Product Requirements for SCSI Devices
in High Availability OpenVMS Configurations
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1 Introduction

This document describes the dependences that high-availability OpenVMS systems have on SCSI device characteristics. In this context, ''SCSI devices'' include host adapters, storage devices, and bus interconnect components such as bus isolators, enclosures, terminators, and cables. The requirements defined here apply to the hardware and the software (operating system, console firmware, and device firmware) associated with SCSI devices.

Highly-available SCSI systems are achieved with OpenVMS by the use of:

- highly-reliable SCSI bus configurations
- host-based volume shadowing
- multiple-host SCSI VMSclusters
- hot plugging

The implementation of these high availability features requires that SCSI devices posses certain characteristics, in addition to those needed for ''basic'' operation under OpenVMS.[1]

In the following sections, the device requirements for each of OpenVMS' high-availability features are described. In this document, the term SCSI bus **segment** refers to two terminators, the electrical path forming continuity between them, and possibly, some attached stubs. Bus segments may be connected together by bus isolators (for example, DWZZA), to form a **logical SCSI bus**.

2 High-Reliability SCSI

~ Requirement 1: There shall be no more than four sources of TERMPWR on a bus segment.

Failure to observe this requirement can cause the maximum current specification for the bus cables to be exceed, causing system failure.

To ensure that this requirement is met, and that TERMPWR is available when required, it is recommended that only initiators, and bus isolators with initiators behind them, supply TERMPWR. Targets shall not supply TERMPWR.

If a device does not meet this requirement, it may be necessary to use bus isolators to build compliant configurations. This work-around increases the cost and complexity of the system.

~ Requirement 2: All devices shall have glitch-free power down/up.

If this requirement is not met, then individual device power cycling may cause a system failure.

[1] A future version of this document will list, for reference, the prerequisite requirements for basic operation of SCSI devices under OpenVMS.

The DWZZA and DWZZB do not currently meet this requirement, and should not be power cycled when the system is running.

~ Requirement 3: The ground offset voltage in single-ended configurations shall be less than 50 millivolts, and in differential configurations it shall be less than 800 millivolts.

If this requirement is not met, then the SCSI signal integrity margin will be reduced, possibly leading to system failure.

Refer to Appendix A for an example procedure for ensuring that this requirement is met.

~ Requirement 4: Stubs at terminators shall be minimized.

If this requirement is not met, then the SCSI signal integrity margin will be reduced, possibly leading to system failure.

The BA350 does not meet this requirement when it is configured in seven-device mode and:

- the BA350's backplane terminator is used, and/or,
- the DWZZ%-VA (installed in slot zero) is used to supply single-ended termination.

Improved signal margin can be achieved by using an external terminator in the BA350's output or input connector, respectively.

~ Requirement : Devices shall carry labels to indicate their speed, interface type (single-ended or differential), width, cable length, bus ID, and the presence of termination and TERMPWR.

SCSI signal integrity depends on meeting all the required configuration rules. The likelihood of this improved when each device's relevant characteristics are readily discernible. This is requirement is especially applicable to situations where hot plugging is being done. If this requirement is not met, then incorrect bus configuration may result, causing system failure.

3 Host-Based Volume Shadowing

~ Requirement : Support for Read Long and Write Long.

If an unrecoverable read error occurs while a new member is being added to a shadow set, then either the error must be propagated to the new member, so that all members are consistent, or the new member must be expelled.

If the SCSI device supports Read Long and Write Long, then OpenVMS shadowing will propagate the error and add the new member. If the SCSI device does not support Read Long and Write Long, then shadowing can still be used, but a unrecoverable read error during new member addition will cause the new member to be expelled.

~ Requirement : The maximum time that a disk device shall be disconnected while processing a command shall be minimized. It shall not exceed 20 seconds.

Devices in highly available configurations must be responsive, so that the system can quickly detect failures and activate redundant components. The OpenVMS timeout for a disconnected command to a disk is 20 seconds. When this timeout occurs, the device is tested, and if accessible, the command is retried. This can introduce extremely long delays in data availability.

When Host Based Volume Shadowing (HBVS) is in use, a shorter timeout will typically be desired. For example, the default timeout imposed by HBVS for the entire command is 20 seconds.

Devices that allow indefinite preemption of queued commands, or that introduce long delays while performing bad block replacement, may reduce system availability.

4 Multiple-Host SCSI VMSclusters

~ Requirement : Initiators and targets shall support tagged command queueing.

Tagged Command Queuing is required, because it provides an ordering guarantee that is used in VMSclusters to ensure that I/O has been flushed.

It is essential that the drive implement queueing so that it complies with Section 7.8.2 of the SCSI-2 specification (X3T9.2 Rev. 10L):

> ...All commands received with a simple queue tag message prior to a command received with an ordered queue tag message, regardless of initiator, shall be executed before that command with the ordered queue tag message...

Failure to meet this requirement can lead to possible data corruption in multiple-host configurations.

~ Requirement : Targets shall support concurrent multiple-initiator I/O

This requires the proper management the following state on a per-initiator basis:

- synchronous negotiated state and speed
- width negotiated state
- Contingent Allegiance and Unit Attention conditions

Failure to meet this requirement can lead to system failures in multiple-host configurations.

~ Requirement : Initiators shall be tolerant of multiple initiators on the bus (bus resets, selection, busy status).

Failure to meet this requirement can lead to system failures in multiple-host configurations.

~ Requirement : Initiators shall support receipt and response to Inquiry and Request Sense.

The host must have the ability to set the data that is passed in the Product Identification field of the Inquiry Data.

The sense data returned in response to a Request sense may be constant: ‘‘ Sense key = Illegal Request Additional sense code = LUN not supported ’’ Failure to meet this requirement will cause automatic configuration checks to fail, which can lead to data corruption.

~ Requirement : Initiators and targets shall support command disconnect.

If this requirement is not met, then the target will be unable to process commands from one initiator when there are commands queued from other initiators.

~ Requirement : Targets shall implement a reselection timeout procedure compliant with SCSI-2 Section 6.1.4.2, Option b, and a retry algorithm that limits the bus time spent on reselection attempts.

If this requirement is not met, the system performance will be reduced, due to attempts to reselect a non-responsive initiator.

~ Requirement : Initiators and targets shall support ARRE and AWRE.

This is to prevent multiple hosts from unnecessarily revectoring the same block.

To avoid data corruption, it is essential that the drive comply with Section 9.3.3.6 of the SCSI-2 specification (X3T9.2 Rev. 10L):

> ...The automatic reallocation shall then be performed only if the target successfully recovers the data...

If this requirement is not met, then multiple hosts may unnecessarily revector the same block.

5 Hot Plugging

Successful hot plugging requires that the SCSI devices meet the requirements state here, and that a set of procedures are defined and followed. An example of the hot plugging procedure for OpenVMS are given in Appendix B

~ Requirement : Comply with SCSI-3 Parallel Interface (SPI) requirements for removal and insertion of SCSI devices while current I/O processes are allowed. (See working draft X3T10/855D, revision 15, Annex A, case 4.

The SPI document places requirements on the receivers and terminators on the segment where the hot plugging is being performed, and on the transceivers, TERMPWR, termination, and power/ground/signal sequencing, of the device that is being hot plugged.

If these requirements are not met, then the segment must be separated from segments that allow hot plugging by a by a bus isolator. This increases the cost and complexity of the system.

~ Requirement : A means for discharging static charge from the device without interfering with active signals shall be provided.

If this requirement is not met, the the active system may be disrupted, and possible component damage may occur.

~ Requirement : A means for ensuring that the only electrical conductors that connector pins contact are their mates.

If this requirement is not met, the the active system may be disrupted, and possible component damage may occur.

~ Requirement : In configurations where SCSI bus IDs are assigned by backplane slot, a means for blocking the inadvertent use of a slot shall be provided.

If this requirement is not met, then incorrect bus configuration may result, causing system failure.

Appendix A

Grounding Requirements

This section describes the grounding requirements for electrical systems in a SCSI VMScluster system.

Improper grounding can result in voltage differentials, called ground offset voltages, between the enclosures in the configuration. Even small ground offset voltages across the SCSI interconnect (as shown in Step 3 in Table A–1) can disrupt the configuration, and the user may experience performance degradation or data corruption.

Table A–1 describes important considerations to ensure proper grounding.

Table A–1: Steps for Ensuring Proper Grounding

	Description
❶	Ensure that site power distribution meets all local electrical codes.
❷	Inspect the entire site power distribution system to ensure that: • All outlets have power ground connections • A grounding prong is present on all computer equipment power cables • Power outlet neutral connections are not actual ground connections • All grounds for the power outlets are connected to the same power distribution panel • All devices that are connected to the same circuit breaker as the computer equipment are UL or IEC approved

Table A–1 (Cont.): Steps for Ensuring Proper Grounding

	Description
❸	If you have difficulty verifying these conditions, you can use a hand-held multimeter to measure the ground offset voltage between any two cabinets. To measure the voltage, connect the multimeter leads to unpainted metal on each enclosure. Then, determine whether the voltage exceeds the following allowable ground offset limits:

SCSI Signaling Method	Maximum Allowable Offset
Single-ended	50 millivolts
Differential	800 millivolts

The multimeter method provides data for only the moment it is measured. The ground offset values may change over time as additional devices are activated or plugged into the same power source. To ensure that the ground offsets remain within acceptable limits over time, Digital recommends that you have a power survey performed by a qualified electrician.

❹ If you are uncertain about the grounding situation or if the measured offset exceeds the allowed limit, Digital recommends that a qualified electrician correct the problem. It may be necessary to install grounding cables between enclosures to reduce the measured offset.

❺ If an unacceptable offset voltage was measured and a ground cable was installed, then measure the voltage again to ensure it is less than the allowed limits. If not, an electrician must determine the source of the ground offset voltage and reduce or eliminate it.

Appendix B

Procedures for SCSI Hot Plugging

With proper procedures, certain SCSI devices can be removed from or inserted onto an active SCSI bus without disrupting the on-going operation of the bus. This capability is referred to as *hot plugging*. Hot plugging can allow a suitably configured VMScluster system to continue to run while a failed component is replaced. Without hot plugging, it is necessary to make the SCSI bus inactive and remove power from all the devices on the SCSI bus before any device is removed from it or inserted onto it.

In a SCSI VMScluster system, hot plugging requires that all devices on the bus have certain electrical characteristics and be configured appropriately on the SCSI bus. Successful hot plugging also depends on strict adherence to the procedures described in this section. These procedures ensure that the hot-plugged device is inactive and that active bus signals are not disturbed.

HOT PLUGGING FOR SCSI BUSES BEHIND A STORAGE CONTROLLER

This section describes hot-plugging procedures for devices that are on the same SCSI bus as the host that is running OpenVMS. The procedures are different for SCSI buses that are behind a storage controller, such as the HSZ40. Refer to the storage controller documentation for the procedures to hot plug devices that they control.

B.1 Terminology for Describing Hot Plugging

The terms shown in bold in this section are used in the discussion of hot plugging rules and procedures.

- A SCSI bus *segment* consists of two terminators, the electrical path forming continuity between them, and possibly, some attached stubs. Bus segments may be connected together by bus isolators (for example, DWZZA), to form a *logical SCSI bus* or just *SCSI bus*.
- There are two types of connections on a segment: *bussing connections*, which break the path between two terminators, and *stubbing connections*, which disconnect all or part of a stub.
- A device is *active* on the SCSI bus when it is asserting one or more of the bus signals. A device is *inactive* when it is not asserting any bus signals.

The segment attached to a bus isolator is inactive when all devices on that segment, except possibly the bus isolator, are inactive.

- A port on a bus isolator has *proper termination* when it is attached to a segment that is terminated at both ends and has TERMPWR in compliance with SCSI–2 requirements.

B.2 Rules for Hot Plugging

The following rules must be followed when planning for and performing hot plugging:

- The device to be hot plugged, and all other devices on the same segment, shall meet the electrical requirements described in Annex A, Section A.4, of the SCSI-3 Parallel Interface (SPI) Standard, working draft X3T10/855D.[1] The SPI document places requirements on the receivers and terminators on the segment where the hot plugging is being performed, and on the transceivers, TERMPWR, termination, and power/ground/signal sequencing, of the device that is being hot plugged.

  All the devices currently supported in SCSI VMSclusters meet these requirements, except the DWZZA. The DWZZA's transceivers do not meet the requirements for glitch-free power on/off. The rules and procedures in this section have been adjusted to compensate for this fact.
- Hot plugging shall occur only at a stubbing connection.

  This implies that a hot-plugged device shall make only one connection to the SCSI bus, the device shall not provide termination for the SCSI bus, and the device's connection shall not exceed the maximum stub length.
- Precautions shall be used to ensure that Electrostatic Discharge (ESD) does not damage devices or disrupt active signals on the SCSI bus. These precautions shall be taken during the process of disconnecting and connecting, as well as during the time that SCSI bus conductors are exposed.
- Precautions shall be used to ensure that ground offset voltages do not pose a safety hazard and will not interfere with SCSI bus signaling, especially in single-ended configurations. The procedures for measuring and eliminating ground offset voltages are described in Appendix A.
- The device that is hot plugged shall be inactive during the disconnection and connection operations. Otherwise, the SCSI bus may become hung.[2]

  NOTE

  Ideally, a device will also be inactive whenever its power is removed, for the same reason.

  The procedures for ensuring that a device is inactive are described in Section B.3.
- A quorum disk shall not be hot plugged. This is because there is no mechanism for stopping the I/O to a quorum disk and because the replacement disk will not contain the correct quorum file.

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[1] Reference to this draft standard is necessary because the SCSI–2 standard does not adequately specify the requirements for hot plugging.

[2] OpenVMS will eventually detect a hung bus and reset it, but this may be temporarily disruptive to VMScluster operations.

The VMScluster system must be reconfigured to remove a device as a quorum disk before that device is removed from the bus. The procedure for accomplishing this is described in ''VMScluster Systems for OpenVMS'' (Section 8.3.3 in the OpenVMS Version 6.1 edition).

An alternate method for increasing the availability of the quorum disk is to use an HSZ40 mirror set as the quorum disk. This would allow a failed member to be replaced while maintaining the quorum disk functionality.

- Disks shall be logically dismounted before removing or replacing them in a hot-plug operation. This is required to ensure that the disk is inactive and to ensure the integrity of the file system.
- The DWZZA shall be powered up when it is inserted onto an active SCSI bus. The DWZZA should remain powered up at all times while it is attached to the active SCSI bus. This is because the DWZZA can disrupt the operation of the attached segments when it is powering up or down.
- The segment attached to a bus isolator shall be maintained in the inactive state whenever the other port on the bus isolator is improperly terminated. This is required because an improperly terminated bus isolator port may pass erroneous signals to the the other port.

  Thus, for a particular hot-plugging operation, one of the segments attached to a bus isolator shall be designated as the (potentially) active segment, and the other shall be maintained in the inactive state. The procedures for ensuring that a segment is inactive are described in Section B.3.

  Note that although a bus isolator may have more than one stubbing connection and thus be capable of hot plugging on each of them, only one segment can be the active segment for any particular hot-plugging operation.
- Precautions shall be taken to ensure that the only electrical conductor that contacts a connector pin is its mate. These precautions must be taken during the process of disconnecting and connecting as well as during the time the connector is disconnected.
- Devices shall be replaced with devices of the same type. That is, if any system in the VMScluster configures a SCSI ID as a ''DK'' or ''MK'' device, then that SCSI ID shall contain only ''DK'' or ''MK'' devices, respectively, for as long as that VMScluster member is running.

  Different implementations of the same device type may be substituted (for example, an RZ26L may be replaced with an RZ28B). Note that the system will not recognize the change in device type until an attempt is made to mount the new device. Also, note that host-based shadowing continues to require that all members of a shadow set be the same device type.
- SCSI IDs that are empty when a system boots shall remain empty as long as that system is running. This rule only applies if there are multiple processors on the SCSI bus and the MSCP server is loaded on any of them. (The MSCP server is loaded when the system parameter MSCP_LOAD equals 1).

  This is required to ensure that nodes on the SCSI bus use their direct path to the disk, rather than the served path. When the new device is configured on a system (using SYSMAN IO commands), that system serves it to the second system on the shared SCSI bus. The second system automatically configures the new device via the MSCP served path. Once this occurs, the second system will be unable to use its direct SCSI path to the new device, because failover from an MSCP served path to a direct SCSI path is not implemented.

B.3 Procedures for Ensuring That a Device or Segment Is Inactive

Use the following procedures to ensure that a device or a segment is inactive:

- To ensure that a disk is inactive:
  1. Dismount the disk on all members of the VMScluster system.
  2. Ensure that any I/O that can occur to a dismounted disk is stopped, for example:
     — disable the disk as a quorum disk
     — allocate the disk (using the DCL ALLOCATE command) to block further mount or initialization attempts
     — disable console polling by all halted hosts on the logical SCSI bus (by setting the console variable SCSI_POLL to OFF, and entering the INIT command)
     — ensure that no host on the logical SCSI bus is executing power-up or initialization self-tests, booting, or configuring the SCSI bus (using SYSMAN IO commands).
- To ensure that an HSZ40 controller is inactive:
  1. Dismount all of the HSZ40 virtual disks on all members of the VMScluster system.
  2. Shut down the controller, following the procedures in the *HS Family of Array Controllers User's Guide*.
  3. Power down the HSZ40, if desired.
- To ensure that a host adapter is inactive:
  1. Halt the system.
  2. Power down the system, or set the console variable SCSI_POLL to OFF and then enter the INIT command on the halted system. This ensures that the system will not poll, or respond to polls.
- To ensure that a segment is inactive, follow the procedure described above for every device on the segment.

B.4 Procedure for Hot Plugging StorageWorks SBB Disks

To remove an SBB disk from an active SCSI bus, use the following procedure:

1. Use an ESD grounding strap that is attached either to a grounding stud or to unpainted metal on one of the cabinets in the system. Refer to the system installation procedures for guidance.
2. Follow the procedure in Section B.3 to make the disk inactive.
3. Squeeze the clips on the side of the SBB, and slide the disk out of the StorageWorks shelf.

To insert an SBB disk onto an active SCSI bus, use the following procedure:

1. Use an ESD grounding strap that is attached either to a grounding stud or to unpainted metal on one of the cabinets in the system. Refer to the system installation procedures for guidance.

2. Ensure that the SCSI ID associated with the device (either by jumpers or by the slot in the StorageWorks shelf) conforms to the following:
   - The SCSI ID is unique for the logical SCSI bus
   - The SCSI ID is already configured as a ''DK'' device on all of the following:
     — Any member of the VMScluster system that already has that ID configured
     — Any OpenVMS processor on the same SCSI bus that is running the MSCP server
3. Slide the SBB into the StorageWorks shelf.
4. Configure the disk on VMScluster members, if required, using SYSMAN IO commands.

B.5 Procedure for Hot Plugging HSZ40s

To remove an HSZ40 controller from an active SCSI bus:

1. Use an ESD grounding strap that is attached either to a grounding stud or to unpainted metal on one of the cabinets in the system. Refer to the system installation procedures for guidance.
2. Follow the procedure in Section B.3 to make the HSZ40 inactive.
3. The HSZ40 can be powered down, but it must remain plugged-in to the power distribution system, to maintain grounding.
4. Unscrew and remove the differential tri-link from the HSZ40.
5. Protect all exposed connector pins from ESD and from contacting any electrical conductor while they are disconnected.

To insert an HSZ40 controller onto an active SCSI bus:

1. Use an ESD grounding strap that is attached either to a grounding stud or to unpainted metal on one of the cabinets in the system. Refer to the system installation procedures for guidance. Also, ensure that the ground offset voltages between the HSZ40 and all components that will be attached to it are within the limits specified in Appendix A.
2. Protect all exposed connector pins from ESD and from contacting any electrical conductor while they are disconnected.
3. Power-up the HSZ40 and ensure that the disk units associated with the HSZ40 conform to the following:
   - The disk units are unique for the logical SCSI bus
   - The disk units are already configured as ''DK'' devices on the following:
     — Any member of the VMScluster system that already has that ID configured
     — Any OpenVMS processor on the same SCSI bus that is running the MSCP server
4. Ensure that the HSZ40 will make a legal stubbing connection to the active segment. (The connection is legal when the tri-connector is attached directly to the HSZ40 controller module, with no intervening cable.)
5. Attach the differential tri-link to the HSZ40, using care to ensure that it is properly aligned. Tighten the screws.
6. Configure the HSZ40 virtual disks on VMScluster members, as required, using SYSMAN IO commands.

B.6 Procedure for Hot Plugging Host Adapters

To remove a host adapter from an active SCSI bus:

1. Use an ESD grounding strap that is attached either to a grounding stud or to unpainted metal on one of the cabinets in the system. Refer to the system installation procedures for guidance.
2. Verify that the connection to be broken is a stubbing connection. If not, then hot plugging must not be performed.
3. Follow the procedure in Section B.3 to make the host adapter inactive.
4. The system can be powered down, but it must remain plugged-in to the power distribution system, to maintain grounding.
5. Remove the ''Y'' cable from the host adapter's single-ended connector.
6. Protect all exposed connector pins from ESD and from contacting any electrical conductor while they are disconnected.
7. Do *not* unplug the adapter from the host's internal bus while the host remains powered up.

   At this point, the adapter has disconnected from the SCSI bus. To remove the adapter from the host, power down the host first, and then remove the adapter from the host's internal bus.

To insert a host adapter onto an active SCSI bus:

1. Use an ESD grounding strap that is attached either to a grounding stud or to unpainted metal on one of the cabinets in the system. Refer to the system installation procedures for guidance. Also, ensure that the ground offset voltages between the host and all components that will be attached to it are within the limits specified in Appendix A.
2. Protect all exposed connector pins from ESD and from contacting any electrical conductor while they are disconnected.
3. Ensure that the host adapter will make a legal stubbing connection to the active segment (the stub length must be within allowed limits, and the host adapter must not provide termination to the active segment).
4. Plug the adapter into the host (if it is unplugged).
5. Plug the system into the power distribution system, to ensure proper grounding. Power-up if desired.
6. Attach the ''Y'' cable to the host adapter, using care to ensure that it is properly aligned.

B.7 Procedure for Hot Plugging DWZZAs

Use the following procedure to remove a DWZZA from an active SCSI bus:

1. Use an ESD grounding strap that is attached either to a grounding stud or to unpainted metal on one of the cabinets in the system. Refer to the system installation procedures for guidance.
2. Verify that the connection to be broken is a stubbing connection. If not, then hot plugging must not be performed.

3. Do not power down the DWZZA. This can disrupt the operation of the attached SCSI bus segments.
4. Determine which SCSI bus segment will remain active after the disconnection. Follow the procedure in Section B.3 to make the other segment inactive.

   When the DWZZA is removed from the active segment, the inactive segment must remain inactive until the DWZZA is also removed from the inactive segment, or proper termination is restored to the DWZZA port that was disconnected from the active segment.
5. The next step depends on the type of DWZZA and the segment that is being hot plugged, as follows:

DWZZA Type	Condition	Action
DWZZA-VA	Single-ended segment will remain active	Squeeze the clips on the side of the SBB, and slide the DWZZA-VA out of the StorageWorks shelf.
DWZZA-VA	Differential segment will remain active	Unscrew and remove the differential tri-link from the DWZZA-VA.
DWZZA-AA	Single-ended segment will remain active	Remove the ''Y'' cable from the DWZZA-AA's single-ended connector.
DWZZA-AA	Differential segment will remain active	Unscrew and remove the differential tri-link from the DWZZA-AA.

6. Protect all exposed connector pins from ESD and from contacting any electrical conductor while they are disconnected.

To insert a DWZZA onto an active SCSI bus:

1. Use an ESD grounding strap that is attached either to a grounding stud or to unpainted metal on one of the cabinets in the system. Refer to the system installation procedures for guidance. Also, ensure that the ground offset voltages between the DWZZA-AA and all components that will be attached to it are within the limits specified in Appendix A.
2. Protect all exposed connector pins from ESD and from contacting any electrical conductor while they are disconnected.
3. Ensure that the DWZZA will make a legal stubbing connection to the active segment (the stub length must be within allowed limits, and the DWZZA must not provide termination to the active segment).
4. The DWZZA must be powered up. The SCSI segment that is being added must be attached and properly terminated. All devices on this segment must be inactive.
5. The next step depends on the type of DWZZA, and which segment is being hot plugged, as follows:

DWZZA Type	Condition	Action
DWZZA-VA	Single-ended segment is being hot plugged	Slide the DWZZA-VA into the StorageWorks shelf.

DWZZA Type	Condition	Action
DWZZA-VA	Differential segment is being hot plugged	Attach the differential tri-link to the DWZZA-VA, using care to ensure that it is properly aligned. Tighten the screws.
DWZZA-AA	Single-ended segment is being hot plugged	Attach the ''Y'' cable to the DWZZA-AA, using care to ensure that it is properly aligned.
DWZZA-AA	Differential segment is being hot plugged	Attach the differential tri-link to the DWZZA-VA, using care to ensure that it is properly aligned. Tighten the screws.

6. If the newly attached segment has storage devices on it, then configure them on VMScluster members, if required, using SYSMAN IO commands.