Virtual Tape Control System

Administrator's Guide

Version 6.1.0

CRC Update Only

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Revision G - February 2008

This edition applies to Version 6.1.0 of the Virtual Tape Control System software. Information in this publication is subject to change. Send comments about this publication to:

SLSFS@sun.com

Please include the publication name, part number, and edition number in your correspondence if they are available.

About this Book

Virtual Tape Control System 6.1.0 (VTCS 6.1.0, hereafter referred to as “VTCS”) is MVS host software, which together with the portions of NCS 6.1.0 that support VTCS and the Virtual Tape Storage Subsystem (VTSS), comprises Virtual Storage Manager (VSM).

Audience

This guide is for StorageTek or customer personnel who are responsible for administering VTCS and VSM. Also see the following:

- *VTCS Installation and Configuration Guide* for information about installing and configuring VTCS.
- *VTCS Command and Utility Reference* for VTCS and NCS reference information.

Reader’s Comments

If you have comments on this book, please e–mail us at `slsfs@sun.com` and include the document title and number with your comments.

Prerequisites

To perform the tasks described in this guide, you should already understand the following:

- MVS or OS/390 operating system
- JES2 or JES3
- System Management Facility (SMF)
- System Modification Program Extended (SMP/E)
- Nearline Control Solution (NCS)

About the Software

This guide applies to VTCS 6.1.0 and NCS 6.1.0 and above. VTCS executes in the native MVS or OS390 environment and does not use or require OS390 OpenEdition services.

How this Guide is Organized

This guide contains the following sections:

- Chapter 1 “VSM Overview”
- Chapter 2 “Managing VSM”
- Chapter 3 “VSM Operations”
- “Glossary”
- “Index”

What’s New in This Guide?

Revision G

The VTCS 6.1.0, Revision G of this guide contains information about the VTCS 6.1 enhancements described in Table 1.

Table 1. VTCS 6.1.0 Updates to VTCS Administrator’s Guide, Revision G

This Enhancement...	...is described in...
Synchronous Replication	“Synchronous/ Asynchronous Replication” on page 75

Synchronous replication, which applies to only VSM4s and VSM5s, has the requirements described in Table 2.

Table 2. Sychronous Replication Requirements for VTCS/NCS 6.1

Synchronous replication requires...	..the following VSM4/VSM5 microcode...	...and the following VTCS/NCS 6.1 PTFs...	...and CDS level...
FICON ports for the CLINKs	D02.03.00.00 or higher	L1H13QS (SWS6100) and L1H13MI (SOS6100)	“F” or higher

Revision F

Revision F of this Guide contains technical updates and corrections.

Revision E

Revision E of this Guide contains technical updates and corrections.

Revision D

Revision D of this Guide contains technical updates and corrections.

Revision C

Revision C of this Guide contains technical updates and corrections.

Revision B

Revision B of this Guide contains technical updates and corrections.

Revision A

Revision A of this Guide contains updates to “Implementing a Clustered VTSS Configuration” on page 56.

Initial Release

The VTCS 6.1.0, Initial Release of this guide contains information about the VTCS 6.1 enhancements described in Table 3.

Table 3. VTCS 6.1.0 Updates to VTCS Administrator's Guide, Initial Release

This Enhancement...	...is described in...
Bi-Directional Clustering	• "Clustered VTSS Configurations" on page 13 • "Implementing a Clustered VTSS Configuration" on page 56
Near Continuous Operations (NCO)	"Near Continuous Operations (NCO)" on page 15
Multi-Volume VTVs	• "How VSM Automatically Manages VTSS Space and Migrates VTVs" on page 5 • "How VSM Automatically Recalls Migrated VTVs" on page 7

Conventions for Reader Usability

Conventions are used to shorten and clarify explanations and examples within this book.

Typographic

The following typographical conventions are used in this book:

- **Bold** is used to introduce new or unfamiliar terminology.
- `Letter Gothic` is used to indicate command names, filenames, and literal output by the computer.
- `Letter Gothic Bold` is used to indicate literal input to the computer.
- `Letter Gothic Italic` is used to indicate that you must substitute the actual value for a command parameter. In the following example, you would substitute your name for the "username" parameter.
- Logon *username*
- A bar (|) is used to separate alternative parameter values. In the example shown below either username or systemname must be entered.
- Logon *username*|*systemname*
- Brackets [ ] are used to indicate that a command parameter is optional.
- Ellipses (...) are used to indicate that a command may be repeated multiple times.
- The use of mixed upper and lower case characters (for non–case sensitive commands) indicates that lower case letters may be omitted to form abbreviations. For example, you may simply enter **Q** when executing the **Quit** command.

Keys

Single keystrokes are represented by double brackets [[ ]] surrounding the key name. For example, press [[ESC]] indicates that you should press only the escape key.

Combined keystrokes use double brackets and the plus sign (+). The double brackets surround the key names and the plus sign is used to add the second keystroke. For example, press [[AL]] + [[C]] indicates that you should press the alternate key and the C key simultaneously.

Enter Command

The instruction to "press the [[ENTER]] key" is omitted from most examples, definitions, and explanations in this book.

For example, if the instructions asked you to "enter" **Logon pat**, you would type in **Logon pat** *and* press lENTERm.

However, if the instructions asked you to "type" **Logon pat**, you would type in **Logon pat** and you would *not* press [[ENTER]].

Symbols

The following symbols are used to highlight text in this book.

Warning: Information necessary to keep you from damaging your hardware or software.

Caution: Information necessary to keep you from corrupting your data.

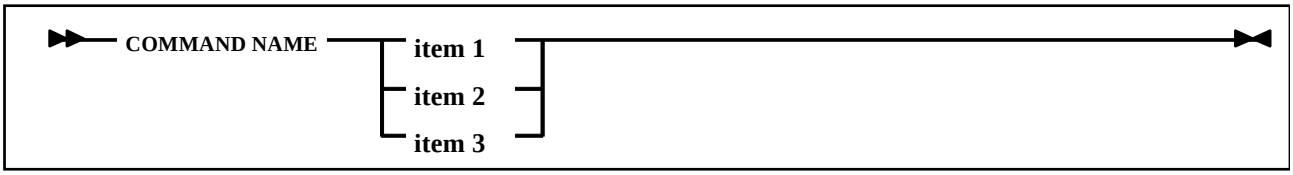
Hint: Information that can be used to shorten or simplify your task or they may simply be used as a reminder.

Note: Information that may be of special interest to you. Notes are also used to point out exceptions to rules or procedures.

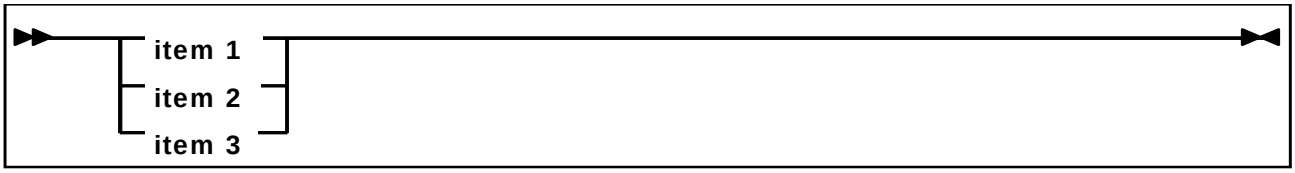
Syntax

Syntax flow diagram conventions include the following:

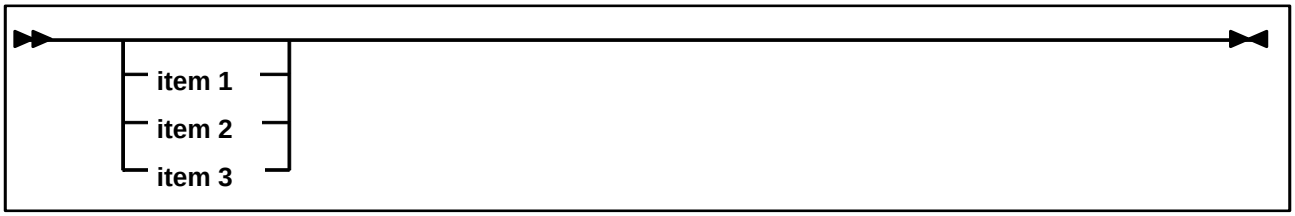
Flow Lines—Syntax diagrams consist of a horizontal baseline, horizontal and vertical branch lines and the command text. Diagrams are read left to right and top to bottom. Arrows show flow and direction.



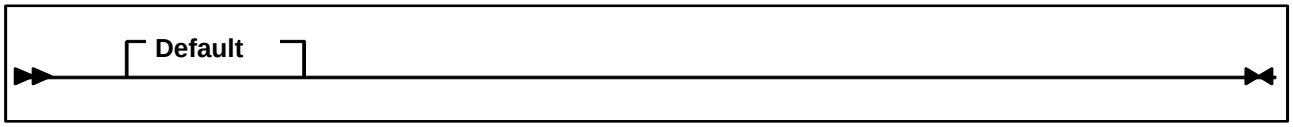
Single Required Choice—Branch lines (without repeat arrows) indicate that a single choice must be made. If one of the items to choose from is on the baseline of the diagram, one item must be selected.



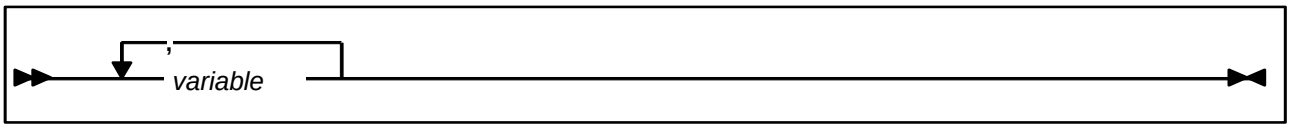
Single Optional Choice—If the first item is on the line below the baseline, one item may optionally be selected.



Defaults—Default values and parameters appear above the baseline.



Repeat Symbol—A repeat symbol indicates that more than one choice can be made or that a single choice can be made more than once. The repeat symbol shown in the following example indicates that a comma is required as the repeat separator.



Keywords—All command keywords are shown in all upper case or in mixed case. When commands are not case sensitive, mixed case implies that the lowercase letters may be omitted to form an abbreviation.

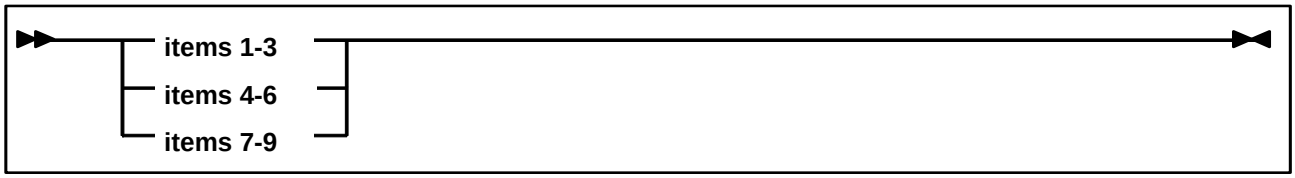
Variables—Italic type is used to indicate a variable.

Alternatives—A bar (|) is used to separate alternative parameter values.

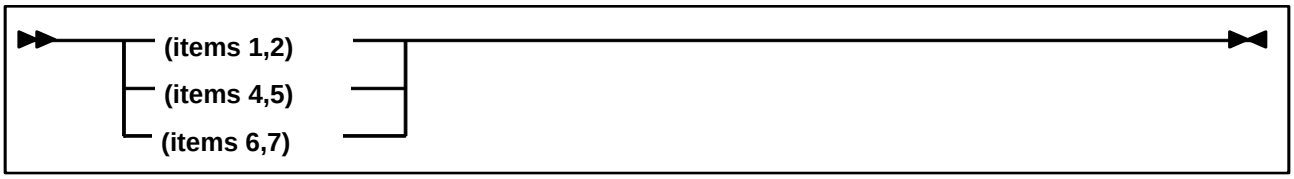
Optional—Brackets [ ] are used to indicate that a command parameter is optional.

Delimiters—If a comma (,), a semicolon (;), or other delimiter is shown with an element of the syntax diagram, it must be entered as part of the statement or command.

Ranges—An inclusive range is indicated by a pair of elements of the same length and data type, joined by a dash. The first element must be strictly less than the second element.



Lists—A list consists of one or more elements. If more than one element is specified, the elements must be separated by a comma or a blank and the entire line must be enclosed by parentheses.



Related Publications

The following publications provide additional information about VSM and StorageTek's Automated Cartridge System software and hardware.

VTCS and VSM

The VTCS and VSM documentation set consists of the following:

- *Introduction to VSM*, which you can request from your StorageTek representative
- The VTCS Information CD-ROM, which contains PDF file formats of *Virtual Tape Control System Installation and Configuration Guide, Virtual Tape Control System Administrator's Guide, Virtual Tape Control System Command and Utility Reference, Virtual Tape Control System Messages*, and *Virtual Tape Control System XML Reference*
- *Virtual Tape Control System Installation and Configuration Guide*
- *Virtual Tape Control System Administrator's Guide* (this book)
- *Virtual Tape Control System Command and Utility Reference*
- *Virtual Tape Control System Messages*
- *Virtual Tape Control System Quick Reference*
- *Virtual Tape Control System XML Reference*
- *VSM Offsite Vault Disaster Recovery Guide* (supplied with the VSM Offsite Vault Disaster Recovery Feature)

VTSS

- *Virtual Storage Manager Planning, Implementation, and Usage Guide*
- *Virtual Storage Manager Physical Planning Guide*
- *VTSS Installation Guide*

NCS	• *NCS Installation Guide* • *SMC Administration and Configuration Guide*
HSC-MVS Environment	• *Configuration Guide* • *Operator's Guide* • *System Programmer's Guide* • *Messages and Codes* • *System Programmer's Reference Summary* • *Operator's Reference Summary*
LibraryStation	• *Configuration Guide* • *Operator and System Programmer's Guide* • *Messages and Codes*
MVS/CSC	• *Configuration Guide* • *Operator Guide* • *System Programmer Guide* • *Messages and Codes*

ExPR

- *Introduction to ExPR*
- *ExPR SMP/E Installation*
- *ExPR MVS Configuration*
- *ExPR MVS Reports*
- *ExPR MVS Reference*

ExLM 4.0.0

The ExLM 4.0.0 documentation set consists of the following:

- The ExLM 4.0.0 Information CD-ROM, which contains PDF file formats of *ExLM Installation Guide*, *ExLM System Administrator's Guide*, *ExLM System Administrator's Guide - Field Tables Supplement,* and *ExLM Messages and Codes*
- *ExLM Installation Guide*
- *ExLM System Administrator's Guide*
- *ExLM System Administrator's Guide - Field Tables Supplement*
- *ExLM Messages and Codes*
- *ExLM Quick Reference*

ExLM 5.0.0

The ExLM 5.0.0 documentation set consists of the following:

- The ExLM 5.0.0 Information CD-ROM, which contains PDF file formats of the ExLM publications
- *ExLM Installation Guide*
- *ExLM System Administrator's Guide*
- *ExLM Messages and Codes*
- *ExLM Quick Reference* (includes information formerly provided in the *ExLM 4.0.0 System Administrator's Guide - Field Tables Supplement*)

IBM Publications

- *IBM ESA/390 Common I/O-Device Commands and Self Description*
- *IBM 3490 Magnetic Tape Subsystem*
  Models A01, A02, A10, A20, B02, B04, B20, and B40
  Introduction
- *IBM 3490 Magnetic Tape Subsystem*
  Models A01, A02, A10, A20, B02, B04, B20, and B40
  Hardware Reference
  (Referred to in this book as the *IBM 3490 Hardware Reference*)
- *IBM 3490 Command Reference*
- *IBM 3480 Magnetic Tape Subsystem Reference*
- *IBM 3480 Installation Guide and Reference*
- *OS/390 V2R4.0 MVS Planning: Global Resource Serialization*
- *MVS Authorized Assembler Services Guide*

Online Documentation on the StorageTek CRC

The StorageTek Customer Resource Center (CRC) on the World Wide Web provides online versions in PDF format of this book, the related StorageTek publications listed on page ix, and many other StorageTek software and hardware publications.

To access PDF documents on the StorageTek CRC:

1. **Using an Internet browser such as Netscape or Internet Explorer, go to the StorageTek CRC at:**

   `http://www.support.storagetek.com/`

2. **Click the** `Login` **link.**

3. **Fill in the login information.**

   If this is the first time you have used the CRC, click `Request a CRC password` and fill in the requested information. You should receive your account information within two business days.

4. **From the upper left bar, click** `Product Information` **and** `Current Products` **from the dropdown links.**

5. **Select** `Software` **from the Product Family dropdown menu and click** `Next`**.**

   Click the desired product link from the Product Categories and navigate to the documents you want to view.

Technical Support

Refer to *Requesting Help from Software Support* for information about contacting StorageTek for technical support and for requesting changes to software products.

Document Effectivity

EC Number	Date	Doc Kit Number	Type	Effectivity
132208	February 2005	---	Initial Release	This document applies to VTCS, Version 6.1.0.
---	July 2005	---	Revision A	This document applies to VTCS, Version 6.1.0.
---	August 2005	---	Revision B	This document applies to VTCS, Version 6.1.0.
---	November 2005	---	Revision C	This document applies to VTCS, Version 6.1.0.
---	July 2006	---	Revision D	This document applies to VTCS, Version 6.1.0.
---	August 2006	---	Revision E	This document applies to VTCS, Version 6.1.0.
---	September 2007	---	Revision F	This document applies to VTCS, Version 6.1.0.
---	February 2008	---	Revision G	This document applies to VTCS, Version 6.1.0.

Contents

Chapter 1. VSM Overview

This chapter provides an overview of VSM, including information about VTSS and VTCS and how the VSM solution works in a Nearline (HSC) system.

What is VSM?

VSM is StorageTek's virtual storage solution to the problem of inefficient use of tape media and transports. VSM consists of VTCS, which is the MVS host software, and the VTSS.

HSC provides mount and dismount services for physical multi-volume cartridges (MVCs), and NCS, working with VTCS, provides the ability for greater than 16 MVS hosts running MVS/CSC to route data to VSM.

To help manage your Nearline and VSM systems, you can also separately license the following StorageTek software products:

- ExPR, which provides PC and mainframe performance reports and capacity planning tools for both Nearline and VSM systems.
- ExLM, which allows you to efficiently manage Nearline ACS contents, VSM resources (MVCs and VTVs), and VTV migration.

Figure 1 on page 2 shows a simple VSM configuration.

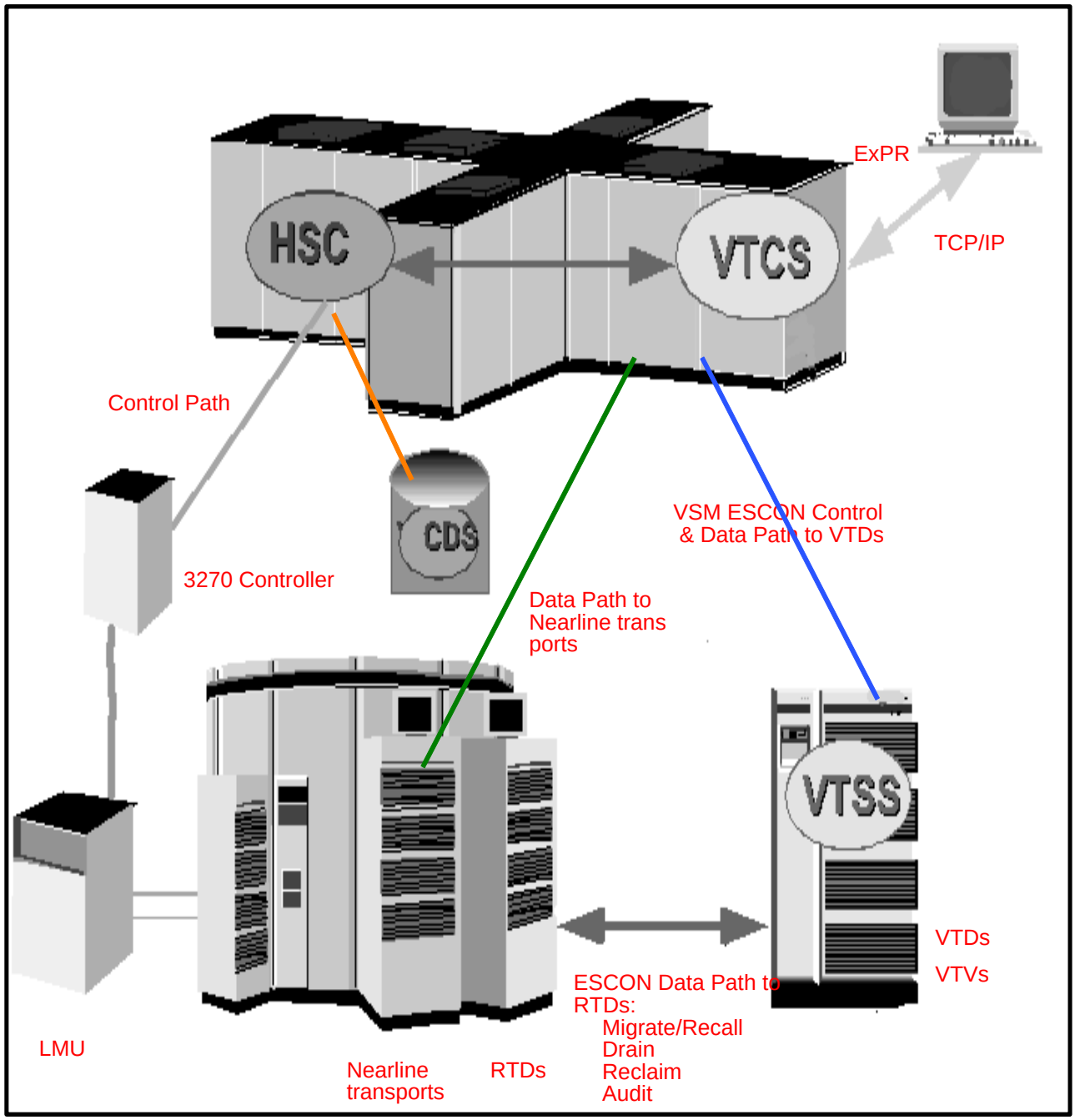


Figure 1. ***Simple VSM Configuration***

How Does VSM Work?

VTCS and HSC work together to provide several methods that you can use to route data to VSM. Each VTSS provides 64 virtual tape drives (VTDs) for VSM2s and VSM3s, and 256 VTDs for VSM4s. VTDs emulate 3490E devices. VSM uses the VTDs to write data sets to virtual tape volumes (VTVs) on the VTSS. The VTSS storage is provided by a RAID-6+ DASD configuration. You specify the VTSS's high and low Automatic Migration Thresholds (AMTs), which control the VTSS space management/VTV migration cycle described on page 5. Real tape drives (RTDs) write migrated VTVs to physical multi-volume cartridges (MVCs). VSM2s and VSM3s support a maximum of 8 RTDs per VTSS, while VSM4s support a maximum of 16 RTDs per VTSS. VTCS controls RTDs (although HSC provides mount and dismount services for MVCs), while HSC controls conventional Nearline tape drives that are not allocated to VSM. By default, VSM migrates a single copy of a VTV. You can, however, used the `MGMTclas MIGpol` parameter to specify that VSM migrates multiple copies of the VTV to separate MVCs.

If the host requests a mount of a VTV that was migrated to an MVC and is not VTSS–resident, VSM automatically recalls the migrated VTV to the VTSS. Figure 2 on page 4 shows the VTV migration/recall cycle.

Note: VSM supports dynamic sharing of RTDs between VTSSs. **Note, however, that when VTSSs share RTDs, the VTSSs must have access to all the same hosts.**

Also note that VSM does **not** support dynamic sharing of transports between VSM and MVS. That is, a transport cannot simultaneously be online to both MVS and to VSM as an RTD. You can, however, manually vary a transport online to MVS and offline to VSM and vice versa.

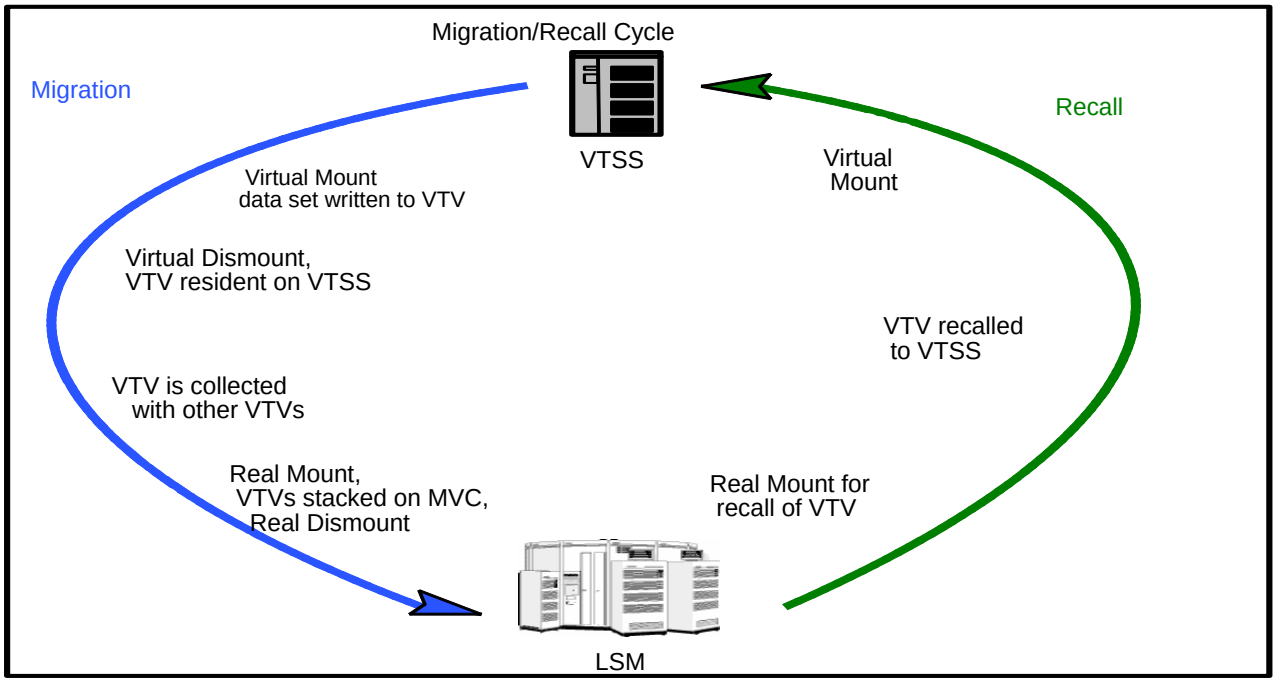


Figure 2. VTV Migration/Recall Cycle

The following sections provide more information about VTV migration and recall, MVC space reclamation, VTCS and NCS enhancements, VTV consolidation, an overview of how to export and import data, and an overview of Clustered VTSS configurations.

How VSM Automatically Manages VTSS Space and Migrates VTVs

VSM automatically manages VTSS space and migrates VTVs as follows:

1. You route data sets to VSM.
2. VTCS mounts a VTV on a VTD, writes the data set to the VTV, then dismounts the VTV, which is now VTSS–resident.
3. Disk Buffer Utilization (DBU) is the percentage of space used on a VTSS compared to its capacity. VTCS starts automigrating VTVs once the DBU reaches or exceeds the High Auto Migration Threshold (HAMT) or the number of VTVs exceeds 97,000 (for VSM2s and VSM3s) or 291,000 (for VSM4s). Automigration continues until the Low Auto Migration Threshold (LAMT) is reached.

Note: VSM will initially start a number of automigration tasks according to the workload characteristics within the limits of the `MINMIG` and `MAXMIG` values. During the migration process, VTCS continuously adjusts the number of tasks based on the DBU, the HAMT, and the migration target (the LAMT or the migrate-to-threshold value).

VTCS selects VTVs for automigration in three modes, normal, high and space release:

- While the DBU is below or equal to the High Automatic Migration Threshold (HAMT), VTCS operates in *normal mode*. In this mode, VTCS selects VTVs for migration that are least likely to be re-referenced (based on VTV age) but also considers VTV size and any recommendation for the residency time of each individual VTV (`RESTIME`). VTCS migrates the selected VTVs and deletes the VTSS-resident copies until DBU reaches the Low Automatic Migration Threshold (LAMT).
- If the DBU exceeds HAMT but is less than 95%, VTCS switches to *high mode*. As DBU approaches 95%, VTCS progressively more heavily weights VTV size versus age to select VTVs for migration. VTCS continues to consider any `RESTIME` recommendations. VTCS migrates the selected VTVs and deletes the VTSS-resident copies until DBU reaches the LAMT.
- If the DBU reaches 95%, VTCS switches to *space release mode*. In this mode, any VTV that is resident but already migrated is first deleted from the VTSS, after which VTCS only migrates VTVs on a size basis until the LAMT is reached. VTCS does *not* honor any `RESTIME` recommendations in space release mode.

Also note that when auto migrate selects candidate VTVs, all VTVs associated with a multiple VTV group that spans a single data set are included within the subsequent migration operation.

Demand Migrations

As an alternative to automatic migration, you can also use `MIGRATE` to do demand migrations.

If you demand migrate specified VTVs, VTCS will start a single migration task. A migrate-to-threshold triggers automigration for the specified VTSS and temporarily sets the LAMT to the specified threshold value. The number of migration tasks is determined as described in Step 3. on page 5.

You can also specify that VTCS immediately schedules VTVs for migration on dismount. Just as with automatic migration and demand migrate-to-threshold, immediate migration spawns one or more migration requests per VTSS within the limits specified by the `CONFIG VTSS MINMIG and MAXMIG` parameters.

How VSM Automatically Recalls Migrated VTVs

If the host requests a specific mount of a VTV whose most current copy is VTSS resident, VSM mounts the VTSS resident copy of the VTV. Otherwise, VSM automatically recalls the VTV as follows:

1. For VTVs with multiple MVC copies managed by Advanced Management Policies, VTCS selects the MVC to recall from as follows:
   - If one MVC is mounted, VTCS selects that MVC.
   - If neither MVC is mounted, VTCS selects the MVC from the first Storage Class specified by the `MIGpol` parameter of the `MGMTclas` statement. If the MVC in the first Storage Class is marked in error, VTCS selects the MVC from the second Storage Class specified by the `MIGpol` parameter.
2. VTCS selects an RTD connected to the VTSS containing the VTD specified in the mount request.
3. VTCS directs HSC to mount the MVC on the selected RTD.
4. VTCS recalls the entire VTV from the MVC.
5. VTCS directs HSC to dismount the MVC (unless it is needed for another VTV recall request).
6. VTCS mounts the VTV on the VTD.

Note: If a host requests a mount of a data set that spans multiple VTVs, when the mount is issued for any VTV referenced by the data set, VTCS also recalls (if necessary) the next VTV in sequence. VTCS thus attempts to "pre-stage" multiple VTVs referenced by the same data set.

7. The host accesses the VTV. If the host changes the contents of the VTV, VTCS marks the VTV space on the MVC as available for reclamation.
8. At the end of the job, the host unloads the VTD.

Note: You can also use `RECALL` to do demand recalls.

Also note that by default, VTCS recalls VTVs with read data checks. For example, if an MVC is defective, only part of a specific VTV may be readable, but VTCS still recalls the readable portion, which creates a "partial" VTV in the VTSS. If a VTV with read data checks contains critical data, you may choose to recall just the readable portion, or you may choose to only recall complete VTVs.

How VSM Automatically Reclaims MVC Space

VSM uses automatic space reclamation processing (which runs once an hour) to reduce MVC fragmentation and increase available space. VSM reclaims space one MVC at a time by copying only current VTVs from the selected MVC to the VTSS, then copying these VTVs back to a second MVC. VSM copies only those VTVs placed after the first open space on the MVC, which saves I/O cycles. In a multi-VTSS environment, VTCS attempts to balance the recall and migration tasks required for reclamation across all VTSSs. Note `EXPORT` marks exported MVCs as readonly, so they are not candidates for space reclamation.

You can use `RECLAIM` to do demand reclamations.

Default MVC Media Preferencing

- By default, in mixed-media VSM systems, VTV automatic and demand migrations (and consolidations) attempt to go to MVCs by media type in this order:
  1. Standard length 3480 cartridge
  2. 3490E cartridge
  3. 3490EE cartridge
  4. T9840A/B cartridge
  5. T9840C cartridge
  6. T9940A cartridge
  7. T9940B cartridge
  8. T10000 full capacity cartridge
- By default, for automatic and demand space reclamations, VSM attempts to write VTVs to output MVCs by media type in this order:
  1. T10000 full capacity cartridge
  2. T9940B cartridge
  3. T9940A cartridge
  4. T9840C cartridge
  5. T9840A/B cartridge
  6. 3490EE cartridge
  7. 3490E cartridge
  8. Standard length 3480 cartridge

Note:

- To optimize recall processing in mixed-media systems, ensure that your MVC pool has at least one media type compatible with each RTD type.
- The `MEDIA` parameter of the `STORclas` statement (which defines Storage Classes) specifies a preference list of MVC media types. This list supersedes the default media selection list. For more information, see *VTCS Command and Utility Reference*.

How VSM Maintains Data Integrity and Availability When Moving VTVs from One MVC to Another

During a drain process (MVC drain or space reclamation), VTCS maintains data integrity and availability by not altering the MVC reference in the VTV record until that VTV has been recalled **and** successfully migrated to a new MVC. In addition, VTCS immediately migrates VTVs recalled by a drain process instead of allowing Automatic Migration to migrate the VTVs. If a drain operation does not complete (is cancelled, the system fails, and so forth), you must rerun the drain operation, but all in-transit VTVs will still point to the MVC that was being drained. If a VTV is migrated to multiple MVCs and one MVC is in error, VTCS recalls the VTV from an alternate MVC and immediately migrates the VTV without waiting for subsequent processing of the in-error MVC.

Note that, for both MVC drains and space reclamations, VTCS does a Management Class lookup after the recall phase and honors any Management Class changes.

VSM Basic and Advanced Management Features

HSC provides the Basic Management Feature that enables the MGMTclas control statement NAME, ACSlist, IMMEDmig, DUPlex, and DELSCR parameters.

The Advanced Management Feature, which is available as a chargeable feature, enables the Basic Management Feature plus:

- The STORclas control statement; for more information.
- The MGMTclas control statement MIGpol, RESTIME, CONSRC, and CONTGT, and REPLICAT parameters.
- EXPORT and IMPORT.

The Advanced Management Feature, therefore, extends VSM Management Class function and enables VSM Storage Classes as described in “VSM Management and Storage Classes” on page 12. EXPORT and IMPORT let you create portable MVCs to move data from one VSM system to another.

Using the Advanced Management Feature, you can:

- Control media selection for migration, reclaim, and consolidation.
- Select the location for consolidation input.
- Specify preferred VTSS residency time for VTVs.
- Group or segregate workloads on MVCs.
- Quickly move data on VTVs and MVCs between VSM systems.
- Create and manage Clustered VTSS configurations.

VSM Management and Storage Classes

VSM Management and Storage Classes provide the following VTV management capabilities:

- VSM Management Classes specify how VTCS manages VTVs. The MGMTclas control statement defines a VSM Management Class and its attributes. For example, the DELSCR parameter of the MGMTclas statement specifies whether VSM deletes scratched VTVs from the VTSS.
- VSM Storage Classes specify where migrated VTVs reside. The HSC STORclas control statement defines a VSM Storage Class and its attributes. For example, the MEDIA parameter of the STORclas statement specifies a preference list of MVC media types. To control the output MVC media and ACS location for consolidation, for example, you can specify a Storage Class with the desired attributes on the CONTGT parameter of the MGMTclas statement.

For more information about VSM Management Features, see “VSM Basic and Advanced Management Features” on page 11. For more information about the VSM policies available through VSM Management and Storage Classes.

Note: You can use the VTVMAINT utility to change a VTV’s Management Class. Also note that while you **cannot** use VTVMAINT to directly change a VTV's Storage Class, you **can** use VTVMAINT to change a VTV's Management Class, which can reference a different Storage Class.

The Import and Export Functions

You can use EXPORT and IMPORT to move VTVs on MVCs from one VSM system to another, where each system has its own unique resources, including different CDSs. EXPORT and IMPORT, therefore, give you the ability to create portable MVCs that you can use to move VTVs from one system to another. For more information, see “Exporting and Importing VTVs” on page 50.

Clustered VTSS Configurations

Clustered VTSS configurations come in two types:

- *Uni-Directional Clusters*, which consist of a *Primary VTSS* and a *Secondary VTSS* connected by one or more cluster links (CLINKs). Figure 3 shows a Uni-Directional Cluster attached to a single ACS. The `CONFIG CLUSTER` statement defines the Cluster, and the `CONFIG CLINK` statement(s) define this the Cluster as Uni-Directional.

  In a Uni-Directional Cluster, you can use the `MGMTclas` statement `REPLICAT` parameter (which requires the Advanced Management Feature) to direct the Primary VTSS to *replicate* (copy) a VTV to the Secondary VTSS via a cluster link (CLINK). If the Primary VTSS becomes unavailable, you can use the `VARY VTSS` to vary it offline to VTCS. You then vary the Secondary VTSS's VTDs online to MVS to continue the workload. The Secondary, therefore, acts as a "warm standby" to the Primary VTSS. **Note that** the Secondary can accept production work as well as replicated VTVs.

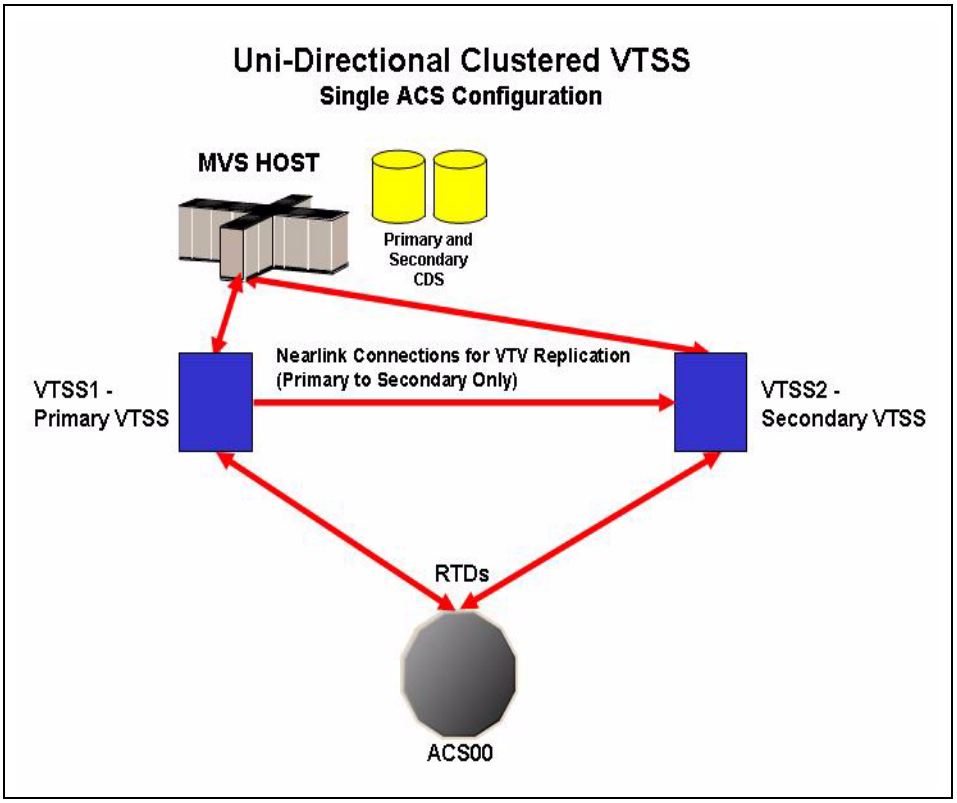


Figure 3. Uni-Directional Cluster attached to a Single ACS

- *Bi-Directional Clusters*, which consist of two *Peer VTSS*s connected by one or more cluster links (CLINKs). Figure 4 shows a Bi-Directional Cluster attached to a single ACS. The `CONFIG CLUSTER` statement defines the Cluster, and the `CONFIG CLINK` statement(s) this Cluster as Bi-Directional.

  In a Bi-Directional Cluster, you can use the `MGMTclas` statement `REPLICAT` parameter (which requires the Advanced Management Feature) to allow replication *in either direction* from peer to peer across a cluster link (CLINK). If either VTSS becomes unavailable, you can use the `VARY VTSS` to vary it offline to VTCS and the Peer VTSS takes over the workload. Each Peer VTSS, therefore, acts as a "warm standby" to the other, and each can accept production work as well as send and receive VTVs.

Figure 4 shows a Peer-to-Peer VTSS Cluster cross-connected to two ACSs for increased redundancy (for example, for enhanced Disaster Recovery capability).

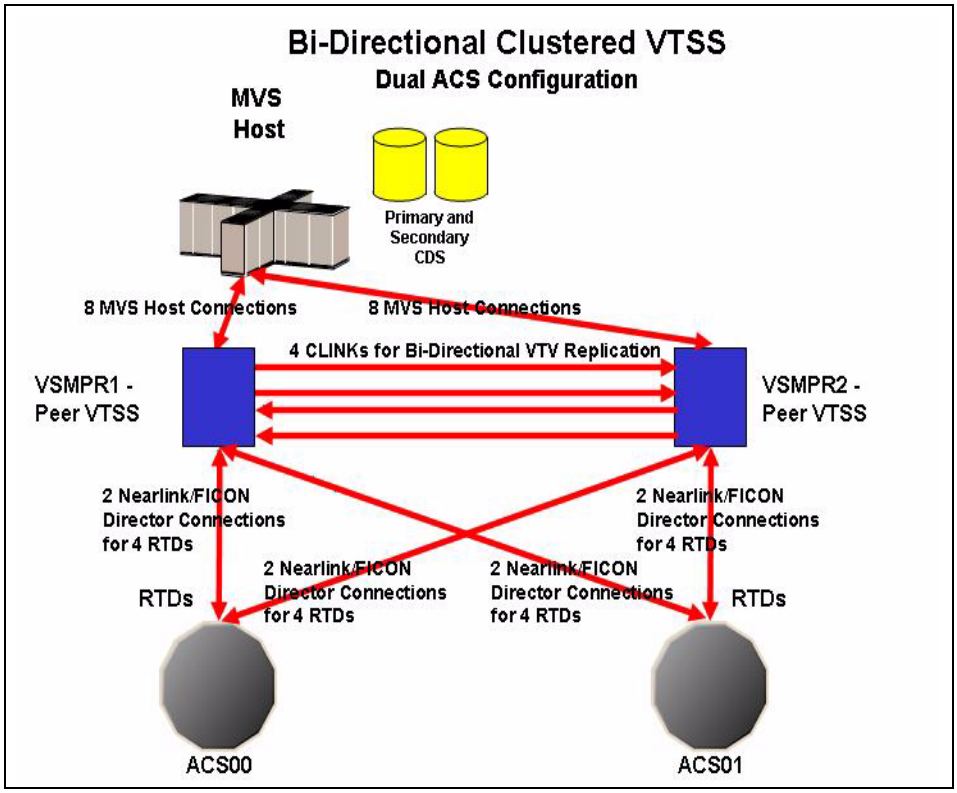


Figure 4. Bi-Directional Cluster attached to a Dual ACS

Compared to a non-clustered configuration, a Clustered VTSS configuration can provide enhanced data availability (business continuance) and enhanced disaster recovery capability (business resumption) for your VSM system.

For more information, see "Implementing a Clustered VTSS Configuration" on page 56.

Near Continuous Operations (NCO)

VTCS 6.1 provides Near Continuous Operations (NCO). Basically, NCO means that you can now dynamically add, change, and delete hardware components, VTVs, and MVCs without having to bring VTCS down and back up again. NCO requires an "F" level CDS, which is enabled by specifying `V61ABOVE` on the `CDSLEVEL` parameter of the `CONFIG` utility. After you have run `CONFIG` with `V61ABOVE`, you can add, change, or delete RTDs and VTSSs while the devices are online and the changes take affect immediately without having to recycle VTCS.

In general, however, and exclusive of NCO, consider the following when you are deleting devices:

- You do not need to empty a VTSS prior to deletion. What you **do** need to ensure is that all VTVs are fully migrated. Also consider changing other parameters, for example, `TAPEREQ` statements so that new work is not routed to the removed VTSS.
- If removing all of one device type/ACS combination from a VTSS, also ensure that all VTVs are fully migrated first. As above, consider changing other parameters to reflect the changed migration capabilities of the VTSS (for example, Management Classes, which point to Storage Classes that specify ACS and media).
- Note that you may choose to make non-NCO changes at the same time you are making NCO device changes...which makes these changes non-NCO as well.
- To summarize, NCO enables you to make a hardware configuration change without restarting VTCS. NCO **does not**, however, eliminate the need for planning the change and understanding its implications.

For more information about configuring VTCS 6.1, see *VTCS Installation and Configuration Guide*. For more information about the `VARY RTD` and `VARY VTSS` commands, see *VTCS Command and Utility Reference*.

How VSM Measures Sizes and Capacities

VTCS uses the binary standard rather than the decimal standard in displaying and calculating sizes and capacities for VTVs and MVCs. Thus:

- 1 kilobyte(KB)=1024 bytes
- 1 megabyte(MB)=1000 kilobytes or 1000*1024 byte
- 1 gigabyte(GB)=1000 megabytes or 1000*1000*1024 bytes

Note, however, that VTCS uses the decimal standard in displaying and calculating sizes and capacities for VTSSs. Thus:

- 1 kilobyte(KB)=1000 bytes
- 1 megabyte(MB)=1000 kilobytes or 1000*1000 bytes
- 1 gigabyte(GB)=1000 megabytes or 1000*1000*1000 bytes

Chapter 2. Managing VSM

This chapter tells how to do the following VSM management tasks:

"VSM Management Tools" on page 18 lists these tools and cross-references the sections of this book that describe these tools.

Warning: The extended format CDS is **required** for VTCS 5.1.0 with VSM4s configured with greater than 64 VTDs and/or greater than 16 RTDs. You must use the HSC 5.0 or higher `MERGEcds` utility to convert the CDS to extended format. **Note that** after you convert the CDS to extended format, you cannot run VTCS 4.0.0 or lower against the converted CDS. For more information, see "Converting the Formatted CDS to Extended Format" in Chapter 5 of *VTCS Installation and Configuration Guide*.

VSM Management Tools

VSM provides the following management tools:

- MVC reports.
- MVC pool summary reports.
- VTV reports.
- `MVCMAINT` and `VTVMAINT`.
- `Query`.
- VTCS messages; see *Virtual Tape Control System Messages*.

In addition, if you have ExPR installed, use ExPR reports to help manage your system, and if you have ExLM installed, you can use it to help manage MVC availability. You should also use your tape management system data set reports to help manage VSM.

Managing VTSSs and VTDs

Use the following guidelines to manage your system's VTSSs and VTDs:

- Periodically review your VTSS management policies.
- Monitor VTD status with `Query VTD`.
- Monitor DBU and VTSS policies with `Query`, ExPR reports, and VSM messages.
- Monitor migration status with `Query` and, if necessary, use `SET MIGOPT` to change AMTs or `MINMIG` or `MAXMIG` settings.
- AMT settings are your primary tool for managing VTSS space and VTV migration.
- Consider the effect a policy has on VTSS space. For example, setting `IMMEDmig DELETE` on the `MGMTclas` statement ensures that VSM quickly migrates jobs in that class to MVCs and conserves VTSS space. Note, however, that immediately migrating VTVs uses MVC space more rapidly.
- Consider doing demand migrations to supplement automatic migration; for more information, see "Doing Demand VTV Migrations" on page 45.
- Ensure that you maintain sufficient free MVCs and usable MVC space; for more information, see "Managing MVCs" on page 22.
- Ensure that you have sufficient RTDs available, for more information, see "Sharing Transports Between VSM and MVS" on page 46.
- If you physically remove a VTSS from your configuration, rerun `CONFIG`.

Note: Before you remove the VTSS, ensure that you migrate and delete all copies of VTVs from that VTSS so these VTVs can be recalled to a different VTSS in your system.

- If a VTSS fails or you want to take it offline for service, you can recall VTVs migrated from the failed VTSS to an alternate VTSS.

Managing VTVs

Use the following guidelines to manage your system's VTVs:

- Periodically review your VTV management policies.

Note: You can use the VTVMAINT utility to change a VTV's Management Class.

- Ensure that you have sufficient VTVs. Use Query and VTV reports to monitor VTV status.

  If you need more VTVs, do one of the following:

  - Free VTV volsers by scratching VTVs with data that is not current.
  - Change your TAPEREQ statements or SMS routines to temporarily reroute tape work to Nearline HSC processing until you can define additional VTVs.
  - Use CONFIG to add VTVs.

  VTVs require additional definitions besides the CONFIG VTVVOL statement.

- Manage VTV scratch status:

  - If you use scratch subpools for VTVs, manage them as described in the guidelines in *VTCS Installation and Configuration Guide*.
  - Use Query, VTV reports, and tape management system reports to monitor VTV scratch status.
  - Use the HSC scratch utilities or the ExLM SYNCVTV function to scratch VTVs with data that is not current.
  - Use CONFIG to add scratch VTVs.
  - Use the HSC Operator commands to manage VTVs.

- Manage VTV accessibility by ensuring that VTVs that are frequently referenced are VTSS-resident:
  - Review your migration policies, especially the settings for the following parameters:
    - The `DELSCR` parameter of the `MGMTclas` statement.
    - The `RESTIME` parameter of the `MGMTclas` statement.
    - The `IMMEDmig` parameter on the `MGMTclas` statement.
  - If these VTVs are not VTSS-resident, consider doing demand recalls before the data is needed; for more information, see “Doing Demand VTV Recalls” on page 45.

Hint: VSM supports host based tape stacking methodologies, which you do not have to disable to use VSM. However, because VSM provides a volume stacking solution, StorageTek does not recommend that you implement a stacking methodology with VSM if you are not already using a stacking methodology.

Managing MVCs

Use the following guidelines to manage your system's MVCs:

- Periodically review your MVC space reclamation policies.
- Ensure that you have sufficient free MVCs and sufficient usable space on MVCs that contain some VTVs. Use `Query` and MVC reports to monitor MVC status.

Note: MVCs that contain VTVs that have a Storage Class cannot be used for migration of VTVs in other Storage Classes. In addition, some free MVCs can be limited to specific Storage Classes based on the MVC ACS location or media type. Use the MVC report to manage these restrictions.

Running out of free MVCs and/or usable MVC space can cause any of the following:

- Migrates fail. As soon as MVC space becomes available, automatic migration will restart, but you must restart any failed manual migrations.
- Unexpected automatic MVC space reclamation starts, which ties up RTDs and slows VTV migration and recall response time.
- Intervention is required on all output VTDs if a VTSS's DBU reaches 100% DBU. If this occurs, you must add or make available more MVCs.

If you need more free MVCs or usable MVC space, do one or more of the following:

- Review your current policies and adjust as needed. You may be able to create free MVCs or free space on MVCs by changing these policies.
- Free VTV volsers by scratching VTVs with data that is not current, which marks MVC space for reclamation.
- Consider doing demand reclamation to free space; for more information, see "Doing Demand MVC Space Reclamations" on page 45.
- If necessary, add MVCs as described in "Adding MVCs to the MVC Pool" on page 32.

- If you have ExLM installed, ensure that ExLM does not move or eject your MVCs or update their HSC scratch status; for more information, see "Using ExLM with VTCS (All Versions)" in Chapter 2, "Using ExLM to Manage Nearline and VTCS Resources" of *ExLM System Administrator's Guide*. Note that you can use ExLM LSM groupings to move MVCs into LSMs with RTDs attached.

- Compare the volsers on the MVC Summary Report to an HSC Volume Report. Are the MVCs actually in the ACS? If not, you must either reenter or replace any MVCs not listed on the HSC Volume Report. For more information about the Volume Report utility, see Chapter 5, "Utility Functions" of the *HSC System Programmer's Guide for MVS.*
- The MVC report, MVC Pool Report, and `Query MVC` report MVC statuses. The following list shows these statuses (per `Query MVC` output) and tells how to resolve problems:

  BROKEN

  This is a generic error that indicates the MVC, drive, or combination of the two has a problem. VTCS attempts to de-preference MVCs with this state. **In general,** to clear this state:

  - If the MVC caused the problem, use a `DRAIN(EJECT)` command to remove the MVC from service.
  - If the RTD caused the problem, use the `MVCMAINT` utility to reset the MVC state.

  Note also that one or more of the following messages is issued for `BROKEN` status: `SLS6686`, `SLS6687`, `SLS6688`, `SLS6690`. For detailed recovery procedures for these messages, see *VTCS Messages and Codes*.

  DATA CHECK

  A data check condition has been reported against this MVC. VTCS attempts to de-preference MVCs with this state. For more information, see "Resolving MVC Data Checks" on page 35.

  DRAINING

  The MVC is either currently being drained or has been the subject of a failed `MVCDRain`.

  IN ERROR

  An error occurred while the MVC was mounted.

INITIALIZED

the MVC has been initialized.

LOST - FAILED TO MOUNT

VTCS attempted to mount an MVC and the mount did not complete within a 15-minute time-out period. VTCS is attempting to recover from a situation that may be caused by hardware problems, HSC problems, or by the MVC being removed from the ACS. VTCS attempts to de-preference MVCs with this state.

If VTCS does perform a subsequent successful mount of an MVC with `LOST(ON)` state, VTCS sets the state to `LOST(OFF)`.

Determine the cause of the error and fix it. You can also use the VTCS `MVCMAINT` utility to set `LOST(OFF)` for the following events:

- `LOST(ON)` was set due to LSM failures or drive errors that have been resolved
- `LOST(ON)` was set because the MVC was outside the ACS and has been reentered.

MARKED FULL

The MVC is full and is not a candidate for future migrations.

MOUNTED

The MVC is mounted on an RTD.

NOT-INITIALIZED

The MVC has been defined via the `CONFIG` utility, but has not ever been used.

READ ONLY

The MVC has been marked read-only because of one of the following conditions:

- The MVC being the target of an export or consolidation process. The read-only state protects the MVC from further updates.
- The MVC media is set to file protect. Correct the error and use the `MVCMAINT` utility to set `READONLY(OFF)`.
- The MVC does not having the appropriate SAF rules set to enable VTCS to update the MVC. Correct the error (for more information, see “Defining A Security System User ID for HSC, SMC, and VTCS” in *VTCS Installation and Configuration Guide*) and use the `MVCMAINT` utility to set `READONLY(OFF)`.

BEING AUDITED

The MVC is either currently being audited or has been the subject of a failed audit. If the audit failed, VTCS will not use the MVC for migration. To clear this condition, rerun the `AUDIT` utility against this MVC.

LOGICALLY EJECTED

The MVC has either been the subject of an `MVCDRain Eject` or the MVC was ejected for update by a `RACROUTE` call. The MVC will not be used again for migration or recall. To clear this condition, use `MVCDRain` against the MVC without the `Eject` option.

RETIRED

The MVC is retired. VTCS will recall from, but not migrate to, the MVC. Replace the MVC as soon as possible.

WARRANTY HAS EXPIRED

The MVC's warranty has expired. VTCS continues to use the MVC. You should start making plans to replace the MVC when it reaches Retired state.

INVALID MIR

VTCS has received status from an RTD to indicate the MIR (media information record) for a 9x40 media is invalid. An invalid MIR does not prevent access to data but may cause significant performance problems while accessing records on the tape. The MVC is not capable of high-speed searches on areas of the tape that do not have a valid MIR entry.

VTCS attempts to de-preference MVCs with this condition. For recalls, if the VTV resides on multiple MVCs, VTCS selects MVCs with valid MIRs ahead of MVCs with invalid MIRs. VTCS avoids using MVCs with invalid MIRs for migration, unless the migration is at the beginning of the tape. Migrating from the beginning of tape will correct the MIR.

VTCS detects the invalid MIR condition at either mount time or dismount time. If detected at mount time and the operation can be completed with another MVC, VTCS dismounts the first MVC and selects the alternate MVC. **Note that** VTCS has only a limited ability to switch to an alternate MVC. That is, it is mainly used for migrate and virtual mount.

For MVCs with invalid MIRs, determine the cause of the error, which may be caused by media or drive problems, and fix the error.

To recover an MVC with an invalid MIR, you simply need to read the MVC to the end of the tape, which can be done via a VTCS audit. If the media is the problem, run an `MVCDRAIN EJECT` to recall the VTVs and cause the MVC to be removed from the MVC pool.

Converting MVCs from T9840A/B Media to T9840C Media

The following sections tell how to convert your MVCs from T9840A or T9840B media to T9840C media.

NCS/VTCS Support for T9840C

The T9840C transport and media is supported as an RTD by the following releases of NCS/VTCS:

- VTCS/NCS 6.1 and 6.2 base
- VTCS/NCS 6.0 plus PTF L1H11TP
- VTCS/NCS 5.1 with the following PTFs installed:
  - L1H11o5 for VTCS 5.1
  - L1H11To for VTCS 5.1
  - L1H11o6 for HSC 5.1
- VTCS/NCS 5.0 with the following PTFs installed:
  - L1H11PX for VTCS 5.0
  - L1H11TN for VTCS 5.0
  - L1H11PW for HSC 5.0

Note:

- T9840C support is available **only** for VSM3s and VSM4, **not** for VSM2s.
- "Changing RTD Device Types" on page 38 describes how to change RTD device types. Follow this procedure to convert one or more RTDs from T9840A/B devices to T9840C devices.
- "Adding MVCs to the MVC Pool" on page 32 describes how to add additional MVC media to your MVCPool. Follow this procedure if additional media is required to support the T9840A/B to T9840C conversion.
- T9840A/T9840B and T9840C transports use the **same physical form factor** but **different recording techniques** resulting in the following restrictions:
  - T9840Cs can read from media written to by T9840As/T9840Bs, but cannot write to T9840A/T9840B media **unless** the entire volume is rewritten from beginning of tape.
  - T9840As and T9840Bs cannot read from or write to media written to by T9840Cs.
  - Use one of the following procedures to change your MVCs to T9840C media:
    - "Converting All T98400A MVCs to T9840C Media" on page 27
    - "Using a Mixture of T9840A/B and T9840C Media" on page 28

Converting All T98400A MVCs to T9840C Media

To convert all T98400A MVCs to T9840C media:

1. **Change the device types of the RTDs from T9840A/B to T9840C.**

   For more information, see “Changing RTD Device Types” on page 38.

   Note: You may want to retain one or more T9840A device types per VTSS until the media conversion is complete.

2. **Modify the HSC** `VOLLATTR` **statements for all T9840A/B MVCs and define them as T9840C media.**

   Warning: T9840C media require `RECTECH(STK1RC)` **in addition to** `MEDIA(STK1R)`!

   For example:

   ```
   VOLATTR SERIAL(MVC900-MVC999) MEDIA(STK1R) RECTECH(STK1RC).
   ```

3. **Review the Storage Class definitions and change all references from** `STK1R` **to** `STK1RC`**.**

   VTCS records the media type of all MVCs. Therefore all pre-existing MVCs with data on them will remain known to VTCS as T9840A/B media. No further migrates will occur from T9840C drives to these MVCs with pre-existing data.

4. **Start HSC/VTCS with the new definitions...**

   ...to run `VOLDEF` against the updated `VOLATTR`s, and so forth.

   All migrates will now be to T9840C media. The data that resides on T9840A/B media will eventually expire and these MVCs will become reclaim candidates. If an MVC that is written in `STK1R` format **and** has a `VOLLATTR` specifying `RECTECH(STK1RC)` is reclaimed then the MVC will be completely drained and will therefore become a candidate for `STK1RC` migration. Thus over a period of time all `STK1R` media will naturally be converted to `STK1RC` media. This process can be accelerated by using `MVCDRAIN` to drain `STK1R` media.Once all `STK1R` media is converted to `STK1RC` media then any remaining T9840A/B drives can be removed.

Using a Mixture of T9840A/B and T9840C Media

If you want to use 9840A/B and 9840C media concurrently, to ensure media and transport compatibility, you **must use** separate VOLATTR statements to segregate 9840A/B and 9840C media as follows:

- **If you have existing** 9840A/B media, these volumes are **already defined** with the VOLATTR MEDIA parameter value of STK1 or STK1R. If you are adding T9840C media, you **must** change your existing 9840A/B VOLATTR statements to specify MEDIA(STK1R) and RECHTECH(STK1RAB). You **also** need to define your new 9840C media with VOLATTR statements that specify MEDIA(STK1R) and RECTECH(STK1RC).

  For example, to define MVCs MVC900-MVC999 as 9840C media and to redefine MVCs MVC600-MVC899 as 9840A/B media, you need the following VOLATTR statements:

  ```
  VOLATTR SERIAL(MVC900-MVC999) MEDIA(STK1R) RECTECH(STK1RC)
  VOLATTR SERIAL(MVC600-MVC899) MEDIA(STK1R) RECTECH(STK1RAB)
  ```

- **If you are adding both** 9840A/B and 9840C media, you must create separate VOLATTR statements to segregate the media as follows:

  - Define the 9840A/B media with VOLATTR statements that specify MEDIA(STK1R) **and** RECTECH(STK1RAB).
  - Define the 9840C volumes with VOLATTR statements that specify MEDIA(STK1R) **and** RECTECH(STK1RC).

  For example, to define MVCs MVC600-MVC899 as 9840A/B media and MVCs MVC900-MVC999 as 9840C media, create the following VOLATTR statements:

  ```
  VOLATTR SERIAL(MVC600-MVC899) MEDIA(STK1R) RECTECH(STK1RAB)
  VOLATTR SERIAL(MVC900-MVC999) MEDIA(STK1R) RECTECH(STK1RC)
  ```

Review your Management Class and Storage Class definitions to ensure that data is directed to the desired MVC media type.

Converting MVCs from T9940A Media to T9940B Media

The following sections tell how to convert your MVCs from T9940A media to T9940B media.

NCS/VTCS Support for T9940B

The T9940B transport and media is supported as an RTD by the following releases of NCS/VTCS:

- VTCS/NCS 6.1 and 6.2 base
- VTCS/NCS 6.0 plus PTF L1H11TP
- VTCS/NCS 5.1 with the following PTFs installed:
  - L1H11o5 for VTCS 5.1
  - L1H11To for VTCS 5.1
  - L1H11o6 for HSC 5.1
- VTCS/NCS 5.0 with the following PTFs installed:
  - L1H11PX for VTCS 5.0
  - L1H11TN for VTCS 5.0
  - L1H11PW for HSC 5.0

Note:

- T9940B support is available **only** for VSM3s and VSM4, **not** for VSM2s.
- "Changing RTD Device Types" on page 38 describes how to change RTD device types. Follow this procedure to convert one or more RTDs from T9940A devices to T9940B devices.
- "Adding MVCs to the MVC Pool" on page 32 describes how to add additional MVC media to your MVCPool. Follow this procedure if additional media is required to support the T9940A to T9940B conversion.
- T9940A and T9940B transports use the **same physical form factor** but **different recording techniques** resulting in the following restrictions:
  - T9940Bs can read from media written to by T9940As, but cannot write to T9940A media **unless** the entire volume is rewritten from beginning of tape.
  - T9940As cannot read from or write to media written to by T9940Bs.
  - Use one of the following procedures to change your MVCs to T9940B media:
    - "Converting All T98400A MVCs to T9840C Media" on page 27
    - "Using a Mixture of T9840A/B and T9840C Media" on page 28

Converting All T9940A MVCs to T9940B Media

To convert all T9940A MVCs to T9940B media:

1. **Change the device types of the RTDs from T9940A to T9940B.**

   For more information, see “Changing RTD Device Types” on page 38.

   Note: You may want to retain one or more T9940A device types per VTSS until the media conversion is complete.

2. **Modify the HSC** VOLLATTR **statements for all T9940A MVCs and define them as T9940B media.**

   Warning: T9940B media require RECTECH(STK2PB) **in addition to** MEDIA(STK2P)!

   For example:

   ```
   VOLATTR SERIAL(MVC900-MVC999) MEDIA(STK2P) RECTECH(STK2PB).
   ```

3. **Review the Storage Class definitions and change all references from** STK2P **to** STK2PB**.**

   VTCS records the media type of all MVCs. Therefore all pre-existing MVCs with data on them will remain known to VTCS as T9940A media. No further migrates will occur from T9940B drives to these MVCs with pre-existing data.

4. **Start HSC/VTCS with the new definitions...**

   ...to run VOLDEF against the updated VOLATTRs, and so forth.

   All migrates will now be to T9940B media. The data that resides on T9940A media will eventually expire and these MVCs will become reclaim candidates. If an MVC that is written in STK2P format **and** has a VOLLATTR specifying RECTECH(STK2PB) is reclaimed then the MVC will be completely drained and will therefore become a candidate for STK2PB migration. Thus over a period of time all STK2P media will naturally be converted to STK2PB media. This process can be accelerated by using MVCDRAIN to drain STK2P media.Once all STK2P media is converted to STK2PB media then any remaining T9940A drives can be removed.

Using a Mixture of T9940A and T9940B Media

If you want to use media concurrently, to ensure media and transport compatibility, you **must use** separate VOLATTR statements to segregate T9940A and T9940B media as follows:

- **If you have existing** T9940A media, these volumes are **already defined** with the VOLATTR MEDIA parameter value of STK2P. If you are adding T9940B media, you **must** change your existing T9940A VOLATTR statements to specify MEDIA(STK2P) and RECHTECH(STK2PA). You **also** need to define your new T9940B media with VOLATTR statements that specify MEDIA(STK2P) and RECTECH(STK2PB).

  For example, to define MVCs MVC900-MVC999 as T9940B media and to redefine MVCs MVC600-MVC899 as T9940A media, you need the following VOLATTR statements:

  ```
  VOLATTR SERIAL(MVC900-MVC999) MEDIA(STK2P) RECTECH(STK2PB)
  VOLATTR SERIAL(MVC600-MVC899) MEDIA(STK2P) RECTECH(STK2PA)
  ```

- **If you are adding both** and T9940B media, you must create separate VOLATTR statements to segregate the media as follows:

  - Define the T9940A media with VOLATTR statements that specify MEDIA(STK2P) **and** RECTECH(STK2PA).
  - Define the T9940B volumes with VOLATTR statements that specify MEDIA(STK2P) **and** RECTECH(STK2PB).

  For example, to define MVCs MVC600-MVC899 as T9940A media and MVCs MVC900-MVC999 as T9940B media, create the following VOLATTR statements:

  ```
  VOLATTR SERIAL(MVC600-MVC899) MEDIA(STK2P) RECTECH(STK2PA)
  VOLATTR SERIAL(MVC900-MVC999) MEDIA(STK2P) RECTECH(STK2PB)
  ```

Review your Management Class and Storage Class definitions to ensure that data is directed to the desired MVC media type.

Adding MVCs to the MVC Pool

You can often create free MVCs or free MVC space as described in "Managing MVCs" on page 22. You may still, however, occasionally need to add MVCs to your MVC pool to increase the available MVC space.

If you have defined MVCs via CONFIG that you are not using because they are not defined on your MVCPool statements, update your MVCPool statements to expand the range of in-use MVCs as shown in the following procedure. Otherwise, rerun CONFIG to define new MVC ranges, then do the procedure below.

Note: If you must rerun CONFIG to define new MVC ranges, you must restart VTCS/HSC after you rerun CONFIG.

To add MVCs to the MVC pool by updating your MVCPool statements:

1. **Edit the data set that contains your system's MVCPool statements.**
2. **Add MVCPool statements for the new MVCs (or update your existing MVCPool statements) and save the data set.**
3. **Run the VT MVCDEF command on all hosts to activate the updated data set.**

Note: MVCs require additional definitions besides the MVCPool statements.

Removing MVCs from the Pool

Permanently Removing MVCs

To permanently remove MVCs from the pool, do the following:

1. **Edit the data set that contains your system's `MVCPool` statements.**
2. **Delete the `MVCPool` statements for the MVCs you want to remove and save the data set.**
3. **Run the `VT MVCDEF` command on all hosts to activate the updated data set.**
4. **Enter `MVCDRain` to drain the MVCs.**
5. **If the MVCs are no longer required in an ACS, use an HSC `Eject` command to eject the MVCs from the ACS.**

   For more information, see *HSC/MVS Operator's Guid*e.
6. **Remove the Nearline definitions, security restrictions, and tape management system restrictions you defined for the MVC.**
7. **If you want to reuse the tape volser for Nearline (non-VTCS) usage, do one of the following:**

   a. Change the external bar code label on the cartridge.

      You must change the external bar code label, because the original MVC volsers are retained in the CDS, and these volsers are only available for use as MVCs.

   b. Reenter the cartridge into the ACS.

   OR

   a. Create a new set of CDS data sets.

   b. Modify VTCS `CONFIG` to remove the definition of the volser as an MVC.

   c. Use HSC `CDSMERGE` to copy the original CDS to the new CDS.

   d. Reenter the volser into the library.

Temporarily Removing MVCs

To temporarily remove MVCs from the pool:

1. **Enter** `MVCDRain Eject` **for the MVC.**

   This does the following:

   - Recalls all VTVs on the MVC and remigrates them to new MVCs.
   - Makes the MVC non-selectable for VTCS migrates.

2. **To return the MVC to the MVC pool, enter a** `MVCDRain` **for the MVC.**

   Entering `MVCDRain` without the `EJect` parameter for the MVC makes it available again.

Note: As an alternative, you can use `MVCMAINT` to mark an MVC as readonly. This prevents VTCS from selecting the MVC for migrates but does not remove the VTVs from the MVC. You can also use `MVCMAINT` to turn off the readonly condition.

Resolving MVC Data Checks

To resolve an MVC data check:

1. **If all VTVs on the MVC are duplexed, run an `MVCDRain` (no eject) on the MVC.**

   The `MVCDrain`:

   - Causes all the available VTVs to be recalled to a VTSS and then remigrated to a new error-free MVC.
   - Logically removes the MVC from the MVC pool.

   If all VTVs on the MVC are **not** duplexed, continue with Step 2. Otherwise, go to Step 5.

2. **If all VTVs on the MVC are *not* duplexed, run an MVC audit against the MVC.**

   The audit attempts to read the VTV metadata sequentially from the MVC. The audit fails when it encounters the data check, which leaves the MVC in an auditing state. This prevents VTCS from selecting this MVC for output.

3. **After the audit, do an `MVCDRAIN` (no eject).**

   The `MVCDrain` recalls the VTVs before the data-check area in ascending block-id order and the VTVs after the data-check area in a descending block-id order. Processing the VTVs in this sequence ensures that VTCS recovers as many VTVs as possible from the media. .

4. **Determine if any VTVs could not be recovered from the MVC.**

   Run an MVC Detail report for the MVC. If any VTVs are still reported as being on the MVC, then these VTVs are not recoverable and were not duplexed; you must recreate your data.

5. **Manage the defective MVC by doing one of the following:**

   - Replace the defective MVC with an initialized tape volume with the same internal and external labels:
     a. HSC `EJECT` the defective MVC.
     b. HSC `ENTER` the replacement MVC.
     c. Initialize the tape as required.
     d. HSC `AUDIT` the new MVC.
     e. Run an `MVCDRAIN` (no `EJECT`) to return the MVC to the MVC pool.
   - Remove the MVC from the system as described in “Permanently Removing MVCs” on page 33.

Moving MVCs Between ACSs

In multi-ACS VSM configurations, especially where you have different VTSS connections to each ACS, you can move MVCs from one ACS to another to make more MVC space available to one or more VTSSs.

To move MVCs from one ACS to another:

1. **Eject the MVCs from the first ACS, then enter them into the second ACS.**

   For more information, see *HSC/MVS Operator's Guid*e.

2. **Enter the** `VT MVCDEF` **command to reload the** `MVCPool` **statements.**

Ejecting MVCs

If you eject MVCs, you must reload the `MVCPool` statements with a `VT MVCDEF` command.

To eject MVC:

1. **Eject the MVCs.**

   For more information, see *HSC/MVS Operator's Guid*e.

2. **Enter the** `VT MVCDEF` **command to reload the** `MVCPool` **statements.**

   The ejected MVCs will now show as not in the ACS on an MVC report or `Q MVC` command.

Managing MVCs in LSM Manual Mode

Managing MVCs when the LSM is in manual mode is just like managing any Nearline volume in this situation. For more information, see "LSM Manual Mode Procedures" in Chapter 3, "Operating an Automated Cartridge System" of *HSC Operator's Guide for MVS*. In manual mode, the transport display panel alternately displays the volser and cell location of the requested volume for both RTDs and Nearline transports that are not RTDs.

In automatic mode, the transport display panel alternately displays the volser and cell location of the requested volume for RTDs, but displays only the volser for Nearline transports that are not RTDs.

Managing RTDs

Use the following guidelines to manage your system's RTDs:

- If VTCS detects a read/write error on an MVC, VTCS will swap the MVC to another RTD to verify the MVC media. StorageTek recommends, therefore, that for each MVC media type you have at least two compatible RTDs available at all times. You can use the `Query RTD` to check RTD availability, `Query TASKs` to monitor tasks associated with RTDs, and `Cancel` to cancel processes that use RTDs. Note that, depending on your configuration, RTDs may be available to multiple hosts, so you need to check RTD availability for each host.

Caution: If you cancel a task associated with migration scheduler (either with the `MIGrate` parameter or by specific process ID), this task will terminate but migration scheduler will start another migration task at its next timer interval. You can, however, use migrate-to-threshold to stop automigration by specifying a value greater than the current DBU.

- Note that VTCS balances requests that require RTDs by giving each request a variable time to complete; if the request does not complete in this time, VTCS allocates the RTD to another queued request. If, therefore, many requests are queued for RTDs, all requests can take longer to process because VTCS is mounting, dismounting, and repositioning MVCs instead of reading from or writing to them. The short term solution, as above, is to use `Query RTD` to check RTD availability, `Query TASKs` to monitor tasks associated with RTDs, and `Cancel` to cancel processes that use RTDs. The long term solution is to review your VSM policies, all of which affect RTD use.
- See "Changing RTD Device Types" on page 38 for more information about changing your system's RTDs from one transport type to another.
- Also see "Resolving Common VSM Problems" on page 86, which tells how to resolve common problems involving RTDs.

Changing RTD Device Types

Use the following procedure to change RTD device types. **Note that** changing RTD device types requires you to **stop VTCS on all hosts**.

To change RTD device types, do the following:

1. **Review your VSM policies.**

   For example, you may want to review your Management Class and Storage Class definitions if this RTD device type is used for migrations.

2. **Vary the old RTDs offline to VTCS.**

3. **If the new RTD devices use new MVS device addresses, do the following:**

   - Define the new addresses to MVS.
   - Run `DECOM` to output your `CONFIG` statements.
   - Edit the `CONFIG` statements to change the RTD addresses to the new values.
   - Run `CONFIG RESET`.

   Caution: Do **not** vary the new transports online to MVS! Otherwise, they can be allocated as Nearline transports.

4. **Install the new RTDs.**

5. **Vary the LSM(s) where transports were replaced to offline status.**

6. **Vary the LSM(s) where transports were replaced to online status.**

7. **Vary the new RTDs online to VTCS.**

8. **If necessary, add MVCs.**

   For more information, see “Adding MVCs to the MVC Pool” on page 32.

Doing CDS Maintenance and Recovery

StorageTek recommends the following guidelines for CDS maintenance and recovery in a VSM system:

- Ensure that the CDS is backed up *at least* daily, and more often if possible (VTV and MVC changes typically occur throughout the day and cause CDS changes).

  If you lose the primary CDS and are recovering from a backup copy, make sure to use the most recent copy.

  A VTCS audit is not a substitute for frequent backup of the CDS. A VTCS audit will regain access to your VSM resources, but in general it will not completely reconstruct the VSM records in a CDS. For example, if you delete all copies of the CDS, an audit will not recreate any Management Class definitions. Therefore, StorageTek strongly recommends that you do **not** delete all copies of the CDS, then run a VTCS audit!

- If you have lost all copies of the CDS, use the procedure described in “Recovering from Losing All Copies of the CDS” on page 41.

- If the primary CDS is intact but you lost information about some VSM resources, use the procedure described in “Recovering from Losing Information about Some VSM Resources” on page 42.

  For example, you would use this procedure if VTCS and HSC abended while applications were writing VTVs to the VTSS and VTCS was doing migrate, recall, and/or reclaim operations. In this situation, VTV and MVC reports can help identify the lost information.

  You would also use this procedure if the VTSS lost power. In this situation, the SYSLOG can help identify any MVCs mounted at the time of the power outage.

- A VSM audit of all MVCs will audit MVCs defined with `CONFIG MVCVOL` statements even if they are *not* specified in the `MVCPool` statements. If these volumes are not in an ACS that VTCS accesses, HSC issues message `SLS2126I` to prompt the operator to enter these volumes. If the volume does not exist or is not available, the operator should reply “I” (ignore). If the operator does not reply to this message, VTCS times out with this MVC after 20 minutes and continues with the next MVC.

- **Note that** VSM does not support copies of the CDS at multiple sites (for example, Primary CDS at one site and Secondary at another). A link failure would allow the two sites to run independently, and VSM cannot enforce separation of all resources. This prevents reconciliation of the two divergent CDSs as can be accomplished in a pure NCS environment.

- If you audit an export MVC, VTCS processes the VTVs on the MVC as follows:
  - VTVs have an MVC1 and MVC2 field in the CDS. If the VTV's time and date stamp matches the CDS and the MVC1 and MVC2 fields are empty (the VTV has not been migrated), VTCS marks the audited VTV as current, fills in the empty MVC1 or MVC2 field, marks the MVC as read-only and as a consolidation MVC, and issues warning messages.
  - If the VTV's time and data stamp matches the CDS and the MVC1 and MVC2 fields are filled in, VTCS ignores this VTV copy. If all VTVs on the MVC are in this state, VTCS marks the MVC as empty and read-only, and issues warning messages.
  - If the VTV's time and date stamp does not match the CDS, VTCS ignores this VTV copy.
- When HSC and VSM audits complete, run the HSC scratch conversion utility (`SLUCONDB`) or the ExLM `SYNCVTV` function. Also ensure that the CDS is backed up at this point.
- *Do not* use VTVs to back up the CDS!

Recovering from Losing All Copies of the CDS

Use the following procedure to recover a VSM system after losing all copies of the CDS.

To recover after losing all copies of the HSC CDS and update the MVC and VTV information, do the following:

1. **To recover the HSC CDS, audit the library.**

   For more information about the HSC `AUDIT` utility, see Chapter 5, "Utility Functions" in the *HSC System Programmer's Guide for MVS.*

2. **Update your system's MVC pool definition to load a null MVC pool.**

   A null MVC pool prevents migrations, consolidations, recalls, and space reclamations, which ensures that MVCs are not overwritten during the audit.

3. **Prevent applications from writing data to or reading data from existing VTVs during the audits.**

   Applications can write new VTVs to the VTSSs if the TMS is correct and sufficient VTSS space exists.

4. **To update the recovered CDS with your VSM system's MVC and VTV information, do a full VSM audit.**

   When VTCS encounters VTVs with the same volsers, VTCS determines which volume is the most current and uses that VTV. VTCS marks not current the other copies of the VTV.

5. **Update the scratch status of your VSM system's MVCs and VTVs.**

   After the VTCS audit, VTCS assumes that all VTVs are non-scratch. After the VTCS audit completes, run the HSC scratch conversion utility or the ExLM `SYNCVTV` function.

6. **Rerun any consolidation jobs that may have been impacted by the loss of the CDS.**

Recovering from Losing Information about Some VSM Resources

Use the following procedure to recover after losing information about some VSM resources.

To recover after losing information about some VSM resources, do the following:

1. **If necessary, recover information about HSC resources by running an HSC audit.**

   For more information about the HSC AUDIT utility, see Chapter 5, "Utility Functions" in the *HSC System Programmer's Guide for MVS.*

2. **Identify which VTVs and MVCs have incorrect information in the CDS.**

   If VTCS and HSC abended while applications were writing VTVs to the VTSS and VTCS was doing migrate, consolidate, recall, and/or reclaim operations, VTV and MVC reports can help identify the lost information. Compare these reports with the most current previous detailed reports.

   If the VTSS lost power, the SYSLOG can help identify any MVCs mounted at the time of the power outage.

3. **Update your system's MVC pool definition to load a pool that *excludes* any MVCs with incorrect information in the CDS.**

   The updated pool definition prevents migrations, recalls, and space reclamations for these MVCs to ensure they are not overwritten during the audit.

4. **Prevent applications from writing data to or reading data from existing VTVs during the audits.**

   Applications can write new VTVs to the VTSSs if the TMS is correct and sufficient VTSS space exists.

5. **To update the CDS, specify the MVCs and VTSSs for the VSM audit.**

6. **Update the scratch status of your VSM system's MVCs and VTVs.**

   After the VTCS audit, VTCS assumes that all VTVs are non-scratch. After the VTCS audit completes, run the HSC scratch conversion utility or the ExLM SYNCVTV function.

7. **Rerun any consolidation jobs that may have been impacted by the lost resource information.**

Expanding Your CDS

As your system grows, you may need to expand your CDS to accommodate additional VTV and/or MVC ranges. How you expand your CDS depends on which HSC facility you use as described in the following procedures:

- "Expanding Your CDS Using HSC RECONFIG"
- "Expanding Your CDS Using HSC MERGEcds" on page 44
- "Expanding Your CDS Using HSC CDS EXPAND" on page 44

Hint: Note the following:

- **For HSC 5.0 and above**, the `CD EXPAND` command lets you expand the CDS dynamically. That is, you do not have to bring down HSC and run the `SLICREAT` macro if you use `CD EXPAND`.
- StorageTek recommends that you use the `MERGEcds` utility over the `RECONFIG` utility, because `MERGEcds` provides more function than available with `RECONFIG`. In addition, a future release of HSC will drop support of the `RECONFIG` utility.

Expanding Your CDS Using HSC RECONFIG

To expand your CDS using HSC `RECONFIG`:

1. **Run `SLICREAT` to format the new CDS.**
2. **Run HSC `RECONFIG` to transfer existing data from the old CDS to the new CDS.**

   For more information about the `RECONFIG` Utility, see Chapter 5, "Utility Functions" of *HSC System Programmer's Guide for MVS.*
3. **Run VTCS `CONFIG` to add the new VTV or MVC ranges to VTCS.**

Expanding Your CDS Using HSC MERGEcds

To expand your CDS using HSC `MERGEcds`:

1. **Run `SLICREAT` to format the new CDS.**
2. **Run VTCS `CONFIG` to create the VTCS configuration for `MERGEcds` and to add the new VTV or MVC ranges to VTCS.**
3. **Run HSC `MERGEcds` to transfer existing data from the old CDS to the new CDS.**

Expanding Your CDS Using HSC CDS EXPAND

To run `CDS EXPAND`, you must have three copies of your CDS. For more information, see Chapter 2, "Commands, Control Statements, and Utilities" of *HSC Operator's Guide for MVS.*

To expand your CDS using HSC `CD EXPAND`:

1. **Run `SLICREAT` to create 3 new empty CDSs, which are larger than the current set.**
2. **Issue `CDS DISABLE` against the old Primary CDS.**

   The old Secondary becomes the Primary, the old Standby becomes the secondary.]\
3. **Issue `CDS ENABLE` against the first of the three new CDSs.**

   It now becomes the standby.
4. **Repeat Step 2 and Step 3 two more times against the second and third of the new CDSs.**

   Now the Primary, Secondary and Standby are the new, larger CDSs.
5. **Issue the `CDS EXPAND` command.**

   The CDS now contains more free records into which VTCS `CONFIG` can write new VSM resource records.

Doing Demand Migrations, Recalls, and Space Reclamations

The following sections provide guidelines for doing demand VTV migrations, VTV recalls, and MVC space reclamations.

Doing Demand VTV Migrations

VSM automatically manages VTSS space and migrates VTVs as described in "How VSM Automatically Manages VTSS Space and Migrates VTVs" on page 5.

You can, however, do demand migration with either of `MIGRATE`. You may, for example, want to force VTV migration to free VTSS space before peak tape processing times by doing one of the following with `MIGrate`:

- Doing a demand migrate-to-threshold for specific VTSSs.
- Doing a demand migrate with `DELete (YES)` (the default) for VTVs not likely to be reaccessed.

With `SET MIGopt`, you can also lower the high AMT to force VSM to migrate VTVs.

You can also use demand migration to ensure that critical data is available and quickly migrated to tape by running a demand migrate with `DELete (NO)` for VTVs likely to be reaccessed.

Doing Demand VTV Recalls

Before running applications that process data sets on migrated VTVs that are not VTSS-resident, you may want to use `RECAll` to do demand recalls of these VTVs to eliminate the delay caused by automatic recalls. Recalled VTVs are the last to re-migrate if they are not mounted.

You can do demand recalls with `RECALL`; for more information.

Doing Demand MVC Space Reclamations

As described in "How VSM Automatically Reclaims MVC Space" on page 8, VSM automatically reclaims space only one MVC at a time on each host running reclamations. If your MVC summary report or `Query` shows a high level of fragmentation on your system's MVCs (and this level is below the value specified on the `CONFIG RECLAIM THRESHLD` parameter or the `MVCPool THRESH` parameter), you may want to schedule demand MVC space reclamation as an off-hours batch job. Space reclamation runs as a background task and should not impact normal VSM activity.

You can do demand MVC space reclamation with `RECLAIM`.

Sharing Transports Between VSM and MVS

VSM does not support dynamic sharing of transports between VSM and MVS. That is, a transport cannot simultaneously be online to both MVS and to VSM as an RTD.

Warning: Note the following:

- You **must have physical connectivity** from VSM and MVS to support sharing transports between the two. For example, you can use an ESCON director to allow both MVS and VSM to physically connect to the same RTD.
- **Do not**, therefore, use MIM, JES3, or tape autoswitch or similar facilities to manage RTDs, otherwise an RTD can be brought online to both MVS and VSM, which can cause data loss.

  If the RTD is defined to MVS, however, you can use `Vary RTD` to vary the RTD offline to VSM, then use the `MVS VARY` command to vary the transport online to MVS. Note, however, that varying RTDs offline to VSM can impact migration, recall, and reclaim processing, especially during peak VSM workloads. Similarly, if a transport is defined to MVS and also defined to VSM as an RTD, you can vary it offline to MVS, then online to VSM. Each VTSS must have a minimum of two library-attached transports as RTDs for each media type used for MVCs.

Hint: You may want to define additional RTDs as backups (up to the limit of 8 RTDs per VTSS) and vary them offline to VSM until needed. If an online RTD malfunctions, you can vary it offline and vary a backup RTD online until the malfunctioning RTD is repaired or replaced. You can also vary backup RTDs online for peak load VTV migration or recall processing.

Note: When a transport is online to VSM as an RTD, the logrec type OBR and MDR records for the RTD always show a channel path ID of 00, which has no meaning to the host because the transport is not online to MVS.

Consolidating VTVs

This section describes VTV consolidation and tells how to explicitly consolidate VTVs.

Hint: In general, VTV export, which creates a manifest file that allows VTV import, is preferable to explicitly consolidating VTVs. For more information, see

As described in "How VSM Automatically Manages VTSS Space and Migrates VTVs" on page 5, VSM selects VTVs to migrate to MVCs. You can, however, use the `CONSolid` to specify which VTVs are written to a *consolidation MVC*. VTCS migrates VTVs to a *migration MVC*; consolidated VTVs and migrated VTVs are never mixed, therefore, on the same MVC. VSM selects migration and consolidation MVCs from the same MVC pool.

You typically consolidate VTVs so that you can eject the consolidation MVC from the ACS and vault the MVC. The VTVs are now grouped on the consolidation MVC; to access any of the VTVs in the group from the consolidation MVC, you reenter the consolidation MVC into the same ACS from which you ejected the MVC. Note, however, that VTCS does not consider a consolidated VTV to be migrated. After the VTV is consolidated, therefore, there is still a copy of the VTV either VTSS resident or migrated.

The following list summarizes how VTV consolidation works:

- Consolidation MVCs must be free MVCs, where a free MVC has 100% usable space and does not contain any VTVs.
- VTCS selects target MVC media for consolidation in this order:

  1.STK2P or STK2

  2.STK1R

  3.ZCART

  4.ECART

  5.STANDARD

  This media preferencing is the default. You can specify the ACS and media preferencing via the via the Storage Class specified on the `CONTGT` parameter of the `MGMTclas` control statement. Note that for target MVCs for consolidation, the media preferencing is the opposite of the order specified in the Storage Class.

If you do not specify a CONTGT value, the DEFLTACS parameter of the CONFIG determines the consolidation MVC location. Note that the DEFLTACS value applies to a specific VTSS. If you are consolidating VTVs that reside in multiple VTSS systems, therefore, VTCS may select consolidation MVCs in different ACSs. If DEFLTACS is not specified for a VTSS, VTCS selects consolidation MVCs from the ACS with the lowest acs-id within the ACSs attached to the VTSS. If you want to consolidate to a specific ACS, you must control the placement of VTVs on only VTSSs connected to that ACS.

- You can use the CONSRC parameter of the MGMTclas control statement to specify the source MVC for consolidation of duplexed VTVs.
- If there are no available free MVCs, VTCS will issue a message requesting the operator to add more MVCs to the MVC pool. The maximum VTVs per MVC policy applies to both migration and consolidation MVCs.
- A consolidation group of VTVs can span consolidation MVCs, but a single VTV cannot span MVCs.
- VTCS will only consolidate a VTV once, and will ignore subsequent requests to consolidate the VTV.
- You can consolidate VTVs by specifying a Management Class. If the Management Class you use for consolidation specifies the DUPlex parameter, duplexing is ignored for consolidation for this Management Class but duplexing *is* supported for migration for this Management Class.
- When VTCS consolidates a VTSS-resident VTV, VTCS does not consider that VTV to be migrated. That is, a subsequent migrate request for that VTV causes VTCS to migrate the VTV to a migration MVC that is different from the consolidation MVC. A consolidated VTV will *not* be duplexed for migration, even if duplexing is specified for migration; only one copy will be migrated.
- Just as with migration, VTCS will not consolidate in-use, in-recovery, or unreadable VTVs. Unlike migration, however, VTCS will not consolidate scratch VTVs.
- Consolidation MVCs are not eligible for reclamation. You can, however, drain a consolidation MVC as described in “Draining a Consolidation MVC” on page 49.

The following sections further describe how consolidation works in different situations (for example, how VTCS consolidates a migrated VTV).

Consolidating a Resident VTV

VTCS consolidates the VTV on a consolidation MVC. As described above, VTCS will subsequently migrate the VTV to a migration MVC if so requested.

Consolidating a Migrated VTV

VTCS recalls the migrated VTV and consolidates it. If the VTV was duplexed for migration, the consolidation MVC will replace one of the duplexed migration MVCs in the list of MVC copies stored in the VTV record in the CDS. If high AMT is reached during consolidation of migrated VTVs, VTCS will ensure that the VTVs for consolidation remain VTSS-resident so that they can be consolidated.

Mounting a Consolidated VTV

VTCS recalls the consolidated VTV and mounts it. If the consolidation MVC is not in an accessible ACS, the mount request fails. If the VTV is modified while it is mounted, then the VTV will be invalidated on any MVC (either consolidation or migration) where it resides. Therefore, if a consolidated VTV is mounted and modified, it is considered not consolidated after the modification, and VTCS determines this state when it dismounts the VTV.

Scratching a Consolidated VTV

Scratching a consolidation VTV has no effect on the other VTVs on the consolidation MVC. If all VTVs on a consolidation MVC are scratched and reused, VTCS no longer considers it a consolidation MVC, and it is then available for reuse as a migration or consolidation MVC if it is in the MVC pool.

Draining a Consolidation MVC

To drain a consolidation MVC, you can use `MVCDRain`.

VTCS processes VTVs on drained consolidation MVCs as follows:

- If a VTV is already VTSS resident, then the VTV will be marked non-current on that MVC.
- If a VTV on the consolidation MVC is already fully migrated, then the VTV will be marked as non-current on that MVC.
- Otherwise, the VTV will be recalled as is currently done by a drain operation; for more information see “How VSM Maintains Data Integrity and Availability When Moving VTVs from One MVC to Another” on page 10.

After a consolidation MVC is drained, VTCS no longer considers it a consolidation MVC, and it is then available for reuse as a migration or consolidation MVC if it is in the MVC pool. A consolidation MVC can also become empty if the last remaining VTV is modified.

Exporting and Importing VTVs

This section tells you how to export and import VTVs as follows:

How to Export and Import VSM Data: General Procedures

You can use EXPORT and IMPORT to move VTVs on MVCs from one VSM system to another, where each system has its own unique resources, including different CDSs. To move VTVs on MVCs between systems, you use EXPORT and IMPORT to do the following general steps:

1. Identify the VTVs and/or MVCs for export as follows:
   - If you specify the VTV or MVC volsers on EXPORT, use an ExLM, tape management system, or VTVRPT or MVCRPT report.
   - If you specify Management or Storage Classes on EXPORT, review your Management or Storage Class definitions.
2. Run EXPORT to create a manifest file that specifies the VTVs and MVCs available for export from the source VSM system. The exported MVCs, which are marked readonly, are now available for ejection from a source system LSM.

Note: You can run EXPORT against an active or inactive CDS. For example, if you lose all resources at the source VSM system except a copy of the CDS and MVCs containing all the source system's VTVs, you can run EXPORT against the CDS copy at the target VSM system to create a manifest file, then do an import to recreate the source system resources.

EXPORT lets you export data in either of the following two ways:

- If you specify the VTV or MGMTclas parameters, which select VTVs for export, EXPORT consolidates (makes copies of) the selected VTVs on *export MVCs*. These copies are additional copies and are not recorded in the CDS. For example, if the VTV was duplexed before the export, the CDS records both duplexed copies, but the third additional copy used for consolidation is *not* recorded in the CDS. The original VTVs, therefore, are still available to the source system. You can use the data on the original VTVs or scratch and reuse them.
- If you specify the MVC or STORclas parameters, however, which select MVCs for export, the VTVs on the export MVCs are unavailable to the source system after ejection. You should use your tape management system to make the VTVs unavailable.

For both types of exports, the MVCs are marked as read-only and as exported in the CDS.

3. After entering the exported MVCs into a target system ACS, you run IMPORT, specifying the manifest file you created in Step 2 Typically, you do a "validate" import, followed by an actual import.

4. VTCS imports MVCs as readonly. To make them writable, you run MVCMAINT, specifying READONLY(OFF).

Note: Moving MVCs that contain VTVs between systems requires other work, such as possibly resizing the CDS on the target system, changing MVC pools, managing VTV scratch status, defining the new VTVs and/or MVCs to the target system via CONFIG, updating the tape management system, and so forth.

Exporting from a Source VSM System

As described in "The Import and Export Functions" on page 12, you can use EXPORT to export MVCs that contain VTVs from a source VSM system. "Importing into a Target VSM System" on page 55 tells how to import these MVCs into a target VSM system.

To export MVCs from a source VSM system, do the following:

1. **Identify the VTVs and/or MVCs that you want to export as follows:**
   - To export VSM data by specifying VTV volsers, use a TMS, ExLM, or VTVRPT report to identify the required VTVs.
   - To export VSM data by specifying the MVCs volser, use a TMS, ExLM, or MVCRPT report to identify the required MVCs.
   - To export VSM data by specifying Management Classes to be exported, review your Management Class definitions to identify the required Management Classes.
   - To export VSM data by specifying Storage Classes to be exported, review your Storage Class definitions to identify the required Storage Classes.
2. **Run EXPORT to create a manifest file that lists the VTVs and MVCs available for export from the source VSM system.**

   Schedule the export for a time when the exported data is not being updated.

   Specify the EXPORT parameters according to your VTV selection in Step 1:
   - To export VTVs by volser, specify them on the VTV parameter.
   - If you want Management Classes to determine the VTVs for export, specify the Management Classes on the MGMT parameter.
   - To export MVCs by volser, specify them on the MVC parameter.
   - If you want Storage Classes to determine the MVCs for export, specify the Storage Classes on the STOR parameter.
3. **Remove the MVCs for export from the MVC pool.**

   For more information, see "Permanently Removing MVCs" on page 33.
4. **Eject the MVCs for export from a source VSM system LSM.**

   For more information, see *HSC/MVS Operator's Guide.*

5. **If desired, scratch or make unavailable the exported VTVs or reuse the data they contain.**

   The source system retains the CDS records of the exported VTVs and MVCs. The MVCs are marked as exported in the CDS.

   If selection was made by MVC on the `MVC` or `STORclas` parameters, you should use your tape management system to make the VTVs unavailable. If selection was made by VTV on the `VTV` or `MGMTclas` parameters, you can use the data on the original VTVs, scratch and reuse them, or make them unavailable. Use the HSC scratch utilities or the ExLM `SYNCVTV` function to scratch exported VTVs.

   To import MVCs, see “Importing into a Target VSM System” on page 55.

Importing into a Target VSM System

As described in "The Import and Export Functions" on page 12, you can use IMPORT to import MVCs that contain VTVs into a target VSM system. "Exporting from a Source VSM System" on page 53 tells how to export MVCs from a source VSM system.

To import MVCs into a target VSM system, do the following:

1. **If the VTVs and MVCs you are importing are not in the target system CDS, rerun CONFIG to add these volsers.**

   If necessary, increase the CDS size on the target VSM system.

2. **Prevent applications from creating or updating VTVs (and migrating them to MVCs) on the target VSM system.**

3. **Enter the MVCs for import into a target VSM system LSM.**

   For more information, see *HSC/MVS Operator's Guide*.

4. **Optionally, do a "validate" run of IMPORT.**

   Specify the NOUPDATE parameter and the manifest file you created in "Exporting from a Source VSM System" on page 53.

5. **Do an actual run of IMPORT.**

   For an actual import:

   - Optionally, **ensure that you want to overwrite any duplicate VTVs**, then specify REPLACE(ALL) so that VTCS overwrites these duplicate VTVs.
   - Optionally, import a subset of the MVCs or VTVs in the manifest file by specifying the VTV or MVC parameter.
   - If you want to return the MVCs to the source system, specify IMMDRAIN(YES) so that VTCS drains all imported VTVs to VTSS space.
   - Do not specify NOUPDATE so that the CDS is updated.

6. **Adjust your VTV definitions as needed.**

   For example, you need to define the new VTVs to the target system's TMS.

7. **Do one of the following:**

   - Optionally, run MVCMAINT to make imported MVCs writable. VTCS imports MVCs as readonly. To make them writable, you run the MVCMAINT, specifying READONLY OFF.

     Next, add the imported MVCs to the MVC pool. For more information, see "Adding MVCs to the MVC Pool" on page 32. At this point, the MVCs can be reclaimed, drained, migrated to, recalled from, and so forth.

   - If you specified IMMDRAIN(YES) in Step 5, you can return the MVCs to the source system.

Implementing a Clustered VTSS Configuration

The following sections tell how to configure and manage Clustered VTSS configurations:

How Clustered VTSS Configurations Work

You can use VSM to connect two VTSSs by Cluster Links (CLINKs) to form a *Clustered VTSS configuration*. You use the following statements to implement a Clustered Configuration:

- As described in "Uni-Directional and Bi-Directional Clusters" on page 59, Clusters can be either Uni-Directional (Primary/Secondary VTSSs) or Bi-Directional (two Peer VTSSs).
- The Secondary VTSS (or the second Peer) can either be at the same physical location as the Primary (or first Peer) or at a remote location.
- The `CONFIG CLUSTER` statement specifies the two VTSSs that form the Cluster.
- The `CONFIG CLINK` statement defines the CLINKs that connect the two VTSSs.
- The `MGMTclas REPLICAT(YES)` parameter (which requires the Advanced Management Feature) identifies the Management Class that contains the data that VSM *replicates* (copies) from one VTSS in the Cluster to the other.
- VTCS immediately migrates (with `KEEP`) replicated VTVs. You can specify the source VTSS for migration of replicated VTVs on the `MIGRATE` parameter of the `STORclas` statement. **Also note** that you **must** specify `REPLICAT(YES)` on a Management Class **that points** to a Storage Class **with** a `MIGRATE` parameter value to migrate from the desired VTSS. Otherwise, migration from the desired VTSS does not occur.

  Because VTCS immediately migrates (with KEEP) replicated VTVs regardless of the `MGMTclas IMMEDmig` setting, StorageTek **strongly recommends** that you **do not** explicitly set a `MGMTclas IMMEDmig` policy for replicated VTVs. If you do, VTCS honors the explicit immediate migrate request, and immediately migrates the affected VTV from whichever VTSS is first capable of performing the migration (that is, the first VTSS that has a resident VTV copy and an available RTD to satisfy the migrate). Setting an explicit `MGMTclas IMMEDmig` policy, therefore, is redundant and may interfere with optimal VTV replication and migration.

  Also note that the immediate migrate (KEEP) following replication is **not the same** as automigration. That is, during the implicit immediate migrate, no VTVs are deleted from either VTSS to manage the DBU. Instead, the VTVs are simply "pre-staged" via migration to an MVC from the receiving VTSS, leaving both VTSS buffer contents unchanged. For space management in a VTSS cluster, VTCS automigrates VTVs according to the space management/migration cycle of **either** VTSS. If the capacity of the receiving VTSS is greater than or equal to that of the sending VTSS, automigration on the sending VTSS deletes a replicate VTV from **both** the VTSSs. If the capacity of the receiving VTSS is less than that of the sending VTSS, automigration may start on the receiving VTSS. In this case, automigration deletes a replicate VTV from only the receiving VTSS, leaving the copy on the sending VTSS still resident.

- **Note that** the replication requirements of data is determined following a dismount, **not** a recall. Merely recalling a VTV will not cause a replicate – so demand recall, `MVCdrain` and reclaim will not cause a replicate. However, if the VTV is recalled and mounted on a VTD, at dismount time it will be replicated to the Secondary or Peer VTSS.
- In dual-ACS environments, the same device types must be represented in the RTDs attached to each ACS so that data migrated by one VTSS can be recalled by the other VTSS. The number of MVCs, the media type and location used for the migration is determined by the `MIGPOL` parameter of the `MGMTclas` statement.
- Each `CLINK` uses a VTD address on the Secondary VTSS in a Uni-Directional Cluster (or both Peers in a Bi-Directional Cluster). These VTD addresses **are not** available to MVS; if you try to vary the VTSS online, you get an "assigned to another system" condition as follows:
  - **For VTCS 6.0 and below**, VSM3 uses the highest addresses of the first 8 VTDs defined for CLINKs; VSM4 uses the highest addresses of the first 16 VTDs defined. For example, in a **VSM3** you define four CLINKs and the following VTD addresses:

    ```
    VTD LOW=5800 HIGH=583F
    ```

    You **cannot** vary online to MVS the four highest of the first eight VTD addresses (5804 through 5807).

    In a **VSM4** you also define four CLINKs with the same VTD addresses:

    ```
    VTD LOW=5800 HIGH=583F
    ```

    In this case, you **cannot** vary online to MVS the four highest order of the first 16 VTD addresses (580C through 580F).
  - **For VTCS 6.1 and above**, VSM3s use 8 VTD addresses for CLINKs and VSM4s use 16 VTD addresses for CLINKs...but these addresses are not static. VTCS assigns addresses dynamically to prevent conflicts and errors. Do not, therefore, vary online to MVS any of the first 16 VTD addresses!.
- As described in "Clustered VTSS Operating Modes" on page 77, a Cluster can support different workloads in each of four operating modes. For example, only Full-Function Clusters can support active replication, but in Degraded Primary Mode, you can vary the Secondary's VTDs online to MVS to take over the workload. You can use `Query` to display Cluster, Cluster link, VTV replication, and VTSS status. You can use `VARY VTSS` to change VTSS states and `VARY CLink` to change CLINK states.

Uni-Directional and Bi-Directional Clusters

For clustering, you need a port in Host mode on one VTSS connected via a CLINK to a port in Nearlink mode on the other VTSS.

For example, Figure 5 shows 2 CLINK ports on each VTSS configured for Bi-Directional Clustering. On the Primary VTSS (VTSS1), the CLINK CIPs/FIPs are configured in **Nearlink Mode**, while on the Secondary VTSS (VTSS2), the CIPs/FIPs are configured in **Host Mode**. Figure 8 on page 65 shows a Uni-Directional Cluster attached to a dual ACS. In a Uni-Directional Cluster, the Primary VTSS replicates VTVs to the Secondary VTSS.

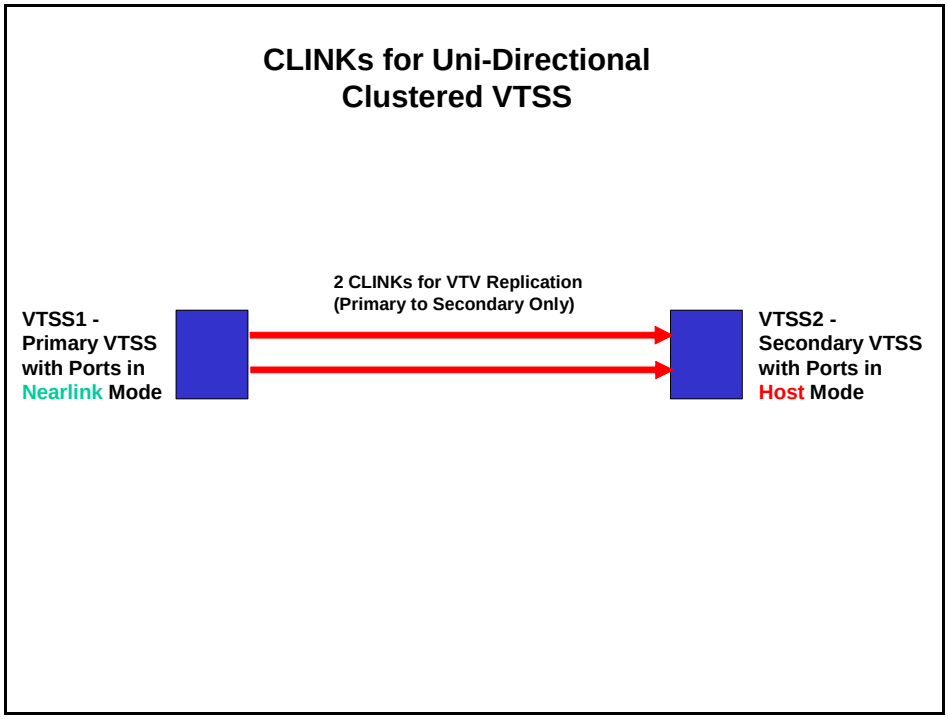


Figure 5. CLINKs for Uni-Directional Clustered VTSS

Figure 6 shows 2 CLINK ports on each VTSS configured for Bi-Directional Clustering. **Each** Peer VTSS (VSMPR1 and VSMPR2), must have **both** of the following:

- **One** CLINK CIP/FIP configured in **Nearlink Mode** for replicating to the Peer.
- **One** CLINK CIP/FIP configured in **Host Mode** for receiving replicated VTVs from the Peer.

Bi-Directional Clustering, therefore, requires pairs of Uni-Directional CLINKs with the CIPs/FIPSs configured so that the data flows in **opposite directions** on the CLINKs.

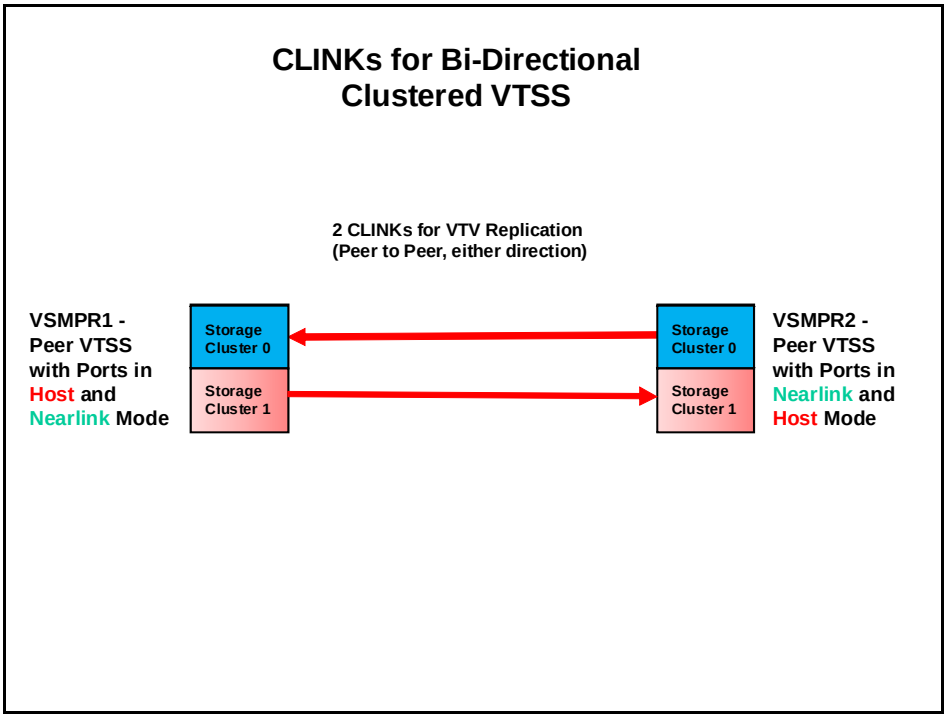


Figure 6. CLINKs for Bi-Directional Clustered VTSS

How Uni-Directional VTSS Clusters Work

In a Uni-Directional Cluster:

- The two VTSSs can be any combination of VSM3 and VSM4 where the Secondary can be of any capacity. All hosts **must** be at VTCS 5.1.0 or above to enable this feature. For example, all of the following are valid:
  - Primary VSM4, Secondary VSM3
  - Primary VSM4, Secondary VSM4
  - Primary VSM3, Secondary VSM3
  - Primary VSM3, Secondary VSM4 (not recommended)
- The Secondary can receive both replicated VTVs from the Primary and non-replicate production workload by any of the standard routing methods (for example, TAPEREQs). You need to vary the VTDs in the Secondary online to MVS so that the Secondary can accept production work. You **cannot** vary online to MVS the VTD addresses used by the CLINK terminations as described in "How Clustered VTSS Configurations Work" on page 57.
- A VTV with REPLICAT(YES) is allocated to an online Primary VTSS unless none are available; in that case, the VTV is allocated to an online Secondary VTSS. If no online Secondary VTSSs are available, the VTV is allocated to a non-cluster VTSS. A VTV without REPLICAT(YES) can be allocated to any online VTSS including the Secondary of a Full-Function Cluster.
- At dismount time, a VTV with REPLICAT(YES) that resides on a Full-Function Cluster is queued for replication to the Secondary VTSS. If a VTV with REPLICAT(YES) is dismounted from a VTD in a VTSS that is not part of a Full-Function Cluster, the VTV is queued for immediate migration.

  When the Secondary VTSS receives a replicated VTV from the Primary VTSS, the VTV is then immediately migrated (with the KEEP option) regardless of Immediate Migrate Management Class settings for this VTV.
- **Both the Primary and the Secondary VTSS** can manage all space reclamations.

How Bi-Directional VTSS Clusters Work

In a Bi-Directional Cluster, in normal operation, both VTSSs are online to VTCS as follows:

- The two VTSSs can be any combination of VSM3 and VSM4 and of any capacity. All hosts **must** be at VTCS 6.1.0 or above to enable this feature. For example, all of the following are valid:
  - Two VSM4s
  - Two VSM3s (not recommended)
  - VSM3 and VSM4 (not recommended)
- In a Bi-Directional Cluster, each of the Peer VTSSs can receive production work via the standard routing methods (for example, `TAPEREQ`s). You need to vary the VTDs in both VTSSs online to MVS so that each can accept production work. However, **note that** you **cannot** vary online to MVS the VTD addresses used by the CLINK connections as described in "How Clustered VTSS Configurations Work" on page 57.
- **In a Bi-Directional Cluster**, a VTV with `REPLICAT(YES)` is allocated to either of the Peer VTSSs. If one of the two Peer VTSSs is either offline or quiesced, production workload can run on the remaining online VTSS. VTVs requiring replication, however, are allocated to the remaining VTSS only if no other Full-Function clusters are available and suitable. In this case, replicate VTVs are migrated immediately with keep and queued for replication when the other VTSS comes online.
- **In a Bi-Directional Cluster**, at dismount time, a VTV with `REPLICAT(YES)` that resides on a Full-Function Cluster is queued for replication to the other Peer VTSS. If a VTV with `REPLICAT(YES)` is dismounted from a VTD in a VTSS that is not part of a Full-Function Cluster, the VTV is queued for immediate migration. **Note that** the replication requirements of data is determined following a dismount, **not** a recall. Merely recalling a VTV will not cause a replicate – so demand recall, `MVCdrain` and reclaim will not cause a replicate. However, if the VTV is recalled and mounted on a VTD, at dismount time it will be replicated to the Secondary VTSS
- **Both Peer VTSSs** can manage all space reclamations.

Example: Uni-Directional Clustered VTSS - Dual ACS Configuration, VSM4s with 32 ESCON Ports

In this section, we'll look at examples of setting up Clustered VTSS configurations using VSM4s with 32 ESCON ports for both VTSSs in the Cluster. Figure 7 shows `CONFIG` channel interface identifiers for the following Nearlink connections for each VSM4 used in our example configurations:

- 16 for hosts
- 4 for CLINKs
- 4 for RTDs in ACS00
- 4 for RTDs in ACS01

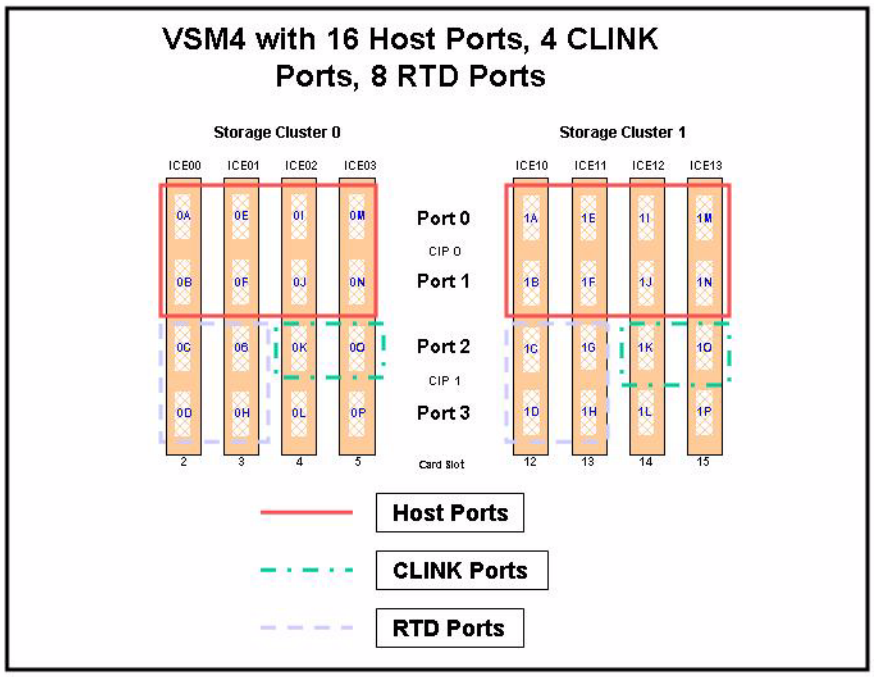


Figure 7. VSM4 with 16 Host Ports, 4 CLINK Ports, 12 RTD Ports (All ESCON)

Figure 8 shows an example of a Uni-Directional Clustered VTSS Dual ACS system using the port configuration shown in Figure 7 on page 64.

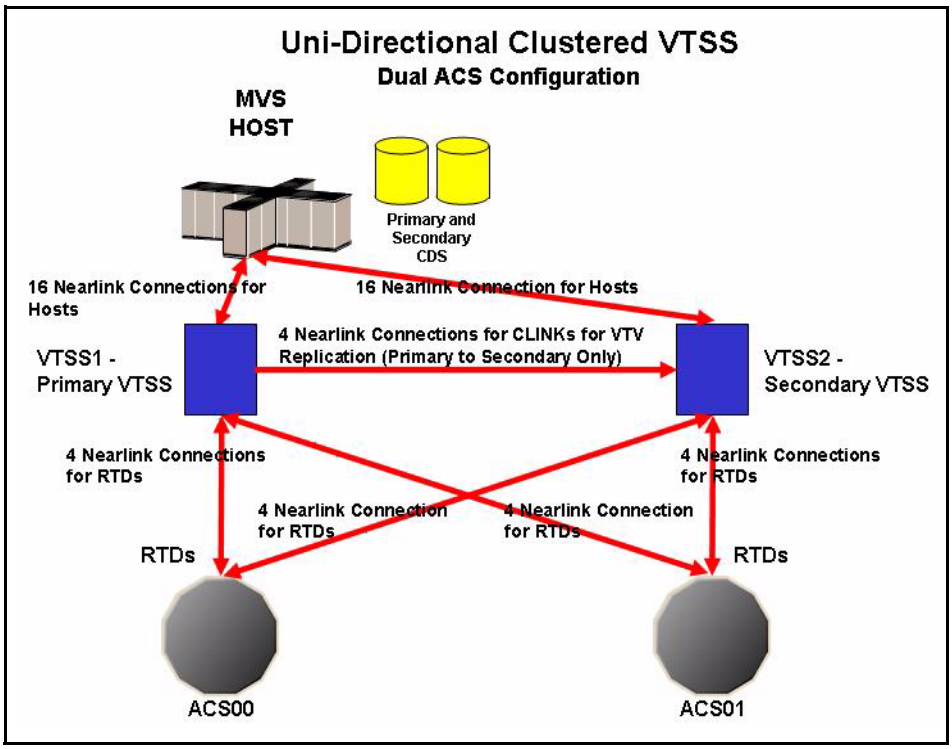


Figure 8. Uni-Directional Clustered VTSS Dual ACS Configuration

Figure 9 on page 66 shows the CONFIG JCL, including CLUSTER and CLINK statements, for a Uni-Directional Cluster. **Note that** there are CLINK statements for **only the Primary VTSS** to enable the Cluster as Uni-Directional.

To configure the dual ACS Uni-Directional Clustered VTSS system shown in Figure 8, do the following:

1. **Ensure that your system has the Clustered VTSS requirements described in** *VTCS Installation and Configuration***.**
2. **Use** CONFIG **to create** CLUSTER **and** CLINK **statements to define the VTSS Cluster and its connections.**

   Figure 9 on page 66 shows the CONFIG JCL, including CLUSTER and CLINK statements, for this configuration. **Note that** there are CLINK statements for **only the Primary VTSS** to enable the Cluster as Uni-Directional.

```
//CREATECFG   EXEC PGM=SWSADMIN,PARM='MIXED'
//STEPLIB     DD DSN=hlq.SLSLINK,DISP=SHR
//SLSCNTL     DD DSN=FEDB.VSMLMULT.DBASEPRM,DISP=SHR
//SLSCNTL2    DD DSN=FEDB.VSMLMULT.DBASESEC,DISP=SHR
//SLSSTBY     DD DSN=FEDB.VSMLMULT.DBASETBY,DISP=SHR
//SLSPRINT    DD   SYSOUT=*
//SLSIN       DD   *
 CONFIG RESET CDSLEVEL(V61ABOVE)
 GLOBAL   MAXVTV=32000   MVCFREE=40
 RECLAIM  THRESHLD=70    MAXMVC=40  START=35
 VTVVOL LOW=905000 HIGH=999999 SCRATCH
 VTVVOL LOW=C00000 HIGH=C25000 SCRATCH
 VTVVOL LOW=RMM000 HIGH=RMM020 SCRATCH
 MVCVOL LOW=N25980 HIGH=N25989
 MVCVOL LOW=N35000 HIGH=N35999
 VTSS NAME=VTSS1 LOW=70 HIGH=80 MAXMIG=8 MINMIG=4 RETAIN=5
 RTD  NAME=PR11A00 DEVNO=1A00 CHANIF=0C
 RTD  NAME=PR11A01 DEVNO=1A01 CHANIF=0D
 RTD  NAME=PR11A02 DEVNO=1A02 CHANIF=0G
 RTD  NAME=PR11A03 DEVNO=1A03 CHANIF=0H
 RTD  NAME=PR12A08 DEVNO=2A08 CHANIF=1C
 RTD  NAME=PR12A09 DEVNO=2A09 CHANIF=1D
 RTD  NAME=PR12A0A DEVNO=2A0A CHANIF=1G
 RTD  NAME=PR12A0B DEVNO=2A0B CHANIF=1H
 VTD LOW=9900 HIGH=99FF
 VTSS NAME=VTSS2 LOW=70 HIGH=80 MAXMIG=8 MINMIG=4 RETAIN=5
 RTD  NAME=PR23A00 DEVNO=3A00 CHANIF=0C
 RTD  NAME=PR23A01 DEVNO=3A01 CHANIF=0D
 RTD  NAME=PR23A02 DEVNO=3A02 CHANIF=0G
 RTD  NAME=PR23A03 DEVNO=3A03 CHANIF=0H
 RTD  NAME=PR24A08 DEVNO=4A08 CHANIF=1C
 RTD  NAME=PR24A09 DEVNO=4A09 CHANIF=1D
 RTD  NAME=PR24A0A DEVNO=4A0A CHANIF=1G
 RTD  NAME=PR24A0B DEVNO=4A0B CHANIF=1H
 VTD LOW=9900 HIGH=99FF
 CLUSTER NAME=CLUSTER1 VTSSs=(VTSS1,VTSS2)
 CLINK VTSS=VTSS1 CHANIF=0K
 CLINK VTSS=VTSS1 CHANIF=0O
 CLINK VTSS=VTSS1 CHANIF=1K
 CLINK VTSS=VTSS1 CHANIF=1O
```

Figure 9. CONFIG ***example: Dual ACS Uni-Directional Clustered VTSS System***

3. **Enable the Advanced Management Feature.**

   The Advanced Management Feature is required to enable the REPLICAT parameter of the MGMTclas statement.

4. **Create a Management Class that specifies VTV replication and two Storage Class to migrate (duplexed) the replicated VTVs.**

```
MGMT NAME(VSMREPL) REPLICAT(YES) MIGPOL(REPLSTR1,REPLSTR2)
```

Figure 10. Management Class for VTV Replication

In Figure 10, Management Class VSMREPL specifies VTV replication and, via the MIGPOL parameter, migrate duplexed to ACSs 01 and 00 by Storage Classes you will create in Step 5.

Note: Note that Management Class VSMREPL **does not** specify an immediate migrate policy. VTV replication automatically enforces immediate migrate. The VTVs in this Management Class will be added to the immediate migration queue on either Peer VTSS once the replication has completed. Note that duplexing **is not** a requirement for replicate VTVs. For more information, see "How Clustered VTSS Configurations Work" on page 57.

5. **Create the Storage Classes for the MVCs that contain the replicated, migrated VTVs.**

```
STOR NAME(REPLSTR1) ACS(01) MEDIA(STK1R) MIRATE(EITHER)
STOR NAME(REPLSTR2) ACS(00) MEDIA(STK1R) MIGRATE(EITHER)
```

Figure 11. Storage Classes for Replicated, Migrated VTVs

In Figure 11, the STORclas statement defines Storage Classes REPLSTR1 and REPLSTR2 referenced in the MIGPOL parameter in Step 4. **Also note** that, to optimize VTSS and RTD resources, the MIGRATE parameters on the Storage Classes allow migrates to come from either VTSS.

6. **Load the MGMTclas and STORclas control statements created in Step 4 and Step 5 with the MGMTDEF command.**

```
MGMTDEF DSN(hsc.parms)
```

Figure 12. MGMTDEF Command to Load Management and Storage Classes

7. **Create a TAPEREQ statement to route the critical data to VSM and assign Management Class VSMREPL to the data.**

```
TAPEREQ DSN(*.PAYROLL.**) MEDIA(VIRTUAL) MGMT(VSMREPL)
```

Figure 13. TAPEREQ Statement to Route Critical Data, Assign Management Class VSMREPL

In Figure 13, the TAPEREQ statement specifies:

- Route data sets with HLQ mask *.PAYROLL.** to VSM...
- .....and assign Management Class VSMREPL that you enabled in Step 4.

Caution: To replicate VTVs, **both** VTSS1 and VTSS2 must be varied online to VTCS so that VTCS can send control commands to both VTSSs. The `MEDIA(VIRTUAL)` parameter allows VTCS to direct work to any available VTSS. See "How Clustered VTSS Configurations Work" on page 57 for more information.

Note: Also note the following:

- You can also use esoteric substitution via SMC `TAPEREQ` statement or NCS User Exits to route replication jobs to VSM. If an esoteric is substituted that spans all VTDs in **all** Peer VTSSs, then VTCS can continue to correctly influence allocation if a one of the Peer VTSSs in a Cluster is taken offline.
- For SMC, a Management Class name, if it is assigned in the StorageTek DFSMS Interface, is available at allocation time. Therefore the esoteric assigned in the interface no longer needs to contain only VTSSs that are part of clusters. As long as the esoteric contains some drives located on the Primary of a full function cluster, SMC has sufficient information to direct allocation to a drive on a Primary VTSS if the Management Class specifies `REPLICAT(YES)`.

8. **Check your HSC PARMLIB options to ensure that subtype 28 records are enabled.**

   If enabled, VTSS clustering writes a subtype 28 record for each replication performed.

Example: Bi-Directional Clustered VTSS - Dual ACS Configuration, 8 VCF Cards, 4 CLINKs, FICON Directors for 8 RTDs

Figure 14 shows `CONFIG` channel interface identifiers for a VSM4 with 8 VCF cards. In this configuration, we've allocated:

- 8 Host ports.
- 4 ports for RTDs. The RTD ports are all connected to FICON directors, each of which is attached to RTDs, so the `CHANIF` identifiers for both RTDs are shown on each port. This allows Back-End connection to 8 RTDs. As with ESCON, only one RTD per port/Director can be active at a time.
- 4 ports for CLINK connections to form a Bi-Directional VTSS Cluster, and 8 ports to host connections. To form the clustered VTSS, we'll have two VSM4s (`VSMPR1` and `VSMPR2`) configured identically as shown in Figure 14. As shown in Figure 6 on page 60, Bi-Directional Clustering requires pairs of Uni-Directional CLINKs with the FIPSs configured so that the data flows in **opposite directions** on the CLINKs. To make that happen, let's make 0G and 1G the sending (Nearlink Mode) ports on both VTSSs and 0O and 1O the receiving (Host Mode) on both VTSSs.

Caution: Bi-Directional Clustering **requires** VTCS 6.1! You **cannot** configure a Bi-Directional Cluster at releases lower than VTCS 6.1! **Also note** that the Clustered VTSSs require the Advanced Management Feature.

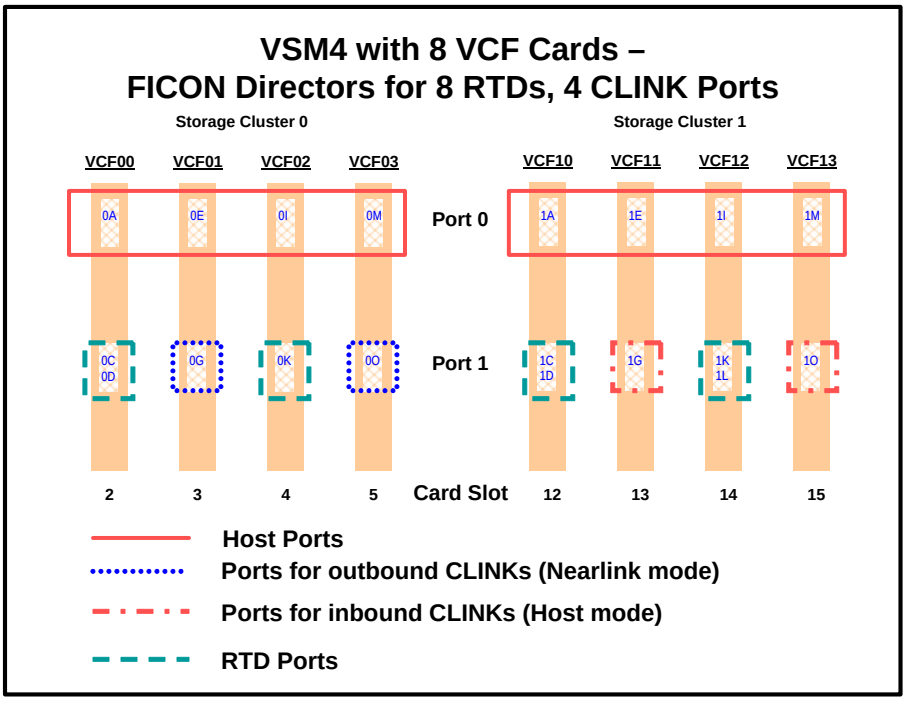


Figure 14. VSM4 with 8 VCF Cards, 8 Host Ports, FICON Directors for 8 RTDs, 4 CLINK Ports

Figure 15 shows an example of a Bi-Directional Clustered VTSS Dual ACS system using the port configuration shown in Figure 14 on page 69.

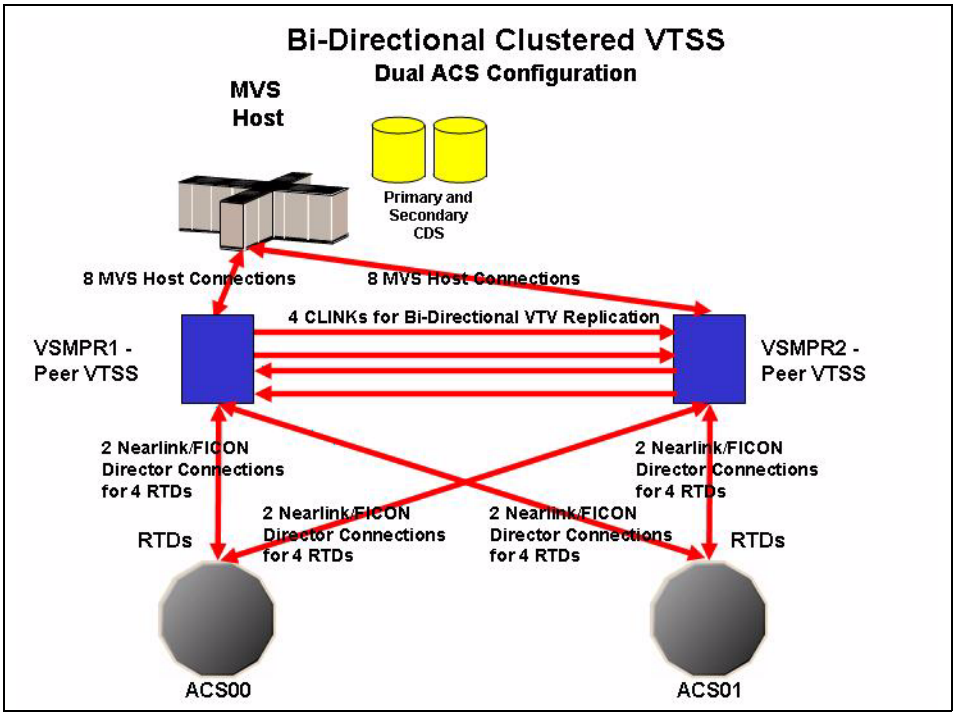


Figure 15. Dual ACS Bi-Directional Clustered VTSS Configuration

Figure 15 shows example CONFIG JCL to define a Bi-Directional Cluster of two VSM4s (VSMPR1 and VSMPR2) with identical VCF card configurations shown in Figure 14 on page 69.

Note: This Cluster is Bi-Directional, but VTSSLST and VTSSSEL statements give us the flexibility to effectively make either VTSS the Primary and the other the Secondary...and switch the relationship by simply rewriting the VTSSLST and VTSSSEL statements as shown in Step 10 on page 74.

To configure and manage the Bi-Directional Clustered system shown in Figure 15, do the following:

1. **Ensure that your system has the Clustered VTSS requirements described in** *VTCS Installation and Configuration***.**
2. **Use** CONFIG **to create** CLUSTER **and** CLINK **statements to define the VTSS Cluster and its connections.**

Figure 16 shows example CONFIG JCL to define a Bi-Directional Cluster of two VSM4s (VSMPR1 and VSMPR2) as shown in Figure 15 on page 70. **Note that**:

- The CLUSTER statement defines the Cluster as consisting of VSMPR1 and VSMPR2.
- There are CLINK statements using the sending (Nearlink Mode) ports of **both VTSSs** to enable the Cluster as Bi-Directional. As described on page 69, the Nearlink ports are 0G and 1G on both VTSSs.

```
//CREATECFG     EXEC PGM=SWSADMIN,PARM='MIXED'
//STEPLIB       DD DSN=hlq.SLSLINK,DISP=SHR
//SLSCNTL       DD DSN=FEDB.VSMLMULT.DBASEPRM,DISP=SHR
//SLSCNTL2      DD DSN=FEDB.VSMLMULT.DBASESEC,DISP=SHR
//SLSSTBY       DD DSN=FEDB.VSMLMULT.DBASETBY,DISP=SHR
//SLSPRINT      DD   SYSOUT=*
//SLSIN         DD   *
 CONFIG RESET CDSLEVEL(V61ABOVE)
 GLOBAL    MAXVTV=32000     MVCFREE=40
 RECLAIM   THRESHLD=70      MAXMVC=40  START=35
 VTVVOL LOW=905000 HIGH=999999 SCRATCH
 VTVVOL LOW=C00000 HIGH=C25000 SCRATCH
 VTVVOL LOW=RMM000 HIGH=RMM020 SCRATCH
 MVCVOL LOW=N25980 HIGH=N25989
 MVCVOL LOW=N35000 HIGH=N35999
 VTSS NAME=VSMPR1 LOW=70 HIGH=80 MAXMIG=8 MINMIG=4 RETAIN=5
 RTD  NAME=PR11A00 DEVNO=1A00 CHANIF=0C
 RTD  NAME=PR11A01 DEVNO=1A01 CHANIF=0D
 RTD  NAME=PR11A02 DEVNO=1A02 CHANIF=0K
 RTD  NAME=PR11A03 DEVNO=1A03 CHANIF=0L
 RTD  NAME=PR12A08 DEVNO=2A08 CHANIF=1C
 RTD  NAME=PR12A09 DEVNO=2A09 CHANIF=1D
 RTD  NAME=PR12A0A DEVNO=2A0A CHANIF=1K
 RTD  NAME=PR12A0B DEVNO=2A0B CHANIF=1L
 VTD LOW=9900 HIGH=99FF
 VTSS NAME=VSMPR2 LOW=70 HIGH=80 MAXMIG=8 MINMIG=4 RETAIN=5
 RTD  NAME=PR23A00 DEVNO=3A00 CHANIF=0C
 RTD  NAME=PR23A01 DEVNO=3A01 CHANIF=0D
 RTD  NAME=PR23A02 DEVNO=3A02 CHANIF=0K
 RTD  NAME=PR23A03 DEVNO=3A03 CHANIF=0L
 RTD  NAME=PR24A08 DEVNO=4A08 CHANIF=1C
 RTD  NAME=PR24A09 DEVNO=4A09 CHANIF=1D
 RTD  NAME=PR24A0A DEVNO=4A0A CHANIF=1K
 RTD  NAME=PR24A0B DEVNO=4A0B CHANIF=1L
 VTD LOW=9900 HIGH=99FF
 CLUSTER NAME=CLUSTER1 VTSSs(VSMPR1,VSMPR2)
 CLINK VTSS=VSMPR1 CHANIF=0G
 CLINK VTSS=VSMPR1 CHANIF=1G
 CLINK VTSS=VSMPR2 CHANIF=0G
 CLINK VTSS=VSMPR2 CHANIF=1G
```

Figure 16. *CONFIG **example: Dual ACS Bi-Directional Clustered VTSS System, VSM4 FICON Back-End***

3. **Enable the Advanced Management Feature.**

   The Advanced Management Feature is required to enable the REPLICAT parameter of the MGMTclas statement.

4. **Create a Management Class that specifies VTV replication and two Storage Class to migrate (duplexed) the replicated VTVs.**

```
MGMT NAME(VSMREPL) REPLICAT(YES) MIGPOL(REPLSTR1,REPLSTR2)
```

Figure 17. Management Class for VTV Replication

   In Figure 17, Management Class VSMREPL specifies VTV replication and, via the MIGPOL parameter, migrate duplexed to ACSs 01 and 00 by Storage Classes you will create in Step 5.

   Note: Note that Management Class VSMREPL **does not** specify an immediate migrate policy. VTV replication automatically enforces immediate migrate. The VTVs in this Management Class will be added to the immediate migration queue on either Peer VTSS once the replication has completed. Note that duplexing **is not** a requirement for replicate VTVs. For more information, see "How Clustered VTSS Configurations Work" on page 57.

5. **Create the Storage Classes for the MVCs that contain the replicated, migrated VTVs.**

```
STOR NAME(REPLSTR1) ACS(01) MEDIA(STK1R) MIRATE(EITHER)
STOR NAME(REPLSTR2) ACS(00) MEDIA(STK1R) MIGRATE(EITHER)
```

Figure 18. Storage Classes for Replicated, Migrated VTVs

   In Figure 18, the STORclas statement defines Storage Classes REPLSTR1 and REPLSTR2 referenced in the MIGPOL parameter in Step 4. **Also note** that, to optimize VTSS and RTD resources, the MIGRATE parameters on the Storage Classes allow migrates to come from either VTSS.

6. **Create the following VTSSLST and VTSSSEL statements.**

```
VTSSLST NAME(SITEA) VTSS(VSMPR1)
VTSSSEL FUNCTION(SCRATCH) HOST(HOST1) VTSSLST(SITEA)
VTSSSEL FUNCTION(SPECIFIC) HOST(HOST1) VTSSLST(SITEA)
```

Figure 19. VTSSLST/VTSSSEL Statements - VSMPR1 Primary, VSMPR2 Secondary

   In Figure 19:

   - The VTSSLST statement defines list SITEA that contains **only** VSMPR1.
   - The VTSSSEL statements direct scratch and specific VTV mounts from HOST1 to SITEA, which contains **only** VSMPR1...thus effectively making it the Primary.

7. **Load the MGMTclas, STORclas, VTSSLST, and VTSSSEL control statements with the MGMTDEF command.**

```
MGMTDEF DSN(hsc.parms)
```

Figure 20. MGMTDEF Command to Load Statements

8. **Create a** TAPEREQ **statement to route the critical data to VSM and assign Management Class** VSMREPL **to the data.**

```
TAPEREQ DSN(*.PAYROLL.**) MEDIA(VIRTUAL) MGMT(VSMREPL)
```

Figure 21. TAPEREQ ***Statement to Route Critical Data, Assign Management Class*** VSMREPL

In Figure 21, the TAPEREQ statement specifies:

- Route data sets with HLQ mask *.PAYROLL.** to VSM...
- .....and assign Management Class VSMREPL that you enabled in Step 4 on page 67.

Caution: To replicate VTVs, **both** VSMPR1 and VSMPR2 must be varied online to VTCS so that VTCS can send control commands to both VTSSs. See "How Clustered VTSS Configurations Work" on page 57 for more information.

Note: Also note the following:

- You can also use esoteric substitution via SMC TAPEREQ statement or NCS User Exits to route replication jobs to VSM. If an esoteric is substituted that spans all VTDs in **all** Peer VTSSs, then VTCS can continue to correctly influence allocation if a one of the Peer VTSSs in a Cluster is taken offline.
- For SMC, a Management Class name, if it is assigned in the StorageTek DFSMS Interface, is available at allocation time. Therefore the esoteric assigned in the interface no longer needs to contain only VTSSs that are part of clusters. As long as the esoteric contains some drives located on the Primary of a full function cluster, SMC has sufficient information to direct allocation to a drive on a Primary VTSS if the Management Class specifies REPLICAT(YES).

9. **Check your HSC PARMLIB options to ensure that subtype 28 records are enabled.**

   If enabled, VTSS clustering writes a subtype 28 record for each replication performed.

10. Next, let's switch...

...VSMPR2 to the Primary and VSMPR1 to the Secondary by rewriting the VTSSLST and VTSSSEL statements.

```
VTSSLST NAME(SITEB) VTSS(VSMPR2)
VTSSSEL FUNCTION(SCRATCH) HOST(HOST2) VTSSLST(SITEB)
VTSSSEL FUNCTION(SPECIFIC) HOST(HOST2) VTSSLST(SITEB)
```

Figure 22. VTSSLST/VTSSSEL Statements - VSMPR2 Primary, VSMPR1 Secondary

In Figure 19:

- The VTSSLST statement defines list SITEB that contains **only** VSMPR2.
- The VTSSSEL statements direct scratch and specific VTV mounts from HOST2 to SITEB, which contains **only** VSMPR2...thus effectively making it the Primary.

11. Load the updated VTSSLST, and VTSSSEL control statements with the MGMTDEF command.

```
MGMTDEF DSN(hsc.parms)
```

Figure 23. MGMTDEF Command to Load Updated Statements

Synchronous/ Asynchronous Replication

VTSS CLINKs are capable of replication, which is copying VTVs from one VTSS to another. You have another choice with replication (assuming that you have satisfied all the requirements in Table 2. on page iv), which is synchronous or asynchronous processing.

VTCS Replication - Synchronous or Asynchronous

Table 4. VTV Replication - Synchronous or Asynchronous

This policy does the following...	Valid values are...	The default is...	To set the policy, use...
Specifies whether synchronous replication is enabled.	YES, NO	NO	CONFIG GLOBAL SYNCHREP

Implementing Synchronous Replication

Caution: With synchronous replication the time required to replicate a virtual volume will delay the completion of any job creating data that has a synchronous replication policy.

To implement Synchronous Replication:

1. **Ensure that your system has the Synchronous Replication requirements described in Table 2. on page iv.**
2. **With all HSC/VTCS systems down, use CONFIG GLOBAL to enable Synchronous Replication:**

   ```
   CONFIG GLOBAL SYNCHREP=YES
   ```

3. **Specify Synchronous Replication on the desired MGMTClas statements:**

   ```
   MGMT (name) ..... REP(YES_SYNC)
   ```

Managing Clustered VTSS Systems

The following sections tell how to switch from Full-Function Mode to Degraded Primary or Degraded Secondary Mode, then return to Full-Function Mode:

- "Clustered VTSS Operating Modes" on page 77
- "Taking a Failed Primary VTSS Offline, Switching to the Secondary, Then Returning to Full-Function Mode" on page 80
- "Taking the Primary VTSS Offline, Switching to the Secondary, Then Returning to Full-Function Mode" on page 82
- "Taking a Failed Secondary VTSS Offline, Then Returning to Full-Function Mode" on page 84
- "Taking the Secondary VTSS Offline, Then Returning to Full-Function Mode" on page 85

Note: You can also use `VARY CLink` to do the following:

- Vary a CLINK offline if it has failed or requires service.
- Vary a CLINK online.

Clustered VTSS Operating Modes

Active replication can only occur in a “Full-Function” Cluster where both VTSSs are online to VTCS. Table 5 describes Cluster operating modes and Table 6 on page 78 describes how VTCS manages VTVs in each of these modes.

Table 5. Clustered VTSS Operating Modes

Cluster Operating Mode	Primary VTSS State	Secondary VTSS State	Replication Workload Possible
FULL-FUNCTION	Online	Online	Workload goes to the Primary for VTV replication to the Secondary.
DEGRADED	n/a (both are Peer VTSSs)	n/a (both are Peer VTSSs)	One of the two peer VTSSs in a Bi-Directional Cluster is either offline or quiesced. Workload can run on the remaining online VTSS. VTVs requiring replication, however, are allocated to the remaining VTSS only if no other Full-Function clusters are available and suitable. In this case, replicate VTVs are migrated immediately with keep and queued for replication when the other VTSS comes online.
DEGRADED SECONDARY	Online	Offline or Quiesced	Workload can run on the Primary. VTVs requiring replication, however, are allocated to the Primary only if no other Full-Function Clusters are available. If no Full-Function Clusters are available, replicate requests are allocated to non-clustered VTSSs and the replicate VTVs are migrated immediately with KEEP as described in Table 6 on page 78. When the Secondary comes back online, VTCS replicates any VTVs requiring replication that are resident on the Primary but not resident on the Secondary. VTCS **does not** recall and replicate any VTVs already migrated and deleted by automigration. Reconciliation also includes the migrate/delete actions described in Table 6 on page 78. The Cluster is now Full-Function again.

Table 5. Clustered VTSS Operating Modes

DEGRADED PRIMARY	Offline or Quiesced	Online	Workload can run on the Secondary. VTVs requiring replication, however, are allocated to the Secondary only if no other Full Function Clusters are available. **Note:** When the Secondary takes over the workload, one VTD per Cluster link on the Secondary is reserved for replication and will not come online to MVS. When the Primary comes back online, VTCS replicates any VTVs requiring replication that are resident on the Primary but not resident on the Secondary (that is, VTVs that were queued for replication but not yet replicated). VTCS **does not** recall and replicate any VTVs already migrated and deleted by automigration. Reconciliation also includes the migrate/delete actions described in Table 6 on page 78. The Cluster is now Full-Function again.
NON-OPERATIONAL	Offline or Quiesced	Offline or Quiesced	No workload is possible on this Cluster.

Table 6. Clustered VTSS Operating Modes, VTV Allocations, REPLICAT Settings, and VTCS Actions

If the Cluster Operating Mode is...	And the VTV is allocated to a VTSS of type...	And the REPLICAT setting is...	Then VTCS does the following at VTV dismount
FULL-FUNCTION	Primary	Yes	Replicates to Secondary then immediately migrates with KEEP from Secondary
FULL-FUNCTION	Primary	No	The VTV is managed by any other assigned Management Class attributes (for example, IMMEDMIG(KEEP))
FULL-FUNCTION	Secondary	No	Immediately migrates with DELETE
FULL-FUNCTION	Non-cluster	No	Nothing
FULL-FUNCTION	Peer	Yes	Replicates to Peer VTSS then immediately migrates with KEEP from the VTSS designated by the STORCLASS MIGRATE policy
DEGRADED SECONDARY	Primary	Yes	Immediately migrates with KEEP
DEGRADED SECONDARY	Secondary	Yes	Not possible

Table 6. Clustered VTSS Operating Modes, VTV Allocations, REPLICAT Settings, and VTCS Actions

DEGRADED SECONDARY	Non-cluster	Yes	Immediately migrates with KEEP
DEGRADED SECONDARY	Primary	No	Nothing
DEGRADED SECONDARY	Primary	Yes	Immediately migrates with KEEP and queues the VTV for replication.
DEGRADED SECONDARY	Secondary	No	Not possible
DEGRADED SECONDARY	Non-cluster	No	Nothing
DEGRADED PRIMARY	Primary	Yes	Not possible
DEGRADED PRIMARY	Secondary	Yes	Immediately migrates with KEEP
DEGRADED PRIMARY	Non-cluster	Yes	Immediately migrates with KEEP
DEGRADED PRIMARY	Primary	No	Not possible
DEGRADED PRIMARY	Secondary	No	Nothing
DEGRADED PRIMARY	Non-cluster	No	Nothing
DEGRADED	Peer	Yes	Immediately migrates with KEEP and queues the VTV for replication. It will be replicated when the Peer VTSS comes online.

Taking a Failed Primary VTSS Offline, Switching to the Secondary, Then Returning to Full-Function Mode

The following procedure tells how to take a failed Primary VTSS offline, switch to the Secondary, then return to Full-Function Mode.

To take a failed Primary offline, switch to the Secondary, then return to Full-Function Mode, do the following:

1. **Vary the Primary VTSS to `Offline` mode.**

   Message SLS6742I indicates when the VTSS is offline to all hosts.

2. **Vary the VTDs in the Secondary online to MVS.**

3. **Ensure that `MINMIG=1` on the Secondary.**

4. **Identify and recreate any unreplicated VTVs.**

   - An HSC `SLS0906E Unable to mount message` is issued by VTCS in response to an attempt to mount a VTV that is not available.
   - You can also run a VTV report with the `UNAVAIL` option to identify those VTVs that are now unavailable; that is, VTVs that are only resident and left mounted in VTSS1.

5. **When the Primary is available again, dismount any VTVs still mounted in the VTSS (MVS perspective), by doing either of the following:**

   - Use the MVS UNLOAD command to dismount the VTVs.
   - Use the VARY OFFLINE command to vary offline the VTD where the VTV is mounted, which will also dismount the VTV.

6. **Clear any boxed VTD conditions in the Primary.**

7. **Vary the Primary VTSS to `Quiesced` mode.**

8. **Audit the Primary VTSS.**

   When a VTSS is offline, a VTV can become “orphaned”. That is, the VTV is resident in the VTSS but the VTV record in the CDS no longer has knowledge of this VTV image on the offline VTSS.

   When the VTSS goes to Quiesced mode, in Step 7, any orphaned VTVs occupy VTSS buffer space and automigrate does not remove them. The audit reconciles the orphaned VTVs as follows:

   - If the orphaned VTV is a current copy, the CDS is updated, and VTCS now manage it via automigration, recall, and so forth.
   - If the orphaned VTV is no longer current, the audit deletes it from the VTSS.

9. **Vary the Primary back online to VTCS and its VTDs back online to MVS.**

   Work will resume on the Primary. Note for a short period, work will also continue on the Secondary. No new allocations will use the Secondary VTSS but existing work will continue to completion (VTV mounts and dismounts

will complete). Also note that VTCS will start to reconcile the Primary and Secondary VTSSs via migrates and deletes from the Secondary VTSS.

10. **Reset** `MINMIG=MAXMIG` **on the Secondary.**
11. **Vary the VTDs in the Secondary offline to MVS.**

    The VTDs will only go offline to MVS once all jobs that are allocated to VTDs in the secondary complete.

12. **Use** `Query CLINK` **to verify that the Cluster link is online.**
13. **Use** `Query CLUSTER` **to verify that the Cluster is in** `Full-Function` **Mode.**

Taking the Primary VTSS Offline, Switching to the Secondary, Then Returning to Full-Function Mode

The following procedure tells how to take the Primary VTSS offline and switch to the Secondary (for service, replacement, and so forth, of the Primary), then return to Full-Function Mode when the Primary is available again.

To explicitly take the Primary offline, switch to the Secondary, then return to Full-Function Mode, do the following:

1. **Vary the Primary to** `Quiesced` **mode.**

   Message SLS6742I indicates when the VTSS is quiesced to all hosts.

2. **Do a demand migrate to 0.**
3. **Audit the Primary VTSS to ensure that all VTVs were successfully migrated.**
4. **Vary the Primary to** `Offline` **mode.**

   Message SLS6742I indicates when the VTSS is offline to all hosts.

5. **Use** `Query CLUSTER` **to verify that the Cluster is in** `Degraded Primary` **Mode.**
6. **Vary the VTDs in the Secondary online to MVS.**
7. **Ensure that** `MINMIG=1` **on the Secondary.**
8. **When the Primary is available again, vary it to** `Quiesced` **mode.**
9. **Audit the Primary VTSS.**

   When a VTSS is offline, a VTV can become “orphaned”. That is, the VTV is resident in the VTSS but the VTV record in the CDS no longer has knowledge of this VTV image on the offline VTSS.

   When the VTSS goes to Quiesced mode, in Step 8, any orphaned VTVs occupy VTSS buffer space and automigrate does not remove them. The audit reconciles the orphaned VTVs as follows:

   - If the orphaned VTV is a current copy, the CDS is updated, and VTCS now manage it via automigration, recall, and so forth.
   - If the orphaned VTV is no longer current, the audit deletes it from the VTSS.

10. **Vary the Primary VTSS online to VTCS and vary the VTDs in the Primary VTSS online to MVS.**

    Work will resume on the Primary. Note for a short period, work will also continue on the Secondary. No new allocations will use the Secondary VTSS but existing work will continue to completion (VTV mounts and dismounts will complete). Also note that VTCS will start to reconcile the Primary and Secondary VTSSs via migrates and deletes from the secondary VTSS.

11. **Reset** `MINMIG=MAXMIG` **on the Secondary.**
12. **Vary the VTDs in the Secondary offline to MVS.**

The VTDs will only go offline to MVS once all jobs that are allocated to VTDs in the secondary complete.

13. **Use** `Query CLINK` **to verify that the Cluster link is online.**
14. **Use** `Query CLUSTER` **to verify that the Cluster is in** `Full-Function` **Mode.**

Taking a Failed Secondary VTSS Offline, Then Returning to Full-Function Mode

The following procedure tells how to take a failed Secondary VTSS offline, then return to Full-Function Mode.

To take a failed Secondary offline, then return to Full-Function Mode, do the following:

1. **Vary the Secondary to** `Offline` **mode.**

   Message SLS6742I indicates when the VTSS is offline to all hosts.

2. **When the Secondary is available again, vary it to** `Quiesced` **mode.**
3. **Audit the Secondary VTSS.**
4. **Vary the Secondary to** `Online` **mode.**
5. **Use** `Query CLINK` **to verify that the Cluster link is online.**
6. **Use** `Query CLUSTER` **to verify that the Cluster is in** `Full-Function` **Mode.**

Taking the Secondary VTSS Offline, Then Returning to Full-Function Mode

The following procedure tells how to take the Secondary VTSS offline (for service, replacement, and so forth), then return to Full-Function Mode when the Secondary is available again.

To explicitly take the Secondary offline, then return to Full-Function Mode, do the following:

1. **Vary the Secondary to `Quiesced` mode.**

   Message SLS6742I indicates when the VTSS is quiesced to all hosts.

2. **Audit the Secondary VTSS to ensure that all VTVs were successfully migrated.**

3. **Vary the Secondary to `Offline` mode.**

   Message SLS6742I indicates when the VTSS is offline to all hosts.

4. **When the Secondary is available again, vary it to `Quiesced` mode.**

5. **Audit the Secondary VTSS.**

6. **Vary the Secondary to `Online` mode.**

7. **Use `Query CLINK` to verify that the Cluster link is online.**

8. **Use `Query CLUSTER` to verify that the Cluster is in `Full-Function` Mode.**

Resolving Common VSM Problems

The following sections tell how to identify and resolve common VSM problems. Some problems may require assistance from StorageTek. If so, contact StorageTek Central Software Support (CSS). For more information, see *Requesting Help from Software Support*. A StorageTek software support representative may ask you to run a trace.

RTD Failures

If VTCS detects read/write errors on an MVC, VTCS swaps the MVC to another RTD. If the read/write errors persist, VTCS marks the MVC as in error. Remove the MVC from the pool as described in "Permanently Removing MVCs" on page 33. If VTCS detects no further read/write errors on the MVC, VTCS assumes that the first RTD is in error.

Message SLS6662A indicates that an RTD is in *maintenance mode*, and this status is also reported on `Query RTD` output. An RTD in maintenance mode is typically in error and requires assistance from your hardware operations or service personnel. Note that an RTD in *recovery mode* is initializing (when varied online, for example), and typically is *not* in error.

If a failed RTD cannot be quickly repaired or if the failed RTD is attached to a remote ACS, you may want to remove the RTD from your configuration to prevent attempts to allocate that RTD. Remove the `RTD` statement for the RTD and rerun `CONFIG`.

Caution: In a dual-ACS configuration (two ACSs connected to a single VTSS), ensure that you do **not** allow all RTDs in either ACS to be unavailable to the VTSS for an extended period. If no RTDs are available in that ACS, migrates to or recalls from that ACS cannot occur, and the VTSS space can fill up. In addition, this condition can also cause stalled migrations to RTDs in the other ACS.

In a dual-ACS configuration, therefore, if you must make all RTDs in an ACS unavailable for an extended period, remove the RTDs from the configuration as described above.

MVC Failures

If VTCS detects read/write errors on an MVC, VTCS swaps the MVC to another RTD. If the read/write errors persist, VTCS marks the MVC as in error. Use the procedure in "Permanently Removing MVCs" on page 33 to attempt to recover the VTVs and remove the MVC from the pool.

Poor VTV Mount Performance

If VTV mounts occur very slowly or not at all, check the following:

- Are mounts failing on a single VTD? This usually occurs because a host requests a mount of an MVC–resident VTV that VSM cannot recall. If so, do the following:
  - Enter a `Query Queue DETail` command to check the queued recalls. If a recall is queued waiting for an MVC, it may be in use by another VTCS process, which you can check with `Query Active DETail`.
  - If the MVC is *not* in use, next enter an HSC `DISPLAY VOLUME` command. Is the MVC actually in the ACS? If not, you must reenter the MVC to complete the recall.
  - Next, are RTDs available to mount the MVC to recall the VTV? Enter `Query RTD` to check RTD availability. If no RTDs are available, use `Query` on all hosts to check active and queued processes. If necessary, use `Cancel` to cancel processes and free an RTD so the recall can complete.

Hint: Setting the `MGMTclas` statement `IMMEDmig` parameter to either `KEEP` or `DELETE` preferences migration processing (and RTD use for migration) and may increase I/O to the RTDs.

Also note that you can change the `CONFIG MAXMIG` and `MINMIG` parameter settings to rebalance automatic migration tasks with other tasks (such as recall and reclaim) for the RTDs you have defined for each VTSS.

- Are the mounts failing on multiple VTDs? If so, check the following:
  - Check VTD status with `Query VTD`.
  - Enter `Query Active`. If there are no active processes, ensure that VTCS, HSC, all VTSSs, and all communications are functioning normally.
  - Ensure that you have sufficient VTSS space; for more information, see “Managing VTSSs and VTDs” on page 19.
  - As described in “Poor Migration Performance” on page 88, check to see if your system is running out of available MVCs or usable MVC space.
  - Raising the low AMT tends to keep more VTVs resident in VTSS space, which may help prevent virtual mounts from failing.

Failed VTV Mounts and Dismounts

If a VTV mount fails, even if VTDs are online, use the `MVS VARY` command to vary VTDs online, use the `MVS UNLOAD` command to clear the VTDs, then use the HSC `MOUNT` and `DISMOUNT` commands to retry the operation.

Also note that VTCS will not attempt to resolve outstanding mounts on VTDs during HSC initialization. You must resubmit the jobs requesting these mounts.

Poor Migration Performance

If VTV migration occurs very slowly or not at all, check the following:

- Ensure that you have sufficient available MVCs and usable MVC space as described in "Managing MVCs" on page 22.
- If your system has sufficient available MVCs and usable MVC space, enter `Query RTD` to check RTD availability, then use `Query Queue DETail` to check the status of queued processes. If many processes are waiting for RTDs, you may want to vary additional RTDs online to VSM; see "Sharing Transports Between VSM and MVS" on page 46.
- Has system security changed or have you added MVCs to the pool without giving VSM update authority to these MVCs? If so, resolve these problems.
- Review your migration and reclamation policies; for more information.
- In the JES3 environment, VTV mounts may fail if you have not created and installed the correct User Exit modifications.

Invalid Management Classes

If VTCS receives a request to migrate a VTV that is assigned to an invalid Management Class, VTCS will dynamically create the !ERROR Storage Class and migrate the VTVs defined by the invalid Management Class to the !ERROR Storage Class. MVC reports show when a VTV is migrated to this Storage Class. Message `SLS6681I` displays the Management and Storage Class of each VTV as it is migrated.

Running out of MVCs or Usable MVC Space

VTV reports and `Query` help you monitor VTSS and VTV activity. MVC reports and `Query` help you monitor MVC status:

- For migrations MVCs, the **Owner/Consolidate Time** field reports the MVC's Storage Class. Use only the minimum Storage Classes required to define the policies you want to implement. Excessive Storage Classes can impact VSM performance due to the MVC mount/dismount overhead incurred. In addition, an MVC can only contain VTVs in a single Storage Class, so excessive Storage Classes can underuse MVC space. To eliminate a Storage Class, do the following:

  1. Delete the `STORclas` statement for the Storage Class.
  2. Delete or update any `MGMTclas` statements to remove references to the Storage Class.
  3. Enter a `MGMTDEF` command to reload the data set that contains the updated/deleted `STORclas` and `MGMTclas` statements.
  4. Enter `MVCDRain` to drain the MVCs owned by this Storage Class.

- Do VTV reports show that you have added VTVs to your system? Does the SIZE field show that your VTVs are growing larger? Does the MIGR field show that many VTVs have been migrated? Have multiple MVC copies been specified for many VTVs? Multiple MVC copies increases space requirements. Ensure that you have specified multiple MVC copies for only the VTVs that require it. You may need to review your migration policies or add more MVCs.
- On MVC reports, if all MVCs show low values for both the %AVAIL and %FRAG fields, your system is probably running out of MVC space. If all MVCs show high values for %AVAIL (especially after reclaim processing), your system's maximum VTVs per MVC is probably set too low.
- If raising the maximum VTVs per MVC does not relieve MVC space constraints and if the %FRAG field shows high MVC fragmentation, consider changing your space reclamation (and migration) policies.
- However, do not wait for VSM to automatically reclaim MVC space. Instead, run demand space reclamations on your existing MVCs before adding more MVCs to the pool. For more information, see "Doing Demand MVC Space Reclamations" on page 45.
- If doing demand space reclamation does not free sufficient MVC space, consider adding MVCs. In mixed–media systems, ensure that you have sufficient space on each media type that your system uses and that you have RTDs available to service each media type.

  As an alternative, in multi-ACS configurations, you can move MVCs from one ACS to another as described in "Moving MVCs Between ACSs" on page 36.

Losing All Copies of the CDS

If you lose all copies of the HSC CDS, see the procedures in *VTCS Installation and Configuration Guide* for recovering the CDS and updating it with VSM information.

Losing CDS Information About Some VSM Resources

If you lose CDS information about some VSM resources, see the procedures in *VTCS Installation and Configuration Guide* for information about recovering the lost information.

Lock Recovery

If an HSC running VTCS is cancelled or the host running HSC fails, the failed host may retain locks against RTDs, MVCs, VTVs, and so forth. To recover, either restart HSC on the failed host or use the HSC `RECover` command to release the locked resources.

You can use the `DISPLAY ACTIVE`, `DISPLAY QUEUE`, and `Query LOCKs` commands to help determine which host has locked resources. Enter these commands on all hosts to display resource status. If a request stays queued for a particular resource for a long time and none of the other hosts appear to be using the resource, the failed host has probably locked the resource.

Chapter 3. VSM Operations

This chapter tells how to do the following VSM operations:

Quiescing a VTSS

To quiesce a VTSS:

1. **Ensure tape allocations are directed to another VTSS if you have been specifically directing data to VTSS you want to quiesce.**

   If necessary, redirect allocations by changing `TAPEREQ` statements or by changing esoterics in JCL.

2. **Vary the VTSS to quiesced state:**

   ```
   .VT V VTSS(vtssname) QUIESCED
   ```

   The VTSS goes to a quiescing state. In quiescing state, VTCS does not direct any DD allocation to the VTSS, which still accepts pending mounts to allow those long running jobs with `unit=aff` chains to complete. When all VTDs are no longer in use (their UCBs are not allocated on MVS), the VTSS goes to quiesced state. In quiescing state, the VTSS continues to accept and process back-end work; for example, migrates, recalls, and audits.

   The VTSS then goes to quiesced state. In quiesced state, the VTSS continues to accept and process back-end work; for example, migrates, recalls, and audits. That is, you can use the recall and migrate commands and utilities to do these operations using the quiesced VTSS.

3. **Display the state of the VTSS:**

   ```
   .VT Q VTSS(vtssname)
   ```

   When the `STATE` column shows `QUIESCED`, the operation is complete.

Usage Scenarios

Use this procedure in the following situations:

- When DBU has reached the HAMT and automatic migration is not releasing VTSS space fast enough.
- Before varying a VTSS offline.

Taking a VTSS Offline

To take a VTSS offline:

1. **Quiesce the VTSS as described in "Quiescing a VTSS" on page 92.**
2. **Enter an MVS `VARY` command to vary the VTDs offline:**

   ```
   VARY vtd-range,OFFLINE
   ```

   For example:

   ```
   VARY 840-87F,OFFLINE
   ```

   Varies 64 VTDs offline beginning with address 840.
3. **If the RTDs are not being shared by other VTSSs, vary the RTDs offline:**

   ```
   .VT V RTD(rtd-range) OFFLINE
   ```
4. **Vary the VTSS offline:**

   ```
   .VT V VTSS(vtssname) OFFLINE
   ```

   The VTSS goes to an offline pending state. In offline pending state, the offline process has started but has not completed on all hosts. VTCS immediately shuts down the VTSS and interrupts and purges all active tasks and purges all queued tasks. The VTSS server task terminates and no longer accepts new front-end and back-end work. VTCS creates new VTVs and mounts/dismounts existing VTVs only on alternate VTSSs, if they are available.

   The VTSS then goes offline. in offline state, The VTSS is offline to all hosts and does not accept either front-end or back-end work. If a copy of a VTV is resident on an offline VTSS and also on an MVC and a job requires the VTV, VTCS automatically recalls the VTV to an alternate VTSS, if available.
5. **Display the state of the VTSS:**

   ```
   .VT Q VTSS(vtssname)
   ```

   When the `STATE` column shows `OFFLINE`, the operation is complete.

6. **If VTDs have been taken offline and VTSS is offline, enter the MVS** `VARY` **command to vary VTD paths offline:**

   ```
   VARY PATH(VTD-id,chpid),OFFLINE
   ```

   For example:

   ```
   VARY PATH(840,FE),OFFLINE
   ```

   Varies CHPID FE path offline to device address 840.

Usage Scenarios

Use this procedure in the following situations:

- If a VTSS fails.
- If you need to do maintenance on a VTSS that you do not need to migrate to zero. If maintenance requires you migrate the VTSS to zero, see “Migrating a VTSS to Zero” on page 97.

Bringing a VTSS Online

To bring a VTSS online:

1. **Enter an MVS `VARY` command to vary VTD paths online:**

   ```
   VARY PATH(VTD-id,chpid),ONLINE
   ```

   For example:

   ```
   VARY PATH(840,FE),ONLINE
   ```

   Varies CHPID FE path online to device address 840.

2. **Vary the VTSS to quiesced state:**

   ```
   .VT V VTSS(vtssname) QUIESCED
   ```

   The VTSS goes to quiescing, then to quiesced state. If the VTSS was offline, when it goes online, VTCS issues a warning message recommending a VTSS audit. For more information, see *VTCS Command and Utility Reference*.

3. **Vary the VTSS online:**

   ```
   .VT V VTSS(vtssname) ONLINE
   ```

   The VTSS goes to online pending state. In online pending state, the online process has started but has not completed on all hosts.

   The VTSS next goes online. In online state, the VTSS is online, available, and accepts both front-end and back-end work. If the VTSS was offline, when it goes online, VTCS issues a warning message recommending a VTSS audit. or more information, see *VTCS Command and Utility Reference*.

4. **Display the state of the VTSS:**

   ```
   .VT Q VTSS(vtssname)
   ```

   When the `STATE` column shows `ONLINE`, the operation is complete.

5. **Enter an MVS `VARY` command to vary the VTDs online:**

   ```
   VARY vtd-range,ONLINE
   ```

   For example:

   ```
   VARY 840-87F,ONLINE
   ```

   Varies 64 VTDs online beginning with address 840.

6. **Enter an MVS `DISPLAY` command to verify VTDs are online:**

   ```
   D U,,,VTD-id,number of range
   ```

   For example:

   ```
   D U,,,840,16
   ```

   Displays 16 VTD addresses beginning with address 840.

7. **Vary RTDs online:**

   ```
   .VT V RTD(rtd-id or rtd-range) ONLINE
   ```

8. **Verify the RTD is online:**

```
.VT QUERY RTD(rtd-id)
```

Usage Scenario Use this procedure to return VTSS to service after maintenance or another outage.

Migrating a VTSS to Zero

To migrate a VTSS to zero:

1. **Ensure tape allocations are directed to another VTSS if you have been specifically directing data to VTSS you want to quiesce.**

   If necessary, redirect allocations by changing TAPEREQ statements or by changing esoterics in JCL.

2. **Display active processes:**

   ```
   .VT QU A DET VTSS(vtssname)
   ```

   Either allow outstanding processes to complete before continuing or enter the VTCS CANCEL command to stop all active and queued processes as follows:

   ```
   .VT CANCEL ID(process-id)
   -or-
   .VT CANCEL TYPE(ALL)
   ```

3. **Enter an MVS VARY command to vary the VTDs offline:**

   ```
   VARY vtd-range,OFFLINE
   ```

   For example:

   ```
   VARY 840-87F,OFFLINE
   ```

   Varies 64 VTDs offline beginning with address 840.

4. **Optionally, increase the number of RTDs used for migration.**

   If desired, enter the VTCS SET MIGOPT command to increase the value for maximum number of RTDs that can be used during migration to allow migration to run faster.

   ```
   . VT SET MIGOPT MAXMIG(n)
   ```

5. **Migrate the VTSS to zero.**

   ```
   .VT MIGRATE VTSS(vtssname) THRESHLD(0)
   ```

6. **Run a VTCS AUDIT to verify the VTSS is migrated to zero.**

   ```
   AUDIT VTSS(vtssname)
   ```

   For more information, see *VTCS Command and Utility Reference*.

7. Run VTCS VTV and MVC detail reports.

```
VTVRPT
MVCRPT DET
```

For more information, see *VTCS Command and Utility Reference*.

8. Review the VTV report...

...to ensure that all VTVs were migrated:

- Migrated VTVs show as `M` in the `MIGR` column.
- VTVs not migrated and still resident in the VTSS show up on the VTV report in the `SIZE` column as one of the following conditions:
  - `MOUNT` - The VTV is in mounted state. Do the following:
    - If the VTV is in mounted state ***and*** the VTV report shows that a copy of the VTV is already migrated to an MVC, then review the MVC report to determine if the MVC contains the most recent copy of the VTV by referencing the timestamps. If the most current copy of the VTV resides on an MVC, you do not need to migrated the VTV.

      If a VTV is in Mounted status and it is ***not*** already on an MVC, then do either of the following:

      - Use the MVS `UNLOAD` command to dismount the VTV.
      - Use the MVS `VARY OFFLINE` command to vary offline the VTD where the VTV is mounted, which will also dismount the VTV.

      Then either migrate the VTSS to zero again or migrate the specific VTV:

      ```
      .VT MIGRATE VTV(volser)
      ```

  - `FENCED` - The VTV is fenced. If the VTV is in fenced state ***and*** the VTV report shows that a copy of the VTV is already migrated to an MVC, then review the MVC report to determine if the MVC contains the most recent copy of the VTV by referencing the timestamps. If the most current copy of the VTV resides on an MVC, then unfence the VTV as follows:

    1. Migrate the VTV and delete it from the VTSS:

       ```
       .VT MIGRATE VTV(volser) DELETE(YES)
       ```

    2. Recall the most recent VTV copy from the MVC:

       ```
       .VT RECALL VTV(volser) VTSS(vtssname)
       ```

    3. Audit the VTSS:

       ```
       AUDIT VTSS(vtssname)
       ```

       For more information, see *VTCS Command and Utility Reference*.

    4. Reenter VTCS `RECALL` command to recall and unfence the VTV:

       ```
       .VT RECALL VTV(volser) VTSS(vtssname)
       ```

If the VTV is in Fenced status and there is no good copy on an MVC, you do not need to migrate the VTV. When the VTSS is back online, do the following unfence the VTV:

1. Scratch the VTV in your TMS.
2. Update the HSC CDS to specify that the VTV is scratch.
3. Allow the VTV to be selected again by normal scratch mount processing.
4. Rewrite the VTV as a new scratch volume. The VTV will now be unfenced.

9. **Vary RTDs offline:**

   ```
   .VT V RTD(rtd-id or rtd-range) OFFLINE
   ```

10. **Vary the VTSS offline:**

    ```
    .VT V VTSS(vtssname) OFFLINE
    ```

11. **Display the state of the VTSS:**

    ```
    .VT Q VTSS(vtssname)
    ```

    When the `STATE` column shows `OFFLINE`, the operation is complete.

12. **Enter the MVS `VARY` command to vary VTD paths offline:**

    ```
    VARY PATH(VID-id,chpid),OFFLINE
    ```

    For example:

    ```
    VARY PATH(840,FE),OFFLINE
    ```

    Varies CHPID FE path offline to device address 840.

Usage Scenarios

Use this procedure in the following situations:

- Maintenance to clean the VTSS.
- Maintenance to load new microcode in the VTSS.
- To swap out the VTSS.
- To remove the VTSS from service.

Unfencing a VTV

For more information, see Step 7 and Step 8 on page 98.

Recovering a Bad VTV on a VTSS (VTV Not Fenced)

To recover a bad VTV on a VTSS (VTV not fenced):

1. **Verify that there is a current copy of the VTV on a MVC and that the VTV is not mounted on a VTD:**

   ```
   .VT QUERY VTV(vtv-id)
   ```

   If a current copy does ***not*** exist on an MVC, go to Step 7. If a current copy exists, it is owned by a VTSS and on an MVC(s). If the VTV is mounted, you must dismount it.

2. **Dismount the VTV:**

   - Enter the MVS `UNLOAD` command:

     ```
     UNLOAD(vtd-id)
     ```

   - Enter the HSC `DISMOUNT` command:

     ```
     .DISMOUNT ,vtd-id
     ```

3. **Migrate the VTV and delete it from the VTSS:**

   ```
   .VT MIGRATE VTV(volser) DELETE(YES)
   ```

4. **Verify that VTV is not owned by a VTSS:**

   ```
   .VT QUERY VTV(vtv-id)
   ```

5. **Recall the current copy of the VTV:**

   ```
   .VT RECALL VTV(volser) VTSS(vtssname)
   ```

6. **Verify that VTV has been recalled:**

   ```
   .VT QUERY VTV(vtv-id)
   ```

   The status should show that the VTV is now resident on the VTSS. StorageTek recommends that you verify the data by reading it (for example, application reading the data, tape copy, tape scan, and so forth).

7. **If a current VTV copy does not exist on an MVC, migrate the VTV and delete it from the VTSS:**

   ```
   .VT MIGRATE VTV(volser) DELETE(YES)
   ```

8. **Recreate the data on a new VTV by re-running the application job.**

Recovering a Bad VTD

When a VTV remains on a VTD after jobs have terminated, diagnose the problem before taking recovery action. VTD problems are usually hardware or software failures, such as (but not limited to) the following:

- Mount or Dismount failures
- HSC crashes
- VTSS crashes
- VTSS warmboots

To recover a bad VTD:

1. **Review the HSC started task log for HSC/VTCS/VTSS errors.**
2. **Enter MIM commands (or GRS) to display the bad VTD.**

   Following are MIM examples:

   ```
   @D G VTD-id,1
   ```

   For example:

   ```
   @D G 824,1
   ```

   Example output of this command is:

   ```
   MIM2053 GLOBAL UNIT STATUS 475
   SYSTEM 824
   CPU1 ON
   CPU2 ON
   CPU3 ON
   CPU4 ON
   CPU5 ON
   CPU6 ON
   CPU7 ON
   CPU8 A,ON
   VOLSER Y46638
   JOBNAME A22167B4
   COMMAND COMPLETE
   ```

3. **Identify the MVS image that had the VTD allocated at the time of the error.**

4. **Then enter one of the following commands from that MVS image:**
   - MVS `UNLOAD` command:

     `UNLOAD(vtd-id)`
   - Followed by HSC dismount command:

     `.DISMOUNT vtv-id vtd-id`

     OR

     `.DISMOUNT ,vtd-id`

     (if VTV volser is unknown)

Recovering from a CLINK Failure

VTCS issues message SLS6751I when a CLINK failure occurs, which typically leaves a VTV stranded on a VTD on the Secondary or Peer VTSS.

To recover from a CLINK failure:

1. **Review the HSC started task log for HSC/VTCS/VTSS errors.**
2. **Enter MIM commands (or GRS) to display the bad VTD.**

   Following are MIM examples:

   ```
   @D G VTD-id,1
   ```

   For example:

   ```
   @D G 824,1
   ```

   Example output of this command is:

   ```
   MIM2053 GLOBAL UNIT STATUS 475
   SYSTEM 824
   CPU1 ON
   CPU2 ON
   CPU3 ON
   CPU4 ON
   CPU5 ON
   CPU6 ON
   CPU7 ON
   CPU8 A,ON
   VOLSER Y46638
   JOBNAME A22167B4
   COMMAND COMPLETE
   ```

3. **Identify the MVS image that had the VTD allocated at the time of the error.**

4. **Then enter the following commands from that MVS image:**
   - MVS VARY command to vary on the VTD with the stranded VTV:
     ```
     VARY vtd-id,ONLINE
     ```
   - MVS UNLOAD command to unload the VTV:
     ```
     UNLOAD(vtd-id)
     ```
   - Followed by HSC dismount command:
     ```
     .DISMOUNT vtv-id vtd-id
     ```
     OR
     ```
     .DISMOUNT ,vtd-id
     ```
     (if VTV volser is unknown)
   - MVS VARY command to vary off the VTD:
     ```
     VARY vtd-id,OFFLINE
     ```

   After the CLINK failure is resolved, you can vary the CLINK/VTD(s) back online and resume operations.

Recovering a Bad RTD

To recover a bad RTD:

1. **Vary the RTD to maintenance mode:**
   ```
   .VT VARY RTD(rtd-id) MAINT
   ```
2. **Verify the RTD is offline:**
   ```
   .VT QUERY RTD(rtd-id)
   ```

Note: If required, you can do maintenance now.

3. **Vary the RTD online:**
   ```
   .VT VARY RTD(rtd-id) ON
   ```
4. **Verify the RTD is online:**
   ```
   .VT QUERY RTD(rtd-id)
   ```

   If RTD fails to vary online, contact StorageTek hardware service.

Recovering an RTD in Maintenance Mode

To recover an RTD in maintenance mode:

1. **There are three reasons for a RTD to go into maintenance mode:**
   - The VTSS had a communication problem with the RTD and dropped communication. This is usually noted by a SLS6684I message with an ECAM code of CC=05 RC=109.
   - VTCS reviewed the ERPA and sense byte information from the RTD via the VTSS and determined the RTD is no longer usable. This is usually noted by a SLS6684I message with an ECAM code of CC=05 RC=108.
   - The RTD is reporting a problem with the MVC currently mounted on it. This is noted by a SLS6684I message with an ECAM code of CC=05 RC=108.
2. **To recover the RTD:**
   - For more information on SLS6684I messages, see *VTCS Messages and Codes*.
   - Review tape drive logs (if available) for any information to determine if this is a media or tape drive problem.
   - If you cannot diagnoses/resolve the problem, contact StorageTek software service.

Recovering from VTSS Warmboots

After the VTSS warmboots, it posts a message to the console, which posts a SLS6659I SIM to the console.

For example: –

```
Reference FSC 7596: 10.08.26 STC06954 .SLS6659I VTSS VSMDAL01 SIM:00
00 10 00 00 00 8F E0 11 10 00 00 20 00 3E 10 42 00 00 9B 00 01 7596
04104203F1FFFFFF 00 22
```

To recover from a VTSS warmboot:

1. **After receiving the SLS6659I message, verify the VTSS recovered and is back online.**
   - Display VTDs to ensure that they are online per their assigned MVS images. Enter the MVS `DISPLAY` command:

     ```
     D U,,,VTD-id,number of range
     ```

     For example:

     ```
     D U,,,840,16
     ```

     Displays 16 VTD addresses beginning with address 840.
   - Display paths to ensure that they are online per their assigned MVS images. Enter the MVS `DISPLAY` command:

     ```
     D M=DEV(vtd-id or vtd-range)
     ```

     For example:

     ```
     D M=DEV(840-87F)
     ```

     Displays channel paths for 64 VTDs beginning with address 840.

     Or enter the MVS command:

     ```
     DS P,vtd-id or DS P,vtd-id,nn
     ```

     For example:

     ```
     DS P,840 or DS P,840,16
     ```

     Displays channel paths for 1 or 16 devices.
   - After 10 minutes, display the RTDs and verify they are online, migrating or recalling. Enter VTCS `QUERY RTD` command to verify RTD is operational:

     ```
     .VT QUERY RTD(rtd-id)
     ```
2. **If VTSS has not recovered, contact StorageTek software service.**

Glossary

A

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

ACS *See* Automated Cartridge System.

ACSid A method used to identify an ACS. An ACSid is the result of defining the SLIALIST macro during the library generation (LIBGEN) process. The first ACS listed in this macro acquires a hexadecimal identifier of 00, the second ACS listed acquires a hexadecimal identifier of 01, and so forth, until all ACSs are identified.

ACS routine An SMS term, referring to automatic class selection routine. Not to be confused with the HSC term, ACS, referring to automatic cartridge system.

AMT automatic migration threshold.

APF Authorized Program Facility.

APPL VTAM APPLID definition for the HSC.

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

audit A VSM audit (which is not the same as an HSC audit) reconstructs VTV and MVC information.

Automated Cartridge System (ACS) The library subsystem consisting of one or two LMUs, and from 1 to 16 attached LSMs.

automated library *See* library.

automatic mode A relationship between an LSM and all attached hosts. LSMs operating in automatic mode handle cartridges without operator intervention. This is the normal operating mode of an LSM that has been modified online.

automatic migration Migrating VTVs to MVCs that is automatically initiated and controlled by VSM.

automatic migration threshold (AMT) AMT values are percentage values that determine when virtual tape volume migration begins and ends. VTV migration begins when the VTSS buffer reaches the high AMT and ends when the buffer reaches or falls below the low AMT. These thresholds apply to all VTSSs.

automatic recall Recalling VTVs to the VTSS that is automatically initiated and controlled by VSM.

automatic reclaim Reclaiming MVC space that is automatically initiated and controlled by VSM.

B

back-end capacity The capacity of the VTSS disk buffer, in bytes, as defined in disk arrays excluding space for system overhead.

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

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

C

CA–1 (TMS) Computer Associates Tape Management System. Third–party software by Computer Associates International, Inc.

CAP *See* Cartridge Access Port.

capacity *See* media capacity.

CAPid A CAPid uniquely defines the location of a CAP by the LSM on which it resides. A CAPid is of the form *AAL:CC* where *AA* is the ACSid, *L* is the LSM number, and *CC* is the CAP number. Some commands and utilities permit an abbreviated CAPid format of *AAL*.

cartridge The plastic housing around the tape. It is approximately 4 inches (100 mm) by 5 inches (125 mm) by 1 inch (25 mm). The tape is threaded automatically when loaded in a transport. A plastic

leader block is attached to the tape for automatic threading. The spine of the cartridge contains a Tri–Optic label listing the VOLSER (tape volume identifier).

Cartridge Access Port (CAP) An assembly which allows an operator to enter/eject cartridges during automated operations. The CAP is located on the access door of an LSM. (*see also*, standard CAP, enhanced CAP, WolfCreek CAP, WolfCreek optional CAP.)

Cartridge Scratch Loader An optional feature for the Cartridge Drive. It allows the automatic loading of premounted tape cartridges or the manual loading of single tape cartridges.

cartridge system tape The basic tape cartridge media that is used with 4480, 4490, or 9490 Cartridge Subsystems. They are visually identified by a one–color cartridge case.

CAW *See* Channel Address Word.

CDRM Cross Domain Resource Manager definition (if not using existing CDRMs).

CDRSC Cross Domain Resource definition.

CDS *See* control data set.

CE Channel End.

cell A storage slot in the LSM that is used to store a tape cartridge.

Central Support Remote Center (CSRC) *See* Remote Diagnostics Center.

CFT Customer field test.

channel A device that connects the host and main storage with the input and output control units.

Channel Address Word (CAW) An area in storage that specifies the location in main storage at which a channel program begins.

channel command A command received by a CU from a channel.

Channel Status Word (CSW) An area in storage that provides information about the termination of input/output operations.

check Detection of an error condition.

CI Converter/Interpreter (JES3).

Clink (cluster link). The path between a primary VTSS and secondary VTSS in a cluster. The Clink path is used to copy replicate VTVs from the primary to the secondary.

Cluster. Two VTSSs which are physically cabled together by Clink paths and are defined in CONFIG as a cluster. A cluster consists of a primary and a secondary VTSS. VTVs with the replicate attribute attached will be copied from the primary to the secondary as soon as possible after dismount time.

connected mode A relationship between a host and an ACS. In this mode, the host and an ACS are capable of communicating (at least one station to this ACS is online).

control data set (CDS) The HSC database. In addition to the current information in the CDS, VSM keeps all its persistent data in the CDS as well.

control data set allocation map A CDS subfile that marks individual blocks as used or free.

control data set data blocks CDS blocks that contain information about the library and its configuration or environment.

control data set directory A part of the CDS that maps its subdivision into subfiles.

control data set pointer blocks CDS blocks that contain pointers to map data blocks belonging to a subfile.

control data set recovery area A portion of the CDS reserved for maintaining integrity for updates that affect multiple CDS blocks.

control data set subfile A portion of the CDS consisting of Data Blocks and Pointer Blocks containing related information.

Control Unit (CU) A microprocessor–based unit situated logically between a host channel (or channels) and from two to sixteen tape transports. It functions to translate channel commands into tape transport commands, send transport status to the channel(s), and pass data between the channel(s) and transport(s).

conventional Nearline transport An HSC–controlled transport that is not defined to VSM as an RTD.

cross–host recovery The ability for one host to perform recovery for another host that has failed.

CSE Customer Service Engineer.

CSI Consolidated System Inventory.

CSL Cartridge Scratch Loader.

CSRC Central Support Remote Center (*See* Remote Diagnostics Center)

CSW Channel Status Word.

CU *See* Control Unit.

D

DAE Dump Analysis Elimination.

DASD Direct access storage device.

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

data class A collection of allocation and space attributes, defined by the storage administrator, that are used to create a data set.

data compaction An algorithmic data–reduction technique that encodes data from the host and stores it in less space than unencoded data. The original data is recovered by an inverse process call decompaction.

data–compaction ratio The number of host data bytes divided by the number of encoded bytes. It is variable depending on the characteristics of the data being processed. The more random the data stream, the lower the opportunity to achieve compaction.

Data Control Block (DCB) A control block used by access 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.

data streaming A continuous stream of data being transmitted in character or binary–digit form, using a specified format.

DBU disk buffer utilization.

DCB Data Control Block.

demand allocation An MVS term meaning that a user has requested a specific unit.

demand migration Migrating VTVs to MVCs that an administrator does with the MIGRATE command or utility.

demand recall Recalling VTVs to the VTSS that an administrator does with the RECALL command or utility.

demand reclaim Reclaiming MVC space that an administrator does with the RECLAIM command or utility.

device number A four–digit hexadecimal number that uniquely identifies a device attached to a processor.

device separation The HSC function which *forces* the MVS device selection process to choose either a nonlibrary transport or a transport in a particular ACS, based on the location of the volume (specific requests) or the given subpool rules in effect (nonspecific request).

DFP Data Facility Product. A program that isolates applications from storage devices, storage management, and storage device hierarchy management.

DFSMS Refers to an environment running MVS/ESA SP and DFSMS/MVS, DFSORT, and RACF. This environment helps automate and centralize the management of storage through a combination of hardware, software, and policies.

DFSMS ACS routine A sequence of instructions for having the system assign data class, storage class, management class, and storage group for a data set.

directed allocation The HSC function of *influencing* MVS's selection of library transports. For a specific request, the HSC influences MVS to choose a transport requiring the fewest number of pass–thrus; for a nonspecific (scratch) request, HSC's influencing is based on the given subpool rules in effect.

disconnected mode A relationship between a host and an ACS. In this mode, the host and an ACS are not capable of communicating (there are no online stations to this ACS).

disk buffer utilization (DBU). The ratio of used to total VTSS buffer capacity.

DOMed Pertaining to a console message that was previously highlighted during execution, but is now at normal intensity.

drain The deletion of data from an MVC. May be accompanied by a "virtual" eject to prevent the MVC from being reused.

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

DSI Dynamic System Interchange (JES3).

dual LMU A hardware/u–software feature that provides a redundant LMU capability.

dual LMU HSC release 1.1.0 or later that automates a switchover to the standby LMU in a dual LMU configuration.

dump To write the contents of storage, or of a part of storage, usually from an internal storage to an 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.

E

Ecart Cartridge system tape with a length of 1100 feet that can be used with 4490 cartridge drives. These tapes are visually identified by a two–tone colored case.

EDL *See* eligible device list.

eligible device list A group of tape drives that are available to satisfy an allocation request.

enhanced CAP An enhanced CAP contains two forty–cell magazine–style CAPs and a one–cell priority CAP (PCAP). Each forty–cell CAP holds

four removable magazines of ten cells each. An LSM access door with an enhanced CAP contains no cell locations for storing cartridges. An enhanced CAP is ordered as Feature Number CC80. (*see also,* Cartridge Access Port (CAP), standard CAP, WolfCreek CAP, WolfCreek optional CAP.)

Effective Recording Density The number of user bytes per unit of length of the recording medium.

eject The LSM robot places a cartridge in a Cartridge Access Port (CAP) so the operator can remove it from the LSM.

ExPR Expert Performance Reporter.

Expert Performance Reporter Expert Performance Reporter collects performance data and generates reports about StorageTek Nearline ACSs and VTSS status and performance. It has an MVS component and a PC component.

Enhanced Capacity Cartridge System Tape Cartridge system tape with increased capacity that can be used with 4490 and 9490 Cartridge Drives. These tapes are visually identified by a two–tone colored case.

EOT End–of–Tape marker.

EPO Emergency Power Off.

ERDS Error Recording Data Set.

EREP Environmental Recording, Editing, Printing.

ERP Error recovery procedures.

error recovery procedures (ERP) Procedures designed to help isolate and, where possible, to recover from errors in equipment.

ExtendedStore Library One or more LSMs with no cartridge drives (CDs) that are attached by pass–thru ports to other LSMs (with CDs) in an ACS. These LSMs provide archive storage for cartridges containing less active data sets. Cartridges can be entered and ejected directly into and out of this LSM though either a standard CAP or an enhanced CAP.

F

file protected Pertaining to a tape volume from which data can be read only. Data cannot be written on or erased from the tape.

format The arrangement or layout of data on a data medium.

G

GB 1,073,741,824 bytes of storage.

GDG Generation Data Group. An MVS data set naming convention. Sequence numbers are appended to the basic data set name to track the generations created for that data set.

GTF Generalized Trace Facility. An MVS facility used to trace software functions and events.

H

HDA Head/disk assembly.

Host Software Component (HSC) That portion of the Automated Cartridge System which executes on host systems attached to an automated library. This component acts as the interface between the operating system and the rest of the automated library.

host system A data processing system that is used to prepare programs and the operating environments for use on another computer or controller.

HSC Host Software Component.

HSM Hierarchical Storage Manager.

HWS High Watermark Setup. Relates to chains set up for tape transport allocation in JES3.

I

ICRC See Improved Cartridge Recording Capability.

Improved Cartridge Recording Capability (ICRC) An improved data recording mode that, when enabled, can increase the effective cartridge data capacity and the effective data rate when invoked.

ID Identifier or identification.

IDAX Interpreter Dynamic Allocation Exit. This is a subfunction of the DFSMS/MVS subsystem request (SSREQ 55) that the MVS JCL Interpreter and dynamic allocation functions issue for calling

DFSMS ACS routines for management of the data set requested.

IML *See* Initial Microprogram Load.

index a function performed by the cartridge loader that moves cartridges down the input or output stack one cartridge position. A loader can perform multiple consecutive indexes.

Initial Microprogram Load (IML) A process that activates a machine reset and loads system programs to prepare a computer system for operation. Processors having diagnostic programs activate these programs at IML execution. Devices running u–software reload the functional u–software usually from a floppy diskette at IML execution.

Initial Program Load (IPL) A process that activates a machine reset and loads system programs to prepare a computer system for operation. Processors having diagnostic programs activate these programs at IPL execution. Devices running u–software reload the functional u–software usually from a floppy diskette at IPL execution.

initial value A value assumed until explicitly changed. It must then be explicitly specified in another command to restore the initial value. An initial value for the HSC is the value in effect when the product is installed.

inline diagnostics Diagnostic routines that test subsystem components while operating on a time–sharing basis with the functional u–software in the subsystem component.

input stack The part of the cartridge loader where cartridges are premounted.

intervention required Manual action is needed.

ips Inches per second.

IVP Installation Verification Programs. A package of programs that is run by a user after the library is installed in order to verify that the library is functioning properly.

J

JCL See Job Control Language.

Job Control Language 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.

journal The log associated with journaling. The log (stored in a data set) contains a record of completed work and changes to the control data set since the last backup was created.

journaling A technique for recovery that involves creating a backup control data set and maintaining a log of all changes (transactions) to that data set.

K

KB Kilobyte, thousand bytes, or 1024 bytes.

kb kilobit, or thousand bits (10^3 bits).

keyword parameter In command and utility syntax, operands that include keywords and their related values (*see* "positional parameter"). Values are concatenated to the keyword either by an equal sign, "KEYWORD=value," or by parentheses, "KEYWORD(value)." Keyword parameters can be specified in any order. The HSC accepts (tolerates) multiple occurrences of a keyword. The value assigned to a keyword reflects the last occurrence of a keyword within a command.

L

LAN Local Area Network.

LCU *See* Library Control Unit.

LED *See* Light Emitting Diode.

LIBGEN The process of defining the configuration of the automated library to the host software.

library An installation of one or more ACSs, attached cartridge drives, volumes placed into the ACSs, host software that controls and manages the ACSs and associated volumes, and the library control data set that describes the state of the ACSs.

library control data set *See* control data set.

Library Control Unit (LCU) The portion of the LSM that controls the picking, mounting, dismounting, and replacing of cartridges.

Light Emitting Diode (LED) An electronic device used mainly as an indicator on status panels to show equipment on/off conditions.

LMU Library Management Unit. The portion of the ACS that manages from one to sixteen LSMs and communicates with the host CPU.

loader *See* Cartridge Scratch Loader.

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

Local Area Network (LAN) A computer network in which devices within the network can access each other for data transmission purposes. The LMU and attached LCUs are connected with a local area network.

logical ejection The process of removing a volume from the control data set without physically ejecting it from its LSM location.

LSM Library Storage Module. Provides the storage area for cartridges plus the robot necessary to move the cartridges. The term LSM often means the LCU and LSM combined.

LSMid An LSMid is composed of the ACSid concatenated with the LSM number.

LSM number A method used to identify an LSM. An LSM number is the result of defining the SLIACS macro LSM parameter during a LIBGEN. The first LSM listed in this parameter acquires the LSM number of 0 (hexadecimal), the second LSM listed acquires a hexadecimal number of 1, and so forth, until all LSMs are identified (maximum of sixteen or hexadecimal F).

M

machine initiated maintenance See ServiceTek.

magnetic recording A technique of storing data by selectively magnetizing portions of a magnetizable material.

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

magnetic tape drive A mechanism for moving magnetic tape and controlling it’s movement.

maintenance facility Hardware contained in the CU and LMU that allows a CSE and the RDC to run diagnostics, retrieve status, and communicate with respective units through their control panels.

management class A collection of management attributes, assigned by the storage administrator, that are used to control the allocation and use of space by a data set. Note that SMS Management Classes are different from VSM Management Classes.

manual mode A relationship between an LSM and all attached hosts. LSMs operating in manual mode have been modified offline and require human assistance to perform cartridge operations.

master LMU The LMU currently controlling the functional work of the ACS in a dual LMU configuration.

MDS Main Device Scheduler (JES3).

media capacity The amount of data that can be contained on storage media and expressed in bytes of data.

micro–software *See* υ –software under Symbols.

migration The movement of VTVs from the VTSS to the RTD where the VTVs are stacked onto MVCs. See *automatic migration* and *demand migration*.

MIM Multi–Image Manager. Third–party software by CA Corporation.

mixed configurations Installations containing cartridge drives under ACS control and cartridge drives outside of library control. These configurations cause the Host Software Component to alter allocation to one or the other.

modem Modulator/demodulator. An electronic device that converts computer digital data to analog data for transmission over a telecommunications line (telephone line). At the receiving end, the modem performs the inverse function.

monitor A device that observes, records, and verifies selected system activities to determine significant departure from expected operation.

Multi-Volume Cartridge (MVC) A physical tape cartridge residing in an LSM that either contains migrated virtual tape volumes (VTVs) or is identified as a volume that can be selected for VTV stacking.

MVCPool Statement An HSC control statement that is contained in the definition data set specified by the `VT MVCDEF` command. An `MVCPool` statement specifies the MVCs that VTCS uses.

MVCDEF An HSC command that is used to load the definition data set that contains `MVCPool` statements.

N

O

output stack The part of the cartridge loader that receives and holds processed cartridges.

P

paired–CAP mode The two forty–cell CAPs in an enhanced CAP function in paired–CAP mode as a single eighty–cell CAP.

PARMLIB control statements Parameter library (PARMLIB) control statements allow you statically specify various operation parameters which take effect at HSC initialization. Identifying your system requirements and then specifying the appropriate control statements permits you to customize the HSC to your data center.

Pass–Thru Port (PTP) A mechanism that allows a cartridge to be passed from one LSM to another in a multiple LSM ACS.

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

positional parameter In command and utility syntax, operands that are identified by their position in the command string rather than by keywords (*see* "keyword parameter"). Positional parameters must be entered in the order shown in the syntax diagram.

POST *See* Program for Online System Testing.

PowderHorn A high–performance LSM (model number 9310) featuring a high–speed robot. The PowderHorn has a capacity of up to approximately 6000 cartridges.

Primary. One of two VTSSs in a cluster which is designated in CONFIG as the primary. During normal operations the primary services the host workload and copies replicate VTVs to the secondary.

Program for Online System Testing (POST) A program in a host computer that allows it to test an attached subsystem while the subsystem is online.

Program Temporary Fix A unit of corrective maintenance delivered to a customer to repair a

defect in a product, or a means of packaging a Small Programming Enhancement (SPE).

Program Update Tape A tape containing a collection of PTFs. PUTs are shipped to customers on a regular basis under the conditions of the customer's maintenance license.

PTF *See* Program Temporary Fix.

PTP *See* pass–thru port.

PUT *See* Program Update Tape.

R

RACF See Resource Access Control Facility.

Real Tape Drive (RTD) The physical transport attached to the LSM. The transport has a data path to a VTSS and may optionally have a data path to MVS or to another VTSS.

RDC *See* Remote Diagnostic Center.

recall The movement of VTVs from the MVC back to the VTSS. May be automatic or on demand.

reclaim Refers to MVC space reclamation. For automatic and demand reclamation, VTCS uses the amount of fragmented free space on the MVC and the amount of VTV data that would have to be moved to determine if space reclamation is justified.

Reconciliation. An automatic process initiated when a cluster is reestablished after the primary or secondary has been offline. Reconciliation ensures that the contents of the primary and secondary are identical with respect to replicate VTVs.

Recording Density The number of bits in a single linear track measured per unit of length of the recording medium.

Remote Diagnostic Center (RDC) The Remote Diagnostic Center at StorageTek. RDC operators can access and test StorageTek systems and software, through telecommunications lines, from remote customer installations. Also referred to as the Central Support Remote Center (CSRC).

Replication. Copying a replicate VTV from the primary VTSS to the secondary VTSS in a cluster. When replication completes, there are two copies of the VTV, one in the primary and one in the secondary.

Replicate VTV. A VTV which has had the replicate attribute attached to it by a management class statement.

Resource Access Control Facility (RACF) Security software controlling access to data sets.

RTD *See* real tape drive.

S

SCP See System Control Program.

scratch tape subpool A defined subset of all scratch tapes. Subpools are composed of one or more ranges of VOLSERs with similar physical characteristics (type of volume {reel or cartridge}, reel size, length, physical location, etc.). Some installations may also subdivide their scratch pools by other characteristics, such as label type (AL, SL, NSL, NL). The purpose of subpooling is to ensure that certain data sets are built only within particular ranges of volumes (for whatever reason the user desires). If a volume which does not belong to the required subpool is mounted for a particular data set, it is dismounted and the mount reissued.

Secondary. One of two VTSSs in a cluster which is designated in CONFIG as the secondary. During normal operations the secondary receives copies of replicate VTVs, stores them, and makes a migration copy on an MVC as soon as possible.

secondary recording A technique for recovery involving maintaining both a control data set and a copy (secondary) of the control data set.

SER Software Enhancement Request.

ServiceTek (machine initiated maintenance) A unique feature of the ACS in which an expert system monitors conditions and performance of subsystems and requests operator attention before a potential problem impacts operations. Customers can set maintenance threshold levels.

servo A device that uses feedback from a sensing element to control mechanical motion.

Small Programming Enhancement (SPE) A supplement to a released program that can affect several products or components.

SMF System Management Facility. An MVS facility used to record system actions which affect system functionality.

SMP System Modification Program.

SMP/E System Modification Program Extended.

SMS System Managed Storage.

SPE Small Programming Enhancement.

standard CAP A standard CAP has a capacity of twenty–one cartridges (three rows of seven cells each). An LSM access door with a standard CAP contains cell locations for storing cartridges. (*see also,* Cartridge Access Port (CAP), enhanced CAP.)

standard LSM A model 4410 LSM which a has a storage capacity of up to approximately 6000 cartridges.

standby The status of a station that has been varied online but is connected to the standby LMU of a dual LMU ACS.

standby LMU The redundant LMU in a dual LMU configuration that is ready to take over in case of a master LMU failure or when the operator issues the SWitch command.

station A hardware path between the host computer and an LMU over which the HSC and LMU send control information.

storage class A named list of storage attributes that identify performance goals and availability requirements for a data set. Note that SMS Storage Classes are different from VSM Storage Classes.

storage group A collection of storage volumes and attributes defined by the storage administrator. Note that this is an SMS concept, not a VSM concept.

switchover The assumption of master LMU functionality by the standby LMU.

System Control Program The general term to describe a program which controls access to system resources, and allocates those resources among executing tasks.

system–managed storage Storage that is managed by the Storage Management Subsystem, which attempts to deliver required services for availability, performance, space, and security applications.

System Modification Program Extended An IBM–licensed program used to install software and software maintenance.

T

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

tape drive A device that is used for moving magnetic tape and includes the mechanisms for writing and reading data to and from the tape.

TAPEREQ An HSC control statement that is contained in the definition data set specified by the TREQDEF command. A TAPEREQ statement defines a specific tape request. It is divided into two parts, the input: job name, step name, program name, data set name, expiration date or retention period, and an indication for specific requests or nonspecific (scratch) requests; and the output: media type and recording technique capabilities. You can use TAPEREQ statements to direct data sets to VSM.

tape unit A device that contains tape drives and their associated power supplies and electronics.

Timberwolf (9740) LSM A high performance LSM that provides a storage capacity of up to 494 cartridges. Up to 10 drives (STD, 4490, 9490, 9490EE, 9840, and SD-3) can be configured. Timberwolf LSMs can only attach to other Timberwolfs.

TMS Tape Management System.

TP Tape–to–Print.

transaction A short series of actions with the control data set. These actions are usually related to a specific function (e.g., Mount, ENter).

transport An electromechanical device capable of threading tape from a cartridge, moving the tape across a read/write head, and writing data onto or reading data from the tape.

TREQDEF An HSC command that is used to load the definition data set that contains TAPEREQ control statements.

Tri–Optic label An external label attached to the spine of a cartridge that is both human and machine readable.

TT Tape–to–Tape.

U

UNITATTR An HSC control statement that is contained in the definition data set specified by the UNITDEF command. A UNITATTR statement defines to the HSC the transport's media type and recording technique capabilities. For VSM, the UNITATTR statements define the VTD addresses to VSM as virtual and associate them with a VTSS.

UNITDEF An HSC command that is used to load the definition data set that contains UNITATTR control statements.

utilities Utility programs. The programs that allow an operator to manage the resources of the library and to monitor overall library performance.

V

Virtual Storage Manager (VSM) A storage solution that virtualizes volumes and transports in a VTSS buffer in order to improve media and transport use. The hardware includes VTSS, which is the DASD buffer, and RTDs. The software includes VTCS, an HSC–based host software, and VTSS microcode.

Virtual Tape Control System (VTCS) The primary host code that controls activity and information about VTSSs, VTVs, RTDs, and MVCs.

Virtual Tape Drive (VTD) An emulation of a physical transport in the VTSS that looks like a physical tape transport to MVS. The data written to a VTD is really being written to DASD. The VTSS has 64 VTDs that do virtual mounts of VTVs.

Virtual Tape Storage Subsystem (VTSS) The DASD buffer containing virtual volumes (VTVs) and virtual drives (VTDs). The VTSS is a STK RAID 6 hardware device with microcode that enables transport emulation. The RAID device can read and write "tape" data from/to disk, and can read and write the data from/to an RTD.

Virtual Tape Volume (VTV) A portion of the DASD buffer that appears to the operating system as a real tape volume. Data is written to and read from the VTV, and the VTV can be migrated to and recalled from real tape.

virtual thumbwheel An HSC feature that allows read–only access to a volume that is not physically write–protected.

VOLATTR An HSC control statement that is contained in the definition data set specified by the VOLDEF command. A VOLATTR statement defines to the HSC the media type and recording technique of the specified volumes. For VSM, the VOLATTR statements define the volsers for volumes that will be used as MVCs.

VOLDEF An HSC command that is used to load the definition data set that contains VOLATTR control statements.

VOLSER A six–character alphanumeric label used to identify a tape volume.

volume A data carrier that is mounted or demounted as a unit. (*See* cartridge).

VSM *See* Virtual Storage Manager.

VTCS *See* Virtual Tape Control System.

VTD *See* virtual tape drive.

W

WolfCreek A smaller capacity high–performance LSM. WolfCreek LSMs are available in 500, 750, and 1000 cartridge capacities (model numbers 9360–050, 9360–075, and 9360–100 respectively). WolfCreek LSMs can be connected by pass–thru ports to 4410, 9310, or other WolfCreek LSMs.

WolfCreek CAP The standard WolfCreek CAP contains a 20–cell magazine–style CAP and a priority CAP (PCAP). (*see also*, Cartridge Access Port (CAP), Enhanced CAP, standard CAP, WolfCreek optional CAP.)

WolfCreek optional CAP The WolfCreek optional CAP contains a 30–cell magazine–style CAP which

is added to the standard WolfCreek CAP. (*see also,* Cartridge Access Port (CAP), Enhanced CAP, standard CAP, WolfCreek CAP.)

Write Tape Mark (WTM) The operation performed to record a special magnetic mark on tape. The mark identifies a specific location on the tape.

WTM *See* Write Tape Mark.

WTO Write–to–Operator.

WTOR Write–to–Operator with reply.

Symbols

υ **-software.** Microprogram. A sequence of microinstructions used to perform preplanned functions and implement machine instructions.

Numerics

4410 LSM *See* standard LSM.

9310 LSM *See* Powderhorn LSM.

9360 LSM See Wolfcreek *LSM.*

9490 Cartridge Subsystem Cartridge tape transports that provide read/write capability for 36–track recording format and extended capacity tape and provide improved performance over the 4490 Cartridge Subsystem. 9490 transports can also read data recorded in 18–track format. The StorageTek 9490 Cartridge Subsystem offers better performance (faster data transfer rate, faster load/unload) than a 3490E device.

9490EE Cartridge Subsystem A high performance tape transport that provides read/write capability for Extended Enhanced (EEtape) cartridges. It is functionally equivalent to the IBM 3490E device.

9**740 LSM** See Timberwolf *LSM.*

9840 Cartridge Subsystem A high performance tape transport system for Enterprise and Open Systems environments that reads and writes 9840 cartridges. 9840s can be defined in 10-drive and 20-drive panel configurations. The 9840 can perform as a stand-alone subsystem with a cartridge scratch loader installed, or it can be attached to a StorageTek ACS.

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