

# DSSI VMScluster

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## Installation and Troubleshooting Guide

Order Number: EK-410AB-MG. D01

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**First Printing, October 1994**

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S2555

This document was prepared using VAX DOCUMENT Version 2.1.

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## Preface

### **Purpose of This Guide**

This guide describes how to install and maintain a DSSI VMScLuster configuration with Alpha AXP systems and VAX systems.

### **Who Should Use This Guide**

This guide is intended for system administrators. A system administrator should be an experienced user who is familiar with OpenVMS AXP and OpenVMS VAX operating systems.

### **Structure of This Guide**

This guide is divided into four chapters and three appendixes:

- Chapter 1 describes the types of DSSI VMScLuster configurations you can create, as well as restrictions and requirements.
- Chapter 2 describes the hardware-related steps in setting up a DSSI VMScLuster system using AXP-only or VAX and AXP systems.
- Chapter 3 describes the hardware-related steps in setting up a DSSI VMScLuster system using only VAX systems.
- Chapter 4 provides troubleshooting tips for solving hardware problems within the DSSI VMScLuster configuration.
- Appendix A provides the DSSI connector type and electrical lengths of DSSI buses for DSSI adapters and enclosures.
- Appendix B provides information on how to examine storage device parameters and describes how OpenVMS uses DSSI parameters.
- Appendix C provides sample VAX configurations that emphasize performance, storage capacity, or data availability.

### **Finding More Information**

The following documents provide information related to DSSI VMScLuster systems:

- *VMScLuster Systems for OpenVMS*
- *OpenVMS AXP Version 6.1 Upgrade and Installation Manual, AA-PV6XB-TE.*
- *OpenVMS AXP Version 5.5-2 Upgrade and Installation Manual*
- *AlphaServer 2000/2100/2100 RM/ 2100 CAB Series Service Guide, EK-KN450-SV.*

- *DEC 4000 AXP Model 600/700 Series Service Guide*, EK-KN430-SV.
- *StorageWorks Solutions HSD05 Array Controller User's Guide*, EK-HSD05-UG
- *StorageWorks Array Controllers HS Family of Array Controllers User's Guide*, EK-HSFAM-UG
- *KFESA DSSI Adapter Installation and User's Guide*, EK-KFESA-OP
- *KFMSB Adapter Installation Guide*, EK-KFMSB-IN

## Conventions

The following conventions are used in this guide.

Convention	Meaning
cdp	AXP console commands are indicated by lowercase type.
SHOW DSSI	VAX console commands are indicated by uppercase type.
<b>Caution</b>	Cautions provide information to prevent damage to equipment or software.
[ ]	In command format descriptions, brackets indicate optional elements.
{ }	In command descriptions, braces containing items separated by commas imply mutually exclusive items.

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# DSSI VMScLuster Configuration and Requirements

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## Introducing VMScLuster Systems

### VMScLuster Capabilities

A VMScLuster is a highly integrated organization of Alpha AXP computers, VAX computers, or a combination of AXP and VAX computers.

As members of a VMScLuster system, computers can share processing resources, data storage, and queues under a single security and management domain, and they can be configured to boot or fail independently.

### In This Chapter

This chapter describes Digital Storage System Interconnect (DSSI) VMScLuster configurations and requirements.

- DSSI VMScLuster Configurations
- DSSI VMScLuster Restrictions
- Licensing and Software Requirements
- DSSI Bus Lengths and Grounding Requirements
- Recommended Guidelines for DSSI VMScLuster Systems

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## DSSI VMScLuster Configurations

### Three Types of DSSI VMScLuster Configurations

Alpha AXP systems can be configured in three types of DSSI VMScLuster configurations:

- Alpha AXP systems in an AXP only DSSI VMScLuster
  - Up to four Alpha AXP systems can share a DSSI.
  - Each AlphaServer 2000/2100 system must have a KFESA DSSI adapter.
  - DEC 4000 AXP systems can coexist as end nodes on a DSSI with AlphaServer 2000/2100 systems.

- Alpha AXP and VAX systems in a dual-architecture DSSI VMScLuster
  - Up to four systems (AXP and VAX) can share a DSSI.
  - AlphaServer 2000/2100 systems using the KFESA DSSI adapter can coexist as middle node or end nodes on a DSSI with VAX 4000/6000/7000/10000 systems.
  - DEC 4000 AXP systems can coexist as end nodes on a DSSI with VAX 4000/6000/7000/10000 systems.
- VAX systems in a VAX only DSSI VMScLuster
  - Up to four VAX systems can share a DSSI.
  - Six DSSI buses per system is the maximum allowable.

### **DSSI Nodes Per Bus**

Each DSSI bus supports up to eight nodes. Each of the following counts as one DSSI node:

- A DSSI adapter
- An HSD05 array controller
- An HSD30 array controller
- An RF-disk controller interface
- A TF-tape controller interface

For a two-system DSSI VMScLuster system, for instance, a maximum of six RF-disks can be configured per DSSI bus: two DSSI adapters + six disks = eight nodes.

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**Note**

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Drives connected through the HSD05 and HSD30 array controllers do not count as DSSI nodes; thus, using multiple HSD05 controllers, up to 42 SCSI drives can be configured in a two-system DSSI VMScLuster configuration, provided you have sufficient storage expansion hardware.

AlphaServer 2100 systems using HSD05 array controllers in the two internal StorageWorks shelves can support up to 24 SCSI drives in a two-system DSSI VMScLuster configuration.

AlphaServer 2000 systems using HSD05 array controllers in the internal StorageWorks shelf can support up to 12 SCSI drives in a two-system DSSI VMScLuster configuration.

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## DSSI VMScLuster Restrictions

### Restrictions for AXP-Only DSSI VMScLuster Systems

The following restrictions apply to AXP-only DSSI VMScLuster systems.

- Because the OpenVMS operating system “names” the first SCSI bus it finds in each system as bus A, the second as bus B, and so on, SCSI drives in a DSSI VMScLuster can appear to share a common bus between systems. For each SCSI bus that OpenVMS sees as common to the DSSI VMScLuster, the total number of drives is limited to eight (node ID plgs 0–7).

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**Note**

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Disks connected through an SWXCR-xx controller cannot be striped or shadowed using host-based shadowing.

These disks can be served to the cluster, however. This restriction is removed with OpenVMS AXP version 6.2.

Hardware shadowing of SCSI disks is supported via the HSD30 array controller.

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- DEC 4000 AXP systems can only exist as end nodes on a DSSI bus.
- AlphaServer 2000 systems cannot be configured with an HSD05 in the internal StorageWorks shelf—installing an HSD05 prevents the front door from closing.

**Restrictions for  
Dual-Architecture  
DSSI  
VMScluster  
Systems**

The following restrictions apply to dual-architecture DSSI VMScluster systems.

- A VAX CPU and an AXP CPU may not boot from a common system disk. AXP processors must boot from an AXP system disk, and VAX processors must boot from a VAX system disk. However, VAX and AXP processors can mount and share access to files on any disk (including system disks) in a VMScluster system.
- AXP CPUs cannot access shadow or stripe sets created on VAX CPUs by the Volume Shadowing for OpenVMS VAX or VAX Disk Striping products.
- Because OpenVMS “names” the first SCSI bus it finds in each system as bus A, the second as bus B, and so on, SCSI drives in a DSSI VMScluster can appear to share a common bus between systems. For each SCSI bus that OpenVMS sees as common to the DSSI VMScluster, the total number of drives is limited to eight (node ID plugs 0–7).

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**Note**

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Disks connected through an SWXCR-xx controller cannot be striped or shadowed using host-based shadowing. These disks can be served to the cluster, however. This restriction is removed with OpenVMS AXP version 6.2. Hardware shadowing of SCSI disks is supported via the HSD30 array controller.

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- DEC 4000 AXP systems can only exist as end nodes on a DSSI bus.
- AlphaServer 2000 systems cannot be configured with an HSD05 in the internal StorageWorks shelf—installing an HSD05 prevents the front door from closing.

**Restrictions for  
VAX-Only DSSI  
VMScluster  
Systems**

The following restrictions apply to VAX-only DSSI VMScluster systems.

- Because OpenVMS “names” the first SCSI bus it finds in each system as bus A, the second as bus B, and so on, SCSI drives in a DSSI VMScluster can appear to share a common bus between systems. For each SCSI bus that OpenVMS sees as common to the DSSI VMScluster, the total number of drives is limited to eight (node ID plugs 0–7).

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## Licensing and Software Requirements

### Software Requirements

Table 1–1 provides the licensing and software requirements for each processor in a DSSI VMScluster system.

**Table 1–1 Licensing and Software Requirements for DSSI VMScluster Systems**

Processor	License	Operating Software
AXP	VMScluster software license	OpenVMS AXP Version 6.1
VAX	VAXcluster software license	OpenVMS VAX Version 5.5-2 (not Version A5.5-2)
	One full-function DECnet license <sup>1</sup>	

<sup>1</sup>Since DSSI VMScluster systems must also be connected by an Ethernet interconnect for DECnet communications, a full-function DECnet license is required for the first system.

Additional licensing information is described in the VMScluster and VAXcluster Software Product Descriptions.

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## DSSI Bus Lengths and Grounding Requirements

### Maximum Bus Lengths

The maximum DSSI bus length supported, that is, the total distance between end-node terminators on the DSSI bus, is:

- 25 m (82 ft) in a computer room environment
- 20 m (65.6 ft) in an office environment

Refer to Appendix A for a table of electrical lengths for enclosures.

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**Note**

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The maximum DSSI bus length (end-to-end) for HSD05 and HSD30 array controllers is 18.28 m (60 ft).

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**Maintain a Common Ground**

The maximum bus lengths are based on grounding conditions typically found in computer room and office environments. Improper grounding can result in voltage potentials, called ground offset voltages, between the enclosures in the configuration. If these voltages exceed certain limits, data transmission across the DSSI bus can be disrupted, and the configuration can experience performance degradation or data corruption.

For these reasons, a common ground must be maintained between all systems and enclosures in a DSSI VMScluster at all times. All systems must receive their power from a common power feed. It is not advisable to power systems and enclosures from different circuit breaker panels.

**Verify Site Conditions**

Before you install a DSSI VMScluster system, you should verify site conditions.

1. A qualified electrician should ensure that site power distribution meets all local electrical codes.
2. The electrician should inspect the entire site power distribution system to ensure that it does not have any of the following faults:
  - Outlets do not have power ground connections
  - Grounding prong is missing from computer equipment power cables
  - Power outlet neutral connections are actual ground connections
  - Grounds for the power outlets are not connected to the same power distribution panel
  - Devices that are not UL or IEC approved are connected to the same circuit breaker as the computer equipment

**Offset Limits**

Table 1–2 shows acceptable ground offset limits between cabinets in a DSSI VMScluster.

**Table 1–2 Acceptable Ground Offset Limits by Length of DSSI Interconnect**

DSSI Length	Allowable Offset
Up to 20 m (65.6 ft)	200 mv (DC); 70 mv (AC)
20–25 m (65–82 ft)	40 mv (DC); 14 mv (AC)

**Measuring Grounding Offset Voltage**

You can use a hand-held multimeter to measure the grounding offset voltage between any two cabinets. Connect the voltmeter leads to unpainted metal on each enclosure, and compare the reading you obtain to the acceptable offset values in Table 1–2.

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

### **Install Grounding Cables**

You should install Digital grounding cables between enclosures. Digital supplies ground cables with some hardware kits. You can also order the cables separately (order numbers BC21G-50 and BC21G-25 for the required number 6 cables; the numbers after the hyphen refer to the length in feet).

### **Maximum Number of Enclosures**

Up to five enclosures can be configured on a DSSI bus:

- Two systems and up to three expansion enclosures
- Three systems and up to two expansion enclosures

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## **Recommended Guidelines for DSSI VMScLuster Systems**

### **General Guidelines**

The following are recommended guidelines for configuring a DSSI VMScLuster:

- Whenever possible, DSSI adapters of the same performance level, measured in I/Os per second, (see Table 1–3) should be connected on the same DSSI bus to optimize performance.
- Different types of adapters are allowed in the same system; whenever possible, connect the same types of adapters on the same DSSI bus to maximize performance. Refer to Table 1–3 for information on adapter performance and characteristics.
- Ensure that each DSSI bus is terminated at each end at all times. Breaking a bus connection or removing a DSSI terminator while a cluster is operational may lead to data corruption.
- Do not configure DSSI VMScLuster systems with a power bus. Inadvertently bringing down the cluster defeats the added reliability of a DSSI VMScLuster.
- You can add an optional uninterruptible power supply (UPS) to the VMScLuster configuration to increase the level of availability.

**DSSI Adapter Characteristics** Table 1–3 provides adapter information for AXP supported adapters.

**Table 1–3 DSSI Adapter Characteristics for AXP Supported Adapters**

<b>Adapters</b>	<b>Cluster Traffic Support</b>	<b>Middle-Node<sup>1</sup> Support</b>	<b>I/Os per Second<sup>2</sup></b>	<b>Type</b>	<b>Cluster Serviceability<sup>3</sup></b>
EDA640	Yes	No	340	Embedded	No
KFDDA	Yes	Yes	1000 x 1	Embedded	Yes
KFddb	Yes	Yes	1000 x 2	Embedded	Yes
KFESA (EISA-to-DSSI)	Yes	Yes	1000 x 1	EISA-bus	Yes
KFESB (EISA-to-DSSI)	Yes	Yes	1000 x 1	EISA-bus	Yes
KFMSA	Yes	Yes, BA variant No, AA variant	800 x 2	XMI	Yes
KFMSB	Yes	Yes, BA variant No, AA variant	608 x 2	XMI	Yes
KFQSA	No	With IN/OUT connectors—Yes Without IN/OUT connectors—No	170	Q-bus	With IN/OUT connectors—Yes Without IN/OUT connectors—No
N710 (DEC 4000 AXP)	Yes	No	1200 x 4	Embedded	Yes
SHAC (KA694, KA692, KA691, KA681, KA676,)	Yes	Bus 0—No Bus 1—Yes	1200 x 2	Embedded	Yes
SHAC (KA670)	Yes	Bus 0—No Bus 1—Yes	800 x 2	Embedded	Yes
SHAC (KA53, KA52)	Yes	With IN/OUT connectors—Yes Without IN/OUT connectors—No	1200 x 2	Embedded	Yes
SHAC (KA660)	Yes	No	800	Embedded	No

<sup>1</sup>Middle nodes do not contain embedded DSSI termination, and thus support more than two hosts on their DSSI bus.

<sup>2</sup>Throughput is per DSSI bus. Total throughput may be less than the sum.

<sup>3</sup>Cluster serviceability refers to the ability to service the adapter without violating DSSI bus termination.

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## Installation: AXP-Only or Dual-Architecture (AXP and VAX) Configurations

### In this Chapter

This chapter describes the hardware steps required to set up and install a DSSI VMScluster that includes AXP-only or dual-architecture configurations of KFESA-based AlphaServer 2000/2100 systems or DEC 4000 AXP systems:

- Step 1: Configure Bus Node IDs for Host Adapters
- Step 2: Configure Bus Node ID Plugs
- Step 3: Set HSD05 Array Controller Bus Node ID
- Step 4: Connect Ground Cables Between Enclosures
- Step 5: Connect DSSI Cables Between Enclosures
- Step 6: Set DSSI Device Parameters
- Step 7: Configure SCSI Node ID Plugs
- Step 8: Set Boot Parameters
- Step 9: Complete the Installation

### Examples of Configurations

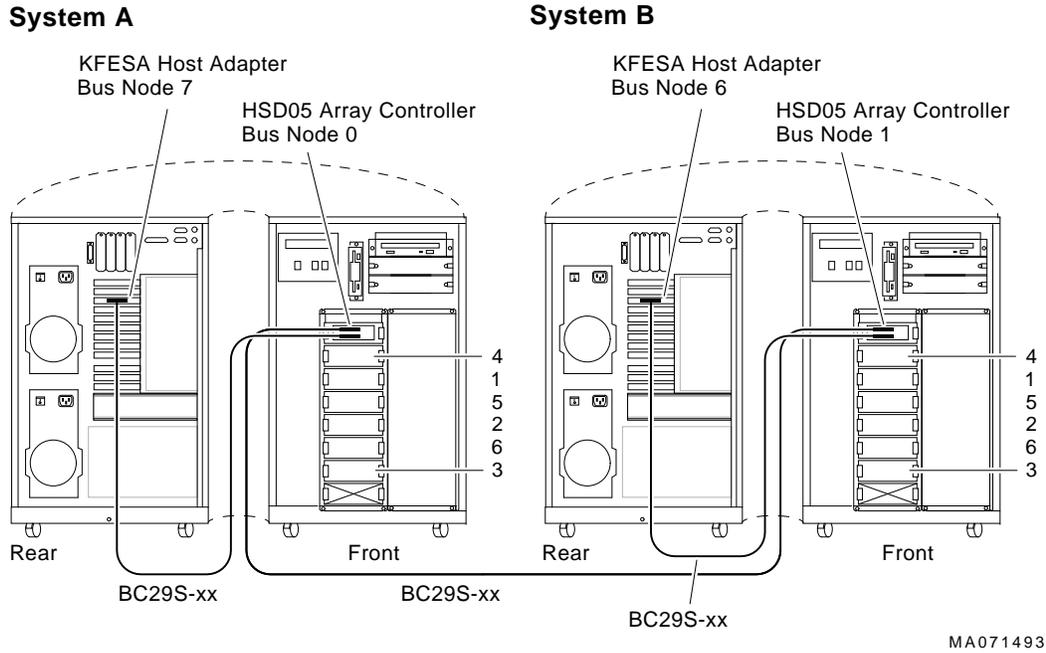
Figure 2–1 shows a sample configuration with two KFESA-based AlphaServer 2100 systems in a DSSI VMScluster.

Figure 2–2 shows a sample configuration with two DEC 4000 AXP systems in a DSSI VMScluster.

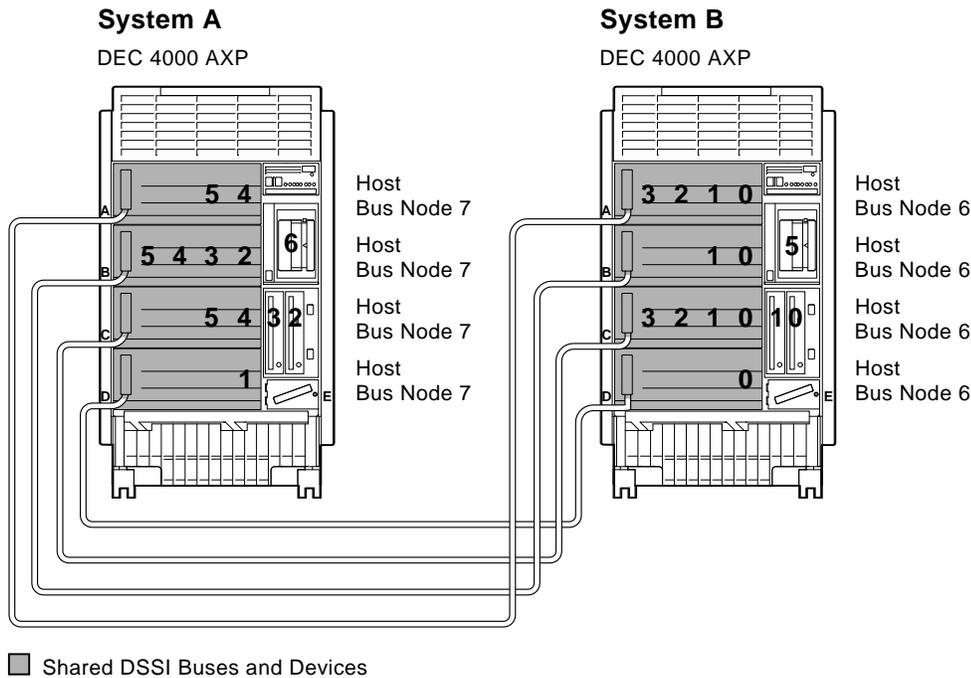
Figure 2–3 shows a sample dual-architecture DSSI VMScluster with two KFESA-based AlphaServer 2100 systems and a VAX 4000.

Figure 2–4 shows a sample dual-architecture DSSI VMScluster with two DEC 4000 AXP systems and a VAX 4000.

**Figure 2-1 AXP-Only DSSI VMScLuster: Two AlphaServer 2100 Systems**



**Figure 2-2 AXP-Only DSSI VMScLuster: Two DEC 4000 Systems**



**Figure 2-3 Dual-Architecture DSSI VMScluster: AlphaServer 2100 Systems and VAX 4000 Systems**

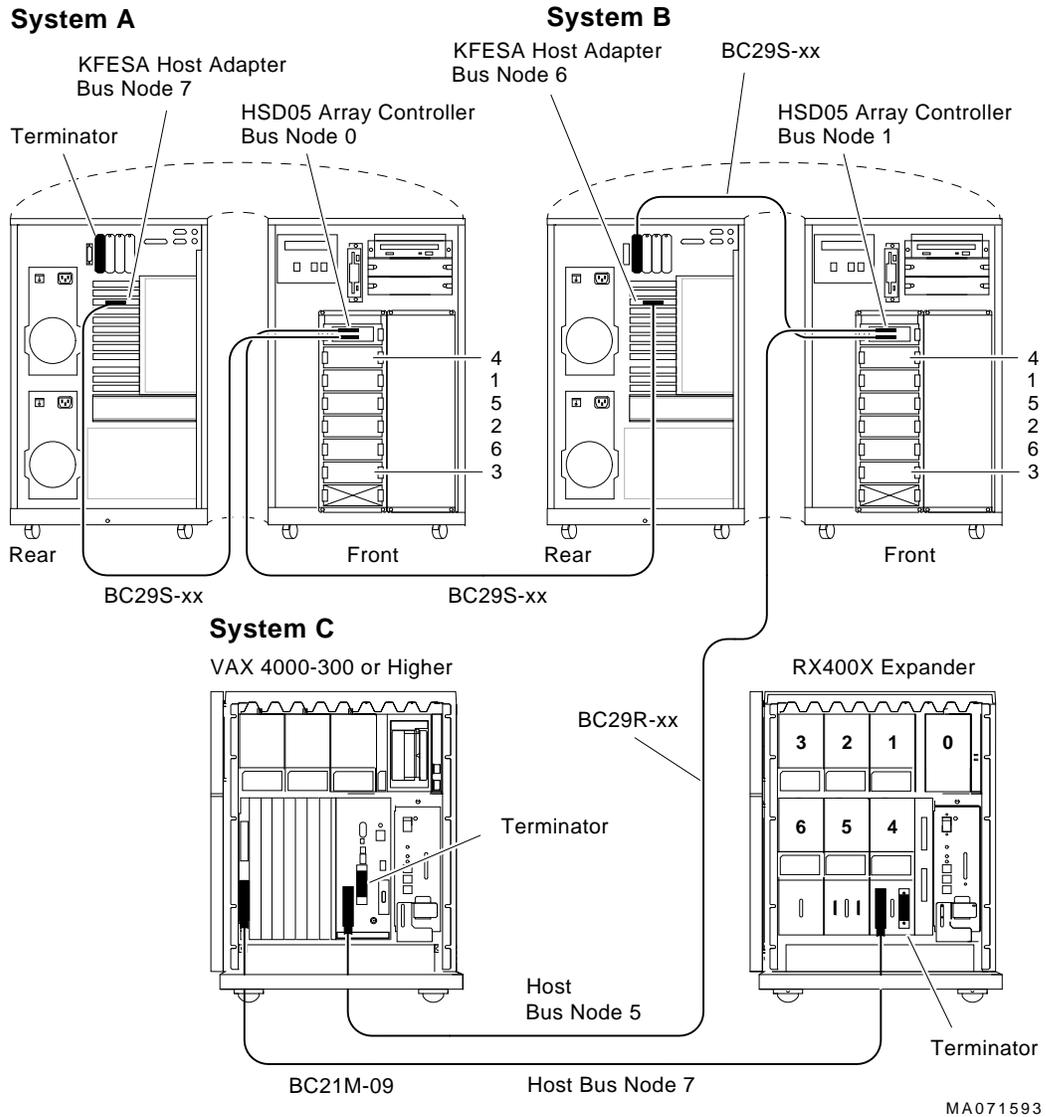
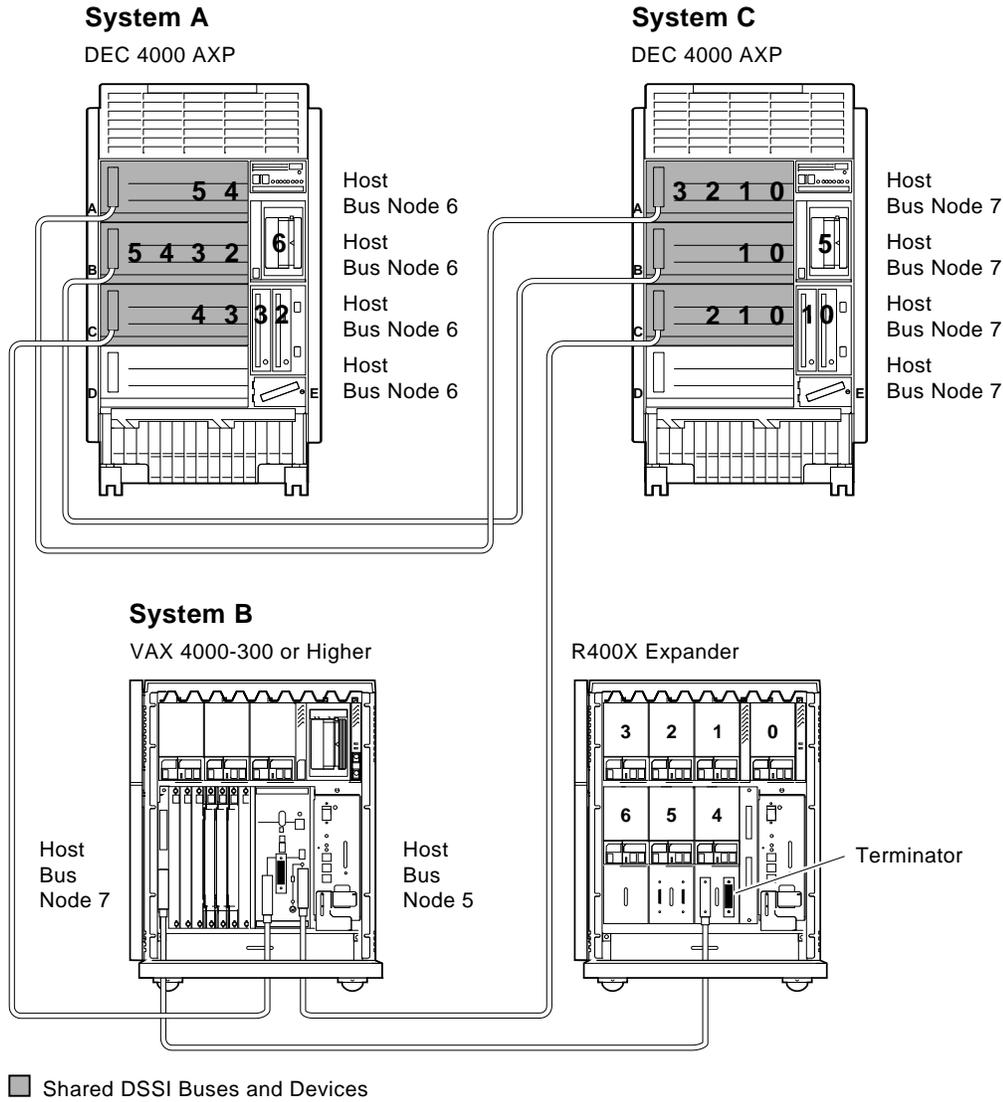


Figure 2-4 Dual-Architecture DSSI VMScluster: DEC 4000 Systems and VAX 4000 System



MLO-010631

---

## Step 1: Configure Bus Node IDs for Host Adapters

<b>DSSI Adapter Bus Node IDs</b>	By convention, host adapters in a two-system DSSI VMSccluster are assigned bus node IDs 6 and 7; in a three-system DSSI VMSccluster they are assigned 5, 6, and 7; and in a four-system DSSI VMSccluster, 4, 5, 6, and 7.
<b>KFESA Adapter IDs</b>	AlphaServer 2000/2100 systems use the KFESA DSSI host adapter. The bus node ID (or device ID) for the KFESA is changed using the EISA Configuration Utility (ECU).
<b>DEC 4000 AXP Adapter IDs</b>	DEC 4000 AXP systems use embedded DSSI host adapters. The bus node ID (or device ID) for DEC 4000 AXP adapters are changed by setting the NCRn_SETUP environment variables.
<b>HSD30 Array Controllers</b>	Each HSD30 array controller counts as one DSSI node. The DSSI bus node ID for these controllers is set using the <code>set this_controller ID=n</code> and <code>set other_controller ID=n</code> from the HSD30 maintenance terminal.
<b>KFMSB Adapter</b>	DEC 7000/10000 AXP systems use the KFMSB host adapter. The bus node ID (or device ID) for KFMSB adapters is changed using the <code>modify</code> command through the Loadable Firmware Update Utility (LFU).

---

### Changing the KFESA Adapter Bus Node ID (AlphaServer 2000/2100 Systems)

<b>Running the ECU</b>	<p>Run the ECU as follows to change the KFESA host bus node ID:</p> <ol style="list-style-type: none"> <li>1. Start the ECU according to the instructions provided with your system documentation.</li> <li>2. After the ECU copyright is displayed, the ECU loads the configuration file for the KFESA. If the file is not included on the ECU diskette, the ECU program prompts you to insert the configuration diskette for the option.</li> </ol> <p>While the configuration files are loading, the ECU displays the message:</p> <pre> Loading configuration files Please wait... </pre>
------------------------	---

When the files have finished loading, a menu similar to the following is displayed:

```
EISA Configuration Utility
Steps in configuring your computer

STEP 1: Important EISA configuration Information
STEP 2: Add or remove boards
STEP 3: View or edit details
STEP 4: Examine required details
STEP 5: Save and exit

>Select=ENTER< <Cancel=ESC>
```

3. Select the “View or edit details option” (Step 3 in the example below) and press the Enter key. Scroll through the file until you find the KFESA option and its slot number. The display lists the current settings. A sample file is shown below:

```
Step 3: View or edit details
Slot 7 -- Digital KFESA DSSI EISA Host Adapter   Added
Host Adapter Interface.....Trigger EDGE
Host Adapter IRQ.....IRQ 15
Host Adapter DSSI ID.....Device ID 7
```

To change the bus node ID setting (edit details), select the “Host Adapter DSSI ID” function or setting and press the Return key.

---

**Note**

---

Never set a host adapter IRQ of 9.

---

When you have finished with the option settings, press F10. A main menu similar to the following is displayed:

```
EISA Configuration Utility
Steps in configuring your computer

STEP 1: Important EISA configuration Information
STEP 2: Add or remove boards
STEP 3: View or edit details
STEP 4: Examine required details
STEP 5: Save and exit

>Select=ENTER< <Cancel=ESC>
```

4. Select "Save and exit" (Step 5 in the example above) and press the Enter key. A screen will verify that you want to save the configuration and a screen similar to the following is then displayed:

EISA Configuration Utility

Your configuration file has been saved, and if possible a backup SYSTEM.SCI file has been made on the current drive.

To complete your configuration, you must do one of the following:

If you need to install boards or change switches and jumpers on boards already installed, turn off your computer and do so.

If you want to test your system or install an operating system, press ENTER to restart your computer, run the configuration utility again, and select the appropriate main menu item.

If you are finished configuring, remove the SYSTEM CONFIGURATION diskette if it is in drive A and press ENTER to restart your system.

Ok=ENTER

Follow the directions on the screen displays until you have saved and exited the ECU.

5. Return to your system documentation for instructions on returning to the SRM console, which supports OpenVMS.

**Turn Off System Power**

After setting the KFESA host adapter bus node numbers, turn off system power by setting the DC On/Off switch to off.

---

## Changing NCRn\_SETUP Environment Variables (DEC 4000 AXP Systems)

**Set Bus Mode and Bus Node Numbers**

For each DEC 4000 AXP host adapter that supports DSSI devices, set the bus mode to "DSSI."

In addition, for DSSI VMScluster systems with two DEC 4000 AXP systems, change one of the system's bus node numbers for the host adapters to be shared. For each host adapter to be shared, set the bus node number to 6.

**Use NCRn\_SETUP Environment Variables**

In DEC 4000 AXP systems, you change the bus mode and bus node numbers for host adapters by setting NCRn\_SETUP environment variables.

**Note**

When diskless DSSI buses are to be shared (for increased performance and redundancy), you still need to set the bus mode to DSSI, and change the host adapter bus node numbers accordingly.

**Host Adapters and Bus Locations**

Table 2-1 shows the relationship of the NCRn\_SETUP environment variables to the DEC 4000 AXP storage buses.

**Table 2-1 Host Adapters for DEC 4000 AXP Systems**

Host Adapters	Storage Bus	Location
NCR0_SETUP	0 (or A in console mode)	Top drawer
NCR1_SETUP	1 (or B in console mode)	Second drawer
NCR2_SETUP	2 (or C in console mode)	Third drawer
NCR3_SETUP	3 (or D in console mode)	Bottom drawer
NCR4_SETUP	4 (or E in console mode)	Removable-media storage compartment (SCSI only)

**Example: Set NCRn\_SETUP Variables**

In the following example, all four DSSI host adapters in Systems A and B are assigned a bus mode of DSSI. All four DSSI host adapters in System B are assigned a bus node number of 6.

```
# For System A
>>> show ncr*
ncr0_setup          AUTO 7
ncr1_setup          AUTO 7
ncr2_setup          AUTO 7
ncr3_setup          AUTO 7
ncr4_setup          AUTO 7
>>> set ncr0_setup "DSSI 7"
>>> set ncr1_setup "DSSI 7"
>>> set ncr2_setup "DSSI 7"
>>> set ncr3_setup "DSSI 7"
>>> show ncr*
ncr0_setup          DSSI 7
ncr1_setup          DSSI 7
ncr2_setup          DSSI 7
ncr3_setup          DSSI 7
ncr4_setup          AUTO 7
>>>
```

```
# For System B
>>> show ncr*
ncr0_setup          AUTO 7
ncr1_setup          AUTO 7
ncr2_setup          AUTO 7
ncr3_setup          AUTO 7
ncr4_setup          AUTO 7
>>> set ncr0_setup "DSSI 6"
>>> set ncr1_setup "DSSI 6"
>>> set ncr2_setup "DSSI 6"
>>> set ncr3_setup "DSSI 6"
>>> show ncr*
ncr0_setup          DSSI 6
ncr1_setup          DSSI 6
ncr2_setup          DSSI 6
ncr3_setup          DSSI 6
ncr4_setup          AUTO 7
>>>
```

**Turn Off  
System Power**

After setting the host adapter bus node numbers and specifying the bus mode, turn off system power by setting the DC On/Off switch to off.

---

## Changing the HSD30 Array Controller Bus Node IDs

**Set  
this\_controller  
ID; Set  
other\_controller  
ID**

Each HSD30 array controller counts as one DSSI node. If your configuration includes an HSD30 array controller, be sure that its controllers are assigned a unique bus node ID. DSSI nodes for the HSD30 are changed using the `set this_controller ID=n` and `set other_controller ID=n` commands from the HSD30 maintenance terminal.

Refer to the *StorageWorks Array Controllers HS Family of Array Controllers User's Guide*, EK-HSFAM-UG.

**HSD30  
Example**

In the following example, one of the HSD30 array controllers is assigned a bus node ID of 7 from the HSD30 maintenance terminal.

## Changing the HSD30 Array Controller Bus Node IDs

```
CLI -> set this_controller id=7
Warning 4000: A restart of this controller will be required
before all the parameters modified will take effect
Restart of this controller required
CLI -> show this_controller
Controller:
    HSD30 ZG33400081 Software V14D, Hardware 0000
    Configured for dual-redundancy with ZG33400048
    In dual-redundant configuration
    SCSI address 7
Host port:
    Node name: VINCE, valid DSSI node 7
    Host path is ON
    MSCP allocation class    5
    TMSCP allocation class   5
Cache:
    No cache
Restart of this controller required
CLI ->
```

---

## Changing the KFMSB Host Adapter Bus Node IDs

### Loadable Firmware Update Utility

DEC 7000/1000 AXP systems use the KFMSB adapter. Each KFMSB provides two DSSI busses, each with a factory setting of bus node ID 7. The bus node ID (or device ID) for KFMSB adapters is changed using the `modify` command through the Loadable Firmware Update Utility (LFU).

Refer to the *KFMSB Adapter Installation Guide*, EK-KFMSB-IN.

---

## Step 2: Configure Bus Node ID Plugs

### Unique Bus Node ID Plugs

Configure bus node ID plugs so that all DSSI devices on a shared bus (mass storage and host adapters) have unique bus node numbers.

DSSI storage devices have bus node ID plugs to provide a DSSI node number for the device. VAX 4000 systems use bus node ID plugs to supply DSSI node numbers for their embedded host adapters. Depending on the number of systems in the cluster, set VAX 4000 host adapters to 6 or 5.

---

## Step 3: Set HSD05 Array Controller Bus Node ID

### HSD05 Bus Node ID

Each HSD05 array controller counts as one DSSI node. If your configuration includes HSD05 array controllers, be sure that the HSD05 is assigned a unique DSSI bus node ID. DSSI node IDs for the HSD05 are set by switches on the HSD05 controller module board (switches 1, 2, and 3, with 3 being the least significant bit). The factory default setting is 0.

Refer to the *StorageWorks Solutions HSD05 Array Controller User's Guide*, EK-HSD05-UG, for information on switchpack settings.

---

## Step 4: Connect Ground Cables Between Enclosures

### Daisy Chain Ground Cables

Attach a number 6 gauge ground cable to the ground terminal on the system power supply. Ground cables should be daisy chained for systems with multiple enclosures.

---

**Caution**

---

Do not attach more than two ground cables per ground terminal.

---

---

## Step 5: Connect DSSI Cables Between Enclosures

### DSSI Connectors and Cables

Figure 2–5 shows the MR (midrange or micro ribbon) and PS (pedestal style or pin socket) DSSI connectors. Appendix A provides the connector type for each enclosure and DSSI adapter. Table 2–2 lists the cable variants used with DSSI VMSclusters. Refer to the *Digital Systems and Options Catalog* for a complete listing of the latest cable order numbers.

**Figure 2–5 Midrange and Pedestal Style DSSI Connectors**

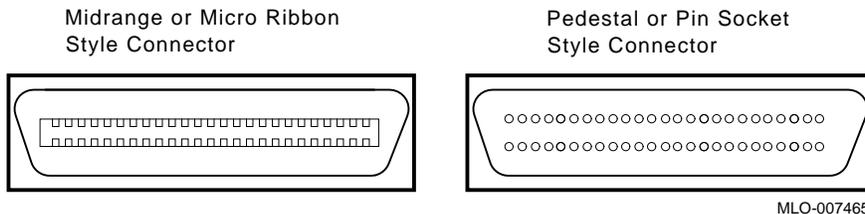


Table 2–2 DSSI Cable Variations

Cable	Type
BC21M-09	<p>A micro-ribbon cable with two right-angle 50-pin pin socket connectors. Used to connect:</p> <ul style="list-style-type: none"> <li>VAX 4000 systems to R400X expanders</li> <li>VAX 4000 systems to VAX 4000 systems</li> <li>R400X expanders to R400X expanders</li> <li>DEC 4000 systems to R400X expanders</li> <li>DEC 4000 systems to VAX 4000 systems</li> </ul>
BC21Q-xx	<p>A micro-ribbon cable with two straight 50-pin micro-ribbon connectors. Used to connect:</p> <ul style="list-style-type: none"> <li>KFESA adapter to KFESA adapter</li> </ul>
BC22Q-xx	<p>A micro-ribbon cable with one right-angle 50-pin pin-socket connector and one straight 50-pin micro-ribbon connector. Used to connect:</p> <ul style="list-style-type: none"> <li>VAX 3000/4000 systems to TF857/SF100</li> </ul>
BC29R-xx	<p>A micro-ribbon cable with one right-angle 50-pin pin-socket connector and one right-angle 50-pin micro-ribbon connector. Used to connect:</p> <ul style="list-style-type: none"> <li>HSD05 array controller to DEC 4000 systems</li> <li>HSD05 array controller to VAX 3000/4000 systems</li> </ul>
BC29S-xx	<p>A micro-ribbon cable with one right-angle 50-pin micro-ribbon connector and one straight 50-pin micro-ribbon connector. Used to connect:</p> <ul style="list-style-type: none"> <li>KFESA host adapter to HSD05 array controller</li> <li>HSD05 array controller to KFMSB adapter</li> <li>HSD05 array controller to VAX 6000/7000/10000 systems</li> </ul>
BC29U-02	<p>A micro-ribbon cable with two right-angle 50-pin micro-ribbon connectors mounted facing opposite directions. Used to connect:</p> <ul style="list-style-type: none"> <li>HSD05 array controller to HSD05 array controller (within same BA740 enclosure (AlphaServer 2100 systems))</li> </ul>

### Check Devices on the Configuration Display

After connecting the DSSI cables, power up the system. Check the system configuration display using the `show config` command to see if there are any missing drives. If drives are missing, check that bus node IDs are unique for each:

- DSSI host adapter
- HSD05 array controller
- HSD30 array controller
- DSSI storage device

---

**Note**

---

If you change the bus node ID plugs, you must recycle power (press the Reset button or turn on power with the DC On/Off switch) before the new setting will take effect. The system reads the bus node ID values at power-up.

---

---

## Step 6: Set DSSI Device Parameters

### DSSI Device Parameters

In creating a DSSI VMSccluster system, you need to set DSSI device parameters according to your configuration:

- **ALLCLASS** — In a DSSI VMSccluster, each device to be served to the cluster must have a nonzero allocation class that matches the allocation class of the system. Each system on a shared DSSI bus must have the same OpenVMS allocation class (ALLOCLASS).

---

**Note**

---

For devices connected through early versions of the HSD05 array controllers, this parameter is called `DISK_ALCS`.

---

- **UNITNUM** — Systems using multiple DSSI buses, as described in Appendix B, require that the default values for DSSI storage devices (supplied by bus node ID plugs) be replaced with unique unit numbers.

---

**Note**

---

Devices connected through the HSD05 and HSD30 array controllers are automatically assigned unique unit numbers.

---

- **NODENAME** — You can provide your own node names for drives; you can use the factory-supplied node names; or you can use the `cdp` console command to supply node names that relate to the device name conventions for AXP systems.

## For More Parameters

For more information on DSSI parameters and their functions, refer to Appendix B and *VMScCluster Systems for OpenVMS*.

## cdp Console Command

---

### Caution

---

The HSD05 and HSD30 array controllers do not currently support the `cdp` command. If your configuration includes the HSD05 or HSD30 controller, do not use the `cdp` command. Doing so causes the console subsystem to hang and requires that you press the Reset button to return to the console prompt.

- For systems configured with an HSD05 array controller, use the `set host -dup -dssi device_name` command to set and examine DSSI parameters using the Diagnostic and Utility Program (DUP).

For examples of the `set host -dup -dssi` command, see the section “`set host -dup -dssi` Command.”

- For systems configured with the HSD30 array controller, use the `set this_controller` and `set other_controller` commands from the HSD30 maintenance terminal to set and examine device parameters.

For more information, refer to the *StorageWorks Solutions HSD05 Array Controller User's Guide*, EK-HSD05-UG and *StorageWorks Array Controllers HS Family of Array Controllers User's Guide*, EK-HSFAM-UG.

---

The AXP console command `cdp` allows you to modify the **NODENAME**, **ALLCLASS**, and **UNITNUM** parameters. The `cdp` command automatically connects to the device's DUP server for all devices or any number of specified devices.

---

### Note

---

When a DSSI bus is shared with a VAX system, the `cdp` console command can connect to all the shared drives, even though they physically reside in the VAX enclosure (or expansion enclosure).

---

Enter the `cdp` command without an option or target device to list the DSSI parameters for all DSSI drives on the system.

## Step 6: Set DSSI Device Parameters

### Command Description

`cdp` (`[-{i,n,a,u,o}] [-sn] [-sa allclass] [-su unitnum] [dssi_device]`)

*Arguments:*

`[dssi_device]` Name of the DSSI device or DSSI adapter. Only the parameters for the specified device or devices on this adapter will be modified.

*Options:*

`[-i]` Selective interactive mode, set all parameters.

`[-n]` Set device node name, NODENAME (alphanumeric, up to 6 characters).

`[-a]` Set device allocation class, ALLCLASS.

`[-u]` Set device unit number, UNITNUM.

`[-sn]` Set node name (NODENAME) for all DSSI drives on the system to either *RFhscn* or *TFhscn*, where:  
*h* is the device hose number (0)  
*s* is the device slot number (0–3)  
*c* is the device channel number (0)  
*n* is the bus node ID (0–6).

`[-sa]` Set ALLCLASS for all DSSI devices on the system to a specified value.

`[-su]` Specify a starting unit number for a device on the system. The unit number for subsequent DSSI devices will be incremented (by 1) from the starting unit number.

### DSSI Parameters Displayed Using `cdp`

A sample display of DSSI device information using the `cdp` command is shown below:

```
>>> cdp
      ❶          ❷          ❸          ❹ ❺ ❻
pua0.0.0.0.0    ALPHA0    0411214901371    2 0 $2$DIA0
pua0.1.0.0.0    ALPHA1    0411214901506    2 1 $2$DIA1
pua0.2.0.0.0    ALPHA2    041122A001625    2 2 $2$DIA2
pua0.3.0.0.0    ALPHA3    0411214901286    2 3 $2$DIA3
pua0.4.0.0.0    ALPHA4    0411224904506    2 4 $2$DIA4
pua0.5.0.0.0    ALPHA5    0411233087412    2 5 $2$DIA5
>>>
```

- ❶ Storage adapter device name
- ❷ Node name (NODENAME)
- ❸ System ID (SYSTEMID) — modified during warm swap
- ❹ Allocation class (ALLCLASS)
- ❺ Unit number (UNITNUM)
- ❻ Operating system device name

**cdp Example**

In the following sample display, which corresponds to the configuration shown in Figure 2–2:

- The unit numbers for drives on DSSI buses B, C, and D are changed to avoid duplicate unit numbers. Bus B is given unit numbers starting with 10; Bus C starting with 20; and Bus D starting with 30.
- The allocation class for all drives is changed to 1.
- Drive dub0 is given the new node name, SYSTEM.

```
>>> cdp -sa 1
pua0.0.0.0.0    ALPHA0    0411214901371    1  0    $1$DIA0
pua0.1.0.0.0    ALPHA1    0411214901506    1  1    $1$DIA1
pua0.2.0.0.0    ALPHA2    041122A001625    1  2    $1$DIA2
pua0.3.0.0.0    ALPHA3    0411214901286    1  3    $1$DIA3
pua0.4.0.0.0    ALPHA4    0411224904506    1  4    $1$DIA4
pua0.5.0.0.0    ALPHA5    0411233087412    1  5    $1$DIA5
>>> cdp -sa 1 -su 10 dub
pub0.0.0.1.0    SNEEZY    0411214906794    1 10    $1$DIA10
pub1.1.0.1.0    DOPEY    0411214457623    1 11    $1$DIA11
pub2.2.0.1.0    SLEEPY    0478512447890    1 12    $1$DIA12
pub3.3.0.1.0    GRUMPY    0571292500565    1 13    $1$DIA13
pub4.4.0.1.0    BASHFL    0768443122700    1 14    $1$DIA14
pub5.5.0.1.0    HAPPY    0768443122259    1 15    $1$DIA1
>>> cdp -sa 1 -su 20 duc
puc0.0.0.2.0    RF0200    0347500845133    1 20    $1$DIA20
puc1.1.0.2.0    RF0201    0889734564411    1 21    $1$DIA21
puc2.2.0.2.0    RF0202    0411780351455    1 22    $1$DIA22
puc3.3.0.2.0    RF0203    0555613903222    1 23    $1$DIA23
puc4.4.0.2.0    RF0204    0744673884100    1 24    $1$DIA24
puc5.5.0.2.0    RF0205    0298438401226    1 25    $1$DIA25
>>> cdp -sa 1 -su 30 dud
pud0.0.0.3.0    RF0300    0620707250334    1 30    $1$DIA30
pud1.1.0.3.0    RF0301    0889734564411    1 31    $1$DIA31
>>> cdp -n dub0
pub0.0.0.1.0:
Node Name [SNEEZY]? SYSTEM
>>>
```

**set host  
-dup -dssi  
Command  
(HSD05/HDS30)**

The `set host -dup -dssi device_name` command is used in place of the `cdp` command for systems using the HSD05 and HSD30 array controllers. This command allows you to enter the DUP server utility for a specified device. Through the DUP server utility, you can set and examine DSSI parameters for the specified device.

## Step 6: Set DSSI Device Parameters

### Starting DUP: Example

```
>>> set host -dup -dssi dub34
starting DIRECT on pub0.3.0.3.1 (HSD05A)
Copyright 1994 Digital
      HSD05   Serial No: 2033
      Firmware Rev. B1   (X36A)

DIRECT V1.0  D  Mar 21 1994 17:09:41
PARAMS V1.0  D  Mar 21 1994 17:09:41
UTILIT V1.0  D  Mar 21 1994 17:09:41

End of directory
Task? params

starting PARAMS on pub0.3.0.3.1 (HSD05A)
Copyright 1994 Digital
      HSD05   Serial No: 2033
      Firmware Rev. B1   (X36A)
PARAMS>
```

### Setting Allocation Class

After entering the DUP server utility for a specified device, you can examine and set the allocation class for the device as follows.

---

#### Note

---

Set the ALLCLASS parameter only through console mode, at the PARAMS> prompt. Setting the ALLCLASS parameter from the operating system is not recommended. Devices connected through early versions of the HSD05 array controller use the parameter DISK\_ALCS for allocation class; all other DSSI devices use the parameter ALLCLASS.

---

1. At the PARAMS> prompt, enter `show allclass` (or `show disk_alcs` for HSD05 devices) to check the allocation class of the device to which you are currently connected.
2. Enter `set allclass 1` (or enter the allocation class you desire).
3. Enter `show allclass` to verify the new allocation class.

The following example shows the steps for examining and changing the allocation class for a specified device. In the example, the allocation class is changed from class 0 to class 1 for a device connected through an HSD05.

```
PARAMS> show disk_alcs
DISK_ALCS          0          0          255   DecimalNum
PARAMS> set disk_alcs 1
PARAMS> show disk_alcs
DISK_ALCS          1          0          255   DecimalNum
```

## Setting Unit Number

After entering the DUP server utility for a specified device, you can examine and set the unit number for the device as follows.

---

### Note

---

The HSD05 and HSD30 array controllers automatically provide unique unit numbers for its drives. For devices connected through the HSD05 and HSD30 controllers, you do not usually need to change this parameter.

---

1. At the PARAMS> prompt, enter `show unitnum` to check the unit number of the device to which you are currently connected.
2. Enter `set unitnum 10` (or enter the unit number you desire).
3. Enter `set forceuni 0` to override the default unit number value supplied by the bus node ID plug.
4. Enter `show unitnum` to verify the new unit number.
5. Enter `show forceuni` to verify that the current value for the FORCEUNI parameter is 0.
6. Label the device with its unit number, using the unit number labels shipped with your system.

The following example shows the commands for changing the unit number of a specified device from number 0 to number 10.

```
PARAMS>show unitnum
```

Parameter	Current	Default	Type	Radix
UNITNUM	0	0	Word	Dec U

```
PARAMS>set unitnum 10
PARAMS>set forceuni 0
PARAMS>show unitnum
```

Parameter	Current	Default	Type	Radix
UNITNUM	10	0	Word	Dec U

```
PARAMS>show forceuni
```

Parameter	Current	Default	Type	Radix
FORCEUNI	0	1	Boolean	0/1 U

## Setting Node Name

After entering the DUP server utility for a specified device, you can examine and set the node name for the device as follows.

1. At the PARAMS> prompt, enter `show nodename` to check the node name of the device to which you are currently connected.
2. Enter `set nodename sysdsk` (or enter the desired alphanumeric node name of up to eight characters).
3. Enter `show nodename` to verify the new node name.

## Step 6: Set DSSI Device Parameters

The following example shows the commands for changing the node name of a specified device from the factory-supplied name to SYSDSK.

```
PARAMS>show nodename
Parameter      Current      Default      Type      Radix
-----
NODENAME       R7CZZC      RZ35         String    Ascii     B

PARAMS>set nodename sysdsk
PARAMS>show nodename
Parameter      Current      Default      Type      Radix
-----
NODENAME       SYSDSK      RZ35         String    Ascii     B
```

### Exiting the DUP Server Utility

After you have finished setting and examining DSSI device parameters for a specified device, enter the `write` command at the `PARAMS>` prompt to save the device parameters you have changed using the `SET` command. The changes are recorded to nonvolatile memory.

---

#### Note

---

If you have set `host` to devices connected through the HSD05 array controller, you must enter `recycle system power`—shut of the system and then turn it back on—for the new parameters to take effect.

---

- If you have changed the allocation class or node name of a device, the DUP server utility will ask you to initialize the controller. Answer Yes (Y) to allow the changes to be recorded and to exit the DUP server utility.

```
PARAMS>write
Changes require controller initialization, ok? [Y/(N)] Y
Stopping DUP server...
>>>
```

- If you have not changed the allocation class or node name, enter the `exit` command at the `PARAMS>` prompt to exit the DUP server utility for the specified device.

---

#### Note

---

You must repeat the procedures in this step for each device for which you want to change parameters.

---

---

## Step 7: Configure SCSI Node ID Plugs

### When to Change SCSI Node Plugs

If systems in a DSSI VMScLuster contain SCSI drives, configure SCSI node ID plugs or SCSI node ID switch settings so that OpenVMS sees each SCSI device name as unique.

To determine if you need to change SCSI node ID plugs, consider these points:

- For each system, the OpenVMS operating system “names” the first SCSI bus it finds as bus A, the second SCSI bus as bus B, and so on.
- All SCSI drives in the DSSI VMScLuster are forced to the allocation class of the host systems.

### Example with Conflicting SCSI Device Names

Figure 2–6 and Table 2–3 show a sample configuration that calls for changing SCSI node ID plugs to avoid duplicate device names.

---

**Note**

---

SCSI unit numbers are forced to 100 x node ID (ID plug).

---

### Example with Unique SCSI Device Names

To avoid the problem of duplicate SCSI device names, shown in Table 2–3, change the SCSI node ID switch settings for the SCSI drives on System A.

Table 2–4 shows how the devices are uniquely named after you change the SCSI node ID switches for the SCSI devices. The SCSI disks in System A are given node ID settings of 0, 1, and the host SCSI ID is set to 6.

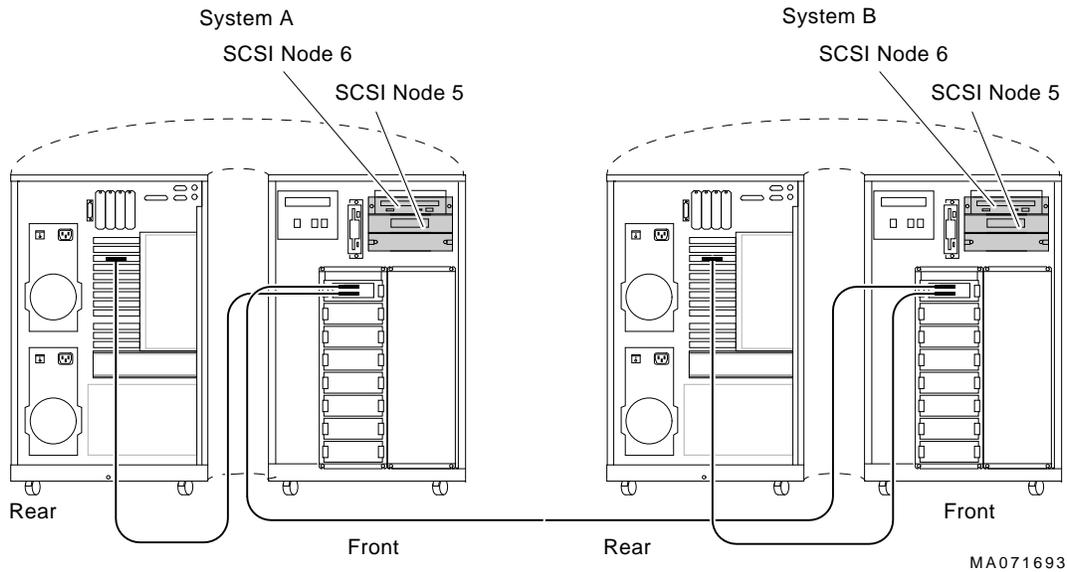
Note that in this example, the node ID for the SCSI host adapter in System A is changed from the default (7) to 6. This allows up to eight SCSI devices to be configured on the SCSI bus, each with a unique SCSI node ID (0–7).

The following commands are used to set SCSI host adapter node IDs:

System	Command
AlphaServer 2000/2100	set pk*_host_id <i>node_ID</i>
DEC 4000 AXP	set ncr*_setup "SCSI <i>node_ID</i> "
VAX 4000 Model 100A/100	SET SCSI_ID <i>bus_number node_ID</i>

Step 7: Configure SCSI Node ID Plugs

**Figure 2-6 Configuration with Duplicate SCSI Device Names**



**Table 2-3 Configuration with Conflicting SCSI Device Names**

<b>System A</b>		
<b>SCSI Node ID</b>	<b>Console Mode Device Name</b>	<b>OpenVMS Device Name</b>
5	MKA500	\$1\$MKA500*
6	DKA600	\$1\$DKA600*
<b>System B</b>		
5	MKA500	\$1\$MKA500*
6	DKA600	\$1\$DKA600*
*Duplicate SCSI device name		

Table 2-4 Configuration with Unique SCSI Device Names

System A		
SCSI Node ID	Console Mode Device Name	OpenVMS Device Name
0	MKA0	\$1\$MKA0 <sup>1</sup>
1	DKA100	\$1\$DKA100
6	Host adapter	
System B		
5	MKA500	\$1\$MKA500
6	DKA600	\$1\$DKA600
7	Host adapter	

<sup>1</sup>In this example, the allocation class is 1.

---

**Note**

---

For each SCSI bus that the OpenVMS operating system sees as common to both systems, the total number of drives is limited to eight (node IDs 0-7).

---

---

## Step 8: Set Boot Parameters

Set the boot parameters for booting on each system.

### Boot Parameters

Table 2–5 lists the boot environment variables and their related boot parameters.

**Table 2–5 Boot Parameters for AXP and VAX Systems**

---

#### AXP Console Boot Parameters

>>> set bootdef_dev dua0	Sets the device or device list from which booting is to be attempted. In this example, dua0 is specified as the boot device.
>>> set boot_osflags 0,0	Sets additional parameters (root number and boot flags) to be passed to the system software during booting if none are specified. In this example, system root 0 [SYS0] with 0 as the boot flag mask.
>>> set boot_osflags 0,1	Sets additional parameters (root number and boot flags) to be passed to the system software during booting if none are specified. In this case the system will stop at SYSBOOT.
>>> set boot_osflags 1,0	Sets additional parameters (root number and boot flags) to be passed to the system software during booting if none are specified. In this case the system boots from the system root [SYS1] rather than [SYS0].

---

#### VAX Console Boot Parameters

>>> set boot dua0	Sets the device or device list from which booting is to be attempted. In this example, dua0 is specified as the boot device.
>>> set bflag 0	Sets additional parameters to be passed to the system software during booting if none are specified. In this example, system root 0 [SYS0].
>>> set bflag 1	Sets additional parameters to be passed to the system software during booting if none are specified. In this case the system will stop at SYSBOOT.
>>> set bflag 10000000	Sets additional parameters to be passed to the system software during booting if none are specified. In this case the system boots from the system root [SYS1] as opposed to [SYS0].

---

## Boot Parameter Examples

### AXP Only Example

In the following example, boot parameters are set for two AXP systems in a DSSI VMScLuster:

```
# For system A
>>> set boot_osflags 0,0
>>> set bootdef_dev dua0
>>> boot
# For system B
>>> set boot_osflags 1,0
>>> set bootdef_dev dua0
>>> boot
```

### Dual-Architecture Example

In the following example, boot parameters are set for a dual-architecture DSSI VMScLuster:

```
# For system A (AXP System)
>>> set boot_osflags 0,0
>>> set bootdef_dev dub10
>>> boot
# For system B (VAX System)
>>> set bflag 10000000
>>> set boot dua0
>>> boot
```

---

#### Note

---

In a dual-architecture configuration, the AXP system and the VAX system **cannot** boot from a common disk.

---



---

## Step 9: Complete the Installation

Complete the software steps of the DSSI VMScLuster installation, such as updating the `cluster_config.com` file. Refer to the information provided in *Factory Installed Software User Information* or *OpenVMS AXP Version 6.1 Upgrade and Installation Manual* and *VMScLuster Systems for OpenVMS*.



---

## Installation: VAX-Only Configuration

### In This Chapter

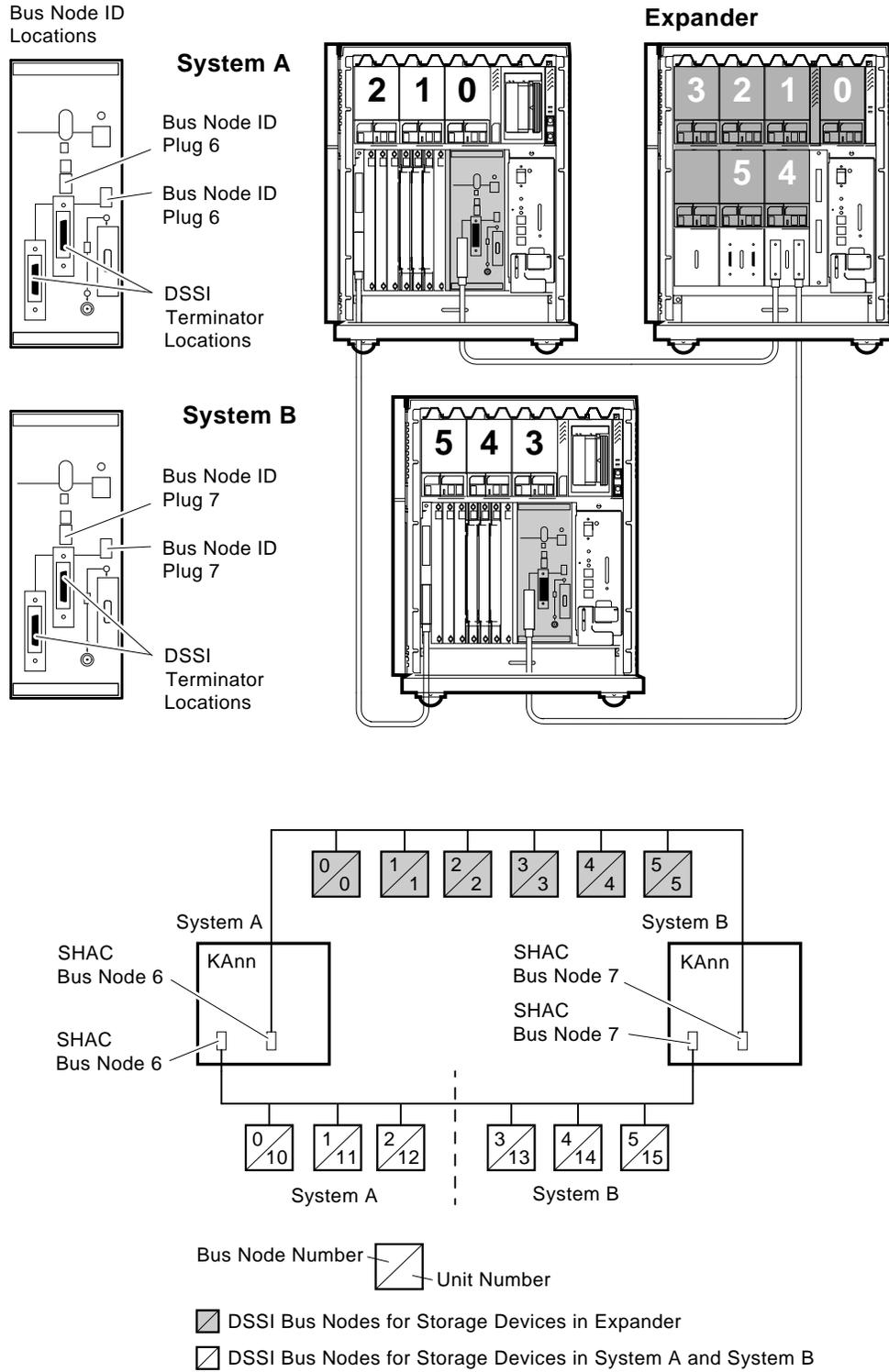
This chapter describes the hardware steps required to set up and install a VAX-only DSSI VMScluster:

- Step 1: Configure Bus Node IDs for Host Adapters and Mass Storage Devices
- Step 2: Connect Ground Cables Between Enclosures
- Step 3: Connect DSSI Cables Between Enclosures
- Step 4: Set DSSI Device Parameters
- Step 5: Configure SCSI Node IDs
- Step 6: Set Boot Parameters
- Step 7: Complete the Installation

### Examples of Configurations

Figure 3–1 shows a sample expanded two-system DSSI VMScluster configuration. The schematic representation shows the path of each DSSI bus, the node numbers for each storage device and host adapter, and the unit numbers for each storage device.

**Figure 3-1 Expanded Two-System DSSI VMScluster**



MLO-008663

---

## Step 1: Configure Bus Node IDs for Host Adapters and Mass Storage Devices

**Unique Bus Node ID Plugs** Configure bus node ID plugs for each mass storage device so that all DSSI devices on a shared bus (mass storage and host adapters) have unique bus node numbers.

**Host Adapters** Often when a DSSI is shared between systems, it will be necessary to change the bus node number for at least one host adapter from the default setting since each bus node on the same bus must be unique.

By convention, host adapters on a DSSI shared between two systems are assigned 6 and 7; 5, 6, and 7 are assigned on a DSSI shared among three systems; and 4, 5, 6, and 7 are shared among four systems.

VAX 4000 systems use bus node ID plugs to select bus node numbers for the host adapters 0 and 1. These same ID plugs also provide the default bus node numbers for buses 2 and 3 for VAX 4000 Model 500A/505A/600A/700A/ 705A systems using the KFDDDB option.

The SET DSSI\_ID firmware command is used to override the default settings for buses 2 and 3 (above), as well as to change the settings for buses 0 and 1 on VAX 4000 Model 100A\105A systems using the KFDDA option.

**SET DSSI\_ID and SHOW DSSI\_ID Commands** The firmware commands SET DSSI\_ID and SHOW DSSI\_ID allow you to override default bus node setting for onboard host adapters. Note that these firmware commands are available only on KA52, KA53, KA681, KA691, KA692, and KA694 CPUs.

---

Command	Function
SET DSSI_ID <i>bus_number</i> <i>bus_node</i>	Use this command to override the default bus node numbers for a specified host adapter. Assigning a value of F for <i>bus_node</i> returns the default determined by the bus node ID plug. These values are stored in nonvolatile FEPRM.
SHOW DSSI_ID	Displays the current bus node settings for the onboard (SHAC) host adapters.

## Step 1: Configure Bus Node IDs for Host Adapters and Mass Storage Devices

### SET DSSI\_ID Example

```
>>>SHOW DSSI_ID
DSSI_ID Bus 0/A = 7 determined by Bus 0 ID Plug
DSSI_ID Bus 1/B = 6 determined by Bus 1 ID Plug
DSSI_ID Bus 2/C = 7 determined by Bus 0 ID Plug
DSSI_ID Bus 3/D = 6 determined by Bus 1 ID Plug
>>>SET DSSI_ID 2 6
>>>SET DSSI_ID 3 5
>>>SHOW DSSI_ID
DSSI_ID Bus 0/A = 7 determined by Bus 0 ID Plug
DSSI_ID Bus 1/B = 6 determined by Bus 1 ID Plug
DSSI_ID Bus 2/C = 6 determined by SET DSSI_ID command, bus 0 ID Plug ignored
DSSI_ID Bus 3/D = 5 determined by SET DSSI_ID command, bus 1 ID Plug ignored
>>>
```

---

#### Note

---

When diskless DSSI buses are to be shared (for increased performance and redundancy), you still need to ensure that the host adapter bus node numbers are unique.

---

### HSD30 Array Controllers

Each HSD30 array controller counts as one DSSI node. If your configuration includes an HSD30 array controller, be sure that its controllers are assigned a unique bus node ID. DSSI nodes for the HSD30 are changed using the `set this_controller ID=n` and `set other_controller ID=n` commands from the HSD30 maintenance terminal.

Refer to the *StorageWorks Array Controllers HS Family of Array Controllers User's Guide*, EK-HSFAM-UG.

### **HSD30 Example**

In the following example, one of the HSD30 controllers is assigned a bus node ID of 7 from the the HSD30 maintenance terminal.

```
CLI -> set this_controller id=7
Warning 4000: A restart of this controller will be required before all the
              parameters modified will take effect
Restart of this controller required

CLI ->show this_controller
Controller:
  HSD30 ZG33400081 Software V14D, Hardware 0000
  HSD30 ZG33400081 Software V14D, Hardware 0000
  Configured for dual-redundancy with ZG33400048
    In dual-redundant configuration
  SCSI address 7
Host port:
  Node name: VINCE, valid DSSI node 7
  Host path is ON
  MSCP allocation class    5
  TMSCP allocation class   5
Cache:
  No cache
Restart of this controller required
CLI ->
```

### **HSD05 Bus Node ID**

Each HSD05 array controller counts as one DSSI node. If your configuration includes HSD05 array controllers, be sure that the HSD05 is assigned a unique DSSI bus node ID. DSSI node IDs for the HSD05 are set by switches on the HSD05 controller module board. The factory default setting is 0.

Refer to the *StorageWorks Solutions HSD05 Array Controller User's Guide*, EK-HSD05-UG, for information on switchpack settings.

### **Turn Off System Power**

After setting the bus node IDs, turn off system power.

---

## Step 2: Connect Ground Cables Between Enclosures

### Daisy Chain Ground Cables

Attach a number 6 gauge ground cable to the ground terminal on the system power supply (VAX 4000 Model 100/100A/105A systems have a ground terminal on the rear of the system box). Ground cables should be daisy-chained for systems with multiple enclosures.

---

**Caution**

---

Do not attach more than two ground cables per ground terminal.

---

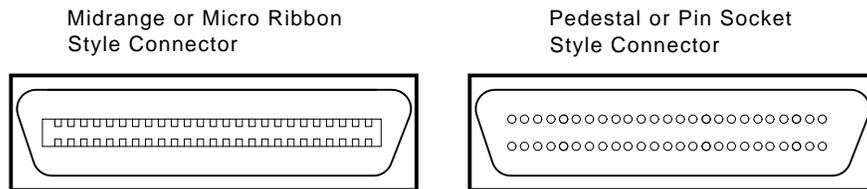
---

## Step 3: Connect DSSI Cables Between Enclosures

### DSSI Connectors and Cables

Figure 3-2 shows the MR (midrange or micro ribbon) and PS (pedestal style or pin-socket) DSSI connectors. Appendix A provides the connector type for each enclosure and DSSI adapter. Table 3-1 lists the DSSI cable variants used with DSSI VMScclusters. Refer to the *Digital Systems and Options Catalog* for a complete listing of the latest cable order numbers.

**Figure 3-2 Midrange and Pedestal Style DSSI Connectors**



MLO-007465

**Table 3–1 DSSI Cable Variations**

<b>Cable</b>	<b>Type</b>
BC21M-09	A micro-ribbon cable with two right-angle 50-pin pin socket connectors. Used to connect: VAX 4000 systems to R400X expanders VAX 4000 systems to VAX 4000 systems R400X expanders to R400X expanders
BC21Q-xx	A micro-ribbon cable with two straight 50-pin micro-ribbon connectors.
BC22Q-xx	A micro-ribbon cable with one right-angle 50-pin pin-socket connector and one straight 50-pin micro-ribbon connector. Used to connect: VAX 3000/4000 systems to TF857/SF100
BC29R-xx	A micro-ribbon cable with one right-angle 50-pin pin-socket connector and one right-angle 50-pin micro-ribbon connector. Used to connect: HSD05 array controller to DEC 4000 systems HSD05 array controller to VAX 3000/4000 systems
BC29S-xx	A micro-ribbon cable with one right-angle 50-pin micro-ribbon connector and one straight 50-pin micro-ribbon connector. Used to connect: HSD05 array controller to KFMSB adapter HSD05 array controller to VAX 6000/7000/10000 systems

**Check Devices  
Using the  
Show DSSI  
Command**

After connecting the DSSI cables, power up the system. Using the `SHOW DSSI` command (`SHOW UQSSP` for KFQSA-based DSSI), check to see if there are any missing drives. If drives are missing, check that bus node IDs are unique for each:

- DSSI host adapter
- HSD05 array controller
- HSD30 array controller
- DSSI storage device—the bus node ID plugs (or DSSI drive switch settings for devices in a VAX 4000 Model 100/100A /105A).

---

**Note**

If you change the bus node ID plugs, you must recycle power (press the Reset button or turn on power with the on/off switch) before the new setting will take effect. The system reads the bus node ID values at power-up.

---

---

## Step 4: Set DSSI Device Parameters

**DSSI Device  
Parameters**

In creating a DSSI VMSccluster system, you need to set the following DSSI device parameters according to your configuration:

- **ALLCLASS** — In a DSSI VMSccluster, each device to be served to the cluster must have a nonzero allocation class that matches the allocation class of the system. Each system on a shared DSSI bus must have the same OpenVMS allocation class (**ALLOCLASS**).

---

**Note**

For devices connected through early versions of the HSD05 array controller, this parameter is called **DISK\_ALCS**.

---

- **UNITNUM** — Systems using multiple DSSI buses, as described in Appendix B, require that the default values (supplied by bus node ID plugs) be replaced with unique unit numbers. To set unit numbers and override the default values, you supply values to the **UNITNUM** parameter and set a value of zero to the related device parameter, **FORCEUNI**. Typically, devices on the second bus are given unit numbers starting with 10; devices on the third bus are given unit numbers starting with 20, and so on.

---

**Note**

---

Devices connected through the HSD05 and HSD30 array controllers are automatically assigned unique unit numbers.

---

- **FORCEUNI** — Controls the use of **UNITNUM** to override the unit numbers supplied by the bus node ID plug. When **FORCEUNI** is set to a value of zero, the operating system uses the value assigned to the **UNITNUM** parameter; when **FORCEUNI** is set to a value of one, the operating system uses the value supplied by the bus node ID plug.
- **NODENAME** — You can provide your own node names for drives or you can use the factory-supplied node names.

**For More Parameters**

For more information on DSSI parameters and their functions, refer to Appendix B and *VMScluster Systems for OpenVMS*.

**SET HOST Command**

The firmware console command **SET HOST** allows you to enter the Diagnostic and Utility Program (DUP) server utility to modify the **NODENAME**, **ALLCLASS**, **UNITNUM**, and **FORCEUNI** parameters. See Table 3–2 for the command syntax for each adapter type.

**Table 3–2 SET HOST Commands According to Host Adapter Type**

System	Adapter Type	Command
HSD05	Array controller	SET HOST/DUP/DSSI <i>device_name</i> PARAMS
VAX 4000 Model 300 and higher, VAX 4000 Model 100A/105A	Embedded	SET HOST/DUP/DSSI/BUS:[0,1,2,3] <i>dssi_node_number</i> PARAMS
VAX 3300, 3400, VAX 4000 Model 100 and 4000 Model 200	Embedded	SET HOST/DUP/DSSI <i>dssi_node_number</i> PARAMS
All systems	KFQSA	SET HOST/DUP/UQSSP <i>port_controller_number</i> <sup>1</sup> PARAMS

---

<sup>1</sup>The port controller number obtained by using the SHOW UQSSP command

---

**Starting DUP: Examples****Starting the DUP Server Utility (Embedded DSSI)**

```
>>>SET HOST/DUP/DSSI/BUS:1 0 PARAMS
Starting DUP server...
Copyright (c) 1994 Digital Equipment Corporation
PARAMS>
```

## Step 4: Set DSSI Device Parameters

### Starting the DUP Server Utility (KFQSA-Based DSSI)

```
>>>SET HOST/DUP/UQSSP/DISK 0 PARAMS
Starting DUP server...
Copyright (c) 1994 Digital Equipment Corporation
PARAMS>
```

### Setting Allocation Class

After entering the DUP server utility for a specified device, you can examine and set the allocation class for the device as follows:

---

#### Note

---

Set the ALLCLASS parameter only through console mode (PARAMS> prompt). Setting the ALLCLASS parameter from the operating system is not recommended.

Devices connected through early versions of the HSD05 array controller use the parameter DISK\_ALCS for allocation class; all other DSSI devices use the parameter ALLCLASS.

---

1. At the PARAMS> prompt, enter SHOW ALLCLASS to check the allocation class of the device to which you are currently connected.
2. Enter SET ALLCLASS 1 (or enter the allocation class you desire).
3. Enter SHOW ALLCLASS to verify the new allocation class.

The following example shows the commands for examining and changing the allocation class for a specified device. In the example, the allocation class is changed from class 0 to class 1.

```
PARAMS>SHOW ALLCLASS
```

Parameter	Current	Default	Type	Radix
ALLCLASS	0	0	Byte	Dec B

```
PARAMS>SET ALLCLASS 1
PARAMS>SHOW ALLCLASS
```

Parameter	Current	Default	Type	Radix
ALLCLASS	1	0	Byte	Dec B

### Setting Unit Number

After entering the DUP server utility for a specified device, you can examine and set the unit number for the device as follows:

---

#### Note

---

The HSD05 and HSD30 array controllers automatically provide unique unit numbers for its drives. For devices connected through the HSD05 and HSD30 controllers, you do not usually need to change this parameter.

---

1. At the `PARAMS>` prompt, enter `SHOW UNITNUM` to check the unit number of the device to which you are currently connected.
2. Enter `SET UNITNUM 10` (or enter the unit number you desire).
3. Enter `SET FORCEUNI 0` to override the default unit number value supplied by the bus node ID plug.
4. Enter `SHOW UNITNUM` to verify the new unit number.
5. Enter `SHOW FORCEUNI` to verify that the current value for the `FORCEUNI` parameter is 0.
6. Label the device with its unit number, using the unit number labels shipped with your system.

The following example shows the commands for changing the unit number of a specified device from number 0 to number 10.

```
PARAMS>SHOW UNITNUM
Parameter      Current      Default      Type      Radix
-----
UNITNUM                0                0      Word      Dec      U

PARAMS>SET UNITNUM 10
PARAMS>SET FORCEUNI 0
PARAMS>SHOW UNITNUM
Parameter      Current      Default      Type      Radix
-----
UNITNUM                10                0      Word      Dec      U

PARAMS>SHOW FORCEUNI
Parameter      Current      Default      Type      Radix
-----
FORCEUNI                0                1  Boolean    0/1      U
```

### Setting Node Name

After entering the DUP server utility for a specified device, you can examine and set the node name for the device as follows:

1. At the `PARAMS>` prompt, enter `SHOW NODENAME` to check the node name of the device to which you are currently connected.
2. Enter `SET NODENAME SYSDSK` (or enter the desired alphanumeric node name of up to eight characters).
3. Enter `SHOW NODENAME` to verify the new node name.

The following example shows the commands for changing the node name of a specified device from the factory-supplied name to `SYSDSK`.

## Step 4: Set DSSI Device Parameters

```
PARAMS>SHOW NODENAME
```

Parameter	Current	Default	Type	Radix	
NODENAME	R7CZZC	RF35	String	Ascii	B

```
PARAMS>SET NODENAME SYSDSK
```

```
PARAMS>SHOW NODENAME
```

Parameter	Current	Default	Type	Radix	
NODENAME	SYSDSK	RF35	String	Ascii	B

### Exiting the DUP Server Utility

After you have finished setting and examining DSSI device parameters for a specified device, enter the `WRITE` command at the `PARAMS>` prompt to save the device parameters you have changed using the `SET` command. The changes are recorded to nonvolatile memory.

---

#### Note

---

If you have set `host` to devices connected through the HSD05 array controller, you must enter recycle system power—shut of the system and then turn it back on—for the new parameters to take effect.

---

- If you have changed the allocation class or node name of a device, the DUP server utility will ask you to initialize the controller. Answer Yes (Y) to allow the changes to be recorded and to exit the DUP server utility.

```
PARAMS>WRITE
```

```
Changes require controller initialization, ok? [Y/(N)] Y
```

```
Stopping DUP server...
```

```
>>>
```

- If you have not changed the allocation class or node name, enter the `EXIT` command at the `PARAMS>` prompt to exit the DUP server utility for the specified device.

---

#### Note

---

You must repeat the procedures in this step for each device for which you want to change parameters.

---

---

## Step 5: Configure SCSI Node IDs

### When to Change SCSI Node Plugs

If two VAX 4000 Model 100/100A/105A systems in a cluster contain SCSI drives, configure SCSI node IDs so that the operating system sees each SCSI device name as unique.

To determine if you need to change SCSI node IDs, consider these points:

- For each system, OpenVMS “names” the first SCSI bus it finds as bus A; the second SCSI bus as bus B; and so on.
- All SCSI drives in the DSSI VMScluster are forced to the allocation class of the host systems.

### Example with Conflicting SCSI Device Names

Table 3–3 shows a sample configuration that calls for changing SCSI node ID switch settings to avoid duplicate device names.

---

**Note**

---

SCSI unit numbers are forced to 100 x node ID (ID plug).

---

**Table 3–3 Configuration with Conflicting SCSI Device Names**

System A		
SCSI Node ID	Console Mode Device Name	OpenVMS Device Name
0	DKA0	\$1\$DKA0*
1	DKA100	\$1\$DKA100*
2	DKA200	\$1\$DKA200*
3	DKA300	\$1\$DKA300*
System B		
0	DKA0	\$1\$DKA0*
1	DKA100	\$1\$DKA100*
2	DKA200	\$1\$DKA200*
3	DKA300	\$1\$DKA300*

---

\*Duplicate SCSI device name

---

### Example with Unique SCSI Device Names

To avoid the problem of duplicate SCSI devices names, shown in Table 3–3, change the SCSI node ID switch settings for the SCSI drives on System A.

Step 5: Configure SCSI Node IDs

Figure 3-3 and Table 3-4 show how the devices are uniquely named after you change the SCSI node ID switches for the SCSI devices. The SCSI disks off System A are given node ID settings of 0, 1, 2, and 7 (host adapter 6); and the SCSI disks off System B are given node ID settings of 3, 4, 5, and 6 (host adapter 7). Note that in this example, the node ID for the SCSI host adapter in System A is changed from the default (7) to 6. The command `SET SCSI_ID bus_number node_ID`, is used to change the host adapter node ID.

Figure 3-3 Configuration with Duplicate SCSI Device Names

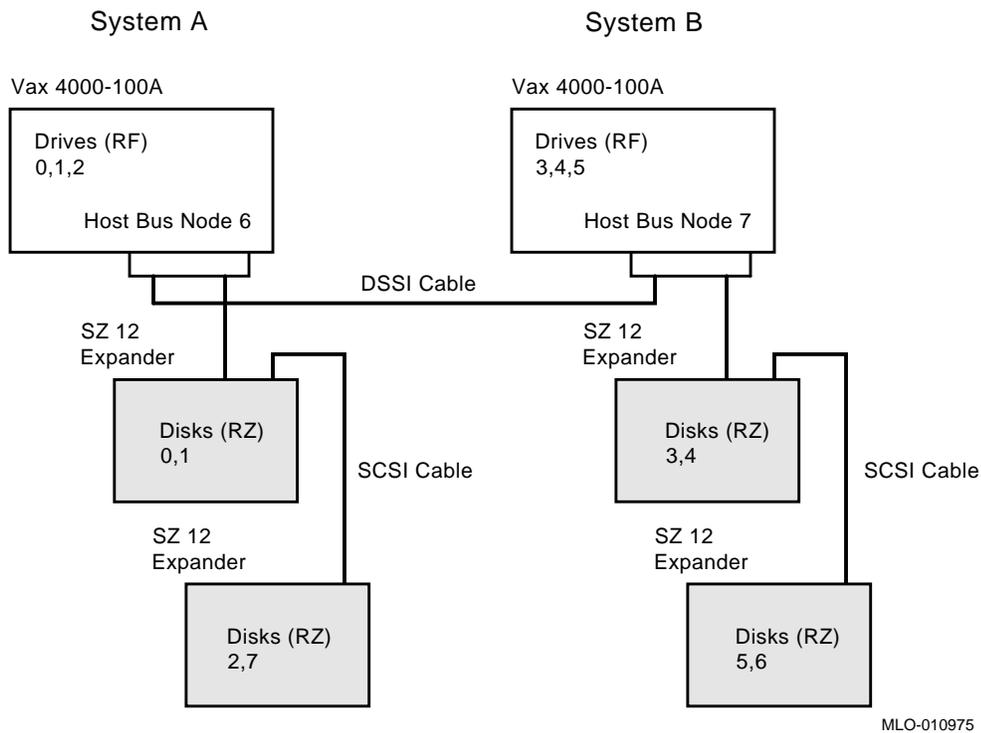


Table 3–4 Configuration with Unique SCSI Device Names

System A		
SCSI Node ID	Console Mode Device Name	OpenVMS Device Name
0	DKA0	\$1\$DIA0 <sup>1</sup>
1	DKA100	\$1\$DKA100
2	DKA200	\$1\$DKA200
7	DKA700	\$1\$DKA700
6	Host Adapter	
System B		
3	DKA300	\$1\$DKA300
4	DKA400	\$1\$DKA400
5	DKA500	\$1\$DKA500
6	DKA600	\$1\$DKA600
7	Host Adapter	

<sup>1</sup>In this example, the allocation class is 1.

---

**Note**

---

For each SCSI bus that OpenVMS sees as common to both systems, the total number of drives is limited to eight (node ID plugs 0–7).

---

---

## Step 6: Set Boot Parameters

**Boot Parameters** Set the boot parameters for booting on each system. Table 3–5 lists the boot environment variables and their related boot parameters.

**Table 3–5 Boot Parameters for VAX Systems**

---

### VAX Console Boot Parameters

---

>>> SET BOOT DUA0	Sets the device or device list from which booting is to be attempted. In this example, DUA0.
>>> SET BFLAG 0	Sets additional parameters to be passed to the system software during booting if none are specified. In this example, system root 0 [SYS0].
>>> SET BFLAG 1	Sets additional parameters to be passed to the system software during booting if none are specified. In this case the system will stop at SYSBOOT.
>>> SET BFLAG 10000000	Sets additional parameters to be passed to the system software during booting if none are specified. In this case the system boots from the system root [SYS1], not [SYS0].

---

**Boot Parameter Examples** In the following example boot parameters are set for VAX systems in a two-system DSSI VMScluster:

```
# For system A
>>> SET BFLAG 0
>>> SET BOOT DUA0
>>> BOOT
# For system B
>>> SET BFLAG 10000000
>>> SET BOOT DUA0
>>> BOOT
```

---

## Step 7: Complete the Installation

Complete the software steps of the DSSI VMScluster installation, such as updating the cluster\_config.com file. Refer to the information provided in *Factory Installed Software User Information* or *OpenVMS VAX Version 5.5-2 Upgrade and Installation Manual* and *VMScluster Systems for OpenVMS*.

---

**Troubleshooting Procedure**

<b>In This Chapter</b>	This chapter provides troubleshooting tips for solving DSSI-related hardware problems.
<b>Common Problems</b>	<p>If hardware failures occur, check these common problem sources first:</p> <ul style="list-style-type: none"><li>• Loose or missing terminators</li><li>• Incorrect bus node ID plugs (duplicate device names)</li><li>• Duplicate DSSI adapter node IDs</li><li>• Loose or damaged cables or connectors</li></ul>
<b>Symptoms and Corrective Action</b>	<p>Table 4–1 lists symptoms and corrective action for AlphaServer 2000/2100 systems.</p> <p>Table 4–2 lists symptoms and corrective action for DEC 4000 AXP systems.</p> <p>Table 4–3 lists symptoms and corrective action for VAX systems.</p>

**Table 4–1 Digital AlphaServer 2000/2100 Systems: DSSI Hardware Installation Troubleshooting**

<b>Symptom</b>	<b>Problem</b>	<b>Corrective Action</b>
Fault LED for drive is on (steady).	Drive failure	Replace drive.
Drives with duplicate bus node IDs are missing from the <code>show config</code> display	Duplicate bus node IDs.	Correct bus node IDs.
Valid drives are missing from the <code>show config</code> display. One drive may appear seven times on the display.	Drive bus node ID set to 7 (reserved for host adapter ID)	Correct bus node IDs. KFESA bus node ID for host adapter is set using the EISA Configuration Utility (ECU).
Drive activity LEDs do not come on. Drive missing from the <code>show config</code> display.	Missing or loose cables	Inspect cable connections.
Read/write errors in console event log; storage adapter port may fail.	Terminator missing	Attach terminators as needed.
Problems persist after eliminating the above problem sources.	KFESA module failure	Replace KFESA module.

**Table 4–2 DEC 4000 AXP Systems: DSSI Hardware Installation Troubleshooting**

<b>Symptom</b>	<b>Problem</b>	<b>Corrective Action</b>
Drives are missing from the configuration screen display.	Duplicate bus node ID plugs (or a missing plug).	Correct bus node ID plugs.
A drive defaults to zero.	"	"
Valid drives are missing from the configuration screen display.	Bus node ID set to 7, or to that of the host adapter.	Correct bus node ID plugs.
One drive appears seven times on the configuration screen display.	"	"
OpenVMS sees duplicate drives.	Duplicate unit numbers (device names are not unique).	Provide unique unit numbers using the <code>cdp</code> command.
Disk power failure LED on PSC <sup>1</sup> is on.	LDC failure.	Replace LDC <sup>2</sup> .
LDC OK LED on storage compartment front panel is off.	"	"
Power-up screen reports a failing storage adapter port.	"	"
Fault LED for drive is on (steady).	Drive failure.	Replace drive.
Disk power failure LED on PSC is on.	Storage drawer not properly seated.	Remove drawer and check its connectors. Reseat drawer.
LDC OK LED on storage compartment front panel is off.	"	"
Power-up screen reports a failing storage adapter port.	"	"
Valid drives missing from the configuration screen display; read/write errors in event/error log; storage adapter port may fail.	Loose or damaged external DSSI cable.	Inspect external DSSI cable and cable connection.

<sup>1</sup>PSC refers to the power system controller.

<sup>2</sup>LDC refers to the disk power supply.

(continued on next page)

**Table 4–2 (Cont.) DEC 4000 AXP Systems: DSSI Hardware Installation Troubleshooting**

<b>Symptom</b>	<b>Problem</b>	<b>Corrective Action</b>
Cable: Storage device to ID panel—Bus node ID defaults to zero; online LEDs do not come on.	Missing or loose internal cables.	Remove storage drawer and inspect cable connections.
Flex circuit: LDC to storage interface module—Disk power failure LED on PSC is on; LDC OK LED on storage compartment front panel is off; and power-up screen reports a failing storage adapter port.	"	"
Cable: LDC to storage interface module—Power-up screen reports a failing storage adapter port; drive LEDs do not come on at power-up.	"	"
Cable: LDC to storage device—Drive does not show up in configuration screen display.	"	"
Read/write errors in console event log; storage adapter port may fail.	Terminator missing.	Attach terminator to connector port.
DSSI terminator LED is off or no termination voltage measured at connector (pin 38, ground pin 1); read/write errors; storage adapter port may fail.	No termination power.	Replace LDC (termination power source for fixed-media storage compartments). Replace DC5 converter (termination power source for storageless fixed-media storage compartments).

**Table 4–3 VAX Systems: DSSI Hardware Installation Troubleshooting**

Symptom	Problem	Corrective Action
Drives are missing from the <code>SHOW DSSI</code> command display ( <code>SHOW UQSSP FOR KFQSA-BASED DSSI</code> ) or a drive defaults to zero.	Duplicate bus node ID plugs (or a missing plug)	Correct bus node ID plugs.
Valid drives are missing from the configuration screen display or one drive appears seven times on the configuration screen display.	Bus node ID set to 7, or to that of the host adapter	Correct bus node ID plugs.
OpenVMS sees duplicate drives.	Duplicate unit numbers (device names are not unique)	Provide unique unit numbers using the <code>SET/HOST/DUP/DSSI</code> command.
Valid drives missing from the configuration screen display; read/write errors in event/error log; storage adapter port may fail.	Loose or damaged external DSSI cable	Inspect external DSSI cable and cable connection.
Cable: storage device to ID panel—Bus node ID defaults to zero; device's online LEDs do not come on.	Missing or loose internal cables	Inspect cable connections.
Read/write errors in console event log; storage adapter port may fail	Terminator missing	Attach terminator to connector port.
DSSI terminator LED is off or no termination voltage measured at DSSI connector (pin 38, ground pin 1); read/write errors; storage adapter port may fail.	No termination power	Check termination power fuses and the termination power source—refer to the service guide for the enclosure.

**DSSI Node Fails to Boot**

If a DSSI node fails to boot, perform the following steps:

1. Check the `BOOT` command you entered.
2. Check the DSSI node ID for the RF device you are trying to boot from and the unit number specified. Ensure that the unit number specified in the `BOOT` command is correctly programmed into the disk node you wish to boot.
3. Run device tests to check that the boot device is operating.
4. Check that the DSSI bus is terminated.

### Termination Problems

It is especially important to check that only two terminators are on every bus (at the ends of the bus), even if none of the above symptoms is present. The SF7x, BA440, BA430, KFMSA, and KFQSA devices may have internal terminators that are not visible externally. These devices do not have the green lights found on the external terminators.

### Grounding and Bus Lengths

Excessive ground offset voltages or DSSI bus length over the maximum can cause virtual circuit closures, system crashes, or degradation in performance. All enclosures should be grounded using number 6 gauge wire, and DSSI bus lengths must be within the limits specified in Chapter 1.

### DSSI-Related Commands

Table 4–4 provides a summary of DSSI-related console commands.

Table 4–4 DSSI Related Console Commands

Adapter Type	Command	Function
<b>VAX Console Commands</b>		
Embedded (multiple buses)	SET HOST/DUP /DSSI/BUS:[0,1,2,3] <i>dssi_node_number</i> PARAMS	Allows you to enter the DUP server to modify DSSI parameters.
Embedded (single bus)	SET HOST/DUP/DSSI <i>dssi_node_number</i> PARAMS	Allows you to enter the DUP server to modify DSSI parameters.
HSD05 /HSD30 array controller	SET HOST/DUP/DSSI <i>device_name</i> PARAMS	Allows you to enter the DUP server for an HSD05 or HSD30 array controller to modify parameters.
Embedded (late models only) <sup>1</sup>	SET DSSI_ID <i>bus_number bus_node</i>	Use this command to override the default bus node numbers for a specified host adapter. Assigning a value of F for <i>bus_node</i> returns the default determined by the bus node ID plug. These values are stored in nonvolatile FEPR0M.
Embedded (late models only) <sup>1</sup>	SHOW DSSI_ID	Displays the current bus node settings for the onboard (SHAC) host adapters.
Embedded	SHOW DSSI	Displays DSSI devices and parameters
KFQSA	SET HOST/DUP/UQSSP <i>port_controller_number</i> <sup>2</sup> PARAMS	Allows you to enter the DUP server to modify DSSI parameters.

<sup>1</sup>Late models include VAX 4000 Model 100A, 500A, 600A, and 700A.

<sup>2</sup>The port controller number obtained by using the SHOW UQSSP command

(continued on next page)

**Table 4–4 (Cont.) DSSI Related Console Commands**

<b>Adapter Type</b>	<b>Command</b>	<b>Function</b>
<b>VAX Console Commands</b>		
KFQSA	SHOW UQSSP	Displays DSSI devices and parameters for devices connected to the KFQSA storage adapter.
Embedded (VAX 4000 Model 100 /100A/105A)	SET SCSI_ID <i>bus_number node_ID</i>	Use this command to override the default node ID for the specified SCSI host adapter. These values are stored in nonvolatile FEPRM.
<b>AXP Console Commands</b>		
HSD05 array controller	set host -dup -dssi <i>device_name</i>	Allows you to enter the DUP server for an HSD05 array controller to modify parameters.
Embedded /KFESA	cdp	Allows you to modify and examine NODENAME, ALLCLASS, and UNITNUM parameters. The cdp command automatically connects to the device's DUP server for all devices in the cluster or any number of specified devices.
N710 (DEC 4000 AXP)	set NCRn_SETUP	Allows you to change the bus mode and bus node numbers for DEC 4000 embedded host adapters.
Embedded /KFESA	show config	Displays the buses on the system and the devices found on those buses.

**For More Information**

For additional troubleshooting information, refer to the system service information.



## Electrical Lengths By Enclosure

### DSSI Bus Lengths by Enclosure

#### Lengths of Interconnects

Table A-1 gives the maximum electrical lengths for embedded DSSI interconnects within the various enclosures, as well as the number and type of DSSI connector.

**Table A-1 Electrical Lengths of Embedded DSSI Interconnects in Enclosures**

Enclosure/Device	Connector Type	Internal DSSI Length
KFESA/B adapter using one connector (end-node)	1 external MR <sup>1</sup>	0.15 m (6 in)
KFESA/B adapter using two connectors (middle-node)	2 external MR <sup>1</sup>	0.6 m (24 in)
KFMSB	4 external MR	2.4 m (95 in)
R400x through-bus mode; no internal terminator; both upper and lower rows	2 external PS <sup>2</sup>	2.36 (93 in)
R400x split bus mode 1; no internal terminator; upper row only	2 external PS	1.68 m (66 in)
R400x split bus mode 2; no internal terminator; lower row only	2 external PS	1.02 m (40 in)
BA640 embedded storage (Bus A-D) has internal terminator; DEC 4000 Model 6xx	4 external PS (one for each of four buses, A-D)	1.8 m (71 in)
BA641 embedded storage (Bus A-D) has internal terminator; rackmount DEC 4000 Model 6xx	4 external PS (one for each of four buses, A-D)	0.38 m (15 in)
BA440 embedded storage (BUS 0) has internal terminator; VAX 4000-300 and higher	1 external PS	1.32 m (52 in)

<sup>1</sup>MR is a midrange or micro ribbon style shielded connector used for bulkhead mounting. This connector mates with MR only.

<sup>2</sup>PS is a pin-and-socket style shielded connector used for bulkhead mounting. This connector mates with PS only.

(continued on next page)

**Table A-1 (Cont.) Electrical Lengths of Embedded DSSI Interconnects in Enclosures**

<b>Enclosure/Device</b>	<b>Connector Type</b>	<b>Internal DSSI Length</b>
BA440 in/out port (BUS 1), no internal terminator; VAX 4000-300 and higher	2 external PS	0.51 m (20 in)
BA440 in/out port (BUS 2), no internal terminator; VAX 4000-300 and higher	2 external PS	1.4 m (56 in)
BA440 in/out port (BUS 3), no internal terminator; VAX 4000-300 and higher	2 external PS	1.4 m (56 in)
BA441 embedded storage (BUS 0) has internal terminator; VAX 4000-300 and higher	1 external PS	2.45 m (96 in)
BA441 in/out port (BUS 1), no internal terminator; VAX 4000-300 and higher	2 external PS	0.51 m (20 in)
BA441 in/out port (BUS 2), no internal terminator; VAX 4000-300 and higher	2 external PS	1.4 m (56 in)
BA441 in/out port (BUS 3), no internal terminator; VAX 4000-300 and higher	2 external PS	1.4 m (56 in)
BA430 embedded storage (BUS 0) has internal terminator; VAX 4000-200	1 external PS	1.37 m (54 in)
BA431 embedded storage (BUS 0) has internal terminator; VAX 4000-200	1 external PS	2.45 m (96 in)
BA42 embedded storage (BUS 0) has internal terminator; VAX 4000-100 /100A/105A	1 external PS	0.76 m (30 in)
BA42 embedded storage (BUS 1), no internal terminator; VAX 4000-100 /100A/105A	2 external PS	1.08 m (43 in)
BA213; has internal terminator	1 external PS	1.14 m (45 in)
B213F; has internal terminator	1 external PS	0.51 m (20 in)
BA215; has internal terminator	1 external PS	0.76 m (30 in)
R215F; no internal terminator	1 external PS	1.52 m (60 in)
R23RF; no internal terminator	2 external PS	1.0 m (39 in)
KFQSA adapter with 1 connector directly attached to KFQSA (for example, BA440)	1 external PS	N/A

(continued on next page)

**Table A-1 (Cont.) Electrical Lengths of Embedded DSSI Interconnects in Enclosures**

<b>Enclosure/Device</b>	<b>Connector Type</b>	<b>Internal DSSI Length</b>
KFQSA adapter with 2 connectors directly attached to KFQSA (for example, BA440)	2 external PS	0.31 m (12 in)
SF12 in through-bus mode; 1 to 4 drives per bus; no internal terminator	2 external MR <sup>2</sup>	1.25 m (50 in)
SF35 in through-bus mode; 1 to 6 drives per bus; no internal terminator	2 external MR <sup>2</sup>	2.13 m (84 in)
SF35 in split-bus mode; 1 to 3 drives per bus using internal terminator	1 external MR	1.07 m (42 in)
SF7 <sub>x</sub> in through-bus mode; 1 to 4 drives per bus; no internal terminator	2 external MR	4.27 m (168 in)
SF72 <sub>x</sub> in split bus mode; 1 or 2 drives using internal SF72 terminator	1 external MR	2.12 m (84 in)
TF857; no internal terminator	2 external MR	0.25 m (10 in)

<sup>2</sup>PS is a pin-and-socket style shielded connector used for bulkhead mounting. This connector mates with PS only.



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## Storage Device Parameters

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### Examining Storage Device Parameters on AXP Systems

#### show device Command

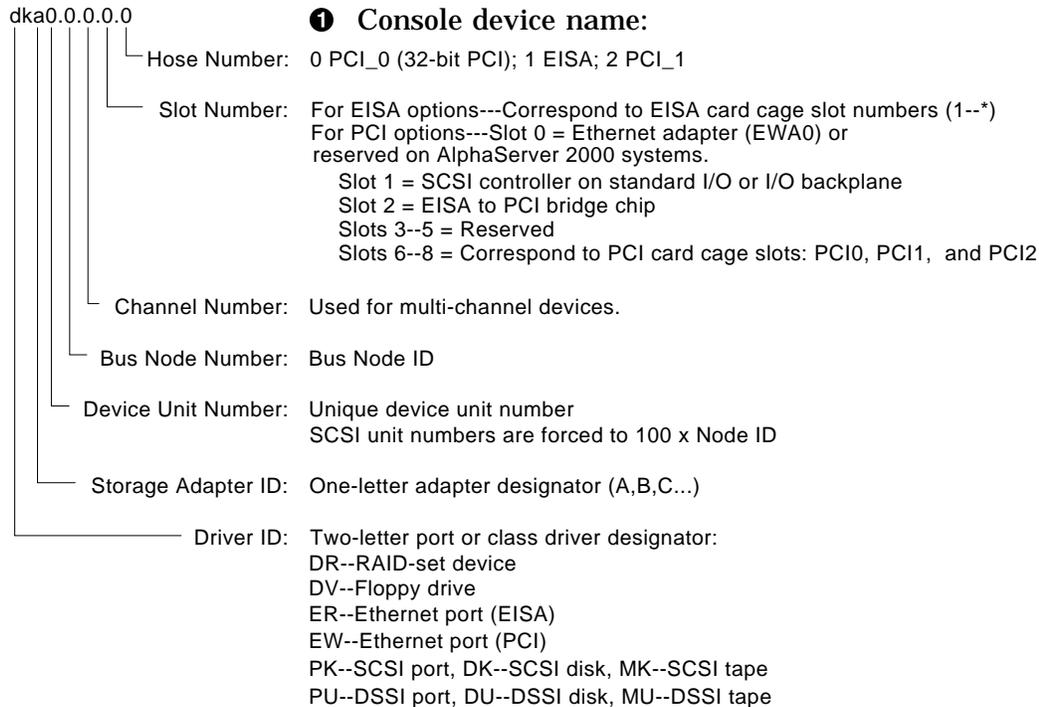
The `show device` command displays information for all DSSI and SCSI devices in the system. The following example provides a sample display:

```
>>> show device

  ①                ②                ③                ④                ⑤
dka600.6.0.1.0      DKA600                RRD43  2893
dua0.0.0.2.1        $2$DIA0 (ALPHA0)      RF35
dua1.1.0.2.1        $2$DIA1 (ALPHA1)      RF35
dua2.2.0.2.1        $2$DIA2 (ALPHA2)      RF35
dua3.3.0.2.1        $2$DIA3 (ALPHA3)      RF35
dua4.4.0.2.1        $2$DIA4 (ALPHA4)      RF35
dua5.5.0.2.1        $2$DIA5 (ALPHA5)      RF35
dva0.0.0.0.1        DVA0                RX26
mka500.5.0.1.0      MKA500                TLZ06  0435
ewa0.0.0.0.0        EWA0                08-00-2B-3B-42-FD
pka0.7.0.1.0        PKA0                SCSI Bus ID 7
pua0.7.0.2.1        PAA0                DSSI Bus ID 7
pub0.6.0.3.1        PAB0                DSSI Bus ID 6
>>>
```

The numbered elements in the display are explained in the following annotations.

## Examining Storage Device Parameters on AXP Systems



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### 2 Operating system device name:

- For an allocation class of zero: `NODENAME$DIA $u$`   
`NODENAME` is a unique node name and  $u$  is the unit number. For example, `R7BUCC$DIA0`.
- For a nonzero allocation class:  
`$ALLCLASS$DIA $u$`   
`ALLCLASS` is the allocation class for the system and devices, and  $u$  is a unique unit number. For example, `$1$DIA0`.

### 3 Node name (alphanumeric, up to 6 characters)

### 4 Device type

### 5 Firmware version (if known)

---

## Examining DSSI Device Parameters on VAX Systems

### SHOW DSSI Command

Enter `SHOW DSSI` to display DSSI devices on embedded DSSI adapters. For each storage device on an embedded DSSI, the firmware displays two lines:

- The first line contains the bus number, node number, and node name.

- The second line contains the device name and unit number followed by the device type in parentheses.

The device name consists of letters, such as DIA or DIB (MIA or MIB for the TF-series tape drive) and a unique unit number:

devices on bus 0 are listed as DIA  
 devices on bus 1 are listed as DIB  
 devices on bus 2 are listed as DIC  
 devices on bus 3 are listed as DID

The embedded DSSI adapter for each bus is identified by an asterisk (\*).

---

**Note**

---

Under operating system control, all drives are seen as DIA and MIA.

---

### SHOW DSSI Example

The following embedded DSSI display shows a system with four DSSI devices (unit numbers 0–2, and 5) and an R400X expander with seven DSSI devices (unit numbers 0–6).

```
>>>SHOW DSSI
DSSI Bus 0 Node 0 (R7ALUC)
-DIA0 (RF73)
DSSI Bus 0 Node 1 (R7EB3C)
-DIA1 (RF73)
DSSI Bus 0 Node 2 (R7EB22)
-DIA2 (RF73)
DSSI Bus 0 Node 5 (TFDR1)
-MIA5 (TF85/TF86)
DSSI Bus 0 Node 6 (*)

DSSI Bus 1 Node 0 (SNEEZY)
-DIB0 (RF73)
DSSI Bus 1 Node 1 (DOPEY)
-DIB1 (RF73)
DSSI Bus 1 Node 2 (SLEEPY)
-DIB2 (RF73)
DSSI Bus 1 Node 3 (GRUMPY)
-DIB3 (RF73)
DSSI Bus 1 Node 4 (BASHFUL)
-DIB4 (RF73)
DSSI Bus 1 Node 5 (HAPPY)
-DIB5 (RF73)
DSSI Bus 1 Node 6 (DOC)
-DIB6 (RF73)
DSSI Bus 1 Node 7 (*)
>>>
```

**SHOW UQSSP  
Command**

Enter `SHOW UQSSP` to display DSSI devices on KFQSA-based adapters. For each storage device on KFQSA-based DSSI, the firmware displays two lines:

- The first line contains the UQSSP disk controller number and device node name.
- The second line contains the device name and unit number followed by the device type in parentheses.

For KFQSA-based DSSI, the device name consists of the letters `DUcu`, where *c* is the controller letter, and *u* is a unique unit number.

---

**Note**

---

Under operating system control, all drives are seen as DIA and MIA.

---

**SHOW UQSSP  
Example**

The following display shows a sample KFQSA-based DSSI bus.

```
>>>SHOW UQSSP
UQSSP Disk Controller 0 (772150)
-DUA0 (RF73)
UQSSP Disk Controller 1 (760334)
-DUB1 (RF73)
UQSSP Disk Controller 2 (760340)
-DUC2 (RF73)
UQSSP Disk Controller 3 (760322)
-DUD3 (RF73)
UQSSP Tape Controller 0 (774500)
-MUA0 (TK70)
>>>
```

---

## DSSI Device Parameters

### Principal Parameters

Five principal parameters are associated with each DSSI device:

- Bus node ID
- ALLCLASS
- UNITNUM (and FORCEUNI)
- NODENAME
- SYSTEMID

### Parameter Descriptions

#### Bus Node ID

The bus node ID parameter for DSSI storage devices is provided by the bus node ID plug on the front panel of the storage compartment (VAX 4000 Model 100/100A/105A systems use the device bus node switches). Each DSSI bus can support up to eight nodes, bus nodes 0–7. Each DSSI adapter, HSD05/HSD30 array controller, and each DSSI storage device counts as a node. Hence:

1. In a single-system configuration, a DSSI bus can support up to seven devices, bus nodes 0–6 (with node 7 reserved for the adapter).
2. In a two-system DSSI VMScluster configuration, the bus can support up to six devices, 0–5 (with nodes 6 and 7 reserved for the adapters).
3. In a three-system DSSI VMScluster configuration, the bus can support up to five devices, 0–4 (with nodes 5, 6, and 7 reserved for the adapters).
4. In a four-system DSSI VMScluster configuration, the bus can support up to four devices, 0–3 (with nodes 4, 5, 6, and 7 reserved for the adapters).

---

**Note**

---

Drives connected through the HSD05/HSD30 array controllers do not count as DSSI nodes; thus, using multiple HSD controllers, up to 42 SCSI drives can be configured in a two-system DSSI VMScLuster, provided you have sufficient storage expansion hardware.

---

- The bus node ID for KFESA/B host adapters is set using the EISA Configuration Utility (ECU).
- The bus node ID for the HSD05 array controller is set by switches on the HSD05 controller module board.
- The bus node ID for the HSD30 array controller is set through the HSD30 maintenance terminal.
- DEC 4000 host adapter IDs are set through the NCRnn\_SETUP environment variable.
- Late model VAX system host adapter IDs can be set using the SET DSSI\_ID command.

**ALLCLASS**

---

**Note**

---

For devices connected through the early versions of the HSD05 array controller, this parameter is called DISK\_ALCS.

---

The ALLCLASS parameter determines the device allocation class. The allocation class is a numeric value from 0–255 that is used by the OpenVMS AXP operating system to derive a path-independent name for multiple access paths to the same device. The ALLCLASS firmware parameter corresponds to the OpenVMS AXP IOGEN parameter ALLOCLASS.

DSSI devices are shipped from the factory with a default allocation class of zero.

---

**Note**

---

Each device to be served to a cluster must have a nonzero allocation class that matches the allocation class of the system.

---

Refer to *VMScLuster Systems for OpenVMS* for rules on specifying allocation class values.

**UNITNUM**

The UNITNUM parameter determines the unit number of the device. By default, the device unit number is supplied by the bus node ID plug on the front panel of the storage compartment.

---

**Note**


---

Systems using multiple DSSI buses require that the default values be replaced with unique unit numbers. See the section “How OpenVMS AXP Uses the DSSI Device Parameters .”

---

To set unit numbers and override the default values, use the `cdp` console command to supply values to the UNITNUM parameter.

---

**Note**


---

Devices connected through the HSD05/HSD30 array controllers are automatically assigned unique unit numbers.

---

**NODENAME**

The NODENAME parameter allows each device to have an alphanumeric node name of up to six characters. DSSI devices are shipped from the factory with a unique identifier, such as R7CZZC, R7ALUC, and so on. You can provide your own node name, keep the factory-supplied node names, or use the `cdp` console command to supply node names that relate to the device name conventions for AXP systems.

**SYSTEMID**

The SYSTEMID parameter provides a number that uniquely identifies the device to the operating system. This parameter is modified when you replace a device using warm-swapping procedures. The SYSTEMID parameter is changed using the DUP server for the specified device.

---

## How OpenVMS AXP Uses the DSSI Device Parameters

**Allocation  
Class Zero**

With an allocation class of zero, the operating system can use the default parameter values to provide each device with a unique device name. The operating system uses the node name along with the device logical name as follows:

NODENAME\$DIA $u$

NODENAME is a unique node name and *u* is the unit number. For example, R7BUCC\$DIA0.

### Nonzero Allocation Class

With a nonzero allocation class, the operating system relies on unit number values to create a unique device name. The operating system uses the allocation class along with the device logical name as follows:

\$ALLCLASS\$DIA*u*

ALLCLASS is the allocation class for the system and devices, and *u* is a unique unit number. For example, \$1\$DIA0.

### Multiple and Shared Buses

Using multiple host adapters, you can fill up to six DSSI buses for VAX systems (for AXP systems the number of KFESB host adapters is only limited by the number of available EISA slots).

Each bus can have up to seven DSSI drives (bus nodes 0–6). When a bus is shared between two systems in a DSSI VMScluster, six DSSI drives can be shared; in a three-system DSSI VMScluster, five DSSI drives can be shared; in a four-system DSSU VMScluster four DSSI drives can be shared.

When more than one bus is being used, and your system is using a nonzero allocation class, you need to assign new unit numbers for devices on all but one of the DSSI buses, since the unit numbers for all DSSI storage devices connected to a system's associated DSSI buses must be unique.

---

**Note**

---

Drives connected through the HSD05/HSD30 array controllers do not count as DSSI nodes; thus, using multiple HSD05/HSD30 controllers, up to 36 SCSI drives can be configured in a two-system DSSI VMScluster.

Devices connected through the HSD05/HSD30 array controllers are automatically assigned unique unit numbers.

---

### Example of Duplicate Device Names

Figure B–1 illustrates the problem of duplicate operating system device names for a system that is using more than one DSSI bus and a nonzero allocation class. In the case of the nonzero allocation class, the operating system sees four of the devices as having duplicate device names. This is an error, as all unit numbers must be unique. The unit numbers for one of the two DSSI buses in this example need to be reprogrammed.

**Figure B-1 How OpenVMS Sees Unit Numbers for DSSI Devices**

Allocation Class=0	Nonzero Allocation Class (Example: ALLCLASS=1)
R7BUCC\$DIA0	\$1\$DIA0 ← * Duplicate 0
R7CZZC\$DIA1	\$1\$DIA1 ← * Duplicate 1
R7ALUC\$DIA2	\$1\$DIA2 ← * Duplicate 2
R7EB3C\$DIA3	\$1\$DIA3 ← * Duplicate 3
R7IDFC\$DIA0	\$1\$DIA0 ←
R7IBZC\$DIA1	\$1\$DIA1 ←
R7IKJC\$DIA2	\$1\$DIA2 ←
R7ID3C\$DIA3	\$1\$DIA3 ←
R7XA4C\$DIA4	\$1\$DIA4
R7QIYC\$DIA5	\$1\$DIA5
R7DA4C\$DIA6	\$1\$DIA6

\* Nonzero allocation class examples with an asterisk indicate duplicate device names.  
For one of the DSSI buses, the unit numbers need to be reprogrammed to avoid this error.

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## Sample DSSI VMScLuster Configurations for VAX Systems

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### Configuration Considerations

In setting up your DSSI VMScLuster for VAX systems, you need to consider your cluster's requirements for performance, storage capacity, and data availability. You also need to consider whether the systems you plan to cluster are compatible in performance. If you have older systems, you may need to consider upgrading them to ensure balance in adapter performance.

#### Combinations of Systems

It is important to consider the performance levels of the systems you plan to cluster. Ideally, you should cluster systems of similar performance levels to ensure that the loss of a system from the cluster will not adversely affect the overall capacity of the cluster.

For example, a VAX 4000 Model 300 should not be clustered with two MicroVAX II systems, because the VAX 4000 Model 300 is more than eight times more powerful than a MicroVAX II. Removal of the VAX 4000 Model 300 in such a cluster represents an 80 percent loss of capacity.

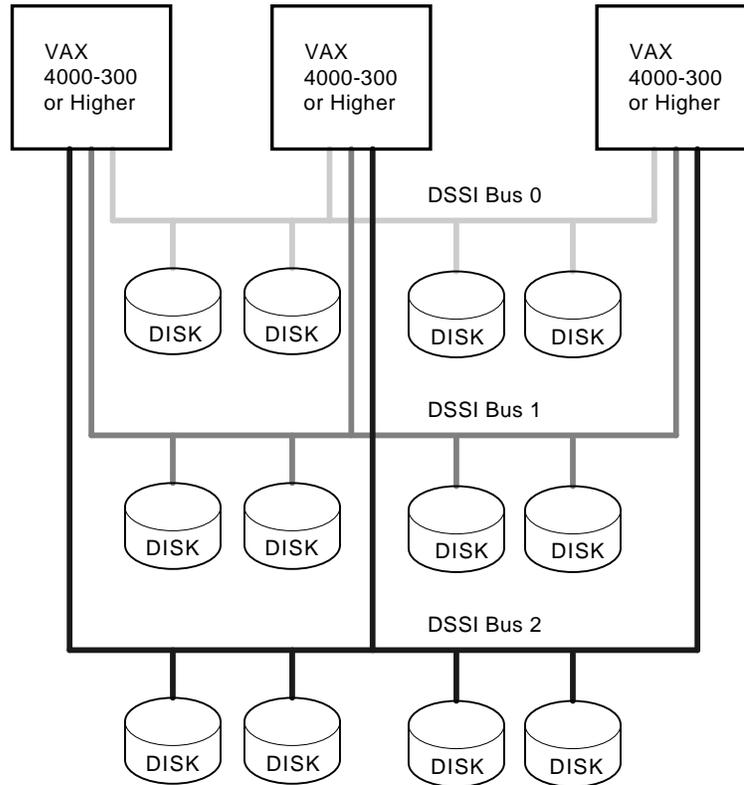
#### Adapters and System Performance

Digital strongly recommends that older MicroVAX II and MicroVAX 3xxx systems in three-system DSSI VMScLuster systems be upgraded to at least a VAX 4000 Model 200. This ensures that the cluster operates optimally by minimizing the disparity between adapter and system performance. Use of the same DSSI adapter (SHAC) on two machines also guarantees that adapter performance is balanced. See Table 1-3 for differences in adapter performance.

#### Configuring for High Performance

When configuring for highest VMScLuster performance, you need to maximize I/O capacity. To do so, ensure that all cluster storage is directly accessible to all systems residing on the DSSI interconnects (see Figure C-1). With direct storage access, fewer devices intervene between a user's terminal and the disk on which required information is stored, and I/O requests are serviced speedily. Direct connection also eliminates server overhead.

**Figure C-1 Directly Shared Disks for High Performance**



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**Configuring for Storage Capacity**

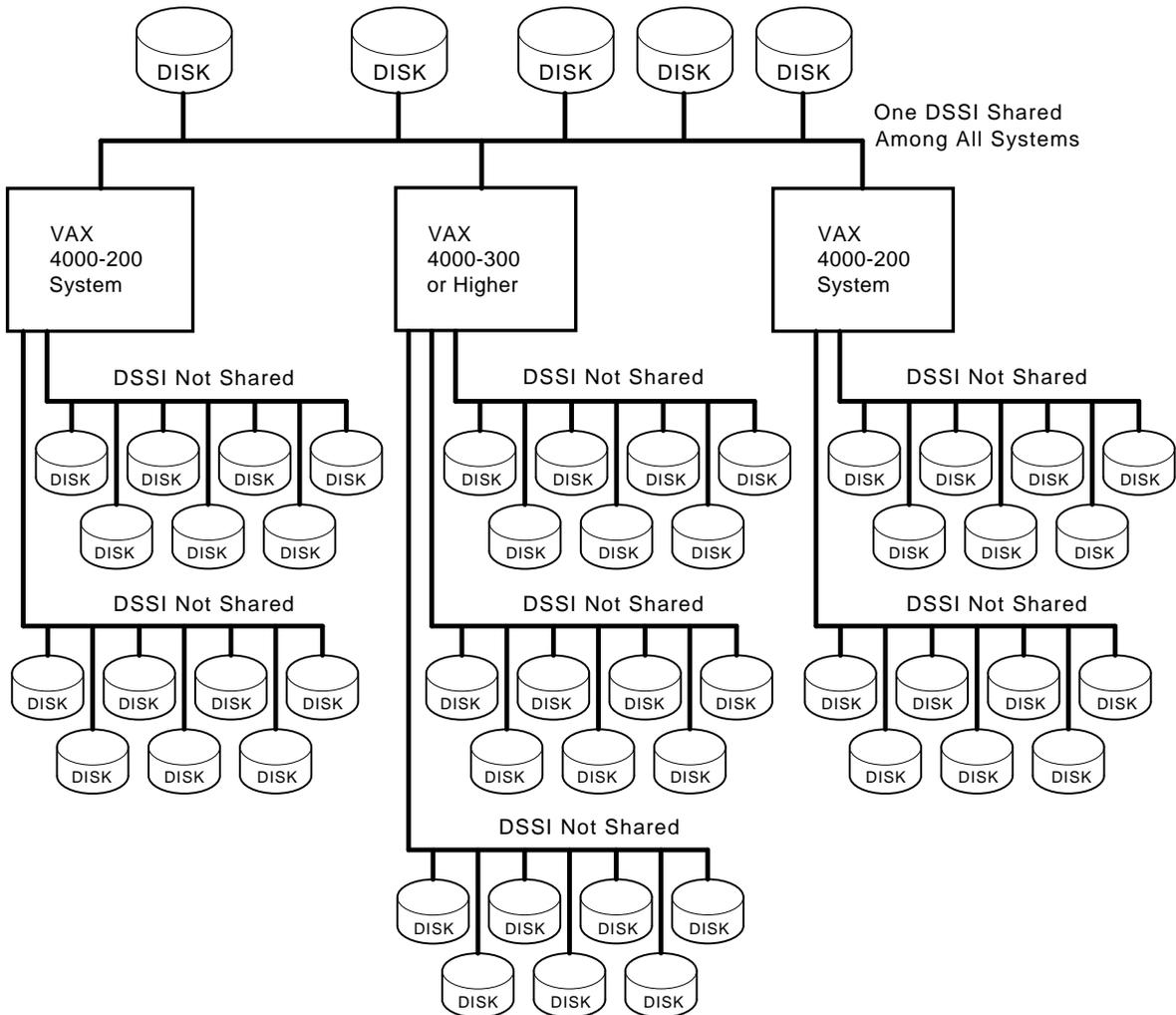
When configuring for maximum storage capacity, you can use the Mass Storage Control Protocol (MSCP) to serve storage to cluster members. To ensure highest MSCP service performance, configure the most powerful systems with the highest-performing adapters as MSCP servers and ensure that those systems are not overloaded with other processing tasks. Also, it is preferable to locate heavily used files on devices with direct storage and locate less active files on served devices.

Although the cluster shown in Figure C-2 provides excellent storage capacity, it runs the risk of lost access to storage as a result of a single-path access to most disks.

**Configuring for Data Availability**

Access to storage upon failure of a system is a key factor in creating and maintaining maximum data availability to users, especially in configurations without direct storage. To ensure access to data, you can attach two MSCP servers (and therefore two systems) to the disk, enabling failover to occur if one system fails.

**Figure C-2 Configuring for Capacity**



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Another way to ensure data availability is to put disks in enclosures separate from the systems. If it becomes necessary to shut down power in an enclosure, the loss will not affect both the system and the disk. It is also recommended that enclosures be connected to different power sources to avoid loss of access if an outlet fails.

It is wise to have at least two boot nodes, so that if one becomes unavailable, satellites can boot from the other.

### **Using Multiple DSSI Interconnects for Redundancy**

The DSSI Interconnect is DC coupled and uses low-level signals. DC coupling ensures that devices, connectors, cables, adapters, and so on are not isolated electrically. In contrast, CI VMScluster systems are AC coupled and are isolated electrically. AC coupling allows you to disconnect cables while systems are running without causing electrical or data-integrity problems. DC coupling does not. DSSI does not allow you to disconnect a cable, short circuit a connector, or in any other way affect the electrical characteristics of a pathway while the cluster is running. Therefore, anything that happens on an interconnect or pathway affects all devices connected to that interconnect.

By distributing disks over multiple buses, you isolate the effects of a bus failure and avoid building in a single point of failure. Furthermore, use of multiple interconnects provides additional paths for host-to-host communication if one interconnect fails. With multiple buses, you can also split the I/O load by placing disks on each bus. By adding volume shadowing, you can duplicate the data on multiple disks connected by different buses. Thus, loss of a bus would not affect cluster operation, since the shadow members on the remaining bus could continue to operate and provide service.

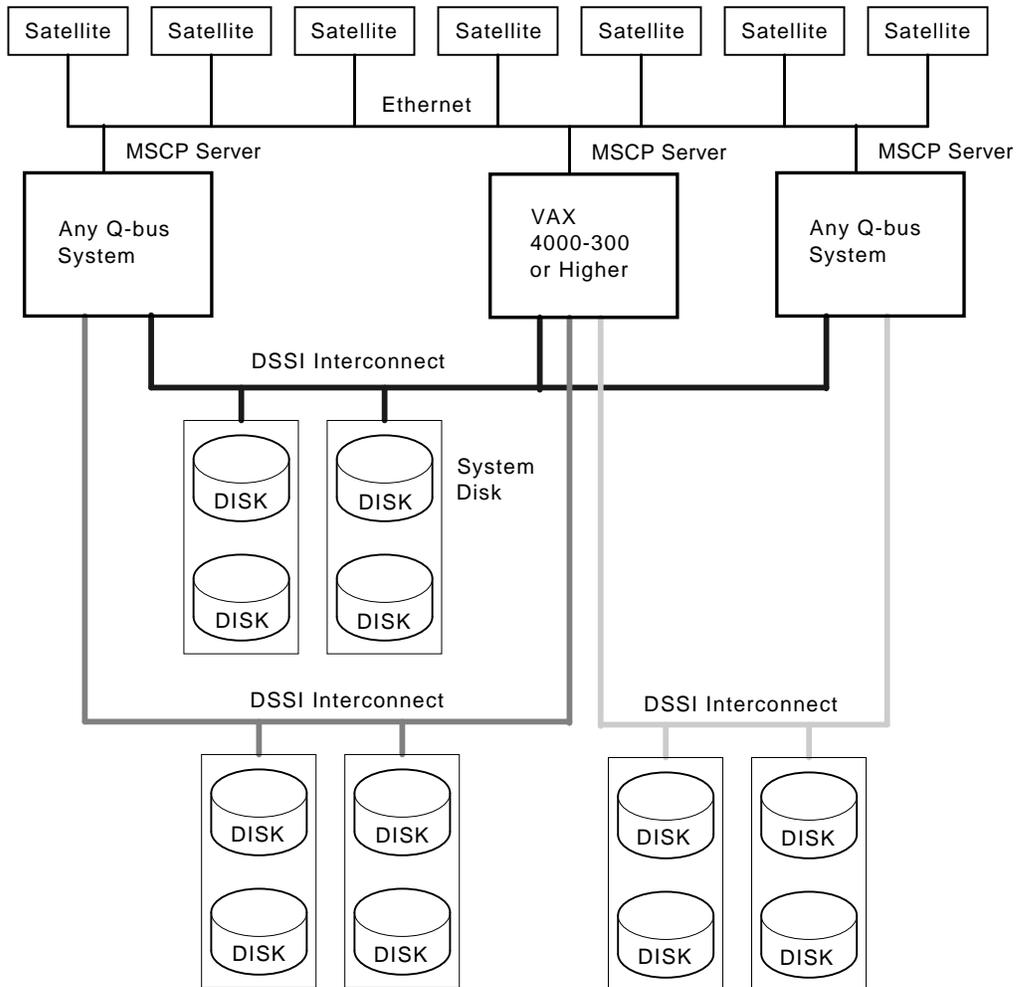
Figure C-3 shows 12 disks, each of which is accessible via at least two DSSI interconnects.

### **Using Volume Shadowing to Prevent Loss of Access or Data**

Common system disks are normally used to minimize the system management of three-system DSSI VMScluster systems. For that reason, it is wise to use Digital's Volume Shadowing software to maintain multiple copies of the system disk for use if hardware fails. With volume shadowing, if a failure occurs (for example, the system disk or its power source or bus breaks down) the system can use another member of the shadow set.

The same principle applies to user or data disks. If all data is kept on one disk or on disks on a single interconnect, upon failure the users will not have access to their data. Worse, if the disk becomes corrupted, they may lose their data. You can prevent loss of access by shadowing critical data disks. Shadowing should also be used from one bus to another. It is wise to keep critical disks in different storage enclosures to prevent loss of data if a power failure occurs in the enclosure.

**Figure C-3 Using Multiple DSSI Interconnects for Redundancy**



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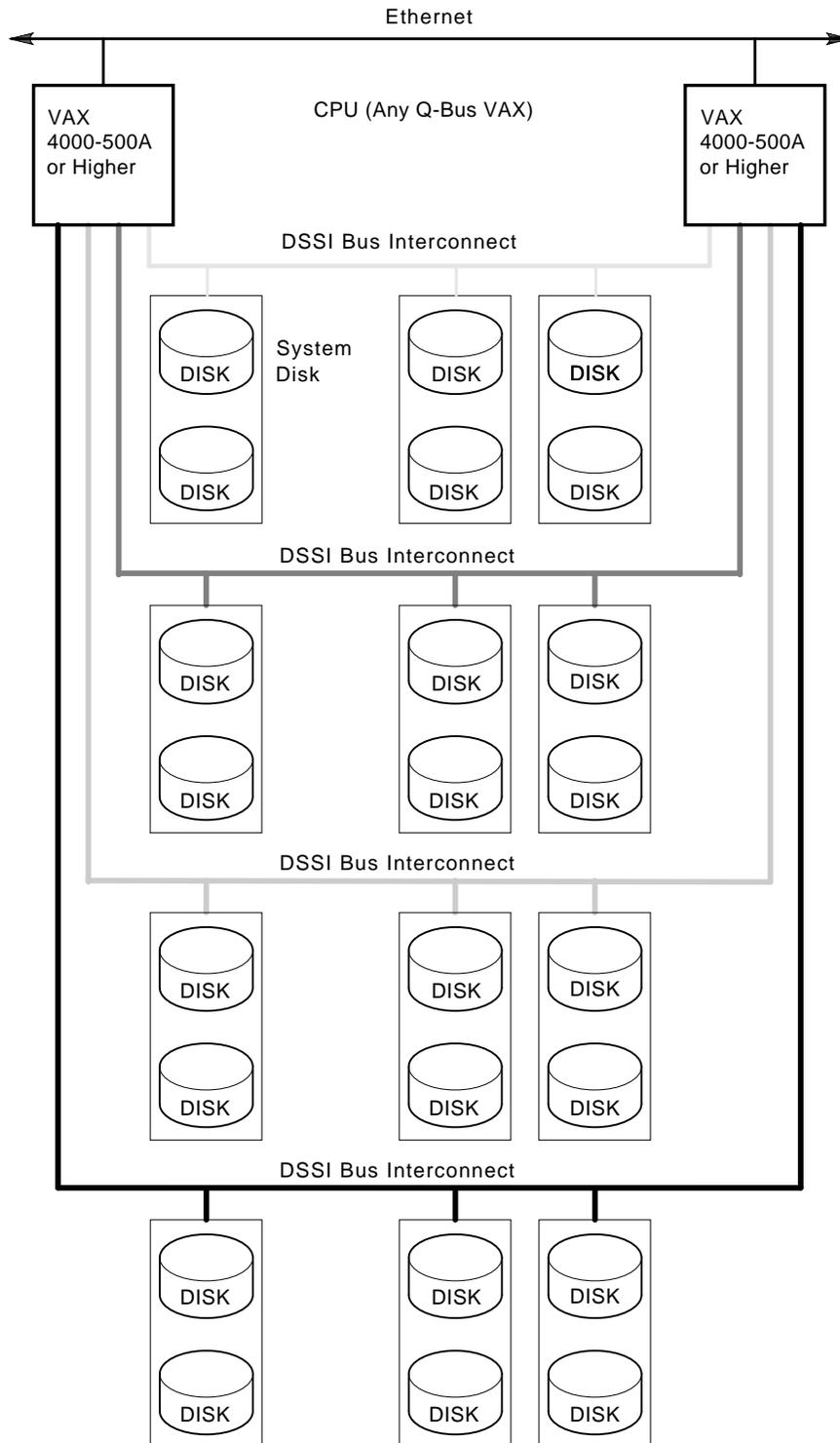
## Sample Configurations

This section contains conceptual and cabling illustrations of sample configurations that you can use as reference material in planning and cabling your own configuration. Each figure contains a diagram of a configuration, followed by one or more diagrams that show how that configuration is cabled with different storage expansion enclosures. A shaded (and numbered) disk or tape in the cabling illustrations indicates that the device is attached to a DSSI bus.

The following configurations are shown:

- Figure C-4, Two-System DSSI VMScLuster with Maximum Shared Storage
- Figure C-5, Three-System DSSI VMScLuster Using Three DSSI Interconnects
- Figure C-6, Three-System DSSI VMScLuster Using Four DSSI Interconnects

**Figure C-4 Two-System DSSI VMScluster with Maximum Shared Storage**

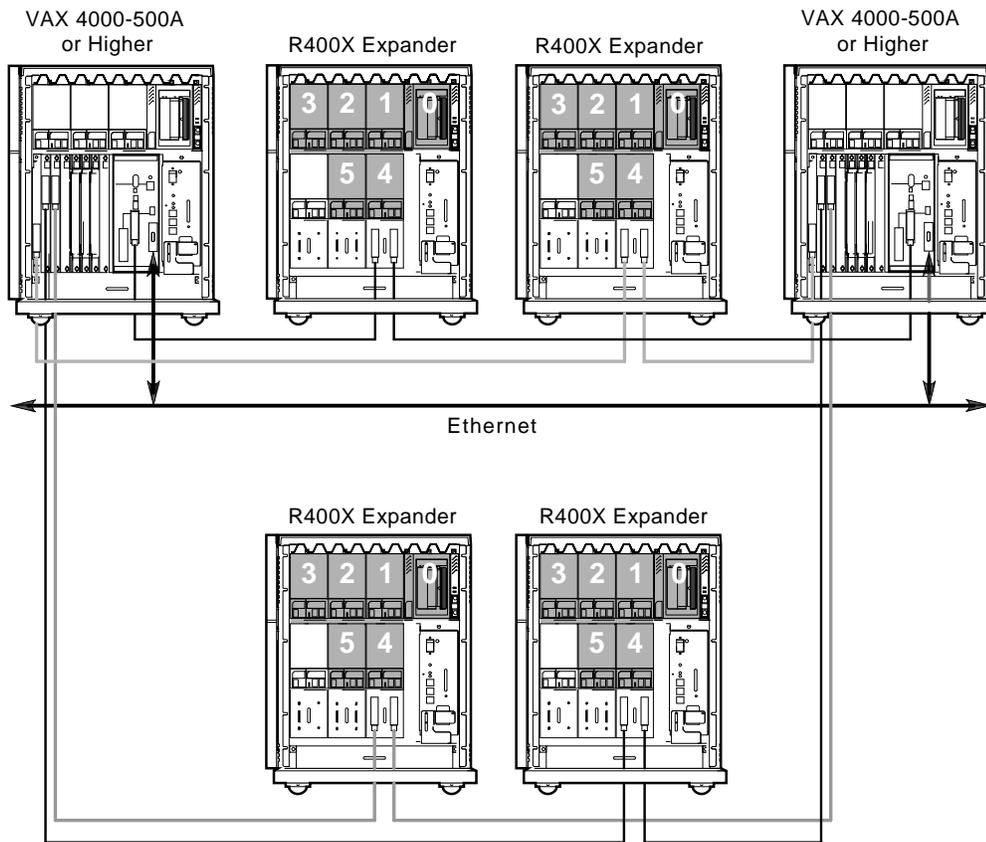


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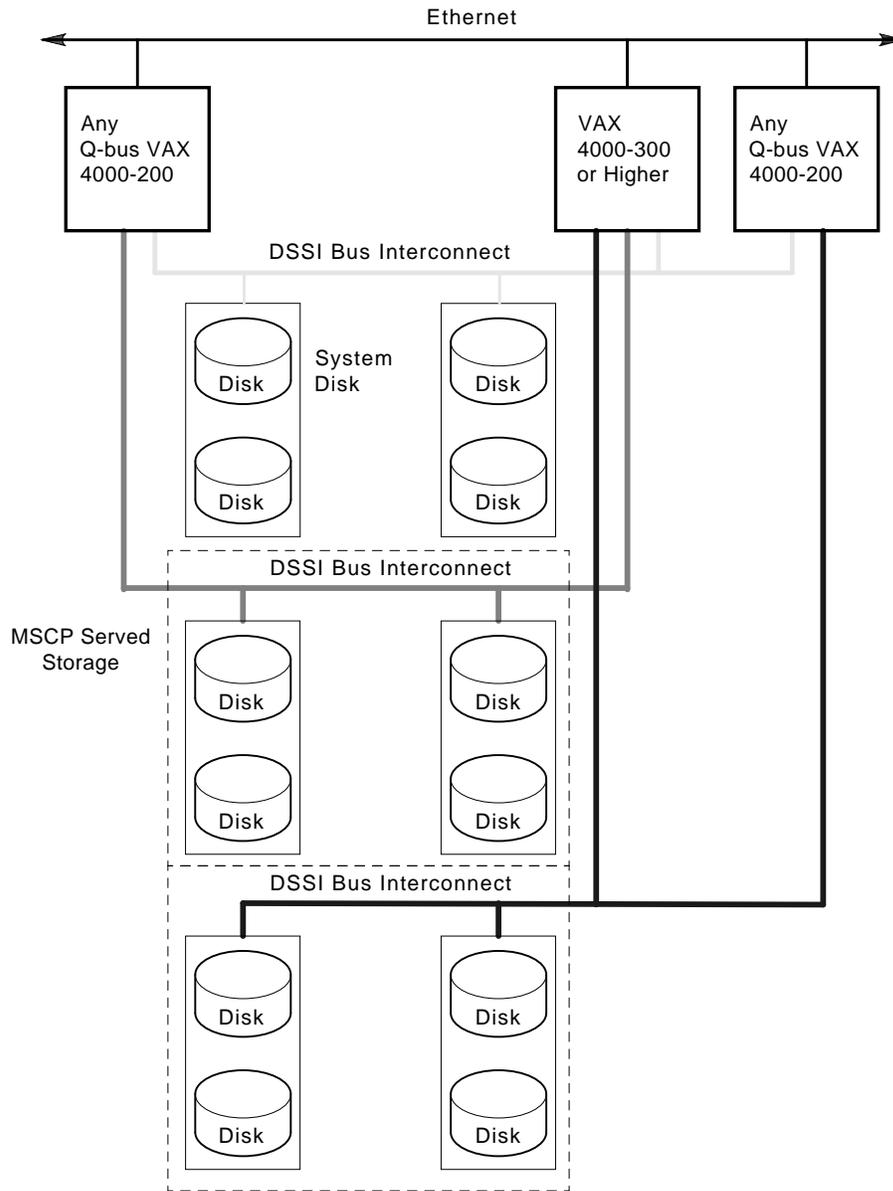
Sample Configurations

Figure C-4 (Cont.) Two-System DSSI VMScluster with Maximum Shared Storage



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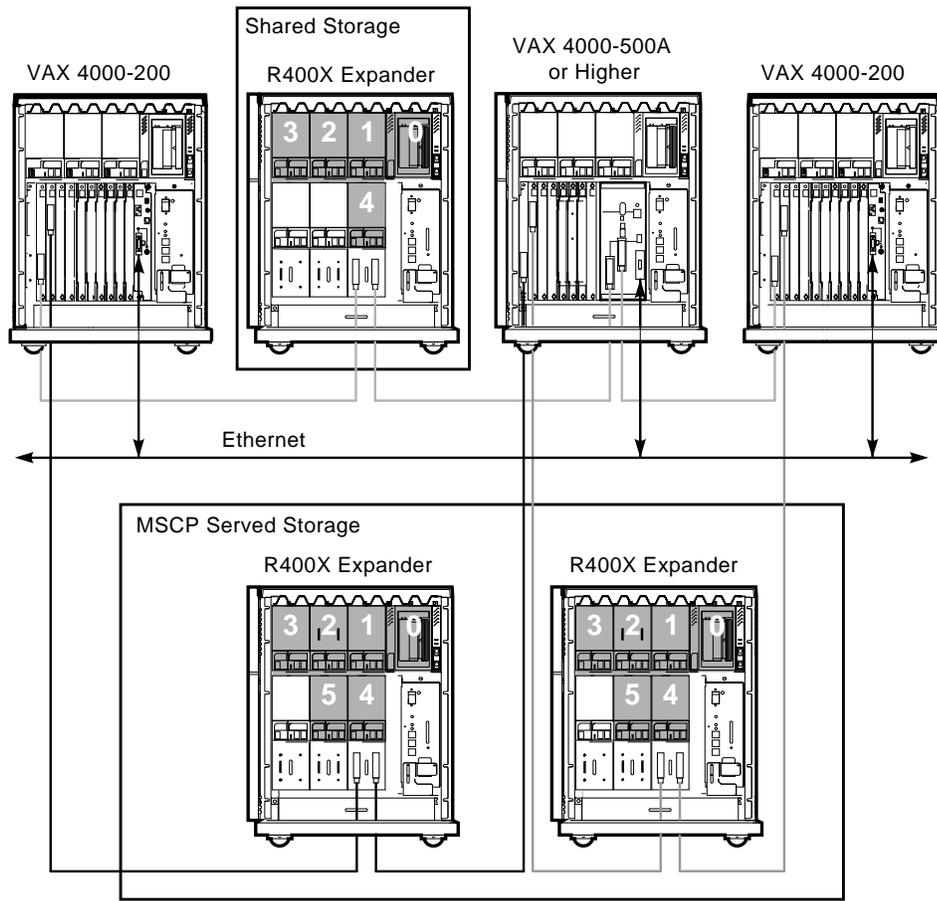
**Figure C-5 Three-System DSSI VMScuser Using Three DSSI Interconnects**



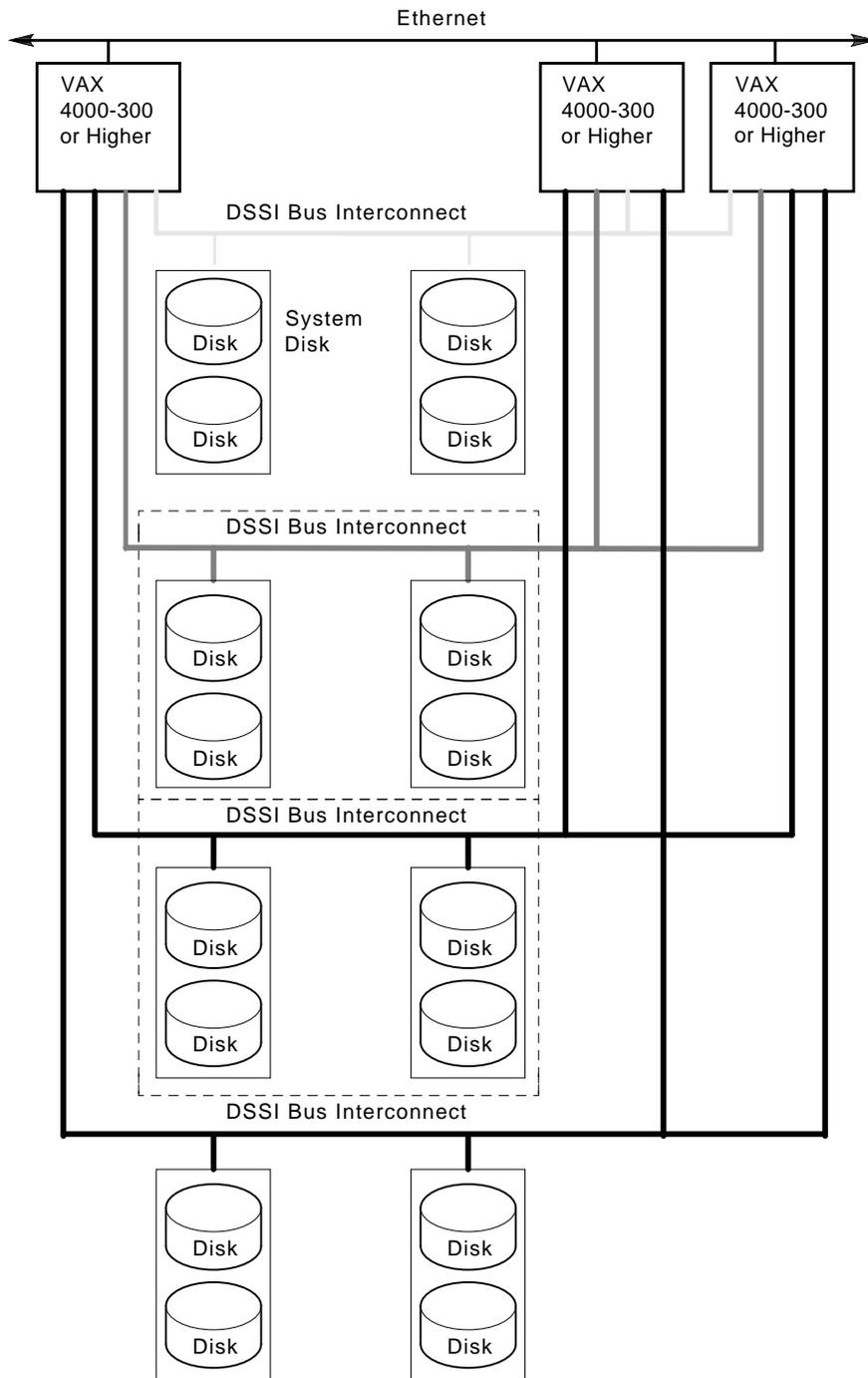
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Figure C-5 (Cont.) Three-System DSSI VMScLuster Using Three DSSI Interconnects



**Figure C-6 Three-System DSSI VMScLuster Using Four DSSI Interconnects**

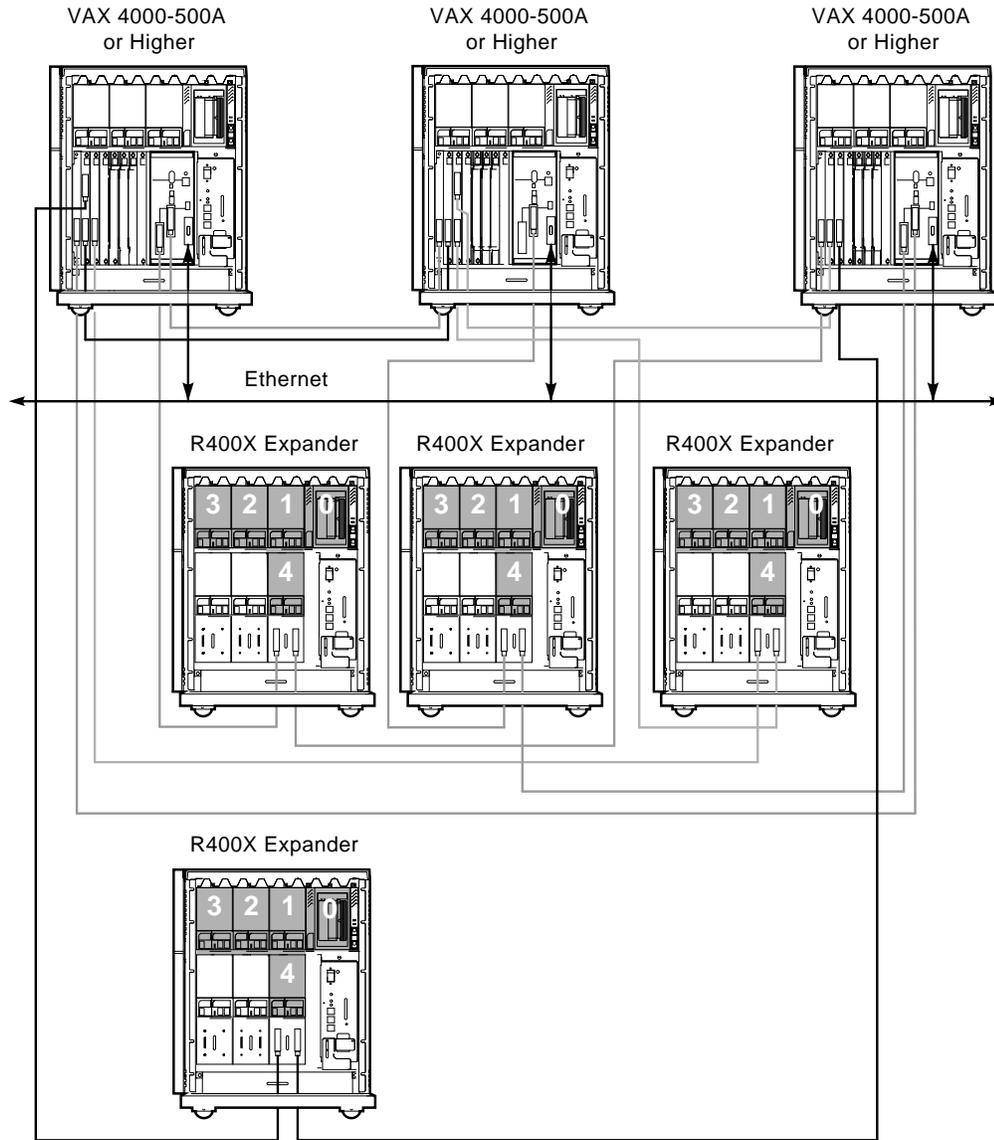


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Sample Configurations

Figure C-6 (Cont.) Three-System DSSI VMScluster Using Four DSSI Interconnects



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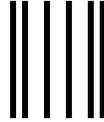
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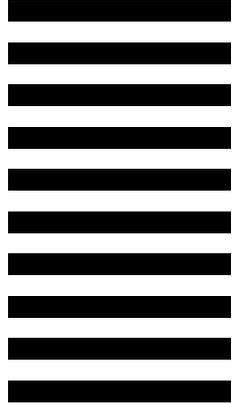
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