** Journalizing typically uses a read-back-check after a record is written to assure the accuracy of the data. Because the 3480 subsystem is buffered, the write validity check option can be used for these journals. (See “Chapter 4. Planning for Application Changes” on page 47 for further discussion of the implementation of write validity check.) Some journalizing does not demand this high level of integrity and can migrate. Those journal tapes that do require a high level of integrity should remain on reel-type drives until the application is modified accordingly. The 3480 is a high-performance, batch-mode device. While it can be used in Tape Write Immediate mode (write validity checking) for those applications that require very low logging activity, it is not recommended for high-activity logging, such as journalizing, because the effective data rate is lowered. High-activity logging applications can use DASD logging as an alternative.
- **Interchange tapes:** These tapes cannot migrate initially. They require selective conversion based on the ability of the interchange system to operate with the 3480 cartridge. Enough reel-type drives must be kept to satisfy interchange demands.

To develop a migration strategy, you should assume that you plan a complete migration/conversion of all possible reels, except for interchange and journal tapes. The total number of cartridges required is equal to the sum of process, DASD backup, scratch, and archive tapes in the current inventory plus possible additions for growth. Enough reel-type drives must be kept to process the interchange and journal tapes.

Planning for the Requirements for Tape Drives

During the period of migration/conversion, the requirement for reel-type drives diminishes, with a corresponding increased requirement for 3480 tape drives. You must carefully plan how to make the equipment available and how to phase it in to avoid job scheduling difficulties. Problems can occur if the need for either type of tape drive exceeds the number available.

The maximum number of allocated tape drives during a shift (reserve drive capacity) is usually known by operations personnel. It can be advantageous to determine the reserve drive requirements more precisely during the 3480 migration period. In MVS, System Management Facilities (SMF) data shows how many devices are allocated at the same time. SMF step termination records can be used with type 74 records to produce this information. For further information, see *OS/VS2 MVS System Programming Library: System Management Facilities*. Extra drives can be kept as reserve drives, particularly during the early stages of the migration project.

Defining tape drive requirements during migration to the 3480 subsystem involves the following steps:

1. Subtract the number of reel-type drives you must keep from the total number of drives you need for maximum tape drive allocations. The drives you must keep include:
 - Drives for interchange tapes, including 800/1600 bpi
 - Drives for journalizing tapes not converted to 3480
 - Reserved drives for these categories.

The balance of the drives become the replacement pool.

2. Determine the number of control units you need to connect the reel-type drives you keep, allowing for appropriate backup and channel attachment.
3. Determine the number of 3480 control units and drives that are required to substitute for the replacement pool. This may not be a direct one-for-one replacement; for example, fewer control units may be required in some environments with multiprocessor attachments because of the increased channel attachment capability of the 3480 control unit.
4. Verify that the reserve drive capacity is adequate for each stage of the migration to the 3480 subsystem. To check this, use the log that shows the devices in use at the same time.

The library turnover chart, in combination with the 3480 delivery schedule, helps you to develop a useful migration plan.

Scheduling the Migration

Detailed scheduling of the individual steps is necessary. This section describes:

- A method of determining the dependencies for jobs on various data sets
- Scheduled and unscheduled tape jobs
- Special considerations.

Determining Data Dependencies

Data dependencies refer to the many jobs and steps in which a particular tape volume is used during its active lifetime or cycle and in which JCL changes are required. You can use a migration control register or JCL analysis to produce a list of the data sets on a volume and all job and step names that refer to the data set. Analysis of the catalog or files from a tape management system is required to develop a list of all the data sets involved. You can use the access method services LISTCAT command. Tape management systems can also have this type of report available. This list should be sorted on the data set name in the VOLSER sequence.

Using this data, analyze the procedure library to find the procedure name, job, step, and DD names of all the data sets that can migrate from the tape volume. Figure 26 shows a sample report of this type. The value of the report depends on the completeness of the data and can be affected by the use of uncataloged tape data sets or the use of JCL that is not in a procedure library. SMF data is another possible source of information for completing this task. As the migration progresses, the UNIT= parameter must be changed from its current value to an esoteric-name for the IBM 3480 tape units. If all tape data sets are cataloged and if JCL that refers to them has only DSN=name, DISP=OLD/SHR, (no reference to unit or volume serial number), you must change only those JCL statements that have the DISP=NEW parameter to the new unit name during normal migration processing. This causes the new tapes to be cataloged as 3480 units.

JCL ANALYSIS			
VOLSER1			
DSNAMEA			
-	PROCNAME1		
-	JOBNAME1		
		STEP1	
		DDNAME1	UNIT=TAPE
		STEP2	
		DDNAME2	UNIT=TAPE
		ETC.....	
-	PROCNAME2		
-	JOBNAME2		
		STEP1	
		DDNAME3	UNIT=TAPE
		ETC.....	
DSNAMEB			
-	PROCNAME3		
-	JOBNAME3		
		STEP1	
		DDNAME4	UNIT=TAPE
		ETC.....	
VOLSER2			
ETC.			

Figure 26. JCL Analysis

Moving Data as Part of Regularly Scheduled Work

If you move your data from tape reels to tape cartridges as part of regularly scheduled work, the number of tape allocation requests is limited to the number of 3480 tape drives installed. Therefore, you can avoid the JES2 “waiting for allocation” situation or a system decrease in the work processed in JES3 systems.

To ease the scheduled migration, you might find it helpful to build a series of charts like the one shown in Figure 27. A 24-hour chart should be constructed for each business cycle and should be updated to reflect changes or scheduling modifications that occur during the migration. This chart is particularly helpful to ensure that you always have enough drives available when you start removing equipment.

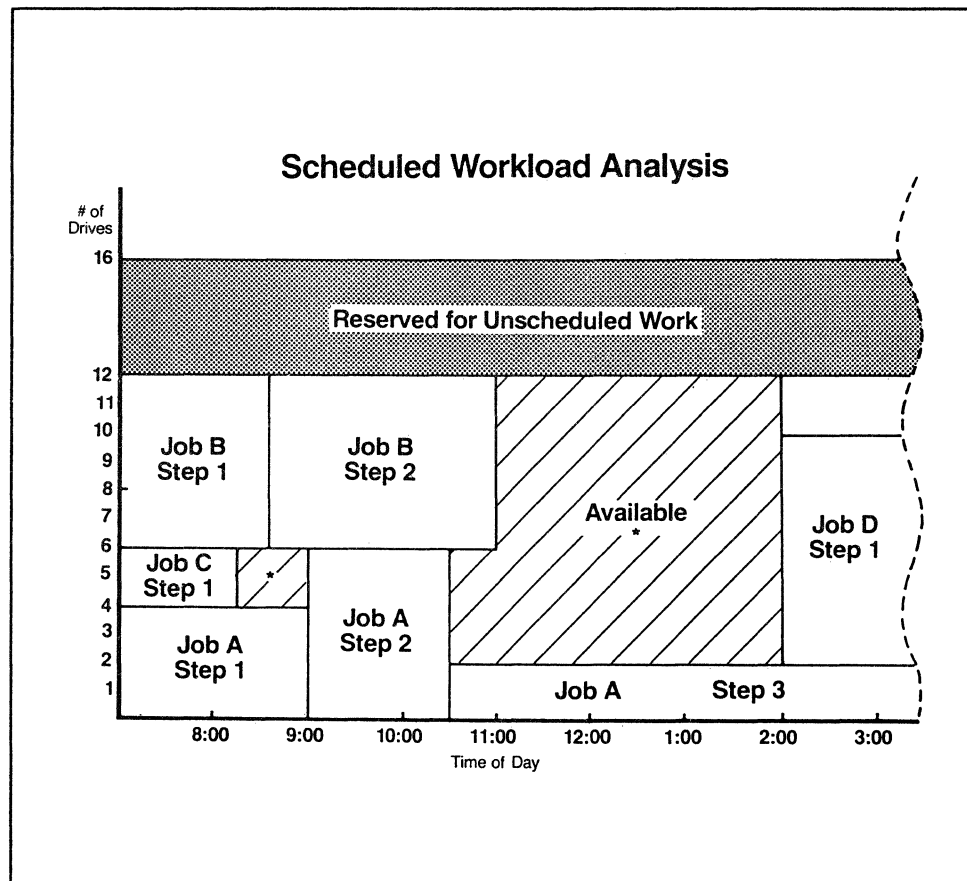


Figure 27. Sample Worksheet of Scheduled Workload Analysis

After building these charts, begin moving work by type of data set. Change the unit parameter in the affected DD cards to the esoteric name chosen for the 3480 tape units. If the subsystem is running in 3420 compatibility mode, DDR swap is not available for 3480 tape units. Long-running tape jobs that cannot use checkpoint/restart for recovery are not recommended for conversion at first. Delay the conversion of these jobs until your expectations for 3480 subsystem reliability are confirmed.

Migrating Unscheduled Work

If unscheduled tape jobs are permitted and exist in significant numbers, you should control access to the 3480 tape drives during the conversion/migration period. In a JES2 system, access can be controlled by reserving a certain number of drives for these jobs, and placing the jobs in a special-hold class for setup. This prevents unscheduled work from interfering with regular allocation of scheduled jobs. JES3 already accomplishes this kind of control.

Special Considerations

The following are some special situations to be considered when migrating to the 3480 subsystem.

Generation Data Group (GDG)

When a generation data group migrates from tape reel to tape cartridge during normal processing, there can be a period when a multimedia generation data group exists. GDGs that have versions on different volume types can be processed together by concatenation or the use of GDGALL. If, during normal processing, you routinely retrieve a multiple generation by concatenation, consider converting the entire group at one time.

Multifile Volumes

All JCL for each of the data sets on these volumes must be converted simultaneously.

Multivolume Files

No special care is required for multivolume data sets because all volumes are the same type.

Block Sizes

Because procedures and JCL are examined and modified during the migration, it might be appropriate to look for inefficient block size specifications at the same time. Elimination of 80-byte block sizes is a good example.

Sample Migration Plan

The example described in the following paragraphs illustrates and reviews the methods presented in this chapter. The installation/migration plan, shown by Figure 29 on page 83, Figure 30 on page 85, and Figure 31 on page 86 represents the end result of a planning process example.

The example is intended to represent the process of the migration as it was planned within the context of operations resources, delivery schedules of the 3480 drives, tape library completion, and software readiness.

The existing sample MVS computer installation includes:

- 3 IBM 308X processors
- 8 3803 Model 2 Control Units
- 48 3420 Tape Drives.

The original 3420 tape pool is configured with two 3 x 16 subsystems, each of which can access all three processors, and one 2 x 16 subsystem that can access two of the processors and includes two dual density drives (6250/1600).

As shown in Figure 28, the tape library contains 50,000 reels subdivided into categories as determined by the library inventory.

Tape Category	Percent of Total	Number of Reels	Cartridge Requirements
Process	68	34,000	34,000
DASD backup	4	2,000	2,000
Scratch	3	1,500	1,500
Interchange	3	1,500	0
Journal	2	1,000	0
Archive	20	10,000	2,500
Total	100	50,000	40,000

Figure 28. Cartridge Requirements for Tape Categories

Assume that the library turnover profile for the installation is the same as was shown in Figure 24 on page 74. The cartridge unit library facilities and all other physical planning requirements were completed before the arrival of the first 3480 tape subsystem. System software is ready and cartridge shipments correspond with the plan. Further, because adequate resources are available, a decision to accelerate the project has been made.

The strategy is to complete the transition in six to seven months to minimize the project control staffing and expenses that would be required until the end of the year. If all the tasks could be accomplished to keep pace with the reel-to-cartridge transfer, the turnover profile indicated that most of the migration would have been completed after a year anyway.

Because the cartridges need to be labelled and initialized and the operators need to be trained and to become familiar with the project and the devices, it was decided that the project should move slowly in the early stages. The library turnover and migration curves in Figure 29 on page 83 show the slow pace in the beginning of the project.

After one month, only 10% of the potential 40% of the files are on cartridges. After three months, 40% of the potential 80% are transferred.

In the next three months, the steady rate of migration and conversion surpasses the turnover rate.

The migration to cartridges represents an approximately even work load over the project. Library turnover is shown as determined by the project team.

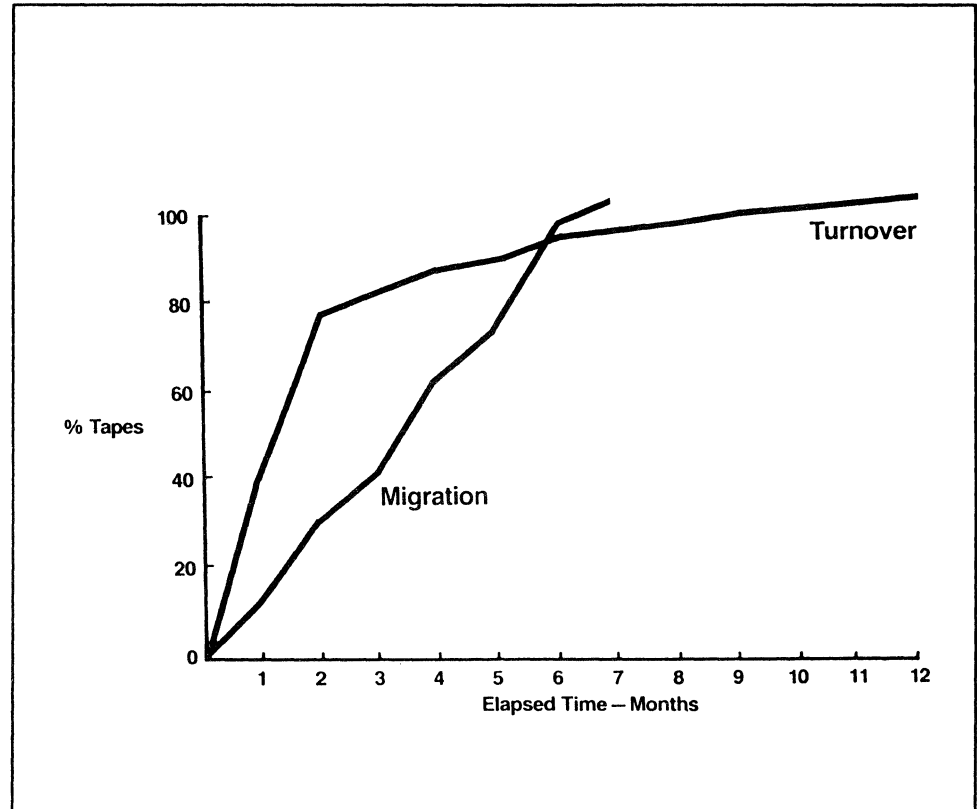


Figure 29. Cartridge Migration vs Actual Library Turnover

To allow for the start-up tasks, some of the weekly/monthly process tapes remain on reels until the later months of the plan. Conversion processing starts in the early months of the project. The files that are represented on the turnover curve between the seventh and twelfth months were preselected and are converted in the first few months of the project.

Enough drives and processor resource must be available during these early months to perform most of the conversion processing. The extra tape drive capability that was shown in the scheduling analysis charts was a factor in the decision to perform the early conversion processing.

Although interchange or journal tapes are not converted, five percent of the archive tapes are converted. Therefore, 40,000 cartridges are needed to complete the migration.

Based on SMF studies of concurrent drive activity, the highest requirement for 3420 drives is equal to or fewer than 32 at the end of the third month, and equal to or fewer than 16 at the end of the fifth month. Interchange and journal tape processing require that six 3420 drives (including two dual density) and two 3803 control units be kept. Ten 3420 drives can be

released at the end of the sixth month. This last group of 3420 drives provides an adequate contingency for schedule changes.

Three dual control unit 3480 subsystems provide a 1:1 replacement for forty-two 3420 tape drives and six 3803 control units. Two 3480 subsystems are fully configured with sixteen tape drives each and the last subsystem contains ten drives, six on one control unit and four on the other. All 3480 tape drives are accessible by the three processors.

Figure 30 on page 85 represents the total productive tape configuration at three points in the 3480 project. Section 1 shows the configuration at the beginning of the project. The section includes the assumption that the 3480 tape subsystem has been installed long enough to have completed its acceptance testing. Section 2 shows the configuration at the beginning of the fourth month. Another subsystem is being installed now, but is not shown since it is not yet a usable resource. Section 3 is the final configuration. Tape drive configurations are shown at the beginning of the migration, after the fourth month, and at the end.

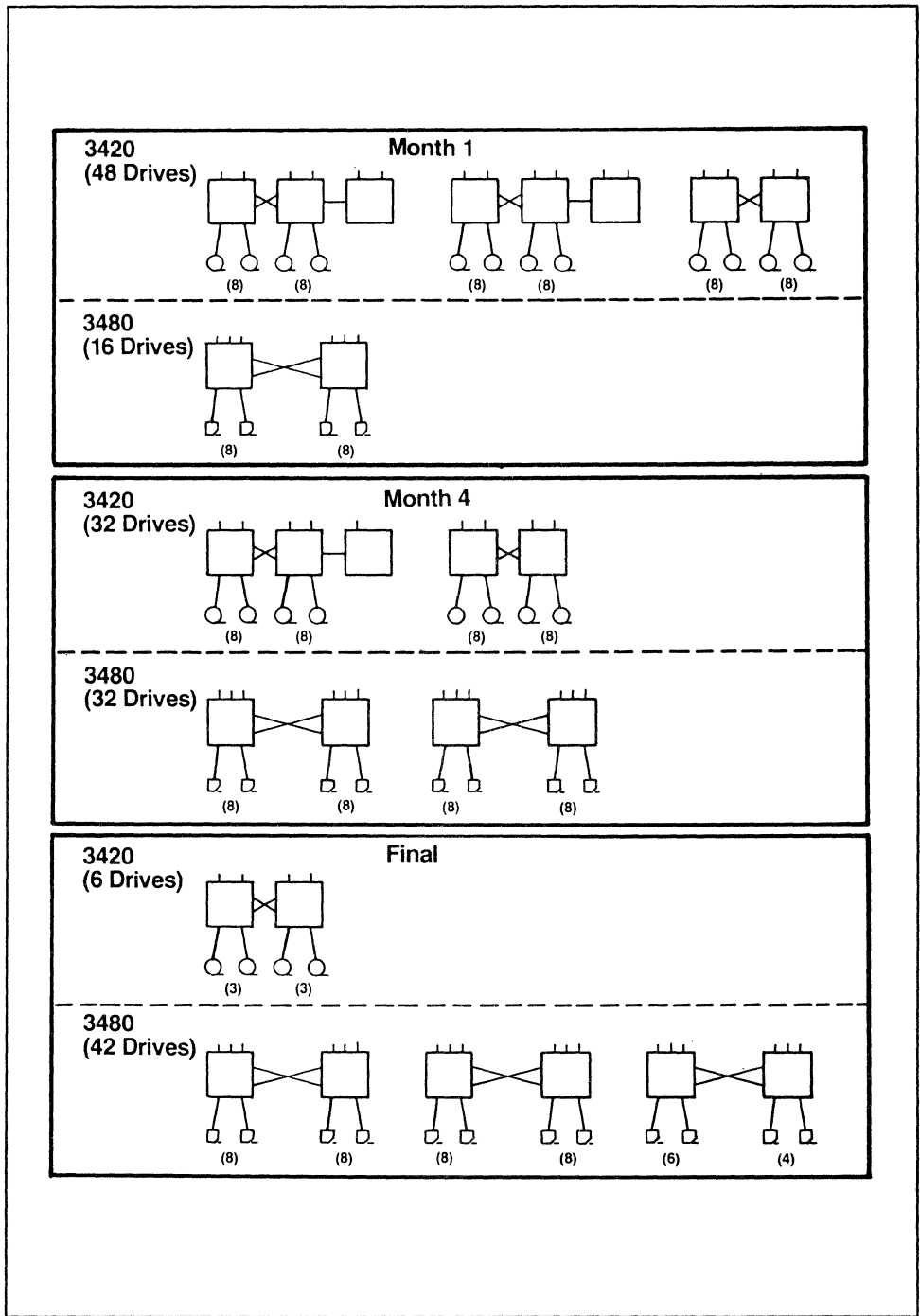


Figure 30. Configuration Capability

Figure 31 and Figure 32 are the last planning documents used in the example project. 3480 installations are matched against 3420 removals and compared with the buildup of cartridge use.

STEP	3480	TESTING	MONTH					
			1	2	3	4	5	6
A (16) 3480 *		I-----	---	---	---	---	---	---
B (16) 3480 *			I---	---	---	---	---	---
C (10) 3480 *					I---	---	---	---

* Each includes 2 Controllers

STEP	3420	TESTING	MONTH					
			1	2	3	4	5	6
1 (3) 3803, (16) 3420		-----	---	---	---	R		
2 (3) 3803, (16) 3420		-----	---	---	---			R
3 (10) 3420		-----	---	---	---			
Retained reel drives (2) 3803, (6) 3420		-----	---	---	---			

Figure 31. Example of Equipment Install/Removal Schedule

			MONTH					
			1	2	3	4	5	6
CARTRIDGES in use %	-----	0	11	28	40	60	72	92
3480 drives in use %	-----	0	33	66	66	100	100	100
REELS in use %	-----	100	89	72	60	40	28	8
3420 drives in use %	-----	100	100	100	67	67	33	12

Figure 32. Example of Cartridge Migration Schedule

Data Migration Planning Tasks

This chapter describes the following tasks from the checklist in Appendix A, “Checklist of Installation Tasks” on page 89.

Data Migration Planning

1. Classify library
2. Inventory library by categories
3. Determine library turnover
4. Examine migration vs conversion of files
5. Determine migration strategy
6. Coordinate with hardware and cartridge availability
7. Develop production schedule
8. Produce migration plan.

Data Migration Implementation

1. Develop project control procedures
2. Select initial migration files
3. Modify JCL
4. Run migration targeted jobs
5. Verify progress.

Appendix A. Checklist of Installation Tasks

The following is a sample checklist of tasks to be performed when developing an installation plan for the 3480 subsystem and is not intended to apply to all environments.

This checklist is arranged by planning categories.

Configuration/Physical Planning Tasks

Configuration Planning

- Determine control unit configuration
- Determine tape unit quantities
 - How many reel-type drive must be kept and for how long?
 - How many 3480 drives are needed to replace reel-type drives?
- Determine feature requirements
 - Additional Channel Adapters?
 - Dual Control Unit Communications Coupler?
 - Automatic Cartridge Loader?

Physical Site Planning

- Determine appropriate power and air-conditioning
- Determine equipment location or relocation
- Identify space for spare parts and documentation
- Determine the number and length of required cables
- Determine channel attachments
- Identify device addresses
- Determine number and type of cartridge storage units
 - How many cartridges should I buy?
- Prepare for library rearrangement.

Ordering Equipment

- Order machines and features
- Order cartridges and storage units
- Order cables
- Order documentation
- Schedule facility changes
 - What delivery schedule of drives and cartridges can be accommodated?

Software Planning Tasks

Planning

- Select full function or 3420 compatibility mode
- Identify software releases and maintenance required
- Identify changes or user modifications required
- Identify vendor software impact
- Develop a software build and test plan
- Identify operational impact
- Coordinate with other project areas.

Installation

- Collect and apply maintenance
- Rework and apply modifications
- Generate the system
- Regression and stress test the system
- Update the documentation and procedures.

Testing

- Schedule test time
- Do a regression test

- Do a stress test
- Do a performance test
- Revise the migration plan, if necessary
- Use 3480 subsystem for limited production
- Use 3480 subsystem for full production
- Use 3480 subsystem for production on all systems.

Application Planning Tasks

Education

- Order documentation
- Develop education.

Application Migration Plan

- Determine high-benefit applications
- Examine device-level dependencies
- Select strategy
- Assign schedule and responsibility for applications
- Re-evaluate schedule for hardware/media delivery
- Develop tracking system for migration.

Application Data Verification

- Design data test plan
- Develop test verification procedures.

Operations Planning Tasks

Operations Planning

- Order documentation
- Train operators
- Develop sharing and switching procedures
- Evaluate library operations
- Coordinate with other project areas.

Data Migration Planning Tasks

Data Migration Planning

- Classify library
- Inventory library by categories
- Determine library turnover
- Examine migration vs conversion of files
- Determine migration strategy
 - Which data sets should be moved first?
 - In what order should the rest of the data sets be moved?
 - What data sets cannot be moved?
 - What controls are required during the library conversion?
- Coordinate with hardware and cartridge availability
- Develop production schedule
- Produce migration plan.

Data Migration Implementation

- Develop project control procedures
- Select initial migration files
- Modify JCL
- Run migration targeted jobs
- Verify progress.

Appendix B. Interpreting the Message Displays

This appendix shows and explains the different kinds of messages that can appear on the message display of a 3480 tape drive. These messages may have several different sources:

- Software created messages (MVS only)
 - Messages created by the operating system (JES3-MDS, Allocation, OPEN/CLOSE/EOV processing, checkpoint/restart, DDR, IEHINITT)
 - Messages created by a user program.
- Hardware created messages
 - Device status messages
 - A message requesting the tape drive to be cleaned
 - Messages indicating a hardware error on a tape drive.

Software Created Messages

Software-created messages are generated using the MSGDISP macro. The keywords and parameters are described in detail in *IBM 3480 Magnetic Tape Subsystem User's Reference*. This option is available in MVS software only. VM/SP, VM/HPO, and VSE/SP do not support system-generated messages.

Mount and Demount Messages

The following examples show some of the messages that the operating system creates whenever it issues a MOUNT or DEMOUNT request to the tape drive. The example shows the various results on the message display as well as a brief explanation of how to interpret them.

M volser x	(blinking)	Mount request, before the tape is mounted. <i>x</i> is the label type and may be either S (standard label (LABEL=SL)); N (non-labelled (LABEL=NL), bypass-label-processing (LABEL=BLP), or leading tape mark (LABEL=LTM)); A (alternate label (LABEL=AL)); X (nonstandard label (LABEL=NSL)); or ? (unknown label type).
volser x	(blinking)	Mount request for a tape that was already mounted.
M IEC701 x	(blinking)	Mount request issued by the IEHINITT utility. The volume serial number of volume to be labelled alternates with the IEC701 message on the drive display, and is also shown on the corresponding console message.
volser x	(steady)	The volume has been accepted as an expected mount. The volume serial number is normally displayed until the tape is unloaded.
D volser	(blinking)	Demount request.
R volser	(blinking)	Demount request. The R indicates that the volume be kept close to the tape unit because another mount request for the same volume may come up soon.
K volser	(blinking)	Demount request. The K means keep the volume; that is, no further mount for the same volume is expected.
D	(blinking)	A Demount request was issued by the operating system, but the drive was already empty.
D volser	(alternating)	Demount the volume, and replace it by the other volume. The two messages repeat alternately on the display (each shown for about two seconds) until the demount is done. Then the mount message is shown alone (blinking) until the mount is satisfied.

M volser

(blinking)

Mount request after the demount.

Application Program Message

(anytxt)

(steady)

User Message. The parentheses indicate that the 6-byte message was issued by an application program. The exact meaning of the message is application-dependent.

Messages during OPEN/CLOSE/EOV and Checkpoint/Restart

Occasionally the operator is requested to take an immediate action at the master console regarding a mounted tape volume that does not involve a demount or mount, although the volume may be demounted as a result of the operator response. These action-oriented messages also flash repeatedly with an asterisk as the action indicator (*) followed by a six character message identifier. The identifier is identical with the message identifier of the corresponding message on the tape pool operator's console. The message flashes until the operator responds or until another message is displayed on the drive.

*** IEC254**

(blinking)

Requests permission to write checkpoint entries on a volume.

*** IEC255**

(blinking)

Requests permission to use an existing checkpoint volume.

*** IEC507**

(blinking)

Requests permission to write on an expiration-date-protected volume.

*** IEC510**

(blinking)

Requests permission to proceed with a file-protected output volume.

*** IEC513**

(blinking)

Requests for another volume to successfully write a new label.

*** IEC534**

(blinking)

Requests permission to destroy the volume label.

*** IEC704**

(blinking)

Requests permission to create a new volume label.

For the text of the above messages and the operator reply options for each, refer to *MVS/370 Message Library: System Messages*, Volumes 1 and 2 or *MVS/Extended Architecture Message Library: System Messages*, Volumes 1 and 2.

Hardware-Created Messages

The next examples show how different operator actions and hardware conditions cause drive status messages to be displayed. These messages (for example, NT RDY, READY, UNLOAD,) normally appear with blanks in the first display position. The character ■ in the first and last display positions means that the drive is physically switched offline (for example, ■ NT RDY ■) except for CHK xy messages.

READY U

(steady)

This message appears when a cartridge is loaded and ready. The U means that the tape is unprotected (not file protected). An F in the last display position means the tape is file protected.

REWINDNG

(steady)

The tape is being rewound. Either a Rewind Unload command was received from the host, or the operator pressed the Rewind switch on the tape drive.

UNLOADNG

(steady)

The tape is being unloaded. Either a Rewind Unload command was received from the host, or the operator pressed the Unload switch on the tape drive. The unload process is complete when the cartridge door opens.

(steady)

The cartridge has been removed by the operator. The drive is empty.

NT RDY U

(steady)

The tape is not ready (for example, the operator put the Ready switch in the Not Ready position). The letter U or F in the last display position indicates the file protection setting.

The message NT RDY can be either hardware or software generated. The hardware-generated NT RDY does not blink and is displayed whenever the device is not ready but no I/O request is outstanding.

The software-generated NT RDY does blink and is displayed whenever an I/O request was issued and the device was found not ready. The software-generated NT RDY is accompanied by console message:

IEA000A ddd,INT REQ,... (intervention required).

E.O.T.	(steady)	The tape is getting near the end. Another mount request may come up soon.
LOCATING	(steady)	A high-speed search request was issued. The tape is being positioned. <i>if done by drive itself no reason tape is not loosely wound.</i>
ERASING	(steady)	A Data Security Erase command is being processed.
* CLEAN	(steady)	A certain amount of tape (above a microcode-defined threshold) was processed since the cleaning cartridge was used last time. The drive should be cleaned soon.

Hardware Error Messages

■ CHK xy ■	(blinking)	A hardware error occurred in the tape drive or control unit. Whenever this message appears on one of the message displays, record this code and give it to your service representative. xy is the hexadecimal error code. The ■ symbol does not mean the drive is offline.
■ ■ ■ ■ ■ ■ ■ ■	(steady)	A hardware error occurred in the tape drive.

Example of the Message Display when Processing a Job

The following chart shows a typical sequence of hardware (HW) and MVS software (SW) originated messages as they appear on the message display during processing of a job. A job requires a tape for output. The operator mounts the tape on a drive, and after the job has finished, the tape rewinds and unloads. The operator then removes the tape from the drive.

SEQUENCE OF EVENTS	DISPLAY	MSG ORIGIN	BRIEF DESCRIPTION
1. Mount request by operating system	M SCRTCH S	SW	Tape drive was empty and Not Ready.
2. Operator loads the tape into the drive and presses the RDY switch	READY U	HW	After tape is loaded. (U = Unprotected)
3. Operating system verifies tape	987654 S	SW	Tape is verified and OK (S = Standard Label) Volser is 987654.
4. Application message (optional)	(msgtxt)	SW	Text appears on display.
5. After processing has finished, system rewinds and unloads	REWINDNG	HW	Tape is rewinding.
	UNLOADNG	HW	Tape is unloading.
6. Demount requested by system (Keep)	K 987654	SW	Tape no longer needed for processing.
7. Operator removes cartridge	*	HW	After removing tape, drive is empty.

Figure 33. Message Display Sequence during Tape Processing

Glossary

This glossary defines the special terms, abbreviations, and acronyms that are used in this publication. It does not include all terms previously established for the IBM System/370 or its operating systems; therefore, if you do not find the term you are looking for, refer to the index or to the *IBM Vocabulary for Data Processing, Telecommunications, and Office Systems*, GC20-1699.

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- The *ISO Vocabulary of Data Processing*, developed by the International Standards Organization, Technical Committee 97, Subcommittee 1. Definitions from published sections of this vocabulary are identified by the symbol "(ISO)" preceding the definition. Definitions from draft proposals and working papers under development by the ISO/TC97 vocabulary subcommittee are identified by the symbol "(TC97)," indicating that final agreement has not yet been reached among its participating members.

ABEND. Abnormal end of task.

access method. A technique for moving data between processor storage and input/output devices.

archiving. (TC97) The storage of backup files and associated journals, usually for a given period of time.

argument. * (ISO) Any value of an independent variable.

automatic cartridge loader. A feature for the 3480 tape drive. This feature attaches to the front of the drive and allows both the automatic loading of premounted tape cartridges, and the manual loading of single tape cartridges.

backup-and-recovery application. The short-term retention of records to be used for restoring essential business and system files when vital data has been lost because of program or system errors or malfunctions.

basic sequential access method (BSAM). An access method for storing or retrieving data blocks in a continuous sequence, using either a sequential access or a direct access device.

BCP. Base control program.

beginning of tape. * (ISO) The location on a magnetic tape that indicates the beginning of the permissible recording area.

block. * A collection of contiguous records recorded as a unit. Blocks are separated by interblock gaps (IBG) and each block may contain one or more records.

BOT. Beginning of tape.

BSAM. Basic sequential access method.

buffer. * A routine or storage used to compensate for a difference in rate of flow of data, or time of occurrence of events, when transferring data from one device to another.

capacity. See media capacity.

CCW. Channel command word.

channel. * A path along which signals can be sent, for example, data channel, output channel.

channel command. An instruction that directs a data channel, control unit, or device to perform an operation or set of operations.

channel command word (CCW). A doubleword at the location in main storage specified by the channel address word. One or more CCWs make up the channel program that directs data channel operations.

channel path. The physical path between the channel and one or more control units. Synonymous with channel.

channel path group. One or more channel paths with a common identity over which the channel and the control unit can communicate.

channel status word (CSW). An area in storage that provides information about the termination of input/output operations.

command. See channel command.

contingent allegiance. A condition in which a drive owes a response to a specific channel path because of a unit check.

conversion. The process of changing from one method of data processing to another or from one data processing system to another.

CSW. Channel status word.

DASD. Direct-access storage device.

data. * Any representations such as characters or analog quantities to which meaning is, or might be, assigned.

data base. (TC97) A set of data that is sufficient for a given purpose or for a given data processing system.

data channel. A device that connects a processor and main storage with I/O control units. Synonymous with input/output channel, I/O channel.

data control block (DCB). A control block used by access method routines in storing and retrieving data.

data set. The major unit of data storage and retrieval, consisting of a collection of data in one of several prescribed arrangements and described by control information to which the system has access.

DCB. Data control block.

DDR. Dynamic device reconfiguration.

deferred unit check. A condition in which a drive returns a unit check indication for an event that

occurred asynchronously with the channel commands. The deferred unit check may not refer to the command that receives the indication.

disband group. To remove the grouping of a channel path group.

drive loaded. A condition of a tape drive in which a tape reel or cartridge has been inserted in the drive, and the tape has been threaded to the beginning-of-tape position.

dump. (ISO) To write the contents of storage, or of a part of storage, usually from an internal storage to a external medium, for a specific purpose such as to allow other use of storage, as a safeguard against faults or errors, or in connection with debugging.

dynamic device reconfiguration (DDR). A facility that allows a demountable volume to be moved, and repositioned if necessary, without abnormally terminating the job or repeating the initial program load procedure.

effective recording density. The number of user bytes per unit of length of the recording medium.

Environmental Recording, Editing, and Printing Program. The program that makes the data contained on the system recorder file available for further analysis.

ERA. Error recovery action.

EREP. See Environmental Recording, Editing, and Printing Program

ERP. Error recovery procedures.

error recovery procedures (ERP). Procedures designed to help isolate and, where possible, to recover from errors in equipment. The procedures are often used in conjunction with programs that record the statistics of machine malfunctions.

extended contingent allegiance. A condition caused by a permanent buffered-write error in which the drive responds only to the channel path group from which the write command was received. The extended contingent allegiance continues until a controlling computer in the channel path group retrieves the unwritten data from the buffer or issues a tape motion command.

field replaceable unit (FRU). An assembly that is replaced in its entirety when any one of its components fails. In some cases a field replaceable unit may contain other field replaceable units; for example, a brush and a brush block that can be replaced individually or as a single unit.

file. * (ISO) A set of related records, treated as a unit, for example, in stock control, a file could consist of a set of invoices.

format. * (ISO) The arrangement or layout of data on a data medium.

FRU. Field replaceable unit.

input/output channel. (ISO) In a data processing system, a functional unit, controlled by the processing unit, that handles the transfer of data between main storage and peripheral equipment.

interchange application. The preparation of tapes for use on other systems or devices, either local or remote, or the use of tape data prepared by another system.

IOCP. Input/output configuration program.

JCL (job control language). * A problem-oriented language designed to express statements in a job that are used to identify the job or describe its requirements to an operating system.

journalizing. Recording transactions against a data set so that the data set can be reconstructed by applying transactions in the journal against a previous version of the data set.

K. 1,024 bytes.

loader. See automatic cartridge loader.

load point. The beginning of the recording area on magnetic tape.

logical end-of-tape. A point on the tape where written data normally ends.

M. 1,048,576 bytes

magnetic recording. * (ISO) A technique of storing data by selectively magnetizing portions of a magnetizable material.

magnetic tape. (TC97) A tape with a magnetizable surface layer on which data can be stored by magnetic recording.

magnetic tape drive. (ISO) A mechanism for moving magnetic tape and controlling its movement.

media capacity. The amount of data that can be contained on a storage medium, such as tape, expressed in bytes of data.

migration. See conversion.

OBR. Outboard recorder.

OEM. Original equipment manufacturer.

outboard recorder. A feature that records pertinent data on the system recorder file when an unrecoverable I/O error occurs.

physical end-of-tape. A point on the tape beyond which the tape is not permitted to move.

primed. Pertaining to a condition of a tape drive when the controlling computer has addressed the drive but the drive was not in a ready state.

QSAM. Queued sequential access method.

queued sequential access method. An extended version of the basic sequential access method (BSAM). When this method is used, a queue is formed of input data blocks that are awaiting processing or output data blocks that have been processed and are awaiting transfer to auxiliary storage or to an output device.

quiesce. To bring a device or system to a halt by a rejection of new requests for work.

record. * (ISO) A collection of related data or words, treated as a unit; for example, in stock control, each invoice could constitute one record.

SMF. System Management Facilities.

synchronization. The process of coordinating the activities of the controlling computer and the 3480 subsystem to obtain the condition in which the buffer is empty and the tape is in the correct position for the next operation.

System Management Facilities (SMF). An optional control program feature of OS/360 and OS/VS that provides the means for gathering and recording information that can be used to evaluate system usage.

SYS1.LOGREC. A log of input/output error recording.

tape cartridge. A container holding magnetic tape that can be processed without separating it from the container.

volume. (1)(ISO) A certain portion of data, together with its data carrier, that can be handled conveniently as a unit. (2)(ISO) A data carrier that is mounted and demounted as a unit, for example, a reel of magnetic tape, a disk pack.

Index

A

ABS parameter, NOTE and POINT macros 19, 48
accelerated data migration 75
access method 99
ADDRESS feature, IODEVICE macro 29
ADDVOL 40
ALTCTRL feature 28, 30
alternative conversion methods
 definition 69
 selecting 76
application
 coding in full function mode 48
 special considerations 49
application planning tasks 51, 91
application program message 48
architecture, new features 53
archiving
 definition of 99
 tapes 71, 72, 76
argument, definition of 99
Assign command 42
Assign/Unassign 43
assigning the 3480 drives 5
attachment
 channels 13
 processor compatibility 11
automatic cartridge loader
 controlling volume allocation 36
 definition of 99
 description 15
 loader operator panel 15
 software support for 24
 SYSGEN and JCL considerations 36
automatic tape threading 6

B

backup and recovery
 DASD planning 70
 definition of 99
 determining tape requirements 72
 migration strategy 76
BACKUP command, DFHSM 40
basic sequential access method
 definition 99
 requirements for 3480 23
beginning of tape, definition of 99
block ID 48
block, definition of 99
BOT
 See beginning of tape
BSAM

 See basic sequential access method
buffer
 definition 99
 description 2
 effects on performance 61
 load balancing 62
 overview 1
buffered read mode 5, 63
buffered write mode
 data streaming 62
 description 62
 device motion 62
 overview 5
Synchronize command 63

C

cable lengths, maximum 14
capacity
 See media capacity
care and handling of cartridges 55
cartridge
 See tape cartridge
catalog considerations 40
CCW
 See channel command word
channel
 additional channel adapters 8
 ADDRESS feature, IODEVICE macro 29
 attachment considerations 13
 block multiplexing 13
 cable lengths, maximum 14
 CHANNEL feature, IODEVICE macro 29
 command retry, EXCP programming 51
 commands used in multiprocessor
 environment 42
 configuration
 examples 12
 samples 13
 definition 99
 interlock 8, 13
 selection algorithm, system or IOCP
 generation 34
 sharing with DASD 14
 streaming 8, 13
 switching considerations 59
channel command word, definition of 100
channel command, definition of 99
channel path group, definition of 100
channel path, definition of 100
channel selection algorithm, system or IOCP
 generation 34
channel status word, definition of 100
check, write validity 49

- checklist
 - application planning tasks 51, 91
 - configuration/physical planning 17, 89
 - data migration
 - planning 87, 91
 - data migration implementation 87, 92
 - implementation 87, 92
 - installation tasks 89
 - operations planning tasks 60, 91
 - ordering equipment 17, 89
 - software planning tasks 44, 90
- checkpoint/restart
 - application description 49
 - messages 95
 - requirements 21
- cleaning cartridge, description 53
- CLOSE messages 95
- CNTLUNIT macro, IOCP generation 32
- compatibility mode
 - compared to full function 20
 - converting to full function mode 41
 - introduction 7
 - IODEVICE macro 28
 - JES initialization 35
 - MVS/XA requirements 21
 - MVS/370 requirements 22
 - sharing in a multi-user environment 42
 - UNIT parameter, UNITNAME macro 31
- compatibility, processor 11
- configurations
 - checklist 17, 89
 - dual control units 12
 - examples 12
 - limitations 12
 - samples 13
 - single controller 11
- contingent allegiance, definition of 100
- Control Access command 42
- control unit
 - description, general 2
 - dimensions 2
 - dual control units 12
 - single control unit 11
- conversion methods
 - definition 69
 - selecting 76
- converting from compatibility mode to full function mode 41
- converting from 3420 to 3480 41
- CSW
 - See channel status word

D

- DASD backup
 - determining tape requirements 72
 - migration strategy 76
 - tape characteristics 70
- data base, definition of 100
- data chaining 49
- data channel, definition of 100
- data control block, definition of 100
- data conversion 69, 75
- data dependencies 78
- data facility data set services (DFDSS) 23
- data facility hierarchical storage manager (DFHSM) 23
- data facility sort (DFS) 23
- data migration
 - block sizes 81
 - conversion, accelerated vs delayed 75
 - definition 67, 100
 - determining data dependencies 78
 - developing a library profile 70
 - developing strategy 76
 - generation data groups 81
 - installation plan 75
 - JCL analysis 79
 - JCL analysis example 79
 - library
 - composition 70
 - inventory 72
 - migration schedule 75
 - turnover 73
 - multifile volumes 81
 - multivolume files 81
 - planning checklist 87, 91
 - sample
 - cartridge migration schedule 86
 - configuration 81
 - configuration capability 85
 - configuration schedule 84
 - equipment installation/removal schedule 86
 - installation 81
 - library inventory 82
 - start-up tasks 83
 - turnover profile 82
 - scheduled work
 - migrating 80
 - sample worksheet 80
 - scheduling 78
 - selecting conversion method 76
 - special considerations
 - block sizes 81
 - generation data groups 81
 - multifile volumes 81
 - multivolume files 81
 - tape drive requirements 77
 - turnover chart 74
 - UNIT parameter 79

- unscheduled work 81
- data migration verification 47
- data security erase 51
- data set, definition of 100
- data streaming 62
- data transfer in large (over 102,417 bytes) blocks 6
- data, definition of 100
- DCB
 - See data control block
- DDR
 - See dynamic device reconfiguration
- deferred unit check, definition of 100
- definition of terms 99
- delayed data migration 75
- DELVOL 40
- demount message 93
- device
 - dependencies 50
 - motion 62
 - preference table 32
 - restricted 27
 - specifying 29
- DEVICE macro, JES initialization 35
- DEVICE macro, JES3 initialization 34, 35
- DEVTYPE macro 21, 51
- DFDSS (data facility data set services) 23
- DFHSM (data facility hierarchical storage manager) 23
 - adding the 3480 40
 - requirements 23
 - tape support 40
- DFS (data facility sort) 23
- dimensions, subsystem 2, 3
- direct access device 14
- disband group, definition of 100
- display pod 56
- display, messages
 - See message display
- drive cleaning operations 53
- drive loaded, definition of 100
- drive operations, simultaneous, effect of performance 61
- drive, magnetic tape
 - See tape drive
- DSE (data security erase) 51
- dual communications feature 9
- dual control unit communications 9, 12
- DUMMY device, specifying 29
- dump, definition of 100
- dynamic device reconfiguration
 - compatibility mode 20
 - definition of 100

E

- EDR
 - See effective data rate
- effective data rate (EDR) 50, 63
- end-of-tape
 - caution notice 3
 - description 3
 - logical, definition of 101
 - physical, definition of 101
- environmental considerations 15
- environmental recording, editing, and printing program (EREP) 19, 23, 50
- EOV messages 95
- equipment checklist 17, 89
- ERA
 - See error recovery action
- erase, data security 51
- EREP
 - See environmental recording, editing, and printing program
- ERP
 - See error recovery procedures
- error messages 97
- error recovery procedures, definition of 100
- esoteric name
 - defining 28, 37, 38
 - in UNITNAME macro 31
 - SYSGEN restriction in UNIT parameter 31
 - using in JCL 28, 37, 38
 - warning 28
- EXCP programming 51
- extended contingent allegiance, definition of 100

F

- facilities preparation checklist 60, 91
- FEATURE parameter, IODEVICE macro 30
- field replaceable unit, definition of 100
- file protection
 - feature 6
 - selector 3, 54
- file, definition of 101
- files
 - multivolume 81
 - sample 86
- foreign language option 2
- format, definition of 101
- forward space file 51
- FRU
 - See field replaceable unit
- full function mode
 - ABS parameter, NOTE and POINT macros 19
 - application enhancements 48
 - compared to compatibility 20
 - converting from compatibility mode 41

- EREP support 19
- introduction 7
- IODEVICE macro 28
- JES initialization 34
- LOGREC recording 19
- MSGDISP macro 19
- MVS/XA requirements 21
- MVS/370 requirements 22
- NOTE macro 19
- POINT macro 19
- sharing in a multi-user environment 43
- SYNCDEV macro 19
- UNIT parameter, IODEVICE macro 31

G

- general installation tasks, checklist 89
- generation and initialization, system 27
- generation data groups 51, 81
- generic name assignment 31
- glossary of terms 99

H

- hardware messages 96
- high speed search 6, 48

I

- I/O devices, characteristics of 27
- I/O generations, performing 27
- I/O routines, user-written 29
- IEBCOPY utility 47
- implementing data migration 87, 92
- input/output channel, definition of 101
- installation
 - device preference table 32
 - software checklist 44, 90
 - tasks checklist 89
- interchange application, definition of 101
- interchange tapes 72, 77
- interlock channel 8, 13
- inventory, library 72
- IOCP generation, example 32
- IODEVICE macro
 - ADDRESS feature 29
 - compatibility mode 28
 - description 27
 - DUMMY device 29
 - example
 - compatibility mode 28
 - full function 28

- FEATURE parameter 28
- full function mode 28
- OFFLINE parameter 29
- OPTCHAN parameter 29
- parameter selection 28
- UNIT parameter 29
- IPL and OFFLINE parameters in IODEVICE macro, warning 29
- IPL, standalone program 51

J

- JCL
 - analysis
 - example 79
 - migration control 79
 - definition of 101
 - UNIT parameter values 31, 37, 39
- JES initialization
 - compatibility mode 35
 - full function mode 34
- JES/BCP combinations 22
- JES2 MVS/XA requirements 22
- JES2 MVS/370 requirements 22
- JES3
 - compatibility mode 20
 - MVS/XA requirements 22
 - MVS/370 requirements 22
- journal tapes 71, 72, 77
- journalizing, definition of 101

K

- K bytes, definition of 101

L

- language option 2
- leader block 3
- library
 - common tape categories
 - archive tapes 71
 - DASD backup tapes 70
 - interchange tapes 72
 - journal tapes 71
 - process tapes 71
 - scratch tapes 72
 - determining composition 70
 - inventory 72
 - sample of determining inventory 82
 - storage units 10
 - turnover 73

- turnover chart 74
- turnover profile, sample 82
- LISTCAT command 79
- load balancing, buffer 62
- load point, definition of 101
- loader
 - See automatic cartridge loader
- loader operator panel
 - description 15
- Locate Block command 6, 48, 51
- lockout, preventing 63
- logical end-of-tape, definition of 101
- LOGREC recording 19

M

- M bytes, definition of 101
- magnetic recording, definition of 101
- magnetic tape
 - beginning and end of 3
 - beginning of tape 99
 - caution notice 3
 - common categories 70, 71, 72
 - DASD backup characteristics 70
 - definition 101
 - determining requirements 72
 - IPL 51
 - logical end-of-tape, definition of 101
 - media classifications 70
 - migration strategy 76
 - physical end-of-tape, definition of 101
 - threading 6
- maintenance for tape drive 53
- MAXBACKUPTASKS parameter 40
- media
 - capacity
 - comparison 63
 - definition of 101
 - classifications 70
- message display
 - description 55
 - example when processing 98
 - examples 57
 - flashing lights 56
 - format 56
 - hardware messages 96
 - interpreting messages 93
 - selected light 56
 - software 93
 - types of messages 55
- migration
 - See data migration
- motion of tape 62
- mount message 93
- MSGDISP macro 19, 48
- multifile volumes 81
- multivolume files 81
- MVS/Extended generation, example 32

N

- MVS/XA requirements, JES2 and JES3 22
- MVS/370 requirements, JES2 and JES3 22
- nonsupported device, specifying 29
- NOTE macro 19
- NOTE/POINT macro 48

O

- OBR
 - See outboard recorder
- OFFLINE and IPL parameters in IODEVICE macro, warning 29
- OFFLINE parameter 31
- OFFLINE parameter, IODEVICE macro 29, 31
- online device in IODEVICE macro, specifying 29
- OPEN messages 95
- operations planning tasks 60, 91
- OPTCHAN parameter of IODEVICE macro, specifying 29
- optional features in IODEVICE macro, specifying 30
- options, specifying 29
- outboard recorder, definition of 101

P

- partitioning
 - See sharing
- performance characteristics
 - effect of buffering 61
 - effect of simultaneous drive operations 61
 - effect of the block size 63
 - factors affecting 60
- performance comparison, tape subsystem 64
- physical end-of-tape, definition of 101
- physical plant considerations 15
- physical site planning checklist 17, 89
- planning checklist
 - data migration tasks 91
 - installation tasks 89
- planning checklists
 - data migration tasks 87
- plant considerations 15
- POINT macro 19
- primed, definition of 101
 - QSAM 101
- process tapes 71, 73, 76
- processor compatibility 11
- protection of file 6

PROTOCOL parameter, CNTLUNIT macro 32

Q

QUERY BACKUP command, DFHSM 40

queued sequential access method

definition 101

requirements for 3480 23

quiesce

changing channel speed 59

definition 101

R

read block ID 51

read-back-check 6, 49

record, definition of 101

recording density, definition of 100

reel capacity 63

requirements for MVS/extended architecture, JES2
and JES3 22

requirements for MVS/370 22

requirements for other IBM MVS products 23

restart 49

S

scheduled work, migration 80

scheduling migration 78

SCHEDULR macro 31

scratch tapes 72, 73

search, high speed 6, 48

sense bytes 49

Set Path Group ID command 42

SETNAME macro, JES3 initialization 34, 35

SETSYS 40

SETSYSCOMMAND, DFHSM 40

SHARABLE feature, IODEVICE macro 28, 30

sharing

compatibility mode 42

direct access device 14

full function mode 43

in a multisystem environment 41

introduction 5

mixed mode guidelines for JES2

environment 43

multiple processors 59

SMF 101

software planning tasks checklist 44, 90

software selection, 21

software support

comparison of full function and compatibility
modes 20

compatibility mode 6, 20

for the automatic cartridge loader feature 24

full function mode 6, 19

VM support 44

software-created messages instruction. 93

sort requirements 23

streaming channel 8, 13

switching channels 59

SYNAD routine, update-in-place 49

SYNCDEV macro 19, 48

synchronization

definition of 101

SYNCDEV macro 48

Synchronize command 63

SYSGEN statements, sample 31

SYSGEN statements, samples 36

system generation and initialization 27

System Management Facilities (SMF)

definition 101

using drive usage to plan data migration 77

SYSl.LOGREC

definition 101

full-function support 20

T

tape

See magnetic tape

tape cartridge

automatic cartridge loader feature 24, 36

capacity 3

care and handling 55

cleaning 53

comparison with 3420 reel 63

definition 101

description, general 3

dimensions 3

file protect selector 3

leader block 3

loader 24, 36

migration considerations 77

system library, description 10

tape drive

cleaning 53

definition 101

description, general 2

dimensions 3

maintenance 53

tape media classifications 70

tape subsystem performance comparison 64

tape synchronous mode 6

tape unit 2

tape-write-immediate mode 6

testing checklist, software 44, 90

threading tape 6

transferring large (over 102,417 bytes) blocks of data 6

U

UCB

See unit control block

UCW

See unit control word

Unassign command 42

unit address, specifying

in IODEVICE macro 29

unit control block (UCB), IODEVICE macro 29

unit control word (UCW) 61

UNIT parameter

IODEVICE and UNITNAME macros 31

JCL statements 79

of IODEVICE macro 29

UNITNAME, SETSYS command 40

unscheduled work, migration 81

update-in-place 49

user-written I/O support routines 29

V

Vary command 5, 42

verification, data migration 47

VM software support 44

volume, definition of 101

W

write validity check 49

Numerics

303x processor 11

3042-2 processor 11

308x processor 11

3480 magnetic tape subsystem

adding to your computer system 40

advantages 53

architecture, new features 53

configurations

dual control units 12

limitations 12

single controller 11

converting from 3420 41

description 2

device type dependencies 50

new features 1

overview 1

performance characteristics 60

software checklist 44, 90

4341 processor 11

4381 processor 11

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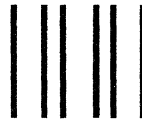
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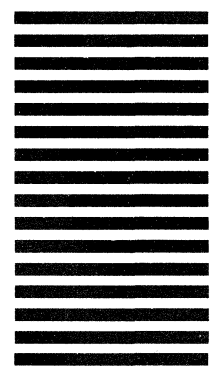
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