



Hardware Cabling Guide

May 2011

51327-00, Rev. A



Revision History

Version and Date	Description of Changes
51327-00, Rev. A, May 2011	Initial release of the document.

LSI and the LSI & Design logo, StorageTek, SANtricity, HotScale, and SANshare are trademarks or registered trademarks of LSI Corporation or its subsidiaries or Sun Microsystems, Inc. All other brand and product names may be trademarks of their respective companies.

This document contains proprietary information of LSI Corporation and Sun Microsystems, Inc. The information contained herein is not to be used by or disclosed to third parties without the express written permission of an officer of LSI or Sun.

It is the policy of LSI and Sun to improve products as new technology, components, software, and firmware become available. We reserve the right to make changes to any products herein at any time without notice. All features, functions, and operations described herein may not be marketed in all parts of the world. In some instances, photographs and figures are of equipment prototypes. Therefore, before using this document, consult your sales representative or account team for information that is applicable and current. WE DO NOT ASSUME ANY RESPONSIBILITY OR LIABILITY FOR THE USE OF ANY PRODUCTS DESCRIBED HEREIN EXCEPT AS EXPRESSLY AGREED TO IN WRITING BY LSI .

LSI products are not intended for use in life-support appliances, devices, or systems. Use of any LSI product in such applications without written consent of the appropriate LSI officer is prohibited.

LSI Corporate Headquarters
Milpitas, CA
800-372-2447

Email
globalsupport@lsi.com

Website
www.lsi.com

Document Number: 51327-00, Rev. A
Copyright © 2011 LSI Corporation. All rights reserved.
Copyright © 2011 Sun Microsystems, Inc. All rights reserved.

Table of Contents

Chapter 1: Cabling Concepts and Best Practices	1
Cabling Concepts	1
Fabric (Switched) Topologies Compared to Direct-Attach Topologies	1
Drive Module	1
Controller Module	2
Array Module	2
Host Channels and Drive Channels	3
Host Ports and Drive Ports	3
Dual-Ported Drives	3
Preferred Controllers and Alternate Controllers	3
Alternate Path Software	4
Failover	4
Redundant and Non-Redundant	4
Single Point of Failure	4
SFP Transceivers, Fiber-Optic Cables, and Copper Cables	5
Host Adapters	6
Host Interface Cards	6
Network Interface Cards	7
Switches and Zoning	7
In-Band Management and Out-of-Band Management	7
Best Practices	10
Drive Cabling for Redundancy	10
Host Cabling for Redundancy	11
Host Cabling for Data Replicator Software	11
Cabling for Performance	11
Considerations for Drive Channel Speed	11
Multiple Types of Drive Modules	12
Single-Controller Topologies and Dual-Controller Topologies	13
Copper Cables and Fiber-Optic Cables	13
Cabling for Drive Modules That Support Loop Switch Technology	13
Labeling Cables	15
Cabling Information Provided by SANtricity ES Storage Manager	15
Adding New Drive Modules to an Existing Storage Array	15
Common Procedures	15
Handling Static-Sensitive Components	15
Installing an SFP Transceiver and a Fiber-Optic Cable	16
Installing a Copper Cable with a Passive SFP Transceiver	17
Installing an iSCSI Cable	18
Installing a SAS Cable	19
Chapter 2: Product Compatibility	21
Host Channel Information by Model	21
Drive Channel Information by Model	21
Drive Module Information by Model	23
Chapter 3: Host Cabling	25
Host Interface Connections	25
Maximum Number of Host Connections	26
Direct-Attach Topologies	26
One Host to a Controller Module or a Array Module	27

Two Hosts to a Controller Module or a Array Module	27
One Single-HBA Host to a Single-Controller Controller Module or a Single-Controller Array Module	28
Switch Topologies	29
One Host to a Controller Module or a Array Module	29
Two Hosts to a Controller Module or a Array Module	30
Four Hosts to a Controller Module or a Array Module	31
Mixed Topologies	32
Chapter 4: Drive Cabling	35
Drive Channel Redundancy for the 6580/6780 Controller Module and the 6780 Controller Module	35
Drive Channel Redundancy for the 6540 Controller Module	36
Drive Channel Redundancy for the 6180 Array Module	37
Drive Channel Redundancy for the 6140 Array Module and the 6140 Array Module	38
Drive Channel Redundancy for the ST2500 M2 Array Module	38
ESM CRU Arrangements	39
Drive Cabling Topologies for the 6580/6780 Controller Module and the 6780 Controller Module	40
Cabling for the 6780 Controller Module or the 6580/6780 Controller Module and One to Four CSM200 Drive Modules	40
Cabling for the 6780 Controller Module or the 6580/6780 Controller Module and Five to Eight CSM200 Drive Modules	42
One 6780 Controller Module or 6580/6780 Controller Module and Nine to 16 CSM200 Drive Modules	44
One 6780 Controller Module or 6580/6780 Controller Module and 17 to 28 CSM200 Drive Modules	46
Drive Cabling Topologies for the 6540 Controller Module	47
One 6540 Controller Module and One Drive Module	47
One 6540 Controller Module and Two Drive Modules	48
One 6540 Controller Module and Four Drive Modules	49
One 6540 Controller Module and Eight Drive Modules	51
One 6540 Controller Module and Multiple Types of Drive Modules	52
Drive Cabling Topologies for the 6180 Array Module	54
Drive Cabling Topologies for the 6140 Array Module and the 6140 Array Module	61
One 6140 Array Module or 6140 Array Module and One Drive Module	61
One 6140 Array Module or 6140 Array Module and Two Drive Modules	61
One 6140 Array Module or 6140 Array Module and Three Drive Modules	62
One 6140 Array Module or 6140 Array Module and Four Drive Modules	64
One 6140 Array Module or 6140 Array Module and Five Drive Modules	65
One 6140 Array Module or 6140 Array Module and Six Drive Modules	67
One 6140 Array Module or 6140 Array Module and Multiple Types of Drive Modules	69
Drive Cabling Topologies for the ST2500 M2 Array Module	71
Drive Cabling Topologies for the ST2500 M2 Array Module With ST2501 M2 Drive Modules or DE5600 Drive Modules	71
Chapter 5: Ethernet Cabling	75
Direct Out-of-Band Ethernet Topology	75
Fabric Out-of-Band Ethernet Topology	76
Chapter 6: Component Locations	77
Port Locations on the 6780 Controller Module and the 6580/6780 Controller Module	77
Component Locations on the 6540 Controller Module	78
Component Locations on the 6180 Array Module	79
Component Locations on the 6140 Array Module and the 6140 Array Module	81
Component Locations on the ST2500 M2 Array Module	81
Component Locations on the CSM200 Drive Module	88
Component Locations on the CSM100 Drive Module	89
Component Locations on the CSM100 Drive Module	90
Component Locations on the FLA200 Drive Module	91
Component Locations on the DE1600 Drive Module and the DE5600 Drive Module	91

Chapter 7: Adding a Drive Module to an Existing System	93
Getting Ready	93
HotScale Technology	93
Adding Redundant Drive Channels	93
Adding One Non-Redundant Drive Channel	93
Appendix A Hardware Installation for Data Replicator Software	95
Site Preparation	95
Switch Zoning Overview	95
Hardware Installation	96
Highest Availability Campus Configuration – Recommended	97
Switch Zoning for Highest Availability Campus Configuration	98
Cabling for the Highest Availability Campus Configuration	99
Campus Configuration	102
Switch Zoning for the Campus Configuration	103
Cabling for the Campus Configuration	104
Intra-Site Configuration	107
Switch Zoning for the Intra-Site Configuration	107
Cabling for the Intra-Site Configuration	108
Installing and Using Data Replicator Software with a Wide Area Network	111
Line Capacities	112

Chapter 1: Cabling Concepts and Best Practices

This chapter has three sections:

- The first section, “[Cabling Concepts](#),” provides definitions of the terms used in this document. This section is intended primarily for reference. Read the entire section to increase your overall understanding of the storage array and help you to optimize your storage array.
- The second section, “[Best Practices](#),” contains information that might affect your choice of cabling topologies. Read this section to understand the options for cabling your storage array.
- The third section, “[Common Procedures](#)” contains procedures that you will need to perform while you are cabling the storage array. Read this section to understand tasks that might be required to cable your storage array.

Cabling Concepts

This section defines terms and concepts that are used in this document.

Fabric (Switched) Topologies Compared to Direct-Attach Topologies

Fabric topologies use a switch. Direct-attach topologies do not use a switch. A switched topology is required if the number of hosts to connect to a controller module or array module is greater than the number available host ports on the tray.

Host connections might be InfiniBand, Fibre Channel, iSCSI, or a mix of Fibre Channel and iSCSI. Switches must support the required connection type or types. A combination of switches of different types might be appropriate for some configurations that support a mixture of connection types.

Drive Module

A drive module contains drives but no controllers. Drive modules usually are attached to either a controller module or an array module so that the controller in the controller module or the array module can configure, access, and manage the storage space in the drive module. Drive modules can be differentiated by type, which are described in the following subsections.

Switched Bunch of Disks

Switched Bunch of Disks (SBOD) is a device that takes all of the drives that are operating in a single Fibre Channel-Arbitrated Loop (FC-AL) segment and provides each drive with access to one or more controllers in a point-to-point fashion. This action is accomplished in a way that appears to be compliant with the FC-AL-2 protocol. As a result, system firmware changes are not required.

In this document, the CSM100 drive modules and the CSM200 drive modules are referred to as SBODs in the cabling diagrams. The CSM100 drive trays are identified as SATA (Serial Advanced Technology). The following figure shows an example of this type of labeling for drive modules. Do not mix FLA200 drive modules with other types of drive modules on the same loop.

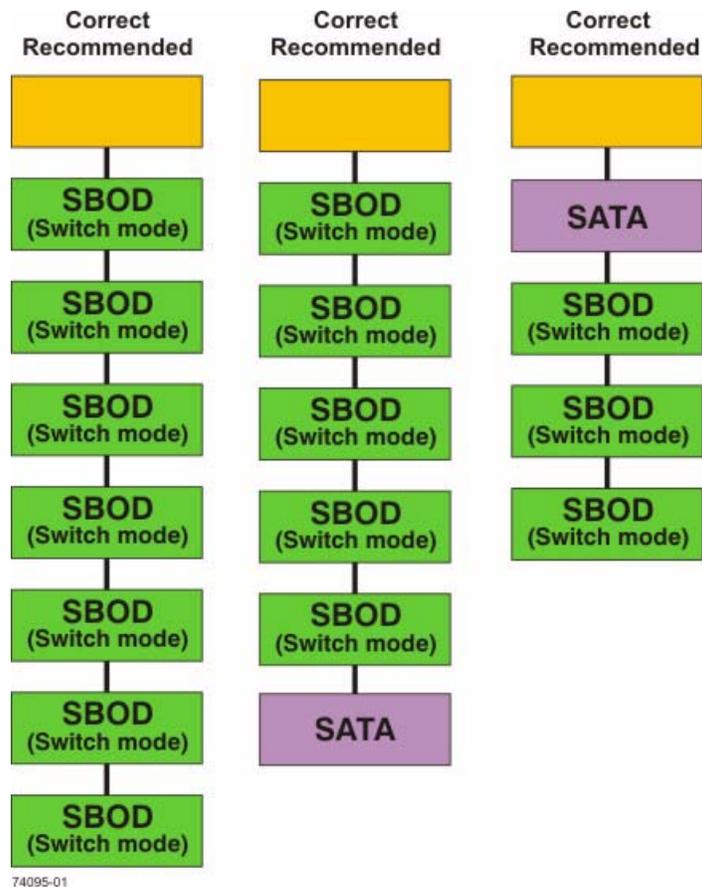


Figure 1 SBOD Labeling in Cabling Diagrams

Controller Module

A controller module contains controllers. A controller module does not contain drives. Controller modules configure, access, and manage the storage space of attached drive modules.

Array Module

An array module contains both controllers and drives. The controllers configure, access, and manage the storage space of the drives in the array module. An array module might configure, access, and manage the storage space of other attached drive modules, depending upon the model.

Host Channels and Drive Channels

In this document, the term *channel* refers to a path for the transfer of data information and control information between the host and the controller, or between the drive modules and the controller modules or array modules. A data path from a host to a controller is a *host channel*. A host channel might be Fibre Channel, InfiniBand, iSCSI, or Serial Attached SCSI (SAS). A path from a drive modules to a controller modules or a array modules is a *drive channel*. Each drive channel is defined by a single Fibre Channel-Arbitrated Loop or by a series of SAS devices connected through expanders. Controllers have between two and eight available host channels, and between one and eight available drive channels, depending upon the model. The maximum number of hosts per host channel and the maximum number of drives per drive channel depends upon the model. For model-specific information, see the topics under "***UNRESOLVED***".

NOTE When you mix different types of drive modules, you must consider the total number of drives that are available in the final configuration of the storage array. For example, if you mix CSM200 drive modules with CSM100 drive modules, the total number of drives might be more than the maximum number that each drive channel can support.

Host Ports and Drive Ports

The ports are the physical connectors on the controller module or the array module that, along with the cabling, enable the transfer of data. If the port communicates with the host server, it is a *host port*. If the port communicates with a drive module, it is a *drive port*. The figures in the topics under "Component Locations" show the connectors on the rear of each of the various modules. These figures will help you differentiate between host ports and drive ports.

Dual-Ported Drives

Each drive in an array module or a drive module is dual ported. Circuitry in the drive module or the array module connects one drive port to one channel and the other port to another channel. Therefore, if one drive port or drive channel fails, the data on the drive is accessible through the other drive port or drive channel.

SATA drives are not dual ported; however, the electronics in the CSM100 drive module emulate the behavior of dual-porting drives. Each SATA drive is available through two paths.

Preferred Controllers and Alternate Controllers

The preferred controller is the controller that "owns" a volume or a pool. SANtricity ES Storage Manager automatically selects the preferred controller when a volume is created, or the user can override the default selection.

Several conditions will force the preferred controller to fail over to the alternate controller. When this event occurs, ownership of the volume is shifted to the alternate controller. These conditions might initiate failover:

- The preferred controller is physically removed.
- The preferred controller is being updated with new firmware.
- The preferred controller has sustained a fatal event.

The paths used by the preferred controller to access either the drives or the host are called the preferred paths, and the redundant paths are the alternate paths. If a failure occurs that causes the preferred path to become inaccessible, the alternate path software detects the failure and automatically switches to the alternate path.

Alternate Path Software

Alternate path software or an alternate path (failover) driver is a software tool that provides redundant data path management between the host bus adapter (HBA) and the controller. This tool is installed on the host in a system that provides redundant HBAs and paths. The tool discovers and identifies multiple paths to a single logical unit number (LUN) and establishes a preferred path to that LUN. If any component in the preferred path fails, the alternate path software automatically reroutes input/output (I/O) requests to the alternate path so that the system continues to operate without interruption.

To learn how alternate path software works with SANtricity ES Storage Manager features to provide data path protection, refer to the topics under *Concepts* or the corresponding PDF document on the SANtricity ES Storage Manager Installation DVD.

Failover

Failover is an automatic operation that switches from a failed component or failing component to an operational component. In the case of a Redundant Array of Independent Disks (RAID) controller failover, an operational controller takes over the ownership of volumes. The operational controller processes I/O from the host in place of the failing component or failed controller. Controller failover is possible only in controller modules or in array modules that contain two controllers.

In a system in which the alternate path software tool is installed on the host, the data paths through the failed HBA are replaced by data paths through the surviving HBA.

For more information, refer to the topics under *Failover* or to the corresponding PDF on the SANtricity ES Storage Manager Installation DVD.

Redundant and Non-Redundant

The term *redundant* indicates the existence of something more than what is essential to accomplish a task. In storage area network technology, redundancy means that essential services are implemented using duplicated components in such a way that if one component fails an alternative component continues to provide the service. This redundancy ensures the availability of data in case a component fails.

In most RAID systems, most of the components are redundant, but that the system might not be fully redundant. In other words, there might be one or two components whose individual failures would cause loss of access to data. Therefore, a *fully redundant system* duplicates all components and is configured to make sure that the duplicate components can be accessed in case of a failure. The manner in which the system is cabled is an essential component of creating a successfully configured redundant system.

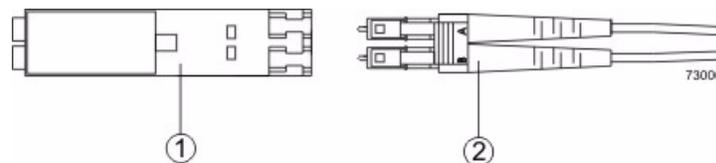
Single Point of Failure

Any component or path that is not duplicated (redundant) or whose failure can cause loss of data access is called a potential *single point of failure*. The cabling scenarios in this document note the components that present a potential single point of failure. Choose a cabling topology that does not create a single point of failure.

SFP Transceivers, Fiber-Optic Cables, and Copper Cables

Array modules, controller modules, and drive modules use fiber-optic cables or copper cables for Fibre Channel connections. For copper Fibre Channel cables, a passive copper Small Form-factor Pluggable (SFP) transceiver is attached to each end of the cable. InfiniBand connections are made with fiber-optic cables. If your system will be connected with Fibre Channel or InfiniBand fiber-optic cables, you must install an active SFP transceiver into each port in which a fiber-optic cable will be connected before plugging in the fiber-optic cable. Connections for 10-Gb/s iSCSI require SFP transceivers. Connections for 1-Gb/s iSCSI use copper cables with RJ-45 connectors and do not require SFP transceivers. Connections for SAS use copper cables with SFF 8088 connectors and do not require SFP transceivers. The following figures show the two types of cables that use SFP transceivers. Note that your SFP transceivers and cables might look slightly different from the ones shown. The differences do not affect the performance of the SFP transceivers.

WARNING (W03) Risk of exposure to laser radiation – Do not disassemble or remove any part of a Small Form-factor Pluggable (SFP) transceiver because you might be exposed to laser radiation.



1. Active SFP Transceiver
2. Fiber-Optic Cable

Figure 2 Active SFP Transceiver with Fiber-Optic Cable

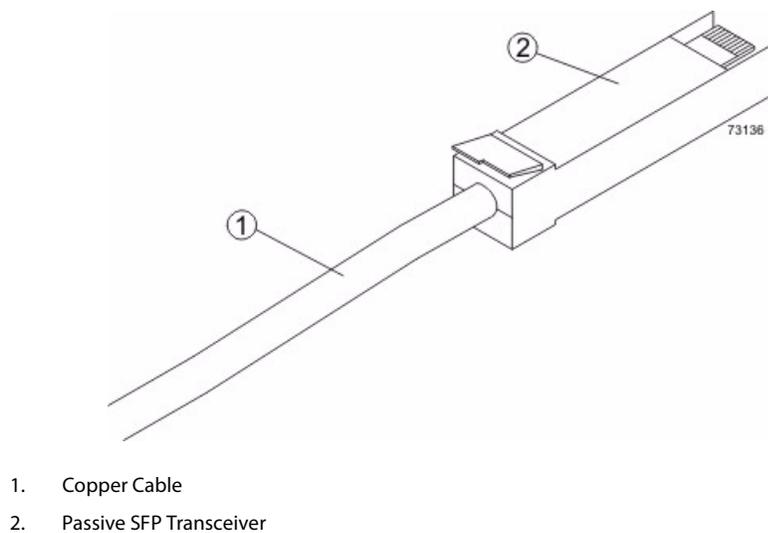


Figure 3 Passive SFP Transceiver with Copper Cable

Host Adapters

Each connection from a host port on a controller module or an array module to a host is made through a host adapter on the host. A host adapter can be a host bus adapter (HBA) for Fibre Channel or SAS connections, a host channel adapter (HCA) for InfiniBand connections, or an Ethernet adapter for iSCSI connections. The host adapter provides the interface to the internal bus of the host. For hardware redundancy, use two host adapters in each host computer. The two host adapters must be of the same type (HBAs, HCAs, or Ethernet). For duplex controller modules or duplex array modules, connect each host adapter to a different controller in a controller module or a array module to make sure that the server will be accessible even if one HBA or one controller fails.

ATTENTION Possible loss of data access – Do not use a combination of HBAs from different vendors in the same storage area network (SAN). For the HBAs to perform correctly, use HBAs from only one manufacturer in a SAN.

You can obtain information about supported host adapters from the Compatibility Matrix. To check for current compatibility, refer to the Compatibility Matrix at <http://www.lsi.com/compatibilitymatrix/>, and click the **Compatibility Matrix** link.

Host Interface Cards

Each controller in a 6580/6780 controller module has one or two host interface cards (HICs) that contain the host ports. Each controller in a 6180 array module has two Fibre Channel host ports built in, as well as an optional HIC for additional host ports. Each controller in a ST2500 M2 array module has two SAS host ports built in, as well as an optional HIC for additional host ports.

An HIC is cabled to a host adapter: a host bus adapter (HBA) for Fibre Channel or SAS, a host channel adapter (HCA) for InfiniBand, or an Ethernet adapter for iSCSI. The host adapter in the host must match the type of HIC to which it is cabled.

Network Interface Cards

A network interface card (NIC) is an expansion board that is installed in the host server. Some servers are equipped with an integrated NIC. The NIC supports Ethernet technology. The NIC is required for network communication. Each Ethernet cable connection for out-of-band storage array management is made through an NIC (see the topics under [In-Band Management and Out-of-Band Management](#)).

NOTE It is the responsibility of the customer to obtain the required NICs and to install them.

Switches and Zoning

A switch is an intelligent device that connects multiple devices. A switch allows data transfer between the devices, depending upon the designated source (*initiator*) and the destination (*target*) of the data. Switches can redirect traffic to ports other than the designated destination, if necessary. A switch provides full bandwidth per port and high-speed routing of data.

Zoning allows a single hardware switch to function as two or more virtual switches. In a zoned configuration, communication among devices in each zone is independent of communication among devices in another zone or zones. Zoned switches allow an administrator to restrict access to specific areas within a storage area network (SAN).

How Initiators and Targets Respond to Zoning

When an initiator first accesses the fabric, it queries the World Wide Identifier (WWID) name server for all of the attached disks and drive modules and their capabilities. Zoning is like a filter that the WWID name server applies to the query from the initiator that limits the information returned by the WWID name server to the initiator. A zone defines the WWID of the initiator and the WWID of the devices that a particular zone is allowed to access. Devices that are not part of the zone are not returned as accessible devices.

The fabric provides universal access for all initiators and targets. Any initiator can query (probe) the fabric for all targets, which can affect performance when many targets are connected to the fabric. The querying process also provides access to devices for which access is not needed. Use zoning to limit the number of devices that an initiator can access. Within your storage area network, you should zone the fabric switches so that the initiators do not “see” or communicate with each other.

How Best to Approach Zone Configuration

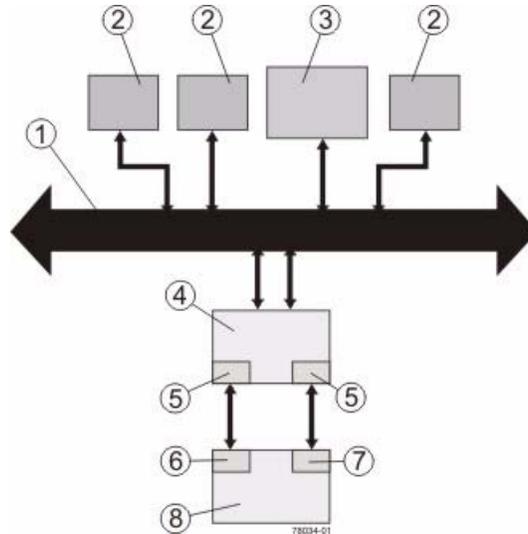
Some of the cabling topologies shown in this document require the use of a zoned switch. By default, the switch uses no zoning, which is not sufficiently robust for most applications. You must configure the switch before you use it.

Zone configuration is managed on a per-fabric basis. While you can administer zone configuration from any switch, use the best practice of selecting one switch for all zone administration. Give preference to the primary switches within the SAN, and choose only a switch that has the most up-to-date storage management software and switch management software installed on it.

In-Band Management and Out-of-Band Management

A system administrator manages a storage array from a storage management station, which is a workstation on which the SANtricity ES Storage Manager Client is installed. Requests and status information sent between the storage array and the storage management station are managed in one of two ways: in-band or out-of-band. A storage array that uses out-of-band management requires a different network topology from a storage array that uses in-band management.

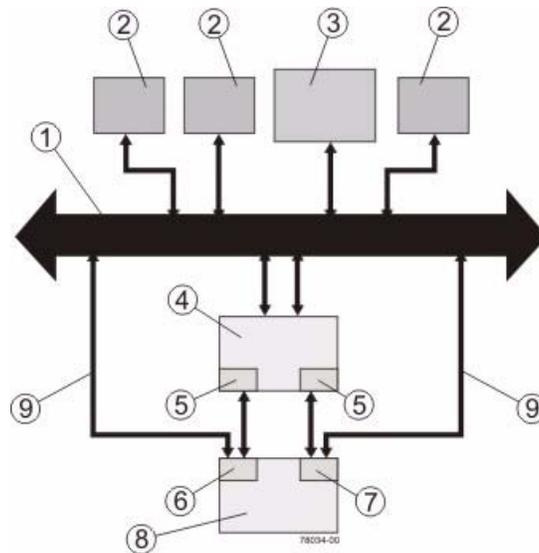
When you use *in-band management*, a SANtricity ES Storage Manager agent running on the host receives requests from the management station. The host agent processes the requests through the host I/O interface to the storage array. The host I/O interface might be Fibre Channel, serial-attached Small Computer System Interface (SAS), InfiniBand, or Internet SCSI (iSCSI).



1. Ethernet Network
2. User Workstations Sending and Receiving Data
3. Storage Management Station
4. Host
5. Host Adapters
6. Controller A
7. Controller B
8. Controller Module or Array Module for the Storage Array

Figure 4 Example of In-Band Management Topology

When you use *out-of-band management*, the storage management station is connected, through an Ethernet network, to each of the controllers in the controller module or the array module.



1. Ethernet Network
2. User Workstations Sending and Receiving Data
3. Storage Management Station
4. Host
5. Host Adapters
6. Controller A
7. Controller B
8. Controller Module or Array Module for the Storage Array
9. Ethernet Cable from the Controllers to the Ethernet Network

Figure 5 Example of Out-of-Band Management Topology

When using out-of-band management, a Dynamic Host Configuration Protocol (DHCP) server is recommended for assigning Internet Protocol (IP) addresses and other network configuration settings. A DHCP server provides the network administrators the ability to manage and automatically assign IP addresses. If a DHCP server is not used, you must manually configure the controllers. For more information, refer to the Adding a Host or Storage Array online help topic in the Enterprise Management Window.

ATTENTION Risk of unauthorized access to or loss of data – If the out-of-band management method is used, connect the Ethernet ports on the controller module or the array module to a private network segment behind a firewall. If the Ethernet connection is not protected by a firewall, your storage array might be at risk of being accessed from outside of your network.

NOTE Where two Ethernet ports are available on each controller (four total), you can use one of the ports on each controller for out-of-band Ethernet connections. Reserve the second Ethernet port on each controller for access by your Sun Customer Care Center representative.

For information about how to create a redundant out-of-band topology, see the topics under "[Drive Cabling](#)".

Best Practices

This section explains recommended cabling practices. To make sure that your cabling topology results in optimal performance and reliability, familiarize yourself with these best practices.

NOTE If your existing storage array cabling does not comply with the best practices described in this section, do not re-cable your storage array unless specifically requested to do so by your Sun Customer Care Center representative.

Drive Cabling for Redundancy

When attaching the drive modules, use a cabling topology that does not create a single point of failure. A single point of failure might appear as a drive module failure or another component failure in the middle of a grouping of drive modules. If a drive module fails, you can no longer access the drive modules beyond the point of failure. By creating an alternate path, you make sure that the drive modules are accessible in the event of a drive module failure.

The following figure shows a typical cabling scenario. In this example, each of the eight drive modules has two connections directly to the controller module: one from ESM A to controller A and one from ESM B to controller B. Each redundant path pair on the controller module connects to one drive module. The ESM 1B ports are used for all of the connections.

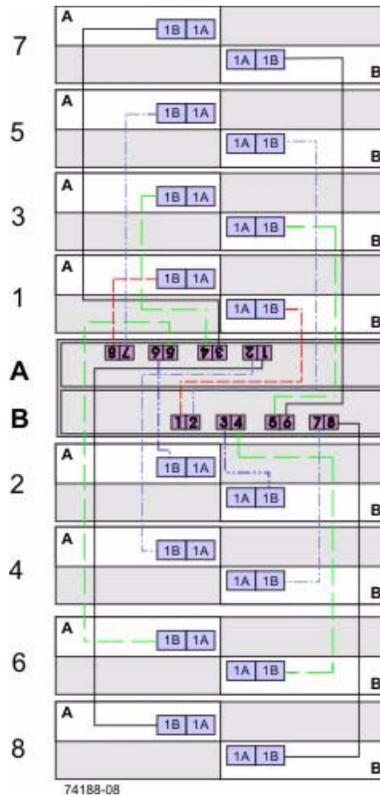


Figure 6 Cabling for Eight Drive Modules

Note how the controller module (denoted by A and B in the figure) is conveniently situated in the middle of the arrangement, which enables you to use cables that are all the same length. Positioning the controller module near the middle of the cabinet also helps prevent the cabinet from becoming top heavy as drive modules are added.

For cabling examples, ranging from simple to complex, see the topics under "[Drive Cabling](#)."

Host Cabling for Redundancy

To ensure that, in the event of a host channel failure, the storage array will stay accessible to the host, establish two physical paths from each host to the controllers, and install alternate path software on the host. This cabling topology, when used with alternate path software, makes sure that a redundant path exists from the host to the controllers.

ATTENTION Possible loss of data access – You must install alternate path software or an alternate path (failover) driver on the host to support failover in the event of an HBA failure or a host channel failure.

For examples of redundant topologies, see the topics under "[Host Cabling](#)."

Host Cabling for Data Replicator Software

The Data Replicator Software premium feature provides online, real-time replication of data between storage arrays over a remote distance. In the event of a disaster or a catastrophic failure at one storage array, you can promote a second storage array to take over responsibility for computing services. See the topics under Hardware Installation for Data Replicator Software for detailed information about cabling for Data Replicator Software.

The Data Replicator Software premium feature requires a dedicated host port for mirroring data between storage arrays. After the Data Replicator Software premium feature has been activated, one host I/O port on each controller is solely dedicated to mirroring operations.

NOTE One of the host ports on *each* controller must be dedicated for the communication that occurs between the two storage arrays (primary volumes and secondary volumes). If you are not using the Data Replicator Software premium feature, these host ports are available for ordinary host connections.

Cabling for Performance

Generally speaking, performance is enhanced by maximizing bandwidth, which is the ability to process more I/O across more channels. Therefore, a configuration that maximizes the number of host channels and the number of drive channels available to process I/O will maximize performance. Of course, faster processing speeds also maximize performance.

In addition to planning a topology that provides maximum performance, choose a RAID level that suits the planned applications. For information on RAID levels, refer to the topics under *Concepts* or to the corresponding PDF document on the SANtricity ES Storage Manager Installation DVD.

Considerations for Drive Channel Speed

When you connect multiple drive modules to the same drive channel, all of the drive modules must operate at the same speed. If you plan to combine drive modules that operate at different speeds on the same drive channel, you must set all of the drive modules to operate at the lowest common speed. The following table lists the operating speeds of each supported drive module.

Table 1 Specifications for the Drive Modules

Model	Port Speed	Drives per Module	Maximum Number of Drive Modules per Loop
CSM200 drive module	4 Gb/s	16	7
CSM100 drive module	2 Gb/s	14	8
CSM100 drive module	2 Gb/s	14	8
DE1600 drive module	6 Gb/s	12	15

Multiple Types of Drive Modules

NOTE Before you create a topology that combines multiple models of drive modules, make sure that your controller module or array module supports this feature. You must configure the controller module or array module to support multiple models of drive modules.

You can combine multiple drive module models in a single storage array topology. Keep the following rules and guidelines in mind when you plan to cable your storage array with more than one drive module type:

- To achieve maximum throughput performance, distribute drive modules across redundant drive channels in a controller module or an array module.
- Configure CSM100 drive modules and CSM200 drive modules (SBODs) in series as described in “Cabling for Drive Modules That Support Loop Switch Technology.”
- Do not create multiple series of CSM100 drive modules and CSM200 drive modules (SBODs) that are separated by CSM100 SATA drive modules.
- Whenever possible, and with consideration of the previously stated rules and guidelines, place all like drive modules on the same drive channel.
- When you cable drive modules to a 6580/6780 controller module, do not mix multiple types of drive modules on the same loop.
-
- Do not exceed the maximum number of drives that each drive channel can support. Mixing drive modules that contain 16 drives with drive modules that contain 14 drives can exceed the maximum number of drives that are supported on a drive channel. Similarly, mixing drive modules that contain 24 drives with drive modules that contain 12 drives can exceed the maximum number of drives that are supported on a drive channel.
- When you cable drive modules to a array module, keep in mind that the drives installed in the array module count toward the maximum number of drives supported on a drive channel.

The following table summarizes the supported combinations of controller modules or array modules with drive modules.

Table 2 Drive Module Cabling Combinations

	CSM200 Drive Module	CSM100 Drive Module	CSM100 Drive Module	FC2600 Drive Module
6780 Controller Module	Up to seven per loop pair; 28 per controller module	Not supported	Not supported	Not supported
6580/6780 Controller Module	<ul style="list-style-type: none"> ■ Up to seven CSM200 drive modules per loop pair; 28 per controller module 	Not supported	Not supported	Not supported

	CSM200 Drive Module	CSM100 Drive Module	CSM100 Drive Module	FC2600 Drive Module
6540 Controller Module	<ul style="list-style-type: none"> ■ Up to seven CSM200 drive modules per channel; up to 14 per controller module ■ Up to eight CSM100, CSM100, or FC2600 drive modules per channel; up to 16 per controller module ■ When a channel has a mixture of CSM200, CSM100, CSM100, or FC2600 drive modules, up to seven drive modules per channel; up to 14 drive modules per controller module ■ When a controller module has a mixture of CSM200, CSM100, CSM100, or FC2600 drive modules but each channel has only one type of drive module, up to seven drive modules for each channel with CSM200 drive modules, up to eight drive modules for each channel with other drive module types 			
6540 Controller Module				
6180 Array Module	Up to six per array module	Not supported	Not supported	Not supported
6140 Array Module	<ul style="list-style-type: none"> ■ Up to seven attached drive modules if no drives are in the array module ■ Up to six attached drive modules if no drives are in the array module ■ Mixing different drive module types on the same loop is supported 			
6140 Array Module				

Single-Controller Topologies and Dual-Controller Topologies

If you are creating a topology for a controller module or an array module that contains only one controller, you can attach only drive modules that contain a single environmental services monitor (ESM). Do not attach a drive module that contains two ESMs to a single-controller controller module or a single-controller array module.

Copper Cables and Fiber-Optic Cables

You can use a combination of copper cables and fiber-optic cables to connect the drive modules to a controller module or to an array module. However, when a drive module communicates with the controller module (or the array module) indirectly, through another drive module, the connections between the drive module and the controller module (or the array module) and between the two drive modules must use the same type of cable. Fiber-optic cables are required for host connections.

Cabling for Drive Modules That Support Loop Switch Technology

The CSM100 drive modules and the CSM200 drive modules operate internally as an array of drives that are connected in a point-to-point configuration by a Fibre Channel-Arbitrated Loop (FC-AL) loop switch. These drive modules are referred to as a Switched Bunch of Disks (SBOD). Drive modules without loop switch support operating as a string of drives on an arbitrated loop. SBOD drive modules operate more reliably than drive modules that use a traditional loop configuration. The loop switch also reduces transfer latency, which can increase performance in some configurations. To operate in Switch mode, you must cluster SBOD drive modules together when they are combined with other types of drive modules in a storage array topology.

The SBOD drive modules operate in *Switch mode* either when an SBOD drive module is connected singly to a controller module or an array module, or when multiple SBOD drive modules are connected in series to a controller module or an array module. An SBOD drive module operates in *Hub mode* when a single SBOD drive module is connected in series with other drive modules that do not support a loop switch. The SBOD drive modules also operate in *Hub mode* when multiple SBOD drive modules are interspersed in series with other drive modules that do not support a loop switch. The SBOD drive module does not take advantage of the internal switch technology when operating in Hub mode. Some statistics that are available in switch mode are not available in Hub mode.

If SBOD drive modules are not clustered together correctly, the SANtricity ES Storage Manager software shows a Needs Attention status for the SBOD drive modules. A Needs Attention status does not prevent the SBOD drive modules from processing data; however, the Needs Attention status persists until you change the cabling topology. To maximize the performance of SBOD drive modules, always cable the SBOD drive modules in a series.

The following figure shows a simple block diagram of three recommended topologies for SBOD drive modules. All three scenarios shown in the figure are arranged to maximize performance. The scenario on the left of the figure (all SBODs) also offers the advantage of flexible drive cabling; for example, connecting two In ports or two Out ports. This flexible approach to drive cabling is enabled by the FC-AL feature.

In the figure, the CSM100 drive modules or the CSM200 drive modules are identified as SBODs. The CSM100 drive modules are identified as SATA (Serial Advanced Technology Attachment).

NOTE When you connect drive modules to the 6780 controller module or the 6580/6780 controller module, you must not mix different types of drive modules on the same loop.

NOTE When you mix different types of drive modules, you must consider the total number of drives that are available in the final configuration of the storage array. For example, if you mix CSM200 drive modules with CSM100 drive modules, the total number of drives might be more than the maximum number that each drive channel can support.

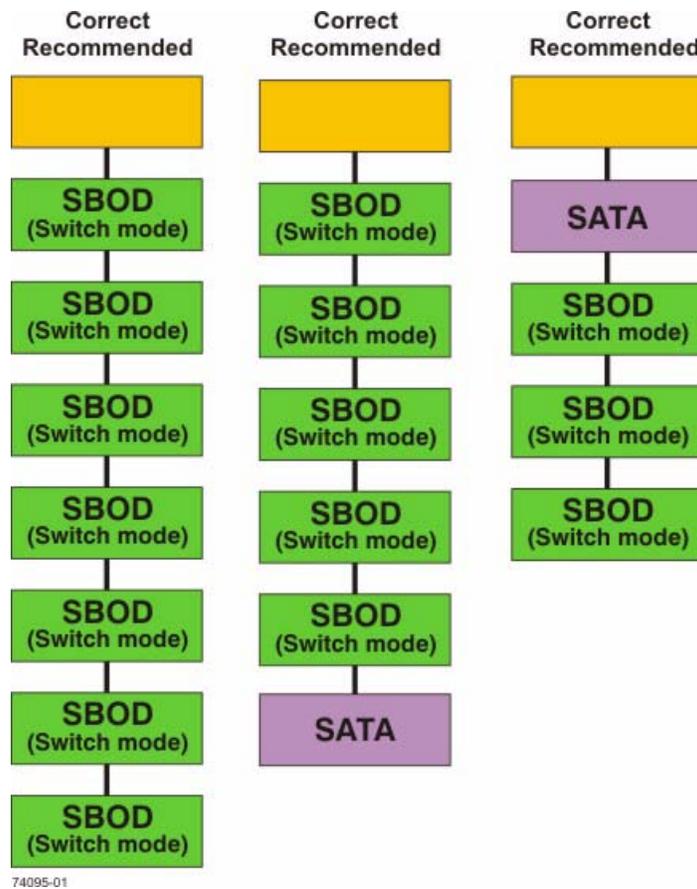


Figure 7 Suitable Cabling Topologies for Multiple SBOD Drive Modules

Labeling Cables

Cabling is an important part of creating a robust storage array. Labeling the cables identifies system components, drive channels, and loops. System maintenance is easier when the cables are correctly identified. Label both ends of each cable. You can use adhesive office labels that are folded in half over the ends of each cable. Mark the labels with the port identifiers to which the cable is connected. If you use the recommended topologies in as described in the topics under [Host Cabling](#) and [Drive Cabling](#), label each cable with the channel number noted in the table that you are following. You can provide additional information by using color-coded cable straps (or ties) to group all of the cables associated with one component, drive channel, or loop.

If a component fails, you must disconnect the cables, replace the failed component, and reattach the cables. Detailed labeling of the cables will simplify the component replacement process.

If you add a new drive module to an existing configuration, correctly labeled cables will help you identify where to connect the new drive module.

Cabling Information Provided by SANtricity ES Storage Manager

After you have completed your cabling topology and installed the SANtricity ES Storage Manager software, you can view cabling information through the SANtricity ES Storage Manager software. The SANtricity ES Storage Manager software shows a table that lists all of the connections in the cabling topology and identifies any incorrectly cabled drive channels or non-redundant drive channels. For more information, refer to the online help topics in the SANtricity ES Storage Manager software.

Adding New Drive Modules to an Existing Storage Array

HotScale™ technology enables you to add drive modules to an existing storage array without interrupting power or data transfer to the storage array. See the topics under “Drive Cabling” for the recommended cabling patterns for various numbers of attached drive modules.

When the number of drive modules exceeds the number of drive ports on a controller, the cabling pattern changes significantly. At this point, you will start to use the “A” ports on the ESMs, and additional drive modules connect to the controller module indirectly, through other drive modules.

If you are adding additional drive modules to an existing configuration so that the total number of attached drive modules will increase from fewer than the number of drive ports per controller to a total that is greater than that number, you will need to re-cable some of the drive modules that were previously installed.

Common Procedures

This section provides procedures that are common to most cable installations.

Handling Static-Sensitive Components

Static electricity can damage dual inline memory modules (DIMMs), system boards, and other static-sensitive components. To prevent damaging the system, follow these precautions:

- Move and store all components in the static-protective packaging in which they came.
- Place components on a grounded surface before removing them from their static-protective packaging. Grounded surfaces include static-dissipating mats or grounded workstations.

- Always be properly grounded when touching a static-sensitive component. To properly ground yourself, wear a wrist strap or boot strap made for this purpose.
- Handle the component by its edges. Do not touch solder joints, pins, or printed circuitry.
- Use conductive field service tools.

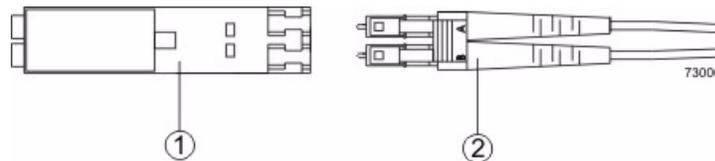
Installing an SFP Transceiver and a Fiber-Optic Cable

You must install SFP transceivers into each connector to which you will connect a fiber-optic cable.

ATTENTION Potential degraded performance – To prevent degraded performance, do not twist, fold, pinch, or step on the fiber-optic cables. Many cables have a minimum bending radius. For example, do not bend fiber-optic Fibre Channel cables tighter than a 5-cm (2-in.) radius. Check the specifications for your cables and do not bend any cable more tightly than the minimum specified radius.

ATTENTION Possible hardware damage – To prevent electrostatic discharge damage to the module, use proper antistatic protection when handling module components.

1. Put on antistatic protection.
2. Make sure that your cables are fiber-optic cables by comparing them to the fiber-optic cable shown in the following figure. Your SFP transceivers might look slightly different from the one shown. The differences do not affect the performance of the SFP transceiver.

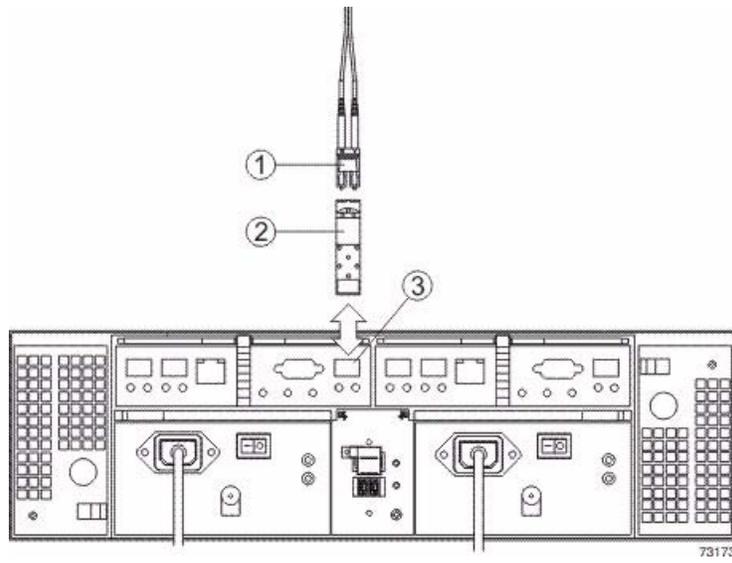


1. SFP Transceiver
2. Fiber-Optic Cable

Figure 8 SFP Transceiver and Fiber-Optic Cable

3. Insert an SFP transceiver into the port in which the fiber-optic cable will be installed.

NOTE Make sure that the SFP transceiver installs with an audible click.



1. Fiber-Optic Cable
2. SFP Transceiver
3. Drive Module Port

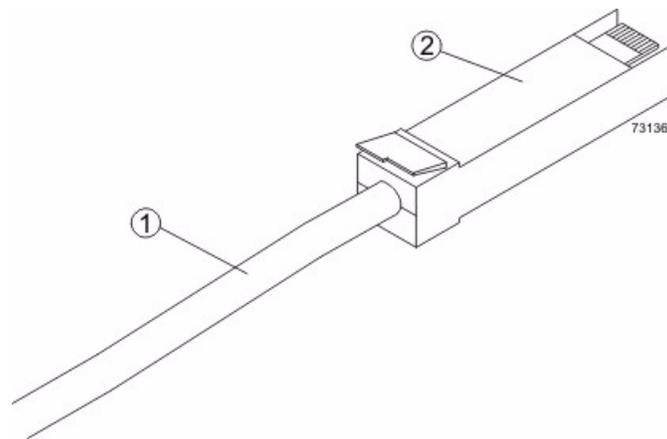
Figure 9 Installing an SFP Transceiver

4. Install the fiber-optic cable.

Installing a Copper Cable with a Passive SFP Transceiver

ATTENTION Possible hardware damage – To prevent electrostatic discharge damage to the module, use proper antistatic protection when handling module components.

1. Put on antistatic protection.
2. Verify that your cables are copper cables by comparing them to the cable shown in the following figure. Your passive SFP transceivers might look slightly different from the one shown. The differences do not affect the performance of the SFP transceiver.



1. Copper Cable
2. Passive SFP Transceiver

Figure 10 Passive SFP Transceiver and Copper Cable

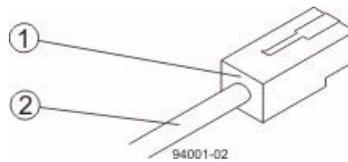
NOTE Make sure that the passive SFP transceiver installs with an audible click.

3. Insert the passive SFP transceiver into the port in which the copper cable will be installed.

Installing an iSCSI Cable

ATTENTION Possible hardware damage – To prevent electrostatic discharge damage to the module, use proper antistatic protection when handling module components.

1. Put on antistatic protection.
2. Verify that you have the correct cables for an iSCSI connections by comparing them to the cable shown in the following figure. Cables for iSCSI connections do not require SFP transceivers.



1. RJ-45 Connector
2. iSCSI Cable

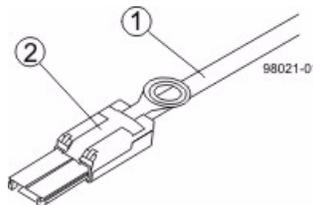
Figure 11 iSCSI Cable with an RJ-45 Connector

3. For each cable, insert one RJ-45 connector into a host interface card port on the array module or the controller module and the other RJ-45 connector into a port on the host's Ethernet adapter.

Installing a SAS Cable

ATTENTION Possible hardware damage – To prevent electrostatic discharge damage to the module, use proper antistatic protection when handling module components.

1. Put on antistatic protection.
2. Verify that you have the correct cables for a SAS connections by comparing them to the cable shown in the following figure. Cables for SAS connections do not require SFP transceivers.



1. SAS Cable
2. SFF-8088 Connector

Figure 12 SAS Cable with an SFF-8088 Connector

3. For each cable, insert one SFF-8088 connector into a host interface card port on the array module or the controller module and the other SFF-8088 connector into an port on the host's HBA.

Chapter 2: Product Compatibility

This chapter lists all currently supported products, along with their host and drive channel specifications.

Host Channel Information by Model

The following table lists the specifications and restrictions that affect host-cabling topologies. Make sure that your planned controller module topology or your planned array module topology is compatible with these specifications and restrictions.

Table 1 Host Channel Information for Controller Modules and Array Modules

Product	Host Port Type	Maximum Host Port Speed	Number of Host Ports per Controller	Maximum Number of Hosts per Cluster	Maximum Number of Hosts	Cable Type
6780 controller module	InfiniBand	2 Gb/s 4 Gb/s	0, 4, or 8	16	2048	Copper or fiber-optic InfiniBand Cables
6580/6780 controller module	Fibre Channel	8 Gb/s (with 8-Gb/s HICs)	0, 4, or 8	16	2048	Fiber-optic
	iSCSI	1 Gb/s 10 Gb/s	0, 4, or 8	16	256	Copper
	InfiniBand	20 Gb/s	0, 4, or 8	16	256	Fiber-optic InfiniBand Cables
6540 controller module	Fibre Channel	4 Gb/s	4	16	1024	Fiber-optic
6180 array module	Fibre Channel	8 Gb/s	2 or 4	16	640	Fiber-optic
	iSCSI	1 Gb/s 10 Gb/s	2	16	640	Copper
6140 array module	Fibre Channel	2 Gb/s	4	16	1024	Fiber-optic
6140 array module	Fibre Channel	2 Gb/s	2 or 4	16	256	Fiber-optic
ST2500 M2 array module	SAS	6 Gb/s 10 Gb/s	2 or 4	16	256	Copper
	Fibre Channel	8 Gb/s	0 or 4	16	256	Fiber-optic
	iSCSI	1 Gb/s 10 Gb/s	0 or 4	16	256	Copper

Drive Channel Information by Model

The following table lists the specifications and restrictions that affect cabling between controller modules and drive modules or between array modules and drive modules. Make sure that the topology you plan for your drive modules is compatible with these specifications and restrictions.

NOTE When you mix different types of drive modules, you must consider the total number of drives that are available in the final configuration of the storage array. For example, if you mix CSM200 drive modules with CSM100 drive modules, the total number of drives might be more than the maximum number that each drive channel can support.

Table 2 Drive Channel Information for Controller Modules and Array Modules

Product	Drive Port Speeds	Maximum Number of Drives	Supported Drive Modules	Cable Type	Notes
6780 controller module	2 Gb/s or 4 Gb/s	480	CSM200	Copper FC cables or fiber-optic FC cables	<p>There is a limit of two expansion drive modules for each redundant pair of loops.</p> <p>Up to 448 drives are possible when CSM200 drive modules are used exclusively. There is a limit of seven expansion drive modules for each redundant pair of loops.</p> <p>Mixing drive types is not supported.</p>
6580/6780 controller module	2 Gb/s or 4 Gb/s	480	CSM200	Copper FC cables or fiber-optic FC cables Copper iSCSI cables	<p>There is a limit of two expansion drive modules for each redundant pair of loops.</p> <p>Up to 448 drives are possible when CSM200 drive modules are used exclusively. There is a limit of seven expansion drive modules for each redundant pair of loops.</p> <p>Mixing drive module types is supported. The maximum number of drives for a mixed configuration is 448.</p> <p>With a 6580/6780 controller module, CSM200 drive modules support solid-state drives (SSDs). A drive module can have both SSDs and hard disk drives. The maximum number of SSDs for the storage array is 20.</p>

Product	Drive Port Speeds	Maximum Number of Drives	Supported Drive Modules	Cable Type	Notes
6540 controller module and 6540 controller module	2 Gb/s or 4 Gb/s	224	CSM200 CSM100 CSM100 FC2600	Copper FC cables or fiber-optic FC cables	<p>If you are using the CSM200 drive module in your configuration, design for a limit of seven expansion drive modules for each redundant pair of loops. With the CSM100, CSM100, or FC2600 expansion drive modules, the limit is eight per channel pair.</p> <p>Mixing drive types is supported. When a channel has a mix of CSM200, CSM100, CSM100, or FC2600 drive modules, up to seven drive modules per channel and up to 14 drive modules per controller module are supported.</p> <p>When a controller module has a mix of CSM200, CSM100, CSM100, or FC2600 drive modules but each channel has only one type of drive module, up to seven drive modules for each channel with CSM200 drive modules and up to eight drive modules for each channel with other drive module types are supported.</p>
6180 array module	4 Gb/s	112	CSM200	Copper FC cables or fiber-optic FC cables Copper iSCSI cables	Design for a limit of six expansion drive modules per dual-ported drive channel.
6140 array module and 6140 array module	2 Gb/s or 4 Gb/s	112	CSM200 CSM100 CSM100 FC2600	Copper FC cables or fiber-optic FC cables	<p>Mixing different drive module types on the same loop is supported.</p> <p>Up to seven attached drive modules if there are no drives in the array module and up to six attached drive modules if there are drives in the array module are supported.</p>
ST2500 M2 array module	6 Gb/s SAS	192	DE1600 DE5600 DE6600	SAS cables	<p>The ST2500 M2 array module has both 12-drive and 24-drive configurations.</p> <p>The DE1600 drive module has up to 12 drives.</p> <p>The DE5600 drive module has up to 24 drives.</p> <p>The DE6600 has up to 60 drives.</p>

Drive Module Information by Model

The following table lists the drive module specifications that might affect your topology. Make sure that your planned topology is compatible with these specifications and restrictions.

NOTE When you mix different types of drive modules, you must consider the total number of drives that are available in the final configuration of the storage array. For example, if you mix CSM200 drive modules with CSM100 drive modules, the total number of drives might be more than the maximum number that each drive channel can support.

Table 3 Specifications for Drive Modules

Model	Port Speed	Drives per Module	Maximum Number of Drive Modules per Channel
CSM200 drive module	4 Gb/s	16	7
CSM100 drive module	2 Gb/s	14	8
FLA200 drive module	2 Gb/s	14	8
CSM100 drive module	2 Gb/s	14	8
DE5600 drive module	6 Gb/s	24	4
DE1600 drive module	6 Gb/s	12	8

Chapter 3: Host Cabling

This chapter provides examples of possible cabling topologies between one or more hosts and a controller module or an array module. Direct-attach topologies, fabric topologies, and mixed topologies are addressed. You are not limited to using only these topologies. Examples are provided to show basic concepts to help you define an optimal host-cabling topology. A table that lists the maximum supported number of hosts is included.

For host port locations on the specific controller module model or array module model that you are installing, see the topics under “Component Locations.”

NOTE If you are using the Data Replicator Software premium feature, see the topics under [Hardware Installation for Data Replicator Software](#) for information on cabling using a host port between two storage arrays.

Host Interface Connections

The 6580/6780 controller module connects to hosts through one or two host interface cards (HICs). The 6180 array module has built-in (base) Fibre Channel (FC) connectors for host connections and might also have an optional HIC. The ST2500 M2 array module has built-in (base) SAS connectors for host connections and might also have an optional HIC. All other supported controller modules and array modules connect through built-in ports.

Table 1 Types of Host Port Configurations and HICs for Controller Modules and Array Modules

Controller Type	Base Ports	HIC 1	HIC 2
6580/6780	None	Quad 4-Gb/s FC or Quad 8-Gb/s FC or Dual 1-Gb/s iSCSI Dual 10-Gb/s iSCSI	None or Quad 4-Gb/s FC or Quad 8-Gb/s FC or Dual 1-Gb/s iSCSI Dual 10-Gb/s iSCSI
6180	Dual 8-Gb/s FC	None or Dual 8-Gb/s FC or Dual 1-Gb/s iSCSI	None
ST2500 M2	Dual 6-Gb/2 SAS	None or Dual 6-Gb/2 SAS Quad 8-Gb/s FC or Quad 1-Gb/s iSCSI Dual 10-Gb/s iSCSI	None

A 6580/6780 controller module, a 6180 array module, a ST2500 M2 array module can mix host interfaces of different types, with some restrictions. In all cases, when host interface types are mixed, both controllers in a duplex controller module or a duplex array module must have the same arrangement of HICs. Each controller must have the same type of HIC in the same relative position as the other controller.

NOTE On the ST2500 M2 array module, each controller has a pair of levers with handles for removing the controller from the array module. If a controller has a HIC installed, one of these handles on the controller is located next to a host port on the HIC. The close spacing between the handle and the host port might make it difficult to remove a cable that is attached to the host port. If this problem occurs, use a flat-blade screwdriver to compress the release on the cable connector.

A HIC is connected to a host adapter: a host bus adapter (HBA) for Fibre Channel or SAS, or an Ethernet adapter for iSCSI. The host adapter in the host must match the type of HIC to which it is connected.

For best performance, connect an 8-Gb/s Fibre Channel HIC to an 8-Gb/s HBA. If the data rate for the HBA is lower, the data transfer rate will be at the lower rate. For instance, if you connect an 8-Gb/s Fibre Channel HIC to a 4-Gb/s HBA, the data transfer rate is 4 Gb/s.

It is possible for a host to have both iSCSI and Fibre Channel adapters for connections to a storage array that has a mix of HICs. Several restrictions apply to such configurations:

- The root boot feature is not supported for hosts with mixed connections to one storage array.
- Cluster configurations are supported for hosts with mixed connections to one storage array.
- When the host operating system is VMware, mixing connection types within a storage partition is not supported.
- When the host operating system is Windows, mixing connection types within a storage partition is not supported. A single server that attaches to multiple storage partitions on a single storage array must not have any overlap in LUN number assignments given to the volumes.
- For other operating systems, mixed connection types from a host to a single storage array are not supported.

Maximum Number of Host Connections

Table 2 Maximum Number of Host Connections by Model to a Controller Module or a Array Module

Model	Maximum Number of Hosts
6780 controller module and 6580/6780 controller module	2048
6540 controller module and 6540 controller module	1024
6180 array module	640
6140 array module and	1024
6140 array module	256
ST2500 M2 array module	256

ATTENTION Possible loss of data access – Do not use a combination of HBAs from different vendors in the same storage area network. For the HBAs to perform correctly, use only HBAs from one manufacturer in a SAN.

Direct-Attach Topologies

The host-to-controller module topologies presented in this section do not use switches. The host adapters might be HBAs for Fibre Channel or SAS, HCAs for InfiniBand, or Ethernet for iSCSI. Some controller modules and array modules support more direct host connections than the examples shown. To cable more host connections, follow the pattern established by the examples in this section.

When a host is cabled to a dual-controller array module or a dual-controller controller module, each attached host should have two host adapters installed. For redundancy, connect one host adapter to controller A and the other to controller B.

One Host to a Controller Module or a Array Module

The following table lists the components in this topology that are non-redundant and present a risk of a single point of failure. The following figure shows an example of a direct-attach topology with one host and a dual-controller controller module or a dual-controller array module.

The example in the figure identifies HBA1 and HBA2 as connecting points on the host. For other configurations, these connecting points might be host channel adapters (HCAs) for InfiniBand connections, Ethernet adapters for iSCSI connections, or a combination of one HBA and one iSCSI Ethernet adapter.

ATTENTION Possible loss of data access – You must install alternate path software or an alternate path (failover) driver on the host to support failover in the event of an HBA, an HCA, or an iSCSI Ethernet adapter failure or a host channel failure.

Table 3 Redundant and Non-Redundant Components in a Direct-Attached Configuration with One Host and a Controller Module or a Array Module

Component	Redundant	Non-Redundant
Host/server		Non-redundant
HBA, HCA, or iSCSI Ethernet adapter	Redundant	
Host-to-controller cable	Redundant	
Controller	Redundant	

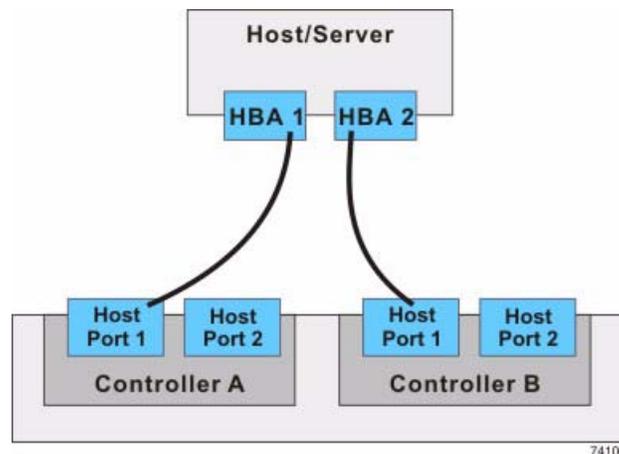


Figure 1 Direct-Attach Topology – One Host and a Controller Module or a Array Module

Two Hosts to a Controller Module or a Array Module

The following table lists the components in this topology which are non-redundant and present a risk of a single point of failure. The following figure shows an example of a direct-attach topology with two hosts and a dual-controller controller module or a dual-controller array module.

The example in the figure shows HBA1 and HBA2 as connecting points on the host. For other configurations, these connecting points might be host channel adapters (HCAs) for InfiniBand connections, Ethernet adapters for iSCSI connections, or a combination of one HBA and one iSCSI Ethernet adapter.

ATTENTION Possible loss of data access – You must install alternate path software or an alternate path (failover) driver on the host to support failover in the event of an HBA, HCA, or iSCSI Ethernet adapter failure or a host channel failure.

Table 4 Redundant and Non-Redundant Components in a Direct-Attached Configuration with Two Hosts and a Controller Module or a Array Module

Component	Redundant	Non-Redundant
Host/server (see note)	Redundant	
iSCSI Ethernet adapter, HBA, HCA, or SAS	Redundant	
Host-to-controller cable	Redundant	
Controller	Redundant	

Note – The hosts/servers in this example must be clustered to be redundant.

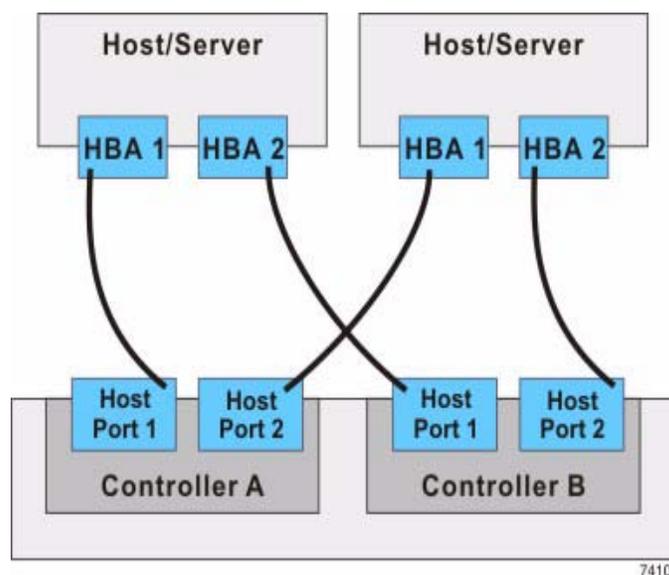


Figure 2 Direct-Attach Topology – Two Hosts and a Controller Module or a Array Module

One Single-HBA Host to a Single-Controller Controller Module or a Single-Controller Array Module

The following figure shows an example of a direct-attach topology with one host and a single-controller controller module or a single-controller array module. The following table describes which of the components in this topology are non-redundant and present a risk of a single point of failure.

Table 5 Direct-Attach Topology – One Host and a Single-Controller Controller Module or a Single-Controller Array Module

Component	Redundant	Non-Redundant
Host/server		Non-redundant
HBA		Non-redundant
Host-to-controller cable		Non-redundant
Controller		Non-redundant

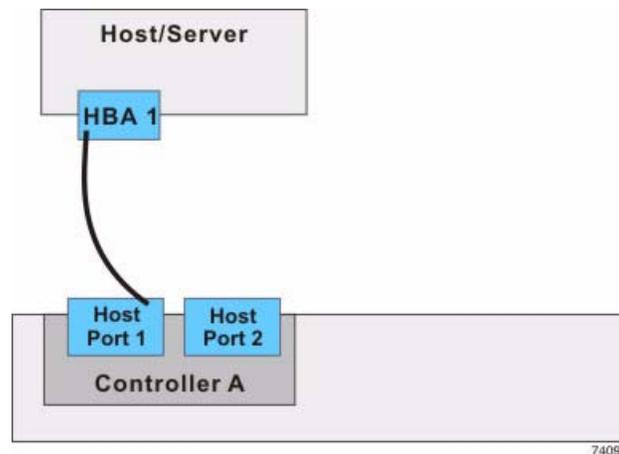


Figure 3 Single-HBA Host to a Single-Controller Controller Module or a Single-Controller Array Module

Switch Topologies

The host-to-controller module topologies or host-to-array module topologies presented in this section include one or more switches. The host adapters in the hosts might be HBAs for Fibre Channel, HCAs for InfiniBand, or Ethernet for iSCSI. Switches are not supported for SAS host connections.

When a host is cabled to a dual-controller array module or a dual-controller controller module, each attached host should have two host adapters installed. For redundancy, attach each of the host adapters to a different switch (or switch zone) so that one switch (or zone) connects to controller A and the other to controller B in the controller module or the array module. In the case where a host has one HBA and one iSCSI Ethernet adapter, the two connections might require two different types of switches.

One Host to a Controller Module or a Array Module

The following figure shows an example of a switch topology with one host, a controller module or a array module, and a zoned switch. The following table describes which of the components in this topology are non-redundant and present a risk of a single point of failure.

ATTENTION Possible loss of data access – You must install alternate path software or an alternate path (failover) driver on the host to support failover in the event of an HBA failure or a host channel failure.

Table 6 Redundant and Non-Redundant Components in a Switched Configuration with One Host and a Controller Module or a Array Module

Component	Redundant	Non-Redundant
Host/server		Non-redundant
Host adapter	Redundant	
Host-to-controller cable	Redundant	
Switch		Non-redundant
Controller	Redundant	

In the following figure, each outlined group of ports represents a zone.

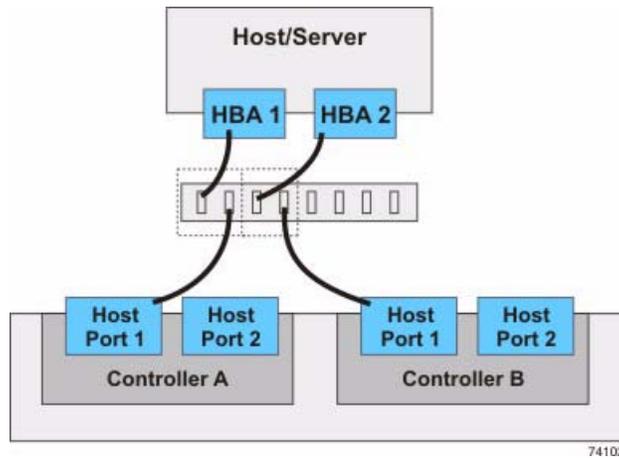


Figure 4 Switch Topology – One Host and a Controller Module or a Array Module with a Switch

Two Hosts to a Controller Module or a Array Module

The following figure shows an example of a switch topology with two hosts, a controller module or a array module, and a zoned switch. The following table describes which of the components in this topology are non-redundant and present a risk of a single point of failure.

ATTENTION Possible loss of data access – You must install alternate path software or an alternate path (failover) driver on the host to support failover in the event of an HBA failure or a host channel failure.

Table 7 Redundant and Non-Redundant Components in a Switched Configuration with Two Hosts and a Controller Module or a Array Module

Component	Redundant	Non-Redundant
Host/server (see note)	Redundant	
Host adapter	Redundant	
Host-to-controller cable	Redundant	
Switch		Non-redundant
Controller	Redundant	

Note – The hosts/servers in this example must be clustered to be redundant.

In the following figure, each outlined group of ports represents a zone.

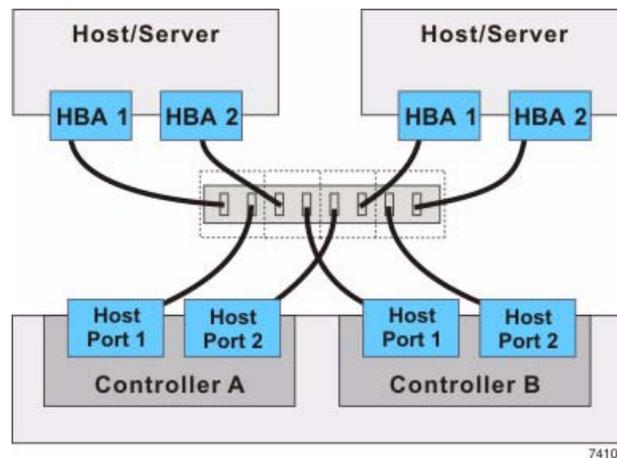


Figure 5 Switch Topology – Two Hosts and a Controller Module or a Array Module with a Zoned Switch

Four Hosts to a Controller Module or a Array Module

The following figure shows an example of a switch topology with four hosts, a controller module or a array module, and two zoned switches. The following table describes which of the components in this topology are non-redundant and present a risk of a single point of failure.

ATTENTION Possible loss of data access – You must install alternate path software or an alternate path (failover) driver on the host to support failover in the event of an HBA failure or a host channel failure.

Table 8 Redundant and Non-Redundant Components in a Switched Configuration with Four Hosts and a Controller Module or a Array Module

Component	Redundant	Non-Redundant
Host/server (see note)	Redundant	
Host adapter	Redundant	
Host-to-controller cable	Redundant	
Switch	Redundant	
Controller	Redundant	

Note – The hosts/servers in this example must be clustered to be redundant.

In the following figure, each outlined group of ports represents a zone.

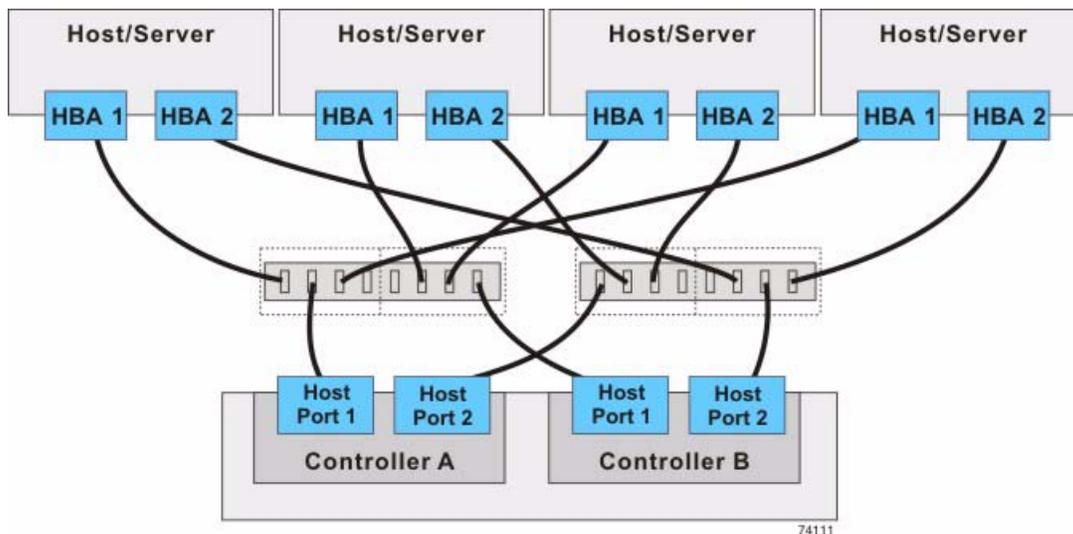


Figure 6 Switch Topology – Four Hosts and a Controller Module or a Array Module with Two Zoned Switches

Mixed Topologies

The following table describes which of the components in this topology are non-redundant and present a risk of a single point of failure. The following figure shows an example of a mixed topology; that is, a topology that combines both switch topology and direct-attach topology. This example shows three hosts, a controller module, and two switches.

The example in the figure identifies HBA1 and HBA2 on each host as connecting points. For other configurations, these connecting points might be Ethernet adapters for iSCSI connections, or a combination of one HBA and one iSCSI Ethernet adapter. Switches are not supported for SAS host connections.

When a host is cabled to a dual-controller array module or a dual-controller controller module, each attached host should have two host adapters installed. The host adapters might be HBAs for Fibre Channel or SAS, or Ethernet for iSCSI. For redundancy, attach each of the host adapters that connects through a switch to a different switch (or switch zone) so that one switch (or zone) connects to controller A and the other to controller B in the controller module or the array module. In the case where a host has one HBA and one iSCSI Ethernet adapter, the two connections might require two different types of switches. Redundancy for a host that attaches directly to a controller module or a array module requires that each host adapter attach to a different controller.

ATTENTION Possible loss of data access – You must install alternate path software or an alternate path (failover) driver on the host to support failover in the event of an HBA failure or a host channel failure.

Table 9 Redundant and Non-Redundant Components in a Mixed Configuration with Three Hosts and a Controller Module or a Array Module

Component	Redundant	Non-Redundant
Host/servers 1 and 2 (see note)	Redundant	
Host/server 3		Non-redundant
HBA or Ethernet iSCSI adapter	Redundant	
Host-to-controller cable	Redundant	

Component	Redundant	Non-Redundant
Switch	Redundant	
Controller	Redundant	

Note – The hosts/servers in this example must be clustered to be redundant.

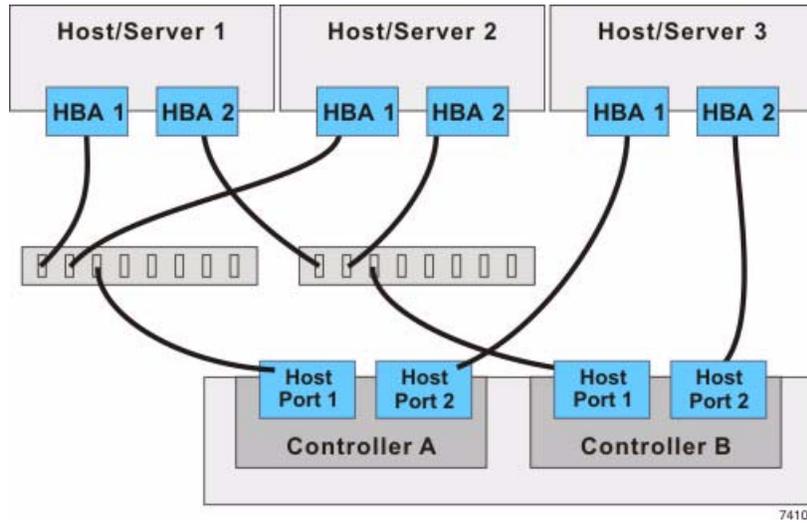


Figure 7 Mixed Topology – Three Hosts and a Controller Module

Chapter 4: Drive Cabling

This chapter provides examples of cabling between a controller module or an array module and the environmental services monitors (ESMs) of one or more expansion drive modules. This chapter also shows potential combinations of these products in storage array configurations.

NOTE Every example in this chapter provides redundant access to each drive.

See the topics under [Component Locations](#) for drive port locations on the specified controller module or array module and drive module models that you are installing.

Refer to the section that applies to the controller module or array module to which you are cabling the drive modules.

Drive Channel Redundancy for the 6580/6780 Controller Module and the 6780 Controller Module

Each controller has four drive channels, and each drive channel has two ports. Therefore, each controller has eight drive ports. A controller module has eight redundant path pairs that are formed using one drive channel of controller A and one drive channel of controller B. The following figure shows the redundant pairs in a controller module. The following table lists the numbers of the redundant path pairs and the drive ports of the drive channels from which the redundant path pairs are formed.

NOTE To maintain data access in the event of the failure of a controller, an ESM, or a drive channel, you must connect a drive module or multiple drive modules on a loop to both drive channels on a redundant path pair.

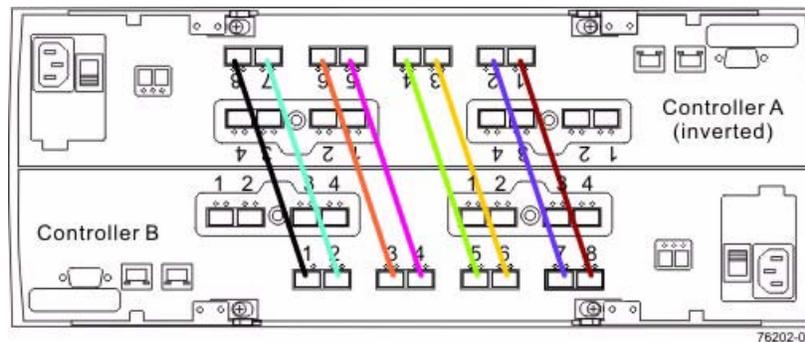


Figure 1 Redundant Path Pairs on the 6580/6780 Controller Module and the 6780 Controller Module
Table 1 Redundant Path Pairs on the 6580/6780 Controller Module and the 6780 Controller Module

Drive Ports on Controller A	Drive Channels on Controller A	Ports on Controller B	Drive Channels on Controller B
Port 8	Channel 1	Port 1	Channel 5
Port 7	Channel 1	Port 2	Channel 5
Port 6	Channel 2	Port 3	Channel 6
Port 5	Channel 2	Port 4	Channel 6
Port 4	Channel 3	Port 5	Channel 7
Port 3	Channel 3	Port 6	Channel 7
Port 2	Channel 4	Port 7	Channel 8
Port 1	Channel 4	Port 8	Channel 8

Drive Channel Redundancy for the 6540 Controller Module

Each controller has two drive channels, and each drive channel has two ports. Therefore, each controller has four drive ports. A controller module has four redundant path pairs that are formed using one drive channel of controller A and one drive channel of controller B. The following figure shows the redundant pairs in a controller module. The following table lists the numbers of the redundant path pairs and the drive ports of the drive channels from which the redundant path pairs are formed.

NOTE To maintain data access in the event of the failure of a controller, an ESM, or a drive channel, you must connect a drive module or a string of drive modules to both drive channels on a redundant path pair.

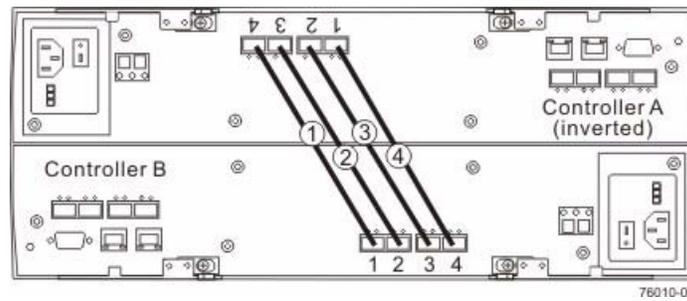


Figure 2 Redundant Path Pairs on the 6540 Controller Module

Table 2 Redundant Path Pairs on the 6540 Controller Module

Redundant Path Pairs	Drive Ports on Controller A	Drive Channels on Controller A	Ports on Controller B	Drive Channels on Controller B
1	Port 4	Channel 1	Port 1	Channel 3
2	Port 3	Channel 1	Port 2	Channel 3
3	Port 2	Channel 2	Port 3	Channel 4
4	Port 1	Channel 2	Port 4	Channel 4

Drive Channel Redundancy for the 6180 Array Module

Each controller has one drive channel, and each drive channel has two ports. Therefore, each controller has two drive ports. A array module has two redundant path pairs that are formed using one drive channel of controller A and one drive channel of controller B. The following figure shows the redundant pairs in a array module. The following table lists the numbers of the redundant path pairs and the drive ports of the drive channels from which the redundant path pairs are formed.

NOTE To maintain data access in the event of the failure of a controller, an ESM, or a drive channel, you must connect a drive module or a string of drive modules to both drive channels on a redundant path pair.

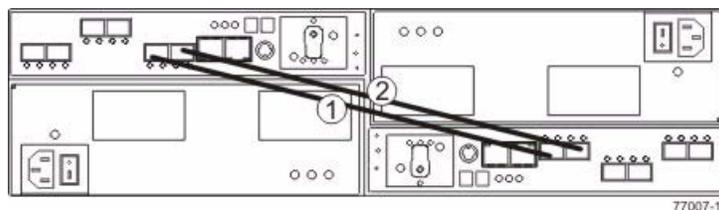


Figure 3 Redundant Path Pairs on the 6180 Array Module

Table 3 Redundant Path Pairs on the 6180 Array Module

Redundant Path Pairs	Drive Ports on Controller A	Drive Channels on Controller A	Ports on Controller B	Drive Channels on Controller B
1	Port 2	Channel 1	Port 1	Channel 2
2	Port 1	Channel 1	Port 2	Channel 2

Drive Channel Redundancy for the 6140 Array Module and the 6140 Array Module

Each controller has one drive channel, and each drive channel has two ports. Therefore, each controller has two drive ports. A array module has two redundant path pairs that are formed using one drive channel of controller A and one drive channel of controller B. The following figure shows the redundant pairs in a array module. The following table lists the numbers of the redundant path pairs and the drive ports of the drive channels from which the redundant path pairs are formed.

NOTE To maintain data access in the event of the failure of a controller, an ESM, or a drive channel, you must connect a drive module or a string of drive modules to both drive channels on a redundant path pair.

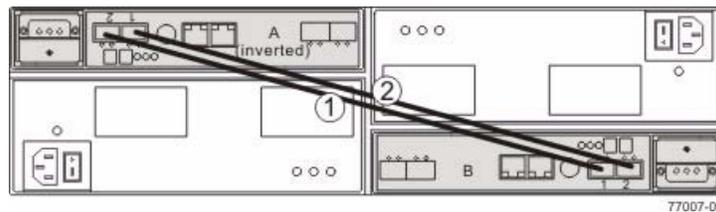


Figure 4 Redundant Path Pairs on the 6140 Array Module and the 6140 Array Module

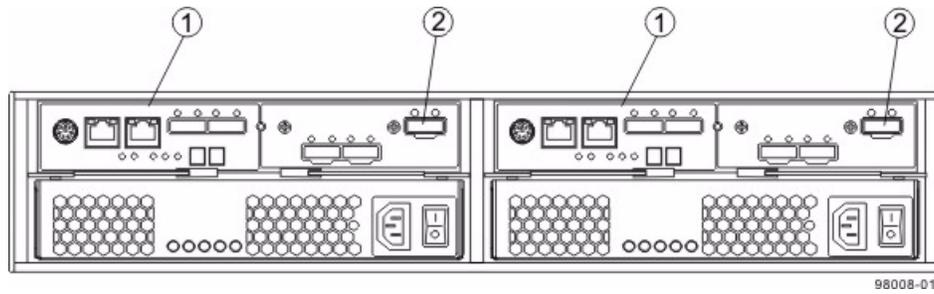
Table 4 Redundant Path Pairs on the 6140 Array Module and the 6140 Array Module

Redundant Path Pairs	Drive Ports on Controller A	Drive Channels on Controller A	Ports on Controller B	Drive Channels on Controller B
1	Port 2	Channel 1	Port 1	Channel 2
2	Port 1	Channel 1	Port 2	Channel 2

Drive Channel Redundancy for the ST2500 M2 Array Module

Each controller in a ST2500 M2 has one drive port. When a array module has two controllers, the drive port on controller A and the drive port on controller B form a redundant pair. The following figure shows the drive ports on a dual-controller configuration.

NOTE To maintain data access in the event of the failure of a controller, an ESM, or a drive channel, you must connect a drive module or a string of drive modules to both drive ports on a dual-controller configuration.



1. Controller CRUs
2. Drive Expansion Connectors (Redundant Path Pair)

Figure 5 Redundant Path Pair on the ST2500 M2 Array Module

ESM CRU Arrangements

Many of the figures in topics for drive cabling topologies show storage arrays that use drive modules with side-by-side ESMs. Each ESM CRU has one In port and one Out port (for Fibre Channel) or two SAS In ports and one SAS Expansion port (SAS). The CRUs are located adjacent to one another, as shown in the following figures.

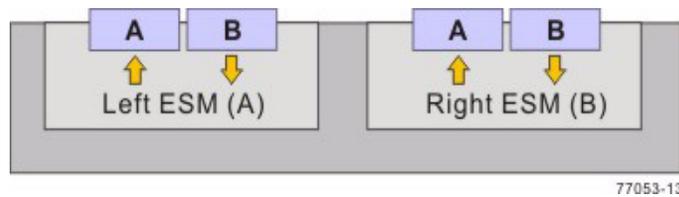


Figure 6 Drive Module with Side-by-Side ESMs (Fibre Channel)

The following figure shows a drive module with side-by-side ESMs and SAS ports.

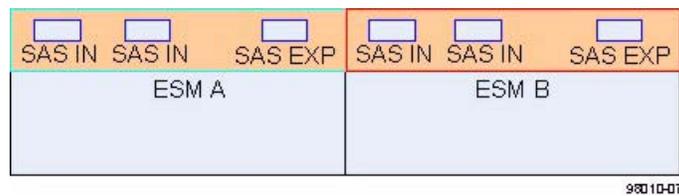


Figure 7 Drive Module with Side-by-Side ESMs (SAS)

The following figure shows another type of drive module. This type of drive module has inverted ESM CRUs. Other figures in this chapter show this type of drive module.

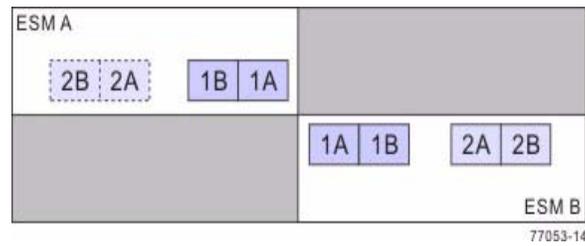


Figure 8 Drive Module with Inverted ESMs

The following figure shows a drive module with ESM CRUs one above the other.

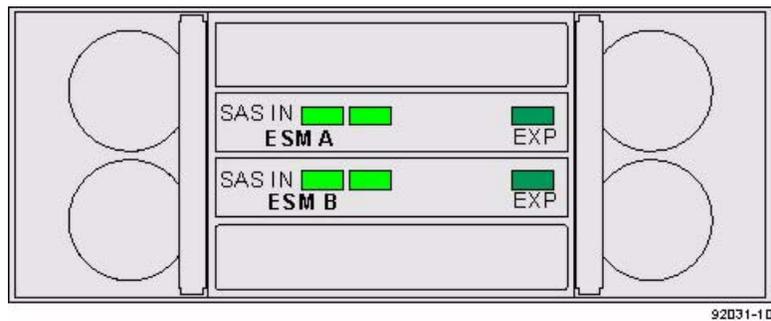


Figure 9 Drive Module with Stacked ESMs

Drive Cabling Topologies for the 6580/6780 Controller Module and the 6780 Controller Module

You can cable the 6780 controller module only to CSM200 drive modules. No more than seven drive modules may be cabled to one loop pair and no more than 28 total drive modules may be cabled to the controller module.

You can cable the 6580/6780 controller module to CSM200 drive modules. No more than seven CSM200 drive modules may be cabled to any one loop pair.

With a 6580/6780 controller module, CSM200 drive modules support solid-state drives (SSDs). A drive module may have both SSDs and hard disk drives. The maximum number of SSDs for the storage array is 20.

Cabling for the 6780 Controller Module or the 6580/6780 Controller Module and One to Four CSM200 Drive Modules

The figures and tables in this section show representative configurations for redundant cabling.

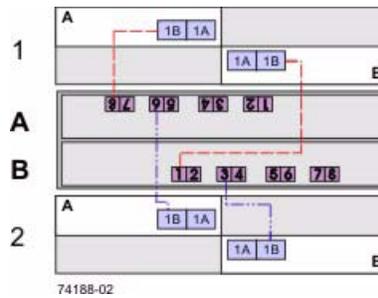


Figure 10 One 6780 Controller Module or 6580/6780 Controller Module and Two Drive Modules

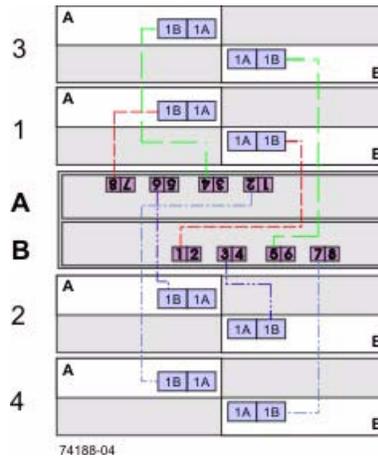


Figure 11 One 6780 Controller Module or 6580/6780 Controller Module and Four Drive Modules

The following table specifies the cabling pattern for a controller module that is attached to one to four drive modules. The “Cable” column indicates that two cables are used for each drive module. In the rows for cable 1 and cable 2, for example, the “Xs” indicate that the cables are connected to controller A, channel 1, port 8 and controller B, channel 5, port 1 respectively. The “Bs” in these rows indicate that the other ends of cable 1 and cable 2 are connected to port 1B of the left ESM (ESM A) and port 1B of the right ESM (ESM B) of drive module 1 respectively. This pattern continues, using even-numbered ports on controller A and odd-numbered ports on controller B for the first four drive trays.

Table 5 One 6780 Controller Module or 6580/6780 Controller Module and One to Four Drive Modules

Cable	Controller A				Controller B				Drive Modules															
	Channel Number				Channel Number				Drive Modules															
	Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	1	2	3	4	ESMs (Left or Right)											
	Port Number				Port Number				ESMs (Left or Right)															
	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	L	R	L	R	L	R	L	R
1	X																B							
2							X											B						
3			X																B					
4										X										B				
5				X																	B			

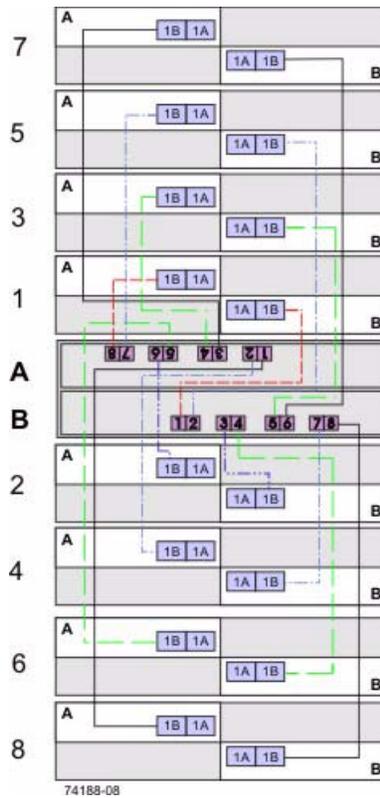


Figure 12 One 6780 Controller Module or 6580/6780 Controller Module and Eight Drive Modules

The following table specifies the cabling pattern for a controller module that is attached to five to eight drive modules. The “Cable” column indicates that two cables are used for each drive module. In the rows for cable 9 and cable 10, for example, the “Xs” indicate that the cables are connected to controller A, channel 1, port 7 and controller B, channel 5, port 2 respectively. The “Bs” in these rows indicate that the other ends of cable 9 and cable 10 are connected to port 1B of the left ESM1 and port 1B of the right ESM of drive module 5 respectively. This pattern continues, using odd-numbered ports on controller A and even-numbered ports on controller B for up to eight drive trays.

Table 6 One 6780 Controller Module or 6580/6780 Controller Module and Five to Eight Drive Modules

Cable	Controller A								Controller B								Drive Modules							
	Channel Number								Channel Number								Drive Modules							
	Ch1		Ch2		Ch3		Ch4		Ch5		Ch6		Ch7		Ch8		5	6	7	8				
	Port Number								Port Number								ESMs (Left or Right)							
8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	L	R	L	R	L	R	L	R	
9		X														B								
10									X								B							
11			X														B							
12										X								B						
13					X														B					

Cable	Controller A								Controller B								Drive Modules							
	Channel Number								Channel Number								Drive Modules							
	Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	5	6	7	8	5	6	7	8	5	6	7	8				
	Port Number								Port Number								ESMs (Left or Right)							
	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	L	R	L	R	L	R	L	R
14													X									B		
15							X															B		
16															X								B	

One 6780 Controller Module or 6580/6780 Controller Module and Nine to 16 CSM200 Drive Modules

When the number of drive modules exceeds eight, the cabling pattern changes significantly. From this point, you will begin to use the "A" ports on the ESMs, and connect the drive modules beyond the eighth one to another drive module.

If you add drive modules to an existing configuration so that the total number of drive modules attached to one controller module increases from eight or fewer to a total of more than eight, you must re-cable some of the drive modules that were previously cabled to that controller module. For each new drive module beyond the eighth one, in addition to adding two cables to attach the new drive module, you must move one cable on a previously installed drive module.

The following figure and table show an example where a ninth and tenth drive module have been added to a controller module that previously had eight drive modules. Cable 1 remains the same as in the previous configuration. The end of cable 2 that was previously connected to drive module 1 now connects to drive module 9. Cables 17 and 18 are added between drive module 1 and drive module 9 so that they now connect in series. Drive module 10 is added using connections to drive module 2 that follow the pattern of the connections between drive module 1 and drive module 9. Drive module 3 is not connected to another drive module, so its cabling remains the same (as it does for drive modules 4 to 8, which do not appear in the table).

You can cable up to 16 drive modules by following the pattern shown in this example.

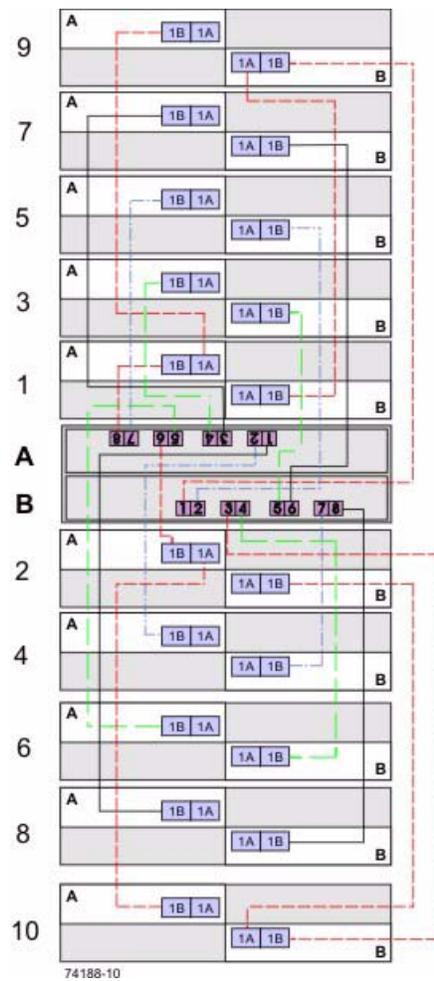


Figure 13 One 6780 Controller Module or 6580/6780 Controller Module and 10 Drive Modules
Table 7 One 6780 Controller Module or 6580/6780 Controller Module and 10 Drive Modules

Cable	Controller A								Controller B								Drive Modules												
	Channel Number				Channel Number				Channel Number				Channel Number				1		2		3		9		10				
	Port Number				Port Number				Port Number				Port Number				L		R		L		R		L		R		
	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	L	R	L	R	L	R	L	R	L	R	L	R	
1	X															B													
2								X																				B	
17																A						B							
18																	B											A	
3			X															B											
4										X																			B
19																		A										B	

Cable	Controller A								Controller B								Drive Modules							
	Channel Number				Channel Number				Channel Number				Channel Number				Drive Modules							
	Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	1	2	3	9	10											
	Port Number				Port Number				ESMs (Left or Right)															
	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	L	R	L	R	L	R	L	R
20																		B					A	
5				X															B					
6												X								B				

One 6780 Controller Module or 6580/6780 Controller Module and 17 to 28 CSM200 Drive Modules

You can add drive modules in series to each redundant pair of drive ports up to 28 drive modules. In a configuration with 28 drive modules, four of the port pairs will have four drive modules each, while the other four will have three drive modules each. The following figure shows this arrangement schematically. The physical arrangement of the drive modules in cabinets will depend on your particular installation.

The following table shows an example cabling pattern for adding three drive modules (drive modules 9, 17, and 25) in series with drive module 1. Add drive modules in series to each redundant pair of drive ports so that the number of drive modules for each pair of drive ports remains balanced, to the extent possible. For example, do not add a third drive module in series with drive module 1 on ports 8 and 1 if another pair of drive ports has only one drive module connected.

Table 8 One 6780 Controller Module or 6580/6780 Controller Module and Ten Drive Modules

Cable	Controller A								Controller B								Drive Modules							
	Channel Number				Channel Number				Channel Number				Channel Number				Drive Modules							
	Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	1	9	17	25												
	Port Number				Port Number				ESMs (Left or Right)															
	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	L	R	L	R	L	R	L	R
1	X															B								
2								X															B	
17																A		B						
18																	B		A					
33																		A		B				
34																			B		A			
49																				A		B		
50																					B		A	

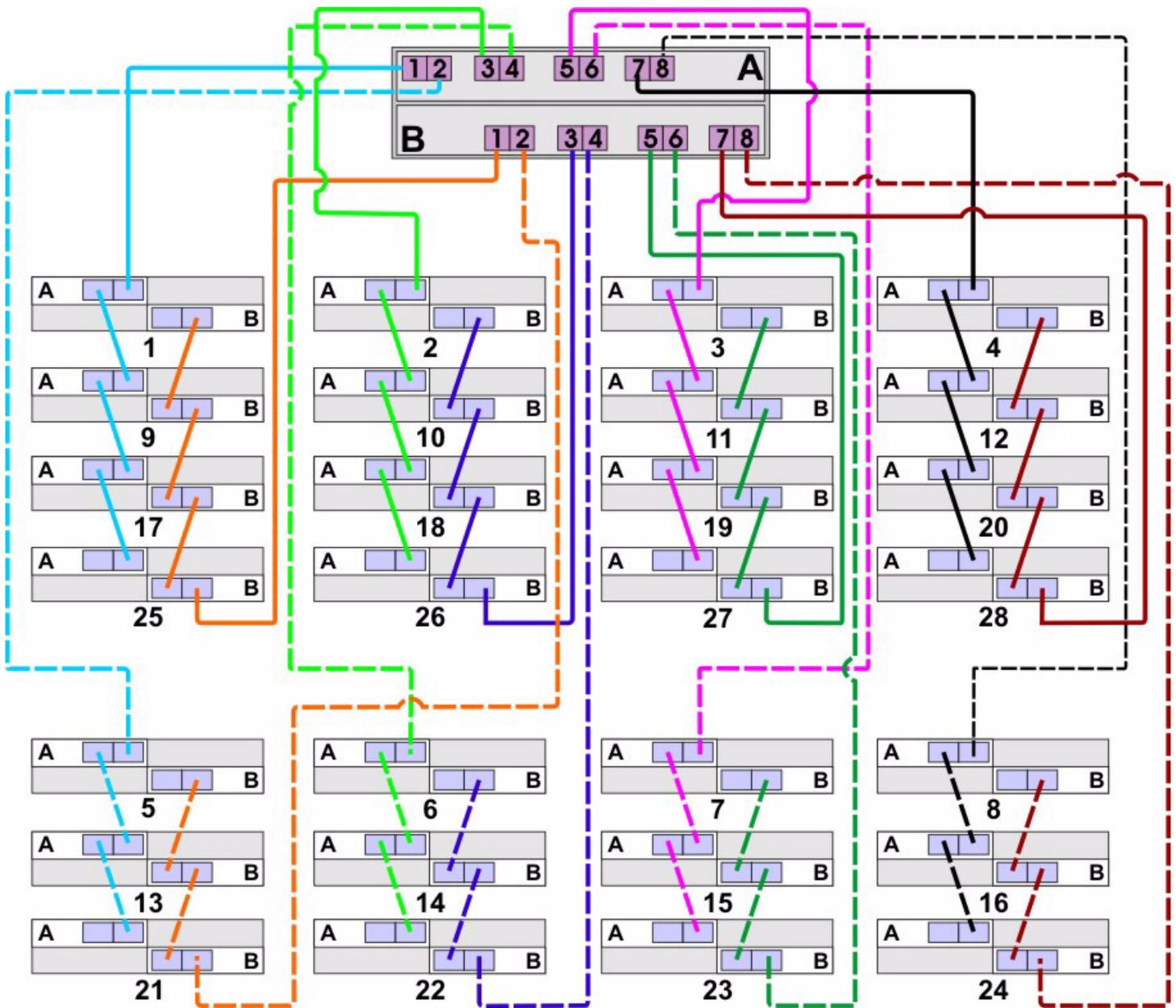


Figure 14 One 6780 or 6580/6780 Controller Module and 28 Drive Modules

Drive Cabling Topologies for the 6540 Controller Module

One 6540 Controller Module and One Drive Module

If you are cabling one 6540 controller module to one drive module, use the cabling topology shown in the following table and figure.

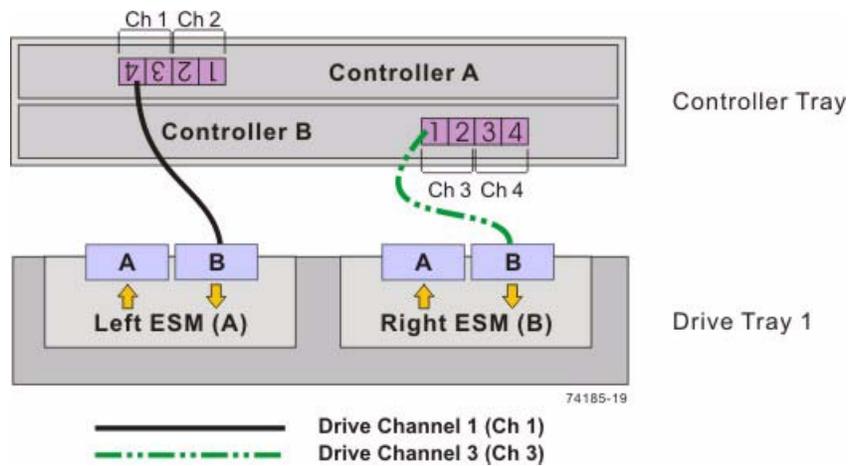


Figure 15 One 6540 Controller Module and One Drive Module

Table 9 One 6540 Controller Module and One Drive Module

Drive Channel	Connection Point		Connection Point	
	Module or Component	Port Number and Location	Module or Component	Port Number and Location
1	Controller A	4	Drive module 1	Left ESM, port B
3	Controller B	1	Drive module 1	Right ESM, port B

NOTE If you have drive modules with inverted ESM CRUs, see [ESM CRU Arrangements](#).

One 6540 Controller Module and Two Drive Modules

If you are cabling one 6540 controller module to two drive modules, use the cabling topology described in the following table and figure.

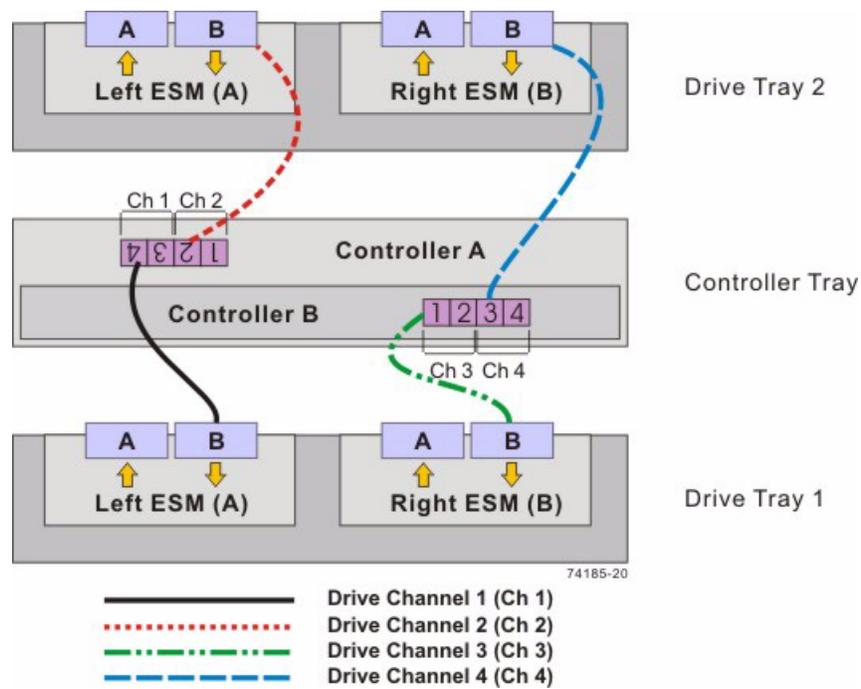


Figure 16 One 6540 Controller Module and Two Drive Modules
Table 10 One 6540 Controller Module and Two Drive Modules

Drive Channel	Connection Point		Connection Point	
	Module or Component	Port Number and Location	Module or Component	Port Number and Location
1	Controller A	4	Drive module 1	Left ESM, port B
2	Controller A	2	Drive module 2	Left ESM, port B
3	Controller B	1	Drive module 1	Right ESM, port B
4	Controller B	3	Drive module 2	Right ESM, port B

NOTE If you have drive modules with inverted ESM CRUs, see [ESM CRU Arrangements](#).

One 6540 Controller Module and Four Drive Modules

If you are cabling one 6540 controller module to four drive modules, use the cabling topology shown in the following figure and table.

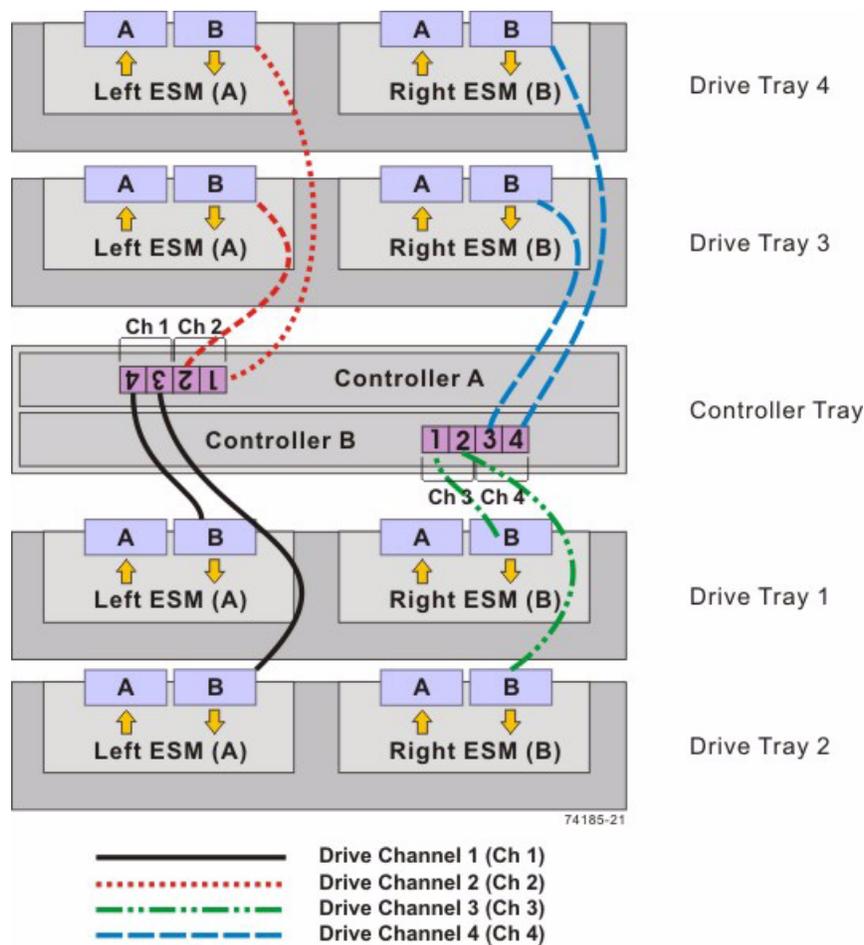


Figure 17 One 6540 Controller Module and Four Drive Modules

Table 11 One 6540 Controller Module and Four Drive Modules

Drive Channel	Connection Point		Connection Point	
	Module or Component	Port Number and Location	Module or Component	Port Number and Location
1	Controller A	4	Drive module 1	Left ESM, port B
	Controller A	3	Drive module 2	Left ESM, port B
2	Controller A	2	Drive module 3	Left ESM, port B
	Controller A	1	Drive module 4	Left ESM, port B
3	Controller B	1	Drive module 1	Right ESM, port B
	Controller B	2	Drive module 2	Right ESM, port B
4	Controller B	3	Drive module 3	Right ESM, port B
	Controller B	4	Drive module 4	Right ESM, port B

NOTE If you have drive modules with inverted ESM CRUs, see [ESM CRU Arrangements](#).

One 6540 Controller Module and Eight Drive Modules

If you are cabling one 6540 controller module to eight drive modules, use the cabling topology described in the following table and figure.

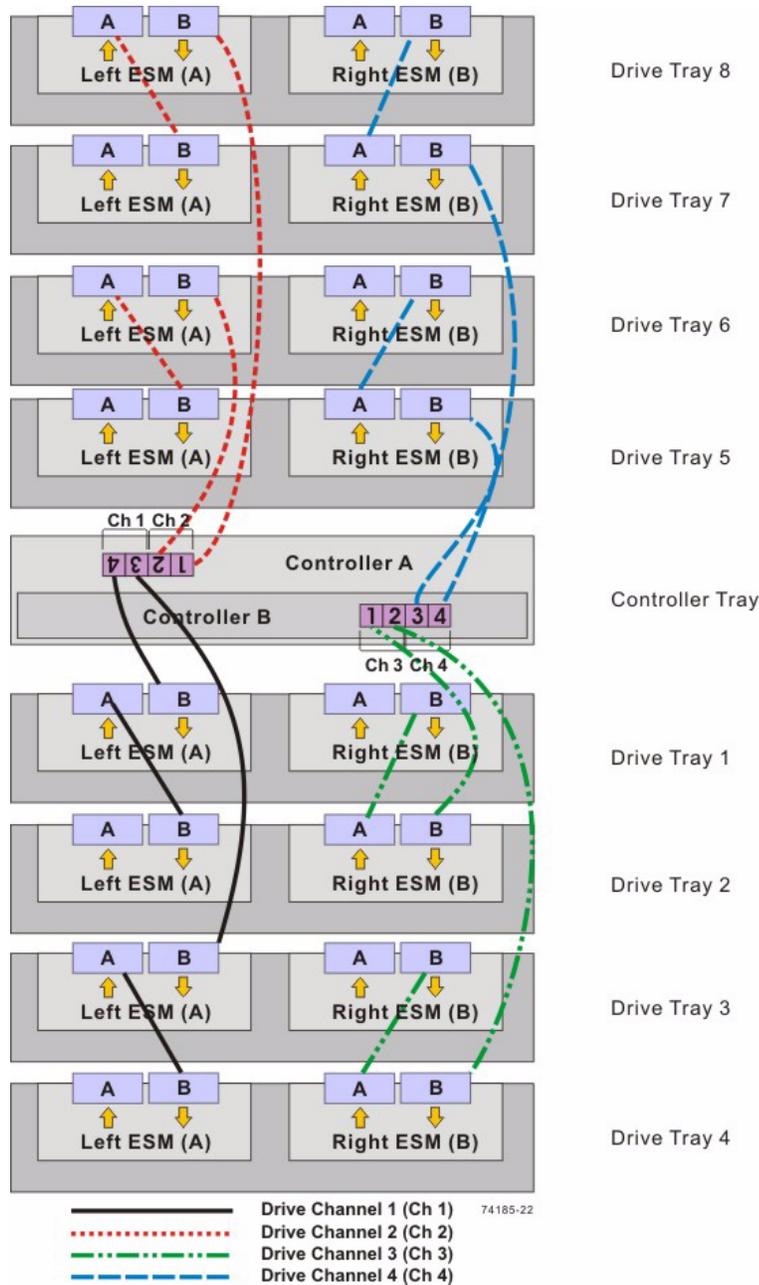


Figure 18 One 6540 Controller Module and Eight Drive Modules

Table 12 One 6540 Controller Module and Eight Drive Modules

Drive Channel	Connection Point		Connection Point	
	Module or Component	Port Number and Location	Module or Component	Port Number and Location
1	Controller A	4	Drive module 1	Left ESM, port B
	Drive module 1		Drive module 2	Left ESM, port B
	Controller A	3	Drive module 3	Left ESM, port B
	Drive module 3		Drive module 4	Left ESM, port B
2	Controller A	2	Drive module 6	Left ESM, port B
	Drive module 6		Drive module 5	Left ESM, port B
	Controller A	1	Drive module 8	Left ESM, port B
	Drive module 8		Drive module 7	Left ESM, port B
3	Controller B	1	Drive module 2	Right ESM, port B
	Drive module 2		Drive module 1	Right ESM, port B
	Controller B	2	Drive module 4	Right ESM, port B
	Drive module 4		Drive module 3	Right ESM, port B
4	Controller B	3	Drive module 5	Right ESM, port B
	Drive module 5		Drive module 6	Right ESM, port B
	Controller B	4	Drive module 7	Right ESM, port B
	Drive module 7		Drive module 8	Right ESM, port B

NOTE If you have drive modules with inverted ESM CRUs, see [ESM CRU Arrangements](#).

One 6540 Controller Module and Multiple Types of Drive Modules

If you are cabling more than one type of drive module to the 6540 controller module, read these topics before you choose a cabling topology:

- Guidelines for Cabling FC2610 Drive Trays or FC4600 Drive Trays
- Guidelines for Cabling AT2655 Drive Trays

Follow these guidelines for cabling multiple types of drive modules to maximize performance and accessibility.

Guidelines for Cabling CSM100 Drive Modules or CSM200 Drive Modules

Follow these guidelines for cabling a topology with multiple types of drive modules, including the CSM100 drive modules or the CSM200 drive modules.

- If your storage array includes CSM100 drive modules or CSM200 drive modules, cable the CSM100 drive modules or the CSM200 drive modules so that they are the first devices on the drive channel (after controller A). The first device on the drive channel is distinguished by the fact that the left ESM of the first device is cabled directly to controller A of the controller module. Because an optimal redundant cabling topology requires that the redundant drive channel be cabled in the opposite order, this same device will be the last in the drive channel when cabled to controller B.
- Evenly distribute the CSM100 drive modules or the CSM200 drive modules in pairs or multiples across redundant pairs of the available drive channels.

- Do not cable a single CSM100 drive module or a single CSM200 drive module on a drive channel unless it is the only CSM100 drive module or CSM200 drive module in the storage array.

Guidelines for Cabling CSM100 Drive Modules

Follow these guidelines for cabling a topology with multiple drive module types, including CSM100 drive modules.

- If your storage array includes CSM100 drive modules, cable the CSM100 drive modules so that they are the last devices on the drive channel (from a top-down cabling perspective).
- Distribute CSM100 drive modules across redundant pairs of drive channels to equalize the number of drive modules on the available channels.

In the following figure, the CSM100 drive modules and the CSM200 drive modules are identified as SBODs (Switched Bunch of Disks). The CSM100 drive module is identified as SATA (Serial Advanced Technology Attachment).

NOTE When you mix different types of drive modules, you must consider the total number of drives that are available in the final configuration of the storage array. For example, if you mix CSM200 drive modules with CSM100 drive modules, the total number of drives might be more than the maximum number that each drive channel can support.

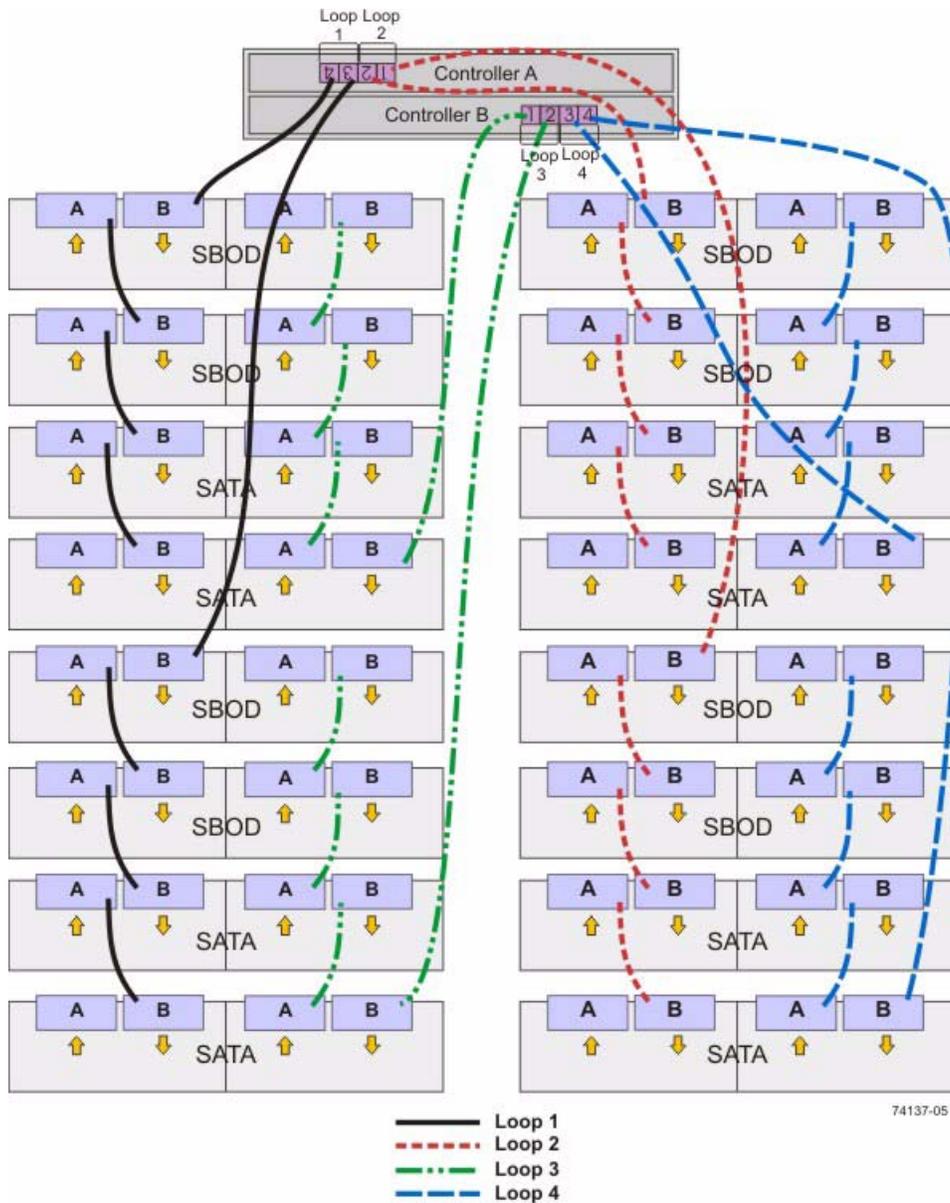


Figure 19 One 6540 Controller Module and Multiple Types of Drive Modules

NOTE If you have drive modules with inverted ESM CRUs, see [ESM CRU Arrangements](#).

Drive Cabling Topologies for the 6180 Array Module

This section provides examples of drive cabling topologies that can be used for cabling the 6180 array module to CSM200 drive modules. Depending on the number of drive modules that you need to connect, see the applicable figure for a cabling configuration. Each example provides redundant paths to the drives. The total number of drives in the storage array, including the drives in the array module and those in the drive modules, must not exceed 112.

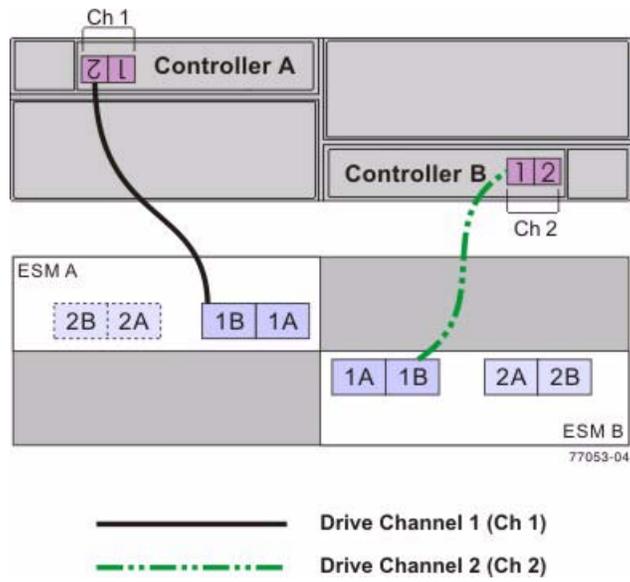


Figure 20 One 6180 Array Module and One CSM200 Drive Module

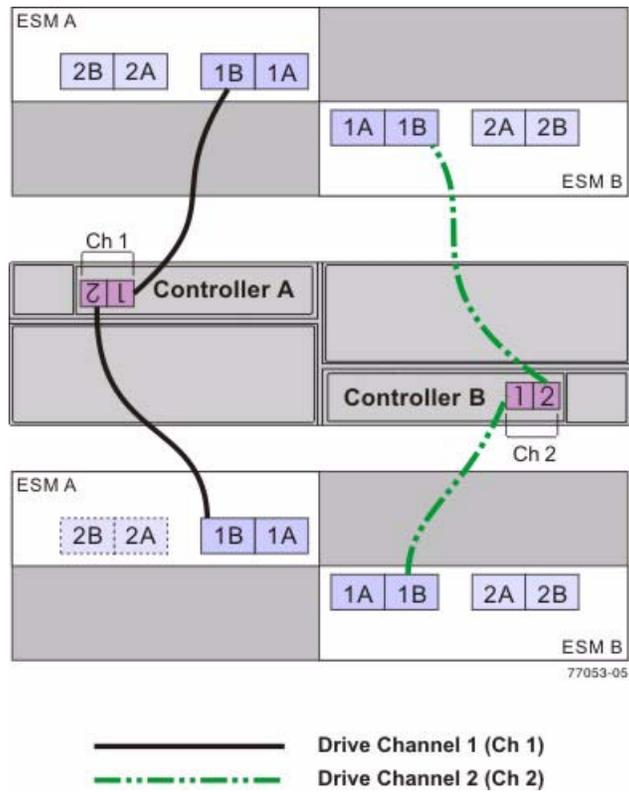


Figure 21 One 6180 Array Module and Two CSM200 Drive Modules

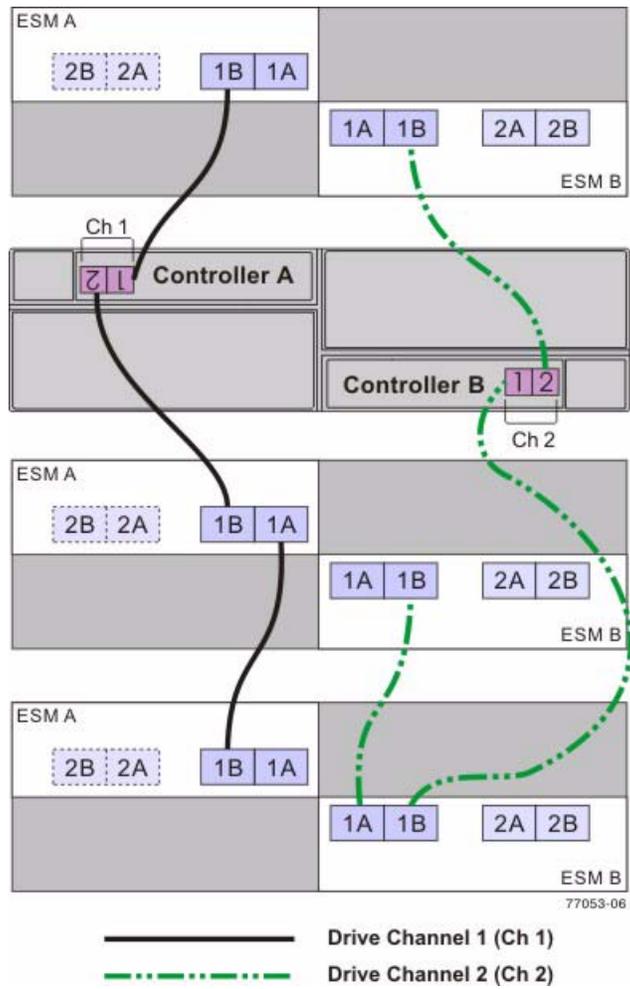


Figure 22 One 6180 Array Module and Three CSM200 Drive Modules

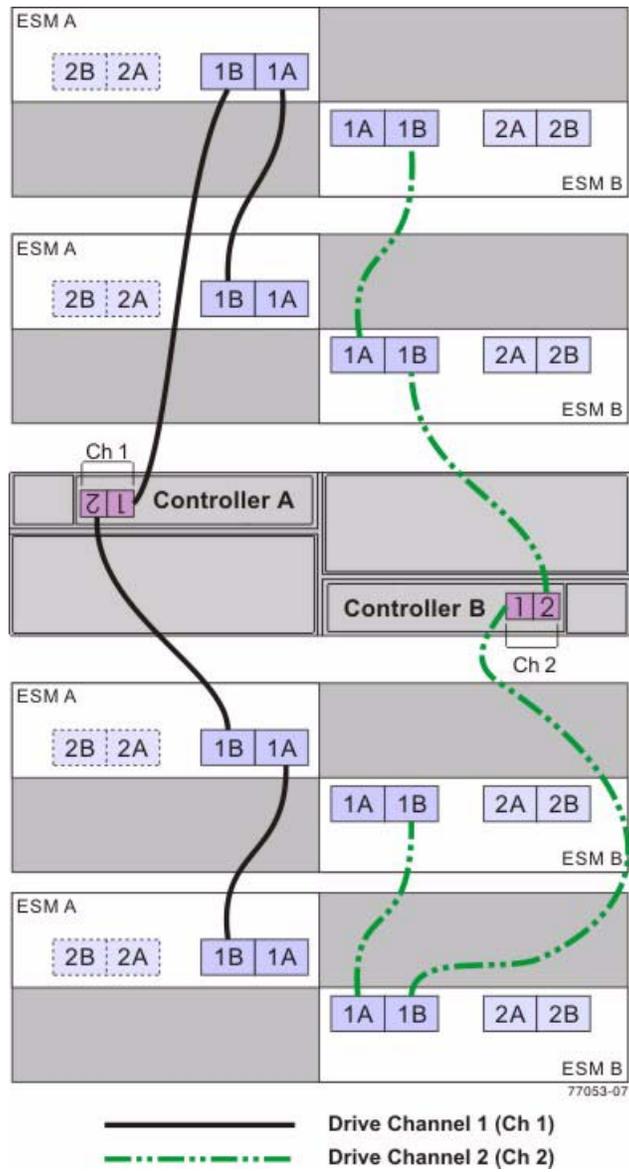


Figure 23 One 6180 Array Module and Four CSM200 Drive Modules

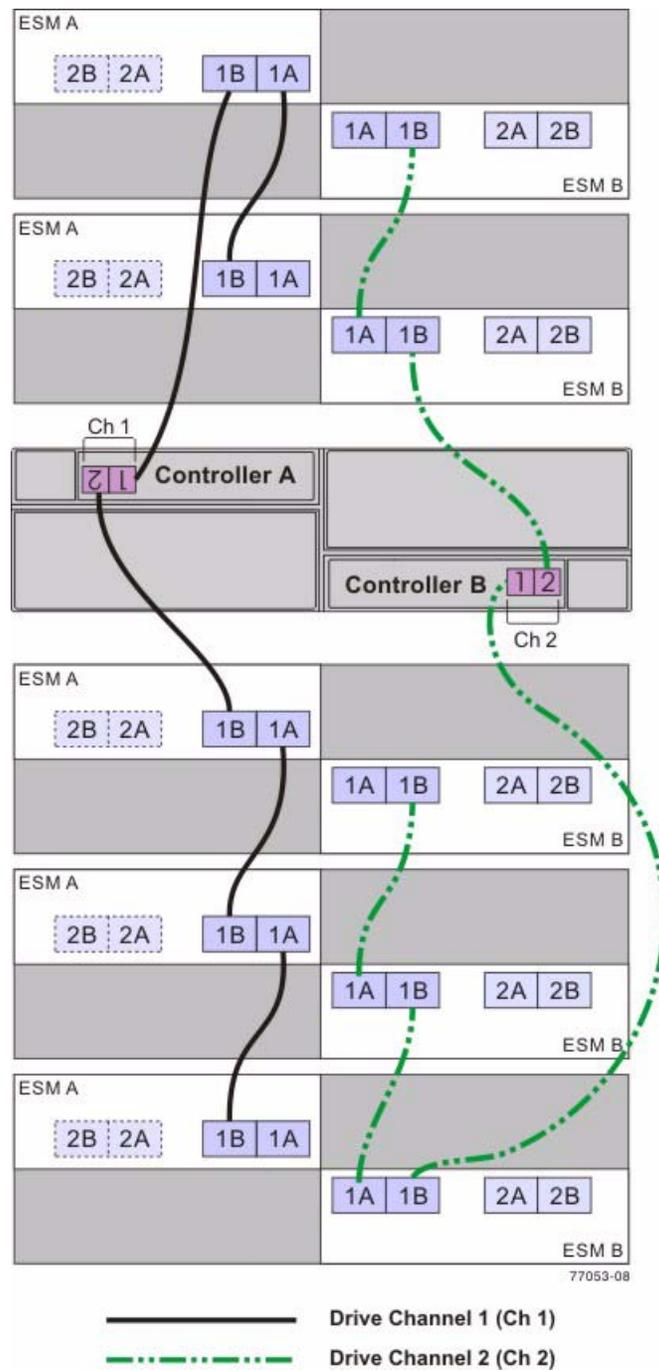


Figure 24 One 6180 Array Module and Five CSM200 Drive Modules

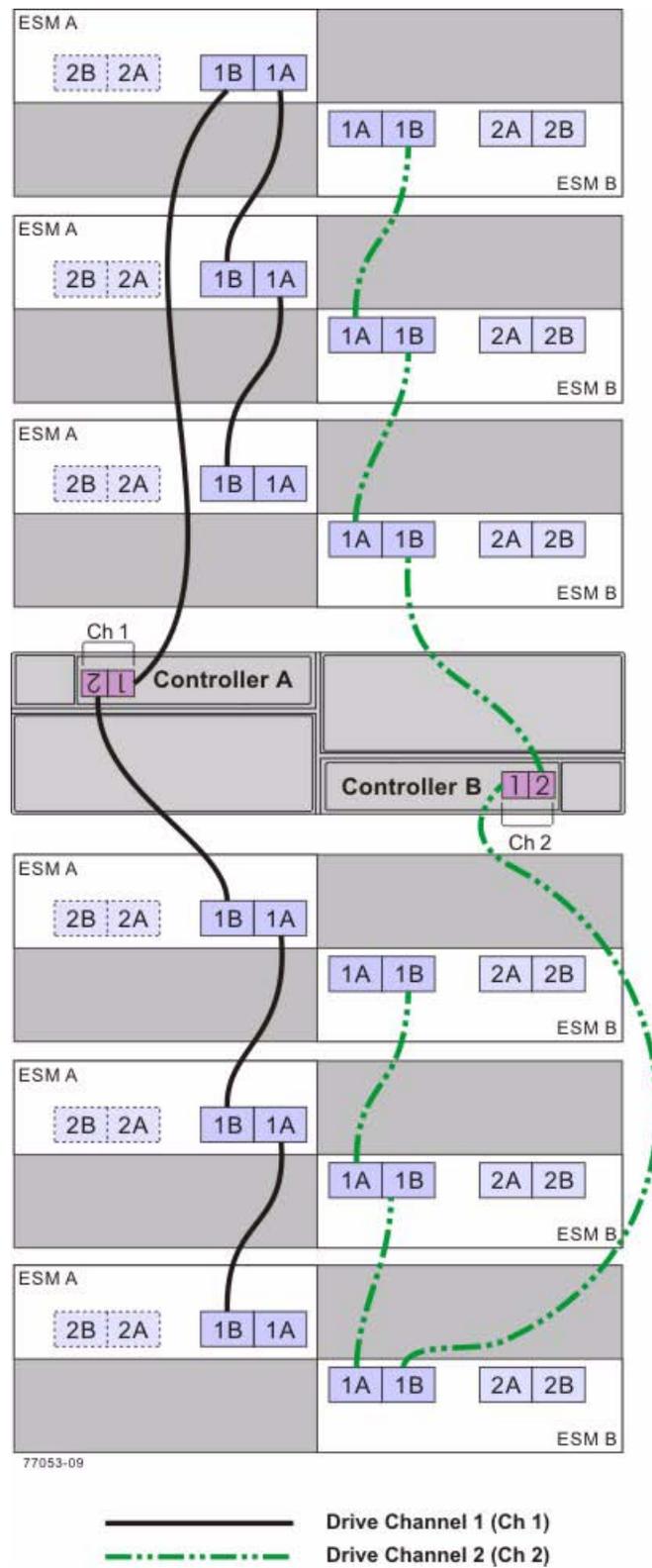


Figure 25 One 6180 Array Module and Six CSM200 Drive Modules

Drive Cabling Topologies for the 6140 Array Module and the 6140 Array Module

This section provides examples of drive cabling topologies that can be used for the 6140 array module. The controllers on the lower-cost 6140 array module have two host ports and two drive ports. The controllers on the higher-cost 6140 array module have four host ports and two drive ports.

Each example provides redundant paths to the drives. If one of these examples is suitable for your hardware and application, complete the cabling connections as described by the tables. However you decide to implement your cabling, follow the recommendations in [Best Practices](#) to make sure that data has full availability.

One 6140 Array Module or 6140 Array Module and One Drive Module

If you are cabling one 6140 array module to one drive module, and that drive module has inverted ESM CRUs, use the cabling topology described in the following table and figure.

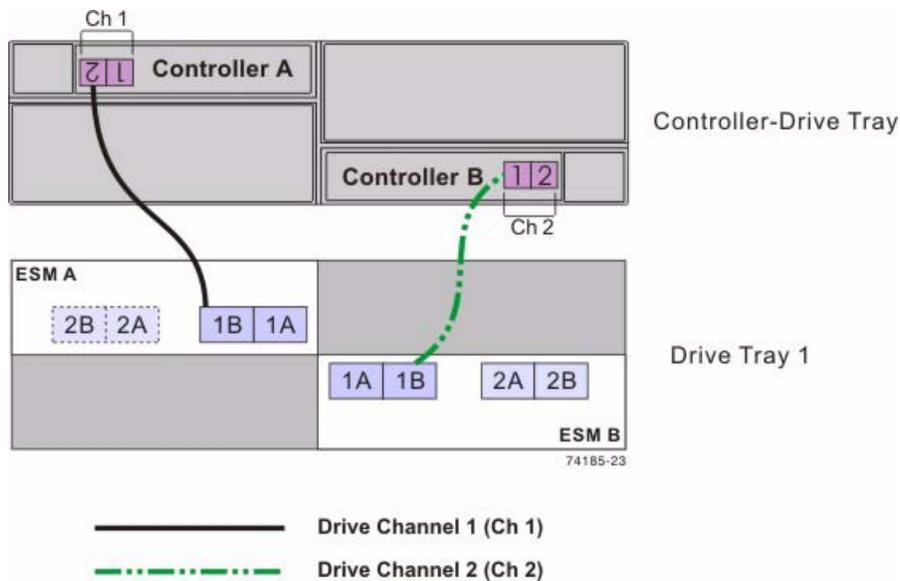


Figure 26 One 6140 Array Module and One Drive Module with Inverted ESMs

Table 13 One 6140 Array Module and One Drive Module with Inverted ESMs

Drive Channel	Connection Point		Connection Point	
	Module or Component	Port Number and Location	Module or Component	Port Number and Location
1	Controller A	2	Drive module 1	ESM A, port 1B
2	Controller B	1	Drive module 1	ESM B, port 1A

NOTE If you have drive modules with inverted ESM CRUs, see [ESM CRU Arrangements](#).

One 6140 Array Module or 6140 Array Module and Two Drive Modules

If you are cabling one 6140 array module to two drive modules, and those drive modules have inverted ESM CRUs, use the cabling topology shown in the following table and figure.

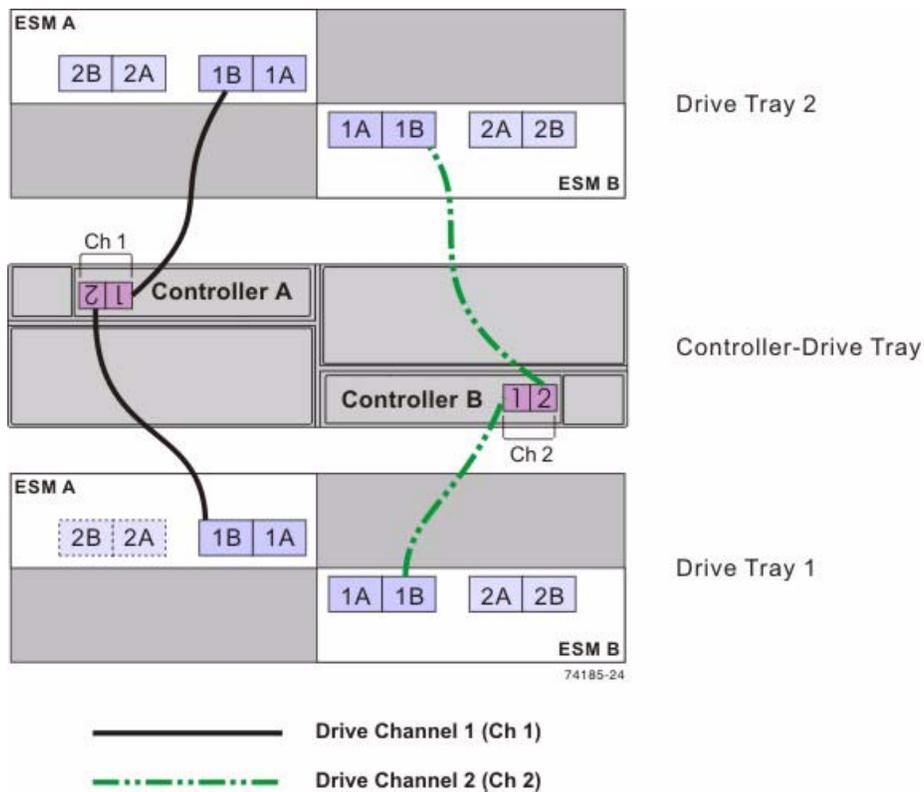


Figure 27 One 6140 Array Module and Two Drive Modules with Inverted ESMs
Table 14 One 6140 Array Module and Two Drive Modules with Inverted ESMs

Drive Channel	Connection Point		Connection Point	
	Module or Component	Port Number and Location	Module or Component	Port Number and Location
1	Controller A	1	Drive module 2	ESM A, port 1B
	Controller A	2	Drive module 1	ESM A, port 1A
2	Controller B	1	Drive module 1	ESM B, port 1B
	Controller B	2	Drive module 2	ESM B, port 1A

NOTE If you have drive modules with inverted ESM CRUs, see [ESM CRU Arrangements](#).

One 6140 Array Module or 6140 Array Module and Three Drive Modules

If you are cabling one 6140 array module to three drive modules, and those drive modules have inverted ESM CRUs, use the cabling topology described in the following table and figure.

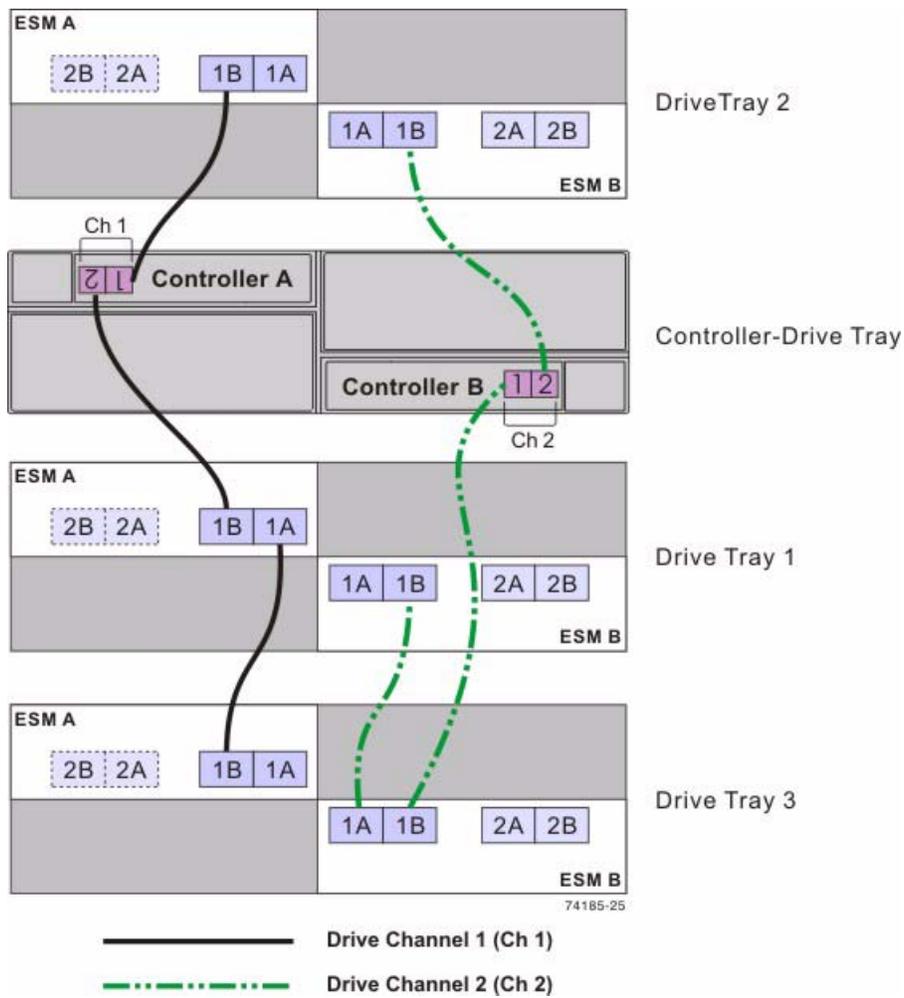


Figure 28 One 6140 Array Module and Three Drive Modules with Inverted ESMs
Table 15 One 6140 Array Module and Three Drive Modules with Inverted ESMs

Drive Channel	Connection Point		Connection Point	
	Module or Component	Port Number and Location	Module or Component	Port Number and Location
1	Controller A	1	Drive module 2	ESM A, Port 1B
	Controller A	2	Drive module 1	ESM A, Port 1B
	Drive module 1	ESM B, Port 1A	Drive module 3	ESM A, Port 1B
2	Controller B	1	Drive module 3	ESM B, Port 1B
	Drive module 3	ESM B, Port 1A	Drive module 1	ESM B, Port 1B
	Controller B	2	Drive module 2	ESM B, Port 1B

NOTE If you have drive modules with inverted ESM CRUs, see [ESM CRU Arrangements](#).

One 6140 Array Module or 6140 Array Module and Four Drive Modules

If you are cabling one 6140 array module to four drive modules, and those drive modules have inverted ESM CRUs, use the cabling topology described in the following figure and table.

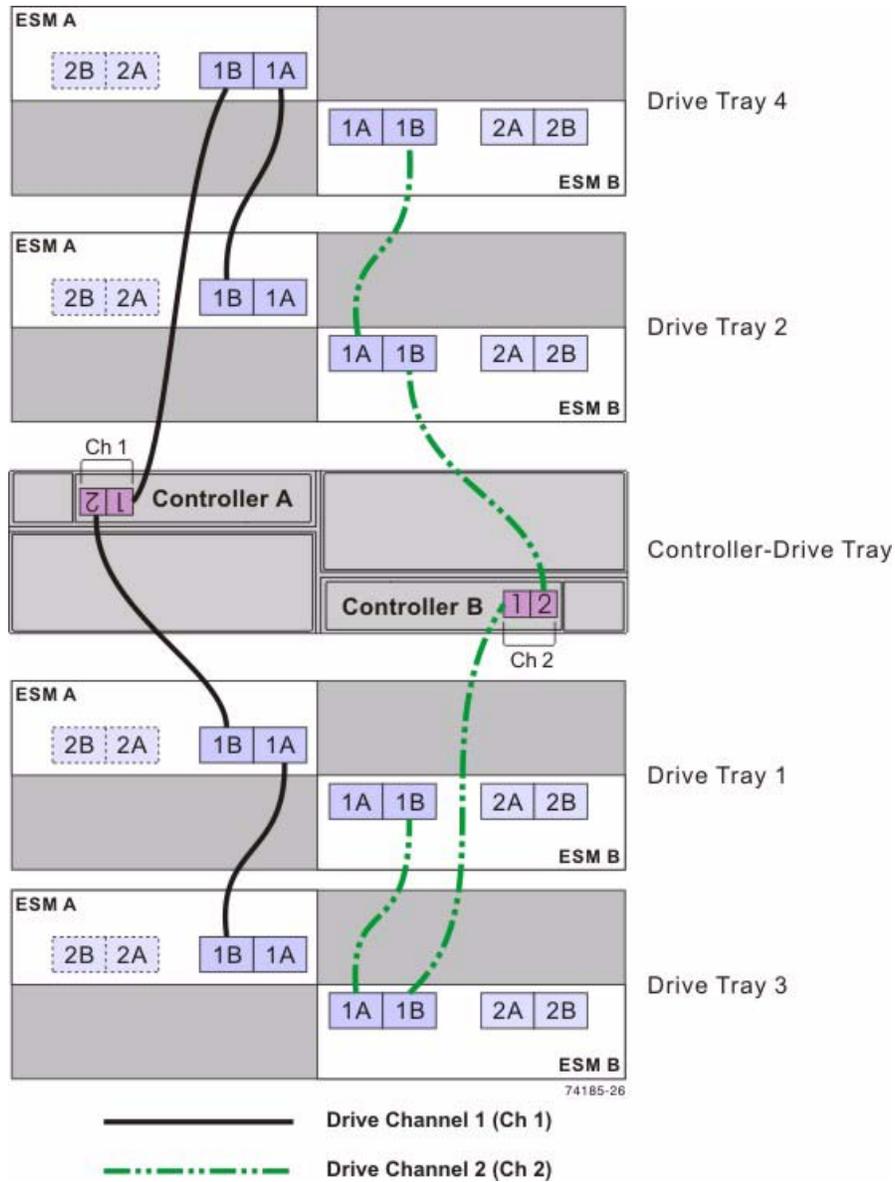


Figure 29 One 6140 Array Module and Four Drive Modules with Inverted ESMs

Table 16 One 6140 Array Module and Four Drive Modules with Inverted ESMs

Drive Channel	Connection Point		Connection Point	
	Module or Component	Port Number and Location	Module or Component	Port Number and Location
1	Controller A	1	Drive module 4*	ESM A, port 1B
	Drive module 4*	ESM A, port 1A	Drive module 2*	ESM A, port 1B
	Controller A	2	Drive module 1*	ESM A, port 1B
	Drive module 1*	ESM A, port 1A	Drive module 3*	ESM A, port 1B
2	Controller B	1	Drive module 3*	ESM B, port 1B
	Drive module 3*	ESM B, port 1A	Drive module 1*	ESM B, port 1B
	Controller B	2	Drive module 2*	ESM B, port 1B
	Drive module 2*	ESM B, port 1A	Drive module 4*	ESM B, port 1B

*The firmware that controls the array module automatically assigns drive module module IDs to the CSM200 drive modules that will usually not match the drive module numbers shown in this table and preceding figure. The cabling is not affected by the assignment of drive module module IDs by the firmware.

NOTE If you have drive modules with inverted ESM CRUs, see [ESM CRU Arrangements](#).

One 6140 Array Module or 6140 Array Module and Five Drive Modules

If you are cabling one 6140 array module to five drive modules, and those drive modules have inverted ESM CRUs, use the cabling topology described in the following figure and table.

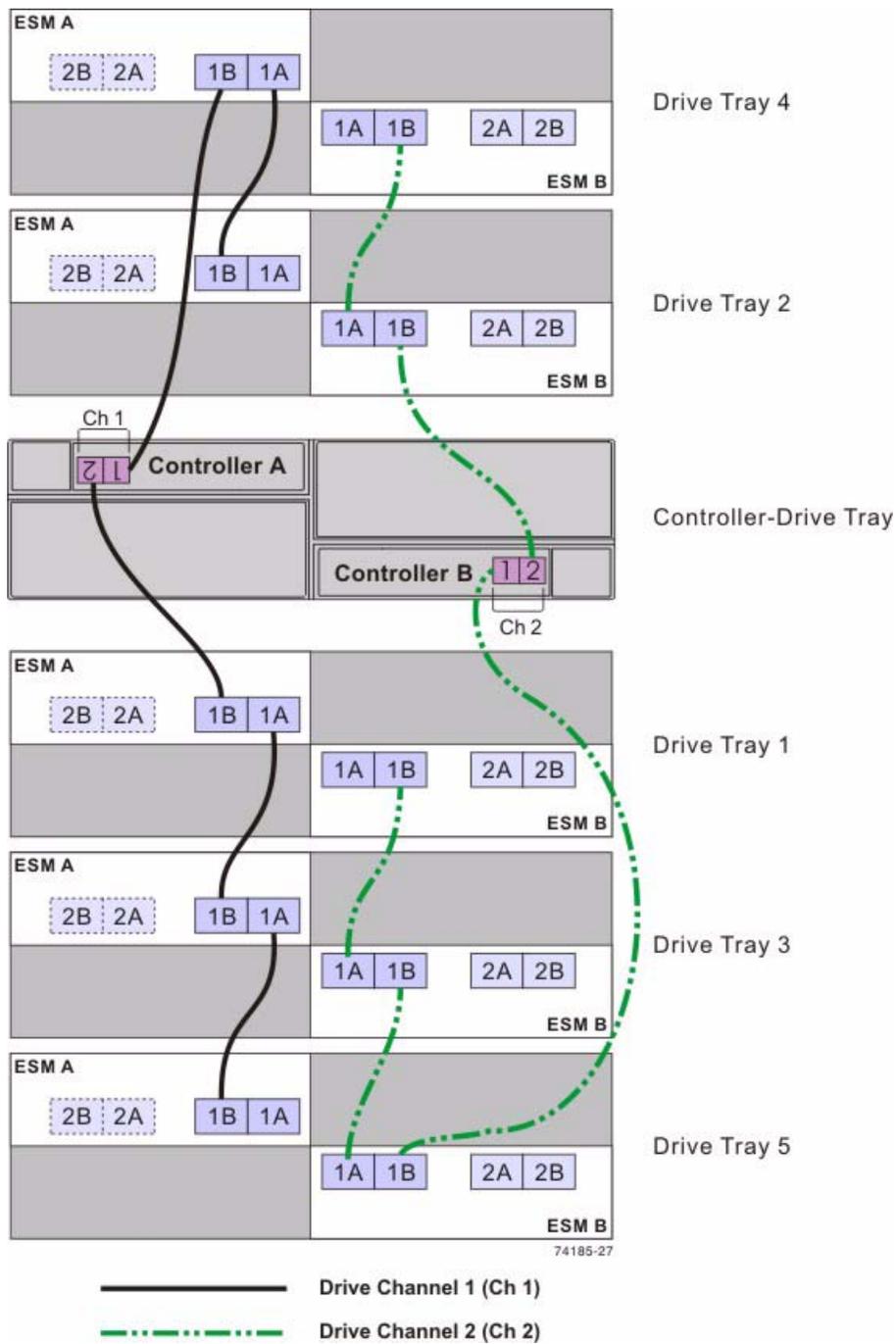


Figure 30 One 6140 Array Module and Five Drive Modules with Inverted ESMs

Table 17 One 6140 Array Module and Five Drive Modules with Inverted ESMs

Drive Channel	Connection Point		Connection Point	
	Module or Component	Port Number and Location	Module or Component	Port Number and Location
1	Controller A	1	Drive module 4	ESM A, port 1B
	Drive module 4	ESM A, port 1A	Drive module 2	ESM A, port 1B
	Controller A	2	Drive module 1	ESM A, port 1B
	Drive module 1	ESM A, port 1A	Drive module 3	ESM A, port 1B
	Drive module 3	ESM A, port 1A	Drive module 5	ESM A, port 1B
2	Controller B	1	Drive module 5	ESM B, port 1B
	Drive module 5	ESM B, port 1A	Drive module 3	ESM B, port 1B
	Drive module 3	ESM B, port 1A	Drive module 1	ESM B, port 1B
	Controller B	2	Drive module 2	ESM B, port 1B
	Drive module 2	ESM B, port 1A	Drive module 4	ESM B, port 1B

NOTE If you have drive modules with inverted ESM CRUs, see [ESM CRU Arrangements](#).

One 6140 Array Module or 6140 Array Module and Six Drive Modules

If you are cabling one 6140 array module to six drive modules, and those drive modules have inverted ESM CRUs, use the cabling topology shown in the following table and figure.

NOTE The 6140 array module supports a maximum of seven drive modules. However, if you are using the CSM200 drive module in your configuration, plan for a limit of six CSM200 drive modules. Seven CSM200 drive modules fully populated with drives exceed the maximum number of drives supported on a single drive channel.

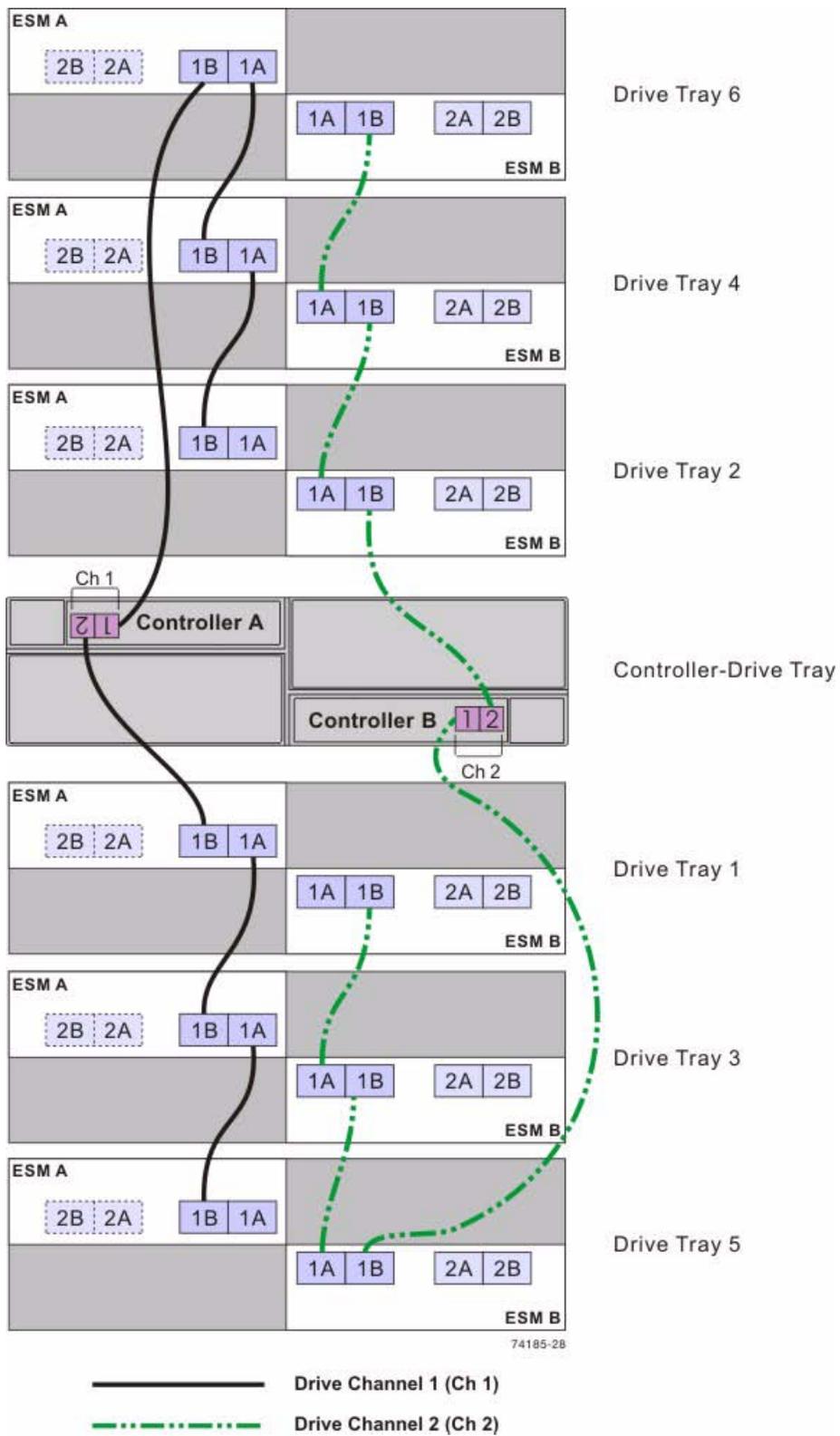


Figure 31 One 6140 Array Module and Six Drive Modules with Inverted ESMs

Table 18 One 6140 Array Module and Six Drive Modules with Inverted ESMs

Drive Channel	Connection Point		Connection Point	
	Module or Component	Port Number and Location	Module or Component	Port Number and Location
1	Controller A	1	Drive module 6*	ESM A, port 1B
	Drive module 6*	ESM A, port 1A	Drive module 4*	ESM A, port 1B
	Drive module 4*	ESM A, port 1A	Drive module 2*	ESM A, port 1B
	Controller A	2	Drive module 1*	ESM A, port 1B
	Drive module 1*	ESM A, port 1A	Drive module 3*	ESM A, port 1B
	Drive module 3*	ESM A, port 1A	Drive module 5*	ESM A, port 1B
2	Controller B	1	Drive module 5*	ESM B, port 1B
	Drive module 5*	ESM B, port 1A	Drive module 3*	ESM B, port 1B
	Drive module 3*	ESM B, port 1A	Drive module 1*	ESM B, port 1B
	Controller B	2	Drive module 2*	ESM B, port 1B
	Drive module 2*	ESM B, port 1A	Drive module 4*	ESM B, port 1B
	Drive module 4*	ESM B, port 1A	Drive module 6*	ESM B, port 1B

*The firmware for the array module automatically assigns module IDs to the CSM200 drive modules. Those module IDs usually will not match the drive module numbers shown in this table and in the preceding figure. The cabling pattern is not affected by the assignment of drive module module IDs by the firmware.

NOTE If you have drive modules with inverted ESM CRUs, see [ESM CRU Arrangements](#).

One 6140 Array Module or 6140 Array Module and Multiple Types of Drive Modules

If you are cabling more than one type of drive module to the 6140 array module, be sure to read [Cabling for Drive Modules That Support Loop Switch Technology](#).

Follow these guidelines for cabling multiple types of drive modules to maximize performance and accessibility. (The first device on the drive channel is distinguished by the fact that the left ESM of the first device is cabled directly to controller A of the controller module or array module. Because an optimal redundant cabling topology requires that the redundant drive channel be cabled in the opposite order, this same device will be the last in the drive channel when cabled to controller B.)

The following figure provides an example of how flexible the cabling can be when you use a 6140 array module as the controller. The firmware is able to detect, and correctly handle, combinations of drive modules with both side-by-side ESMs and inverted ESMs. This feature allows you to easily add new drive modules to your storage environment, while continuing to take advantage of pre-existing drive modules that you own.

If your storage array includes CSM100 drive modules, it is still advisable to cable the CSM100 drive modules so that they are the last devices on the drive channel (farthest from controller A).

NOTE When you mix different types of drive modules, you must consider the total number of drives that are available in the final configuration of the storage array. For example, if you mix CSM200 drive modules with CSM100 drive modules, the total number of drives might be more than the maximum number that each drive channel can support.

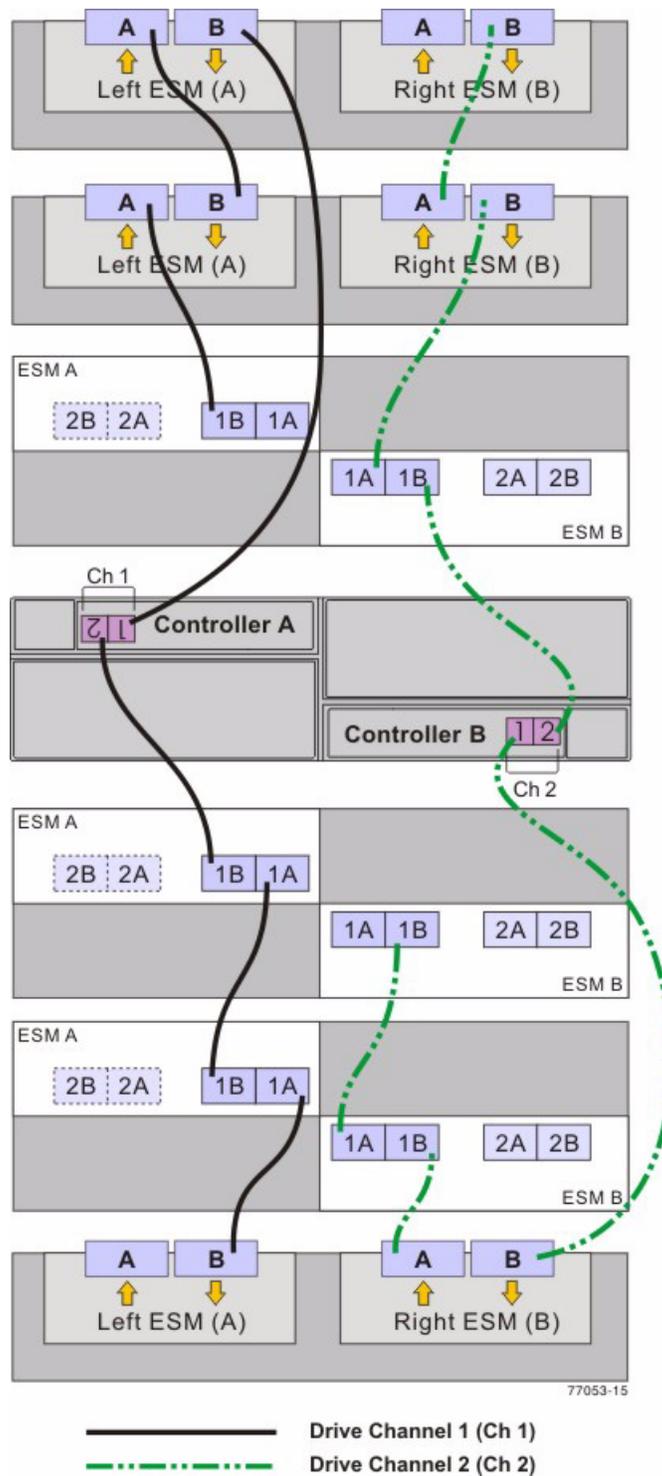


Figure 32 One 6140 Array Module and Multiple Types of Drive Modules

Drive Cabling Topologies for the ST2500 M2 Array Module

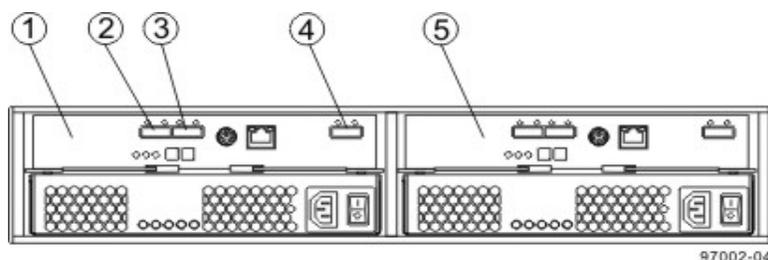
This section provides examples of drive cabling topologies for the ST2500 M2 array module. The ST2500 M2 array module can be cabled to ST2501 M2 drive modules, DE5600 drive modules, or combinations of these two drive modules. The total number of drives in the storage array, including the drives in the array module and those in the drive modules, must not exceed 192.

NOTE Simplex systems do not provide redundant connections to drive modules. If a connection or an environmental services monitor (ESM) fails, all drive modules that connect to the array module indirectly through the failed connection or drive module will become inaccessible.

Drive Cabling Topologies for the ST2500 M2 Array Module With ST2501 M2 Drive Modules or DE5600 Drive Modules

Depending on the number of drive modules that you need to connect, see the applicable figure for a cabling topology. Each example shows a duplex array module configuration with redundant paths to the drive modules. For a simplex array module configuration, use the cabling topology shown for controller A in the applicable figure.

NOTE The following figures shows the SAS ports on a ST2501 M2 drive module or a DE5600 drive module. You may connect either of the SAS ports labeled SAS 1 and SAS 2 to the SAS expansion port on another drive module or on a array module. You should not make connections to both the SAS 1 port and the SAS 2 port on the same ESM.



1. ESM A
2. SAS Port 1
3. SAS Port 2
4. SAS Expansion Port
5. ESM B

Figure 33 SAS Ports on a ST2501 M2 Drive Module or a DE5600 Drive Module

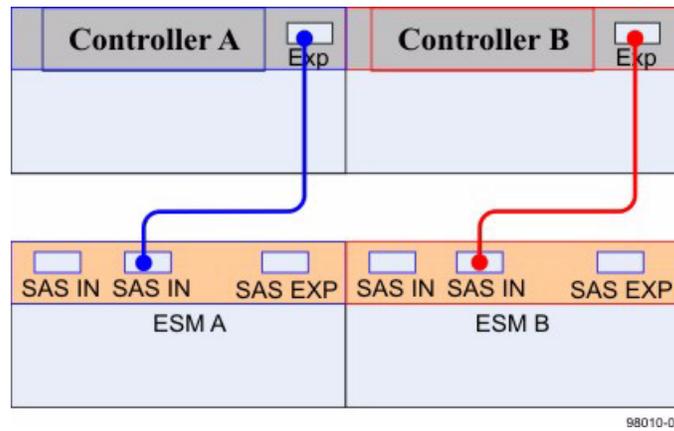


Figure 34 One ST2500 M2 Array Module and One Drive Module

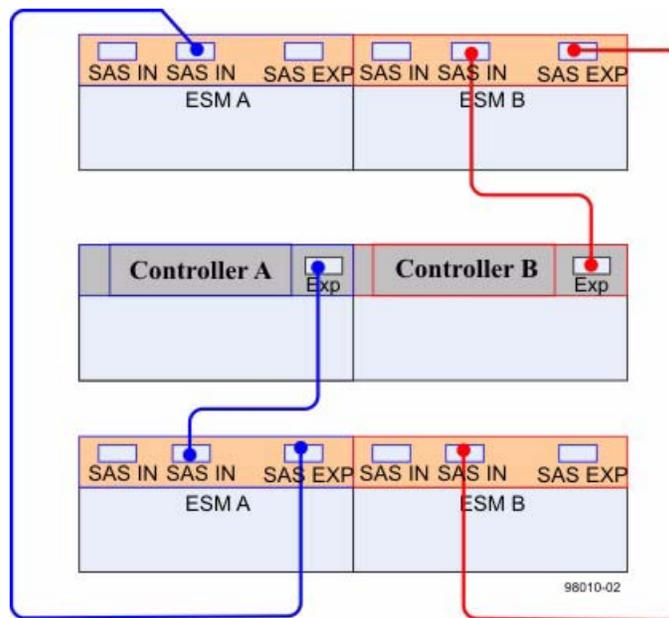


Figure 35 One ST2500 M2 Array Module and Two Drive Modules

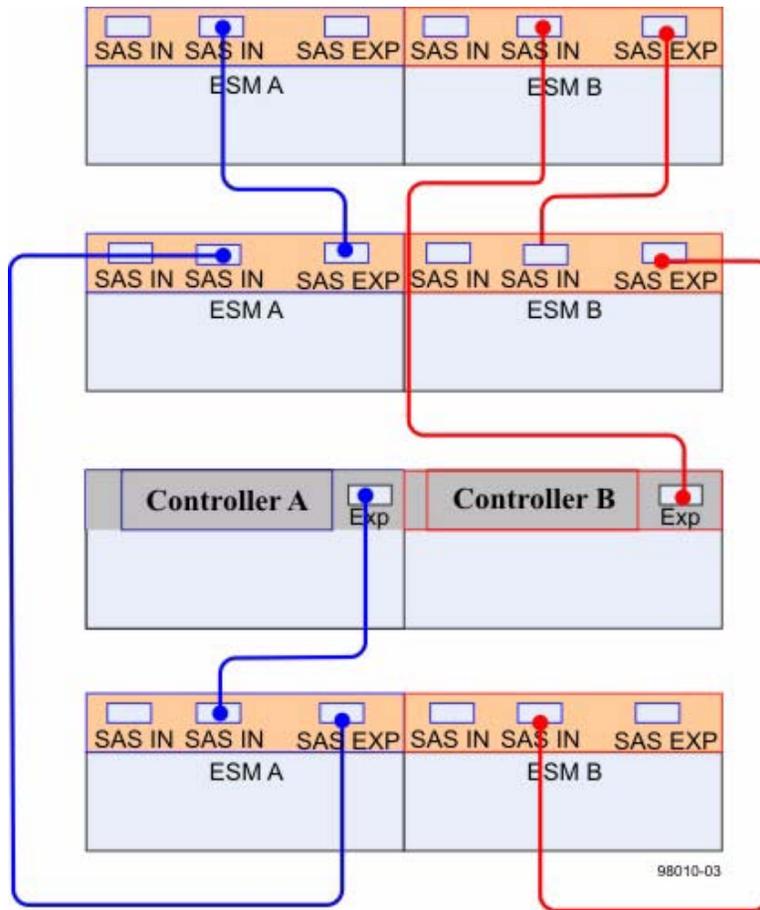
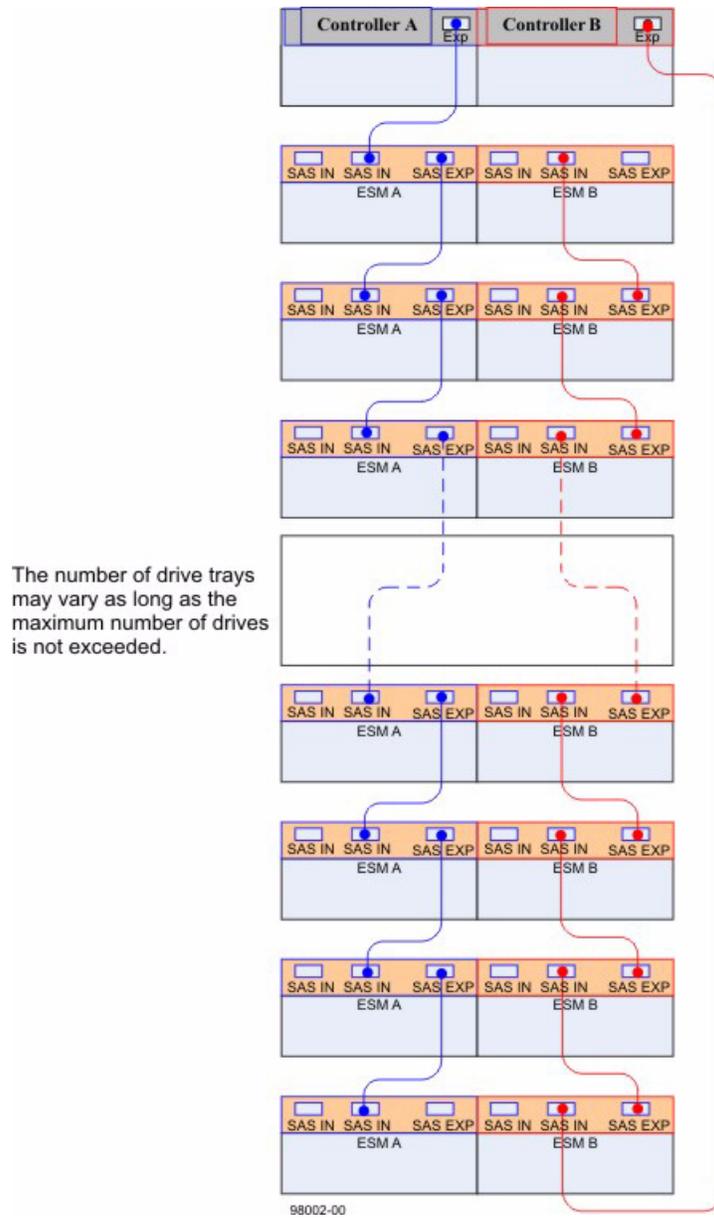


Figure 36 One ST2500 M2 Array Module and Three Drive Modules



The number of drive trays may vary as long as the maximum number of drives is not exceeded.

Figure 37 One ST2500 M2 Array Module and Eight Drive Modules

Chapter 5: Ethernet Cabling

This chapter provides examples of how to connect your storage array to an Ethernet network for out-of-band storage array management. If you plan to use in-band storage array management, Ethernet cabling might not be necessary for management connections.

For illustrations showing the Ethernet port locations on the specific controller module model or array module model that you are installing, see the topics under [Component Locations](#).

ATTENTION Possible loss of data access – If you use out-of-band management, connect the Ethernet ports on the controller module or the array module to a private network segment behind a firewall. If the Ethernet connection is not protected by a firewall, your storage array might be at risk of being accessed from outside of your network.

Direct Out-of-Band Ethernet Topology

The following figure shows storage array management connections from the controller module or array module to the Ethernet. In this topology, you must install a network interface card (NIC) in the storage management station in which the client software resides. For dual controllers, you must install two NICs in the storage management station.

NOTE For more information about NICs, see [Network Interface Cards](#).

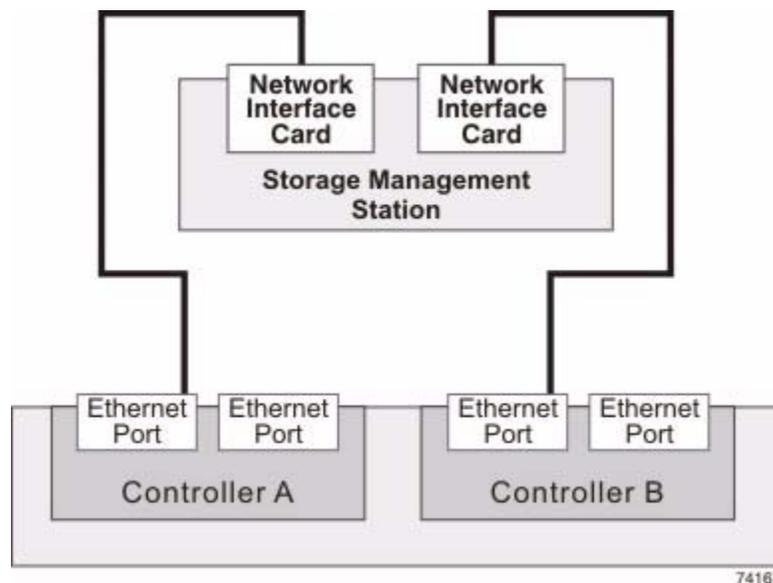


Figure 1 Network Out-of-Band Ethernet Topology

NOTE In limited situations where the storage management station is connected directly to the controller module or the array module, you must use an Ethernet crossover cable to connect the storage management station to the Ethernet port. An Ethernet crossover cable is a special cable that reverses the pin contacts between the two ends of the cable.

Fabric Out-of-Band Ethernet Topology

The following figure shows two storage array management connections from the controller module or the array module to two ports on an Ethernet switch. In this topology, you must install a NIC in the storage management station where the client software resides. You must use Ethernet cables for all storage array management connections.

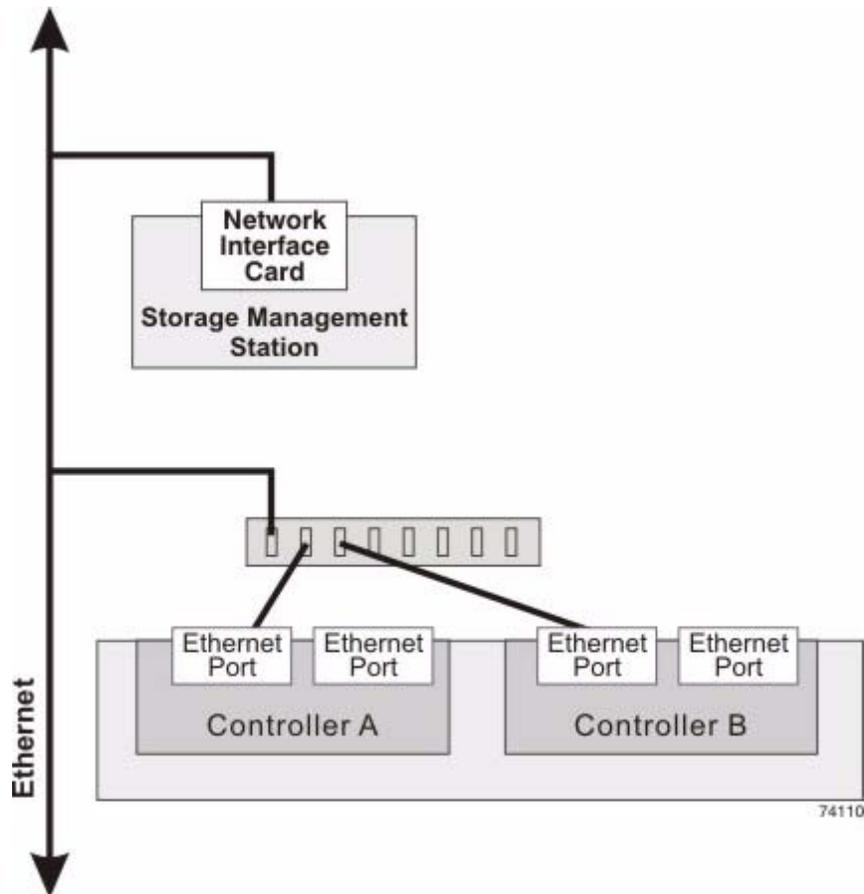


Figure 2 Fabric Redundant Out-of-Band Ethernet Topology

For more information, see "[In-Band Management and Out-of-Band Management](#)."

NOTE If you have two available Ethernet ports on each controller, reserve one port on each controller for access to the storage array by your Sun Customer Care Center representative.

Chapter 6: Component Locations

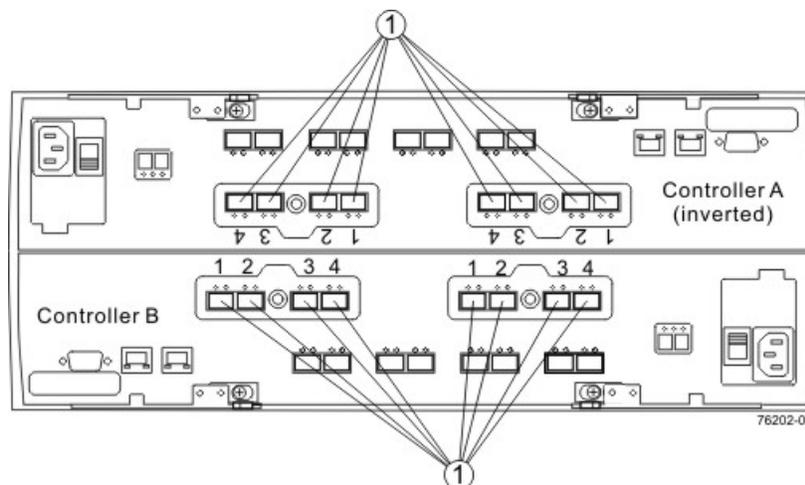
This chapter provides shows the rear of each controller module, array module, and drive module. The figures identify the locations of controllers, environmental services monitors (ESMs), host ports, drive ports, and Ethernet ports. The figures also show port identifiers.

Use the figures in the following topics to make sure that you have correctly identified the cable connection for host cabling, drive cabling and Ethernet cabling.

Port Locations on the 6780 Controller Module and the 6580/6780 Controller Module

The 6780 controller module and the 6580/6780 controller module have host channels that you can attach to the hosts, and drive channels that you can attach to the drive modules. The examples in this section show the 6580/6780 controller module. The port locations are the same for the 6780 controller module.

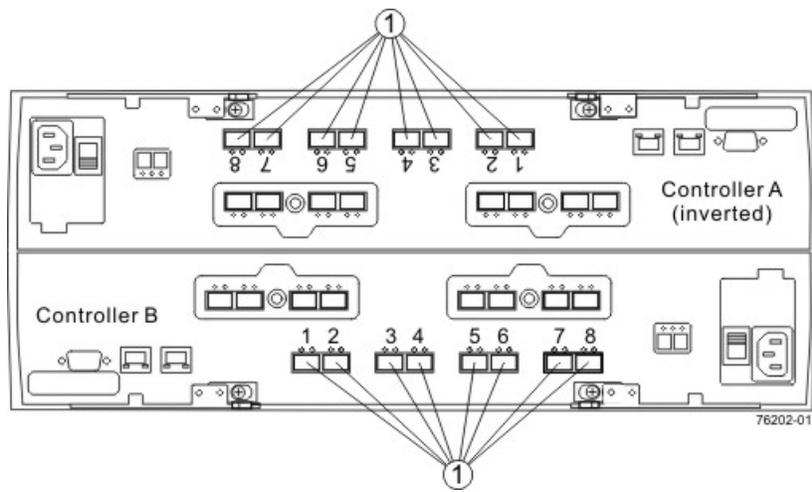
- Each of the two controllers in the 6580/6780 controller module might have two host cards with four host ports on each card. This configuration is shown in the following figure. Some 6580/6780 controller modules might have controllers with only one host card each.
- Controller A is inverted from controller B, which means that its host channels are upside-down.



1. Host Channel Ports

Figure 1 Host Channels on the 6780 Controller Module and the 6580/6780 Controller Module – Rear View

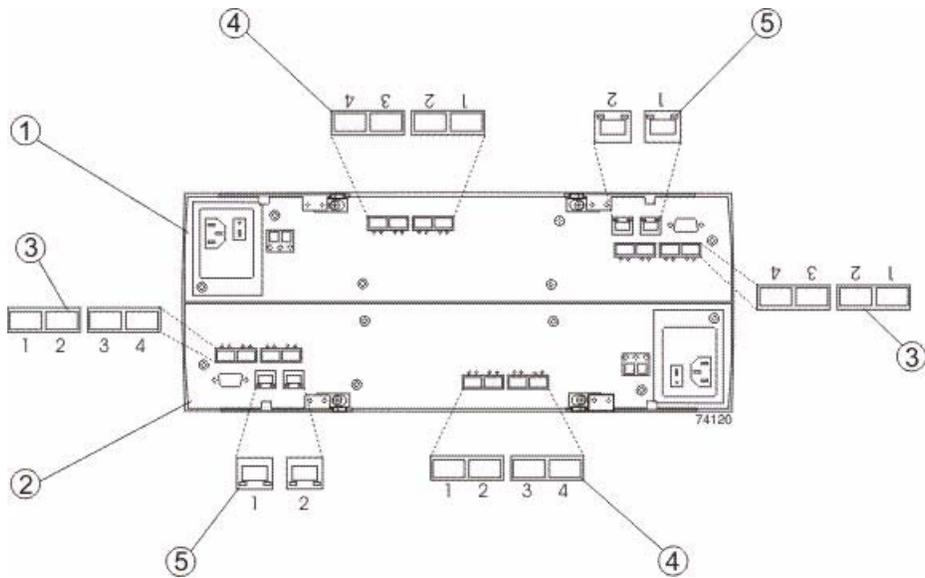
- Each controller in the 6780 controller module and the 6580/6780 controller module has four drive channels, and each drive channel has two ports, so each controller has eight drive ports.
- Controller A is inverted from controller B, which means that its drive channels are upside-down.



- 1. Drive Channel Ports

Figure 2 Drive Channel Ports on the 6780 Controller Module and the 6580/6780 Controller Module – Rear View

Component Locations on the 6540 Controller Module



- 1. Controller A (Inverted)
- 2. Controller B
- 3. Host Ports
- 4. Drive Ports
- 5. Ethernet Ports

Figure 3 Component Locations on the 6540 Controller Module – Rear View

NOTE Host port 4 on each controller of the 6540 controller module is reserved for the Data Replicator Software premium feature. If you are not using the Data Replicator Software premium feature, these host ports are available for host connections.

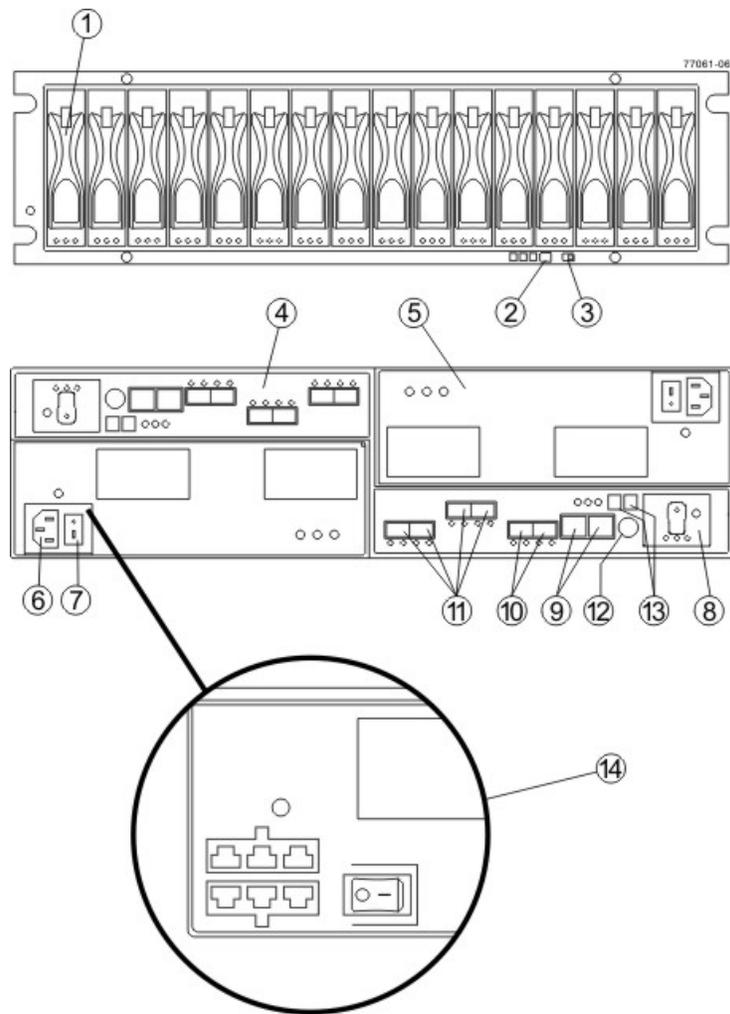
Table 1 Drive Ports and Drive Channels on the 6540 Controller Module

Drive Channel Number	Controller	Drive Port Numbers
1	A	4 and 3
2	A	2 and 1
3	B	1 and 2
4	B	3 and 4

NOTE When you cable the 6540 controller module, it is important to note that drive channel 1 and drive channel 3 are a redundant pair, and drive channel 2 and drive channel 4 are a redundant pair. In other words, if a failure occurred in drive channel 1, drive channel 3 would allow communication with the drives. If a failure occurred in drive channel 2, drive channel 4 would allow communication with the drives.

Component Locations on the 6180 Array Module

- The top controller, controller A, is inverted from the bottom controller, controller B.
- The top of the array module is the side with labels.
- The configuration of the host ports might appear different on your system depending on which host interface card configuration is installed.

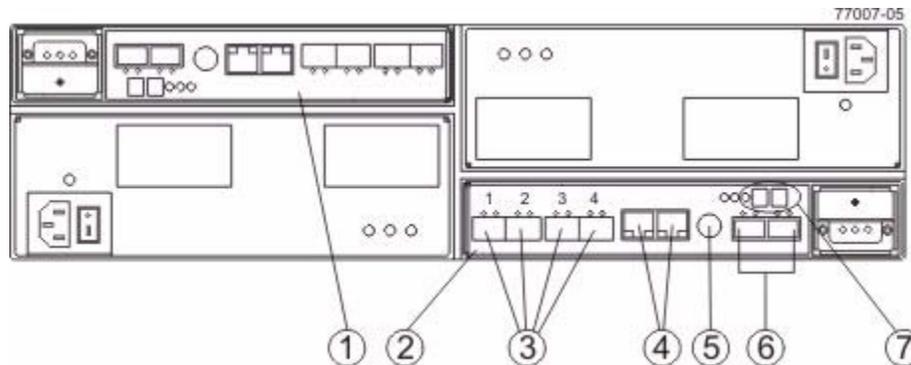


1. Drive CRU
2. Alarm Mute Switch
3. Link Rate Switch
4. Controller A (Inverted)
5. Power-Fan CRU
6. AC Power Connector
7. AC Power Switch
8. Battery CRU
9. Ethernet Ports
10. Drive Channels
11. Host Channels
12. Serial Port
13. Seven-Segment Display
14. Optional DC Power Connector and DC Power Switch

Figure 4 6180 Array Module – Front View and Rear View

Component Locations on the 6140 Array Module and the 6140 Array Module

The following figure shows the AC power option.



1. Controller A (Inverted)
2. Controller B
3. Host Ports (2 Ports for the 6140 Array Module or 4 Ports for the 6140 Array Module)
4. Ethernet Ports
5. Serial Port
6. Dual-Ported Drive Ports
7. Seven-Segment Display

Figure 5 Component Locations on the 6140 Array Module and the 6140 Array Module – Rear View
Table 2 Drive Ports and Drive Channels on the 6140 Array Module and the 6140 Array Module

Drive Channel Number	Controller	Drive Port Identifier
1	A	2 and 1
2	B	1 and 2

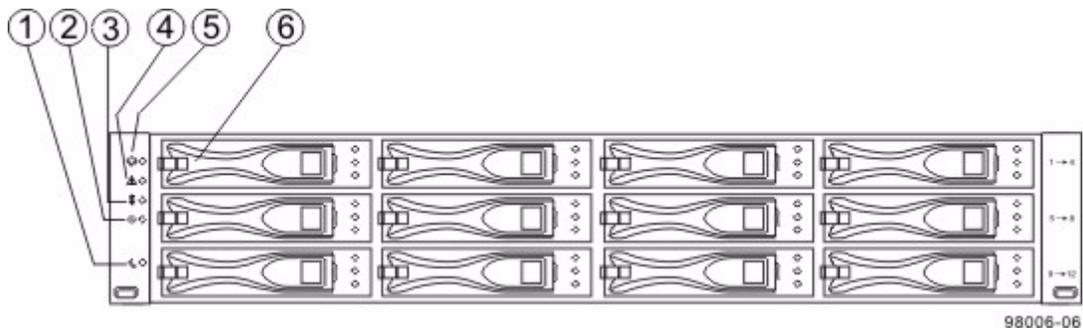
Component Locations on the ST2500 M2 Array Module

The ST2500 M2 array module is available in two different drive configurations: one with up to twelve 3.5-in. drives and another with up to twenty-four 2.5-in. drives. With either drive configuration, the array module is available in two different controller configurations: simplex and duplex.

Keep these points in mind when you compare the figures in this section to your hardware.

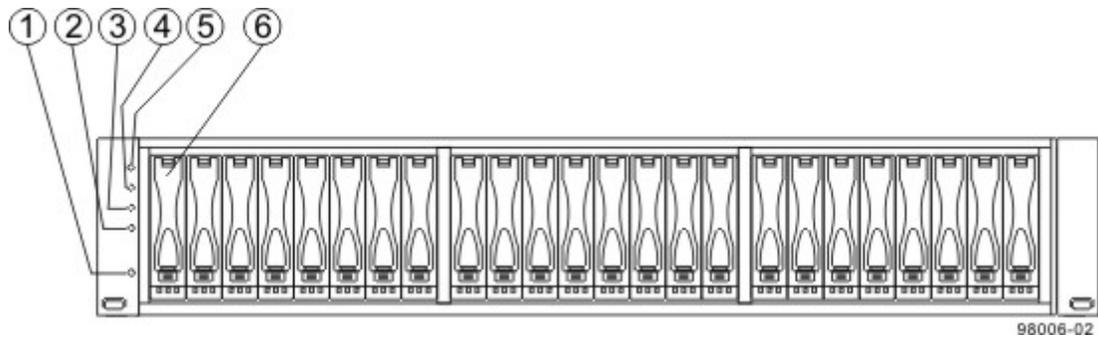
- The top of the array module is the side with the labels.
- The configuration of the host ports depends on which host interface card configuration is installed.
- The figures in this section show the AC power option.

NOTE On the ST2500 M2 array module, each controller has a pair of levers with handles for removing the controller from the array module. If a controller has a HIC installed, one of these handles on the controller is located next to a host port on the HIC. The close spacing between the handle and the host port might make it difficult to remove a cable that is attached to the host port. If this problem occurs, use a flat-blade screwdriver to compress the release on the cable connector.



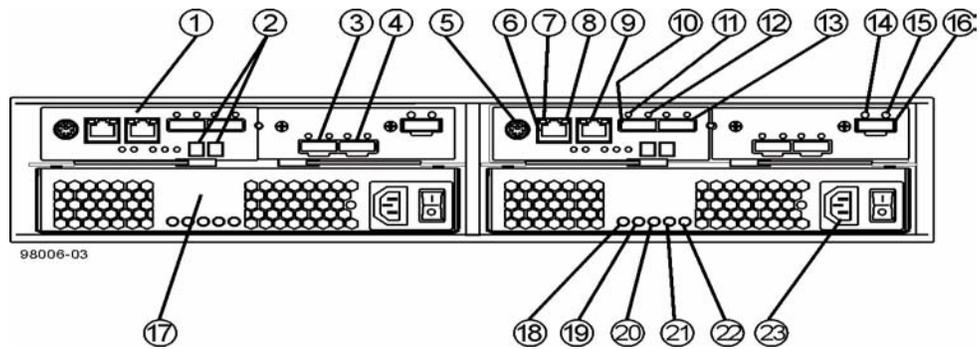
1. Standby Power LED
2. Power LED
3. Over-Temperature LED
4. Service Action Required LED
5. Locate LED
6. Drive Canister

Figure 6 ST2500 M2 Array Module with 12 Drives – Front View



1. Standby Power LED
2. Power LED
3. Over-Temperature LED
4. Service Action Required LED
5. Locate LED
6. Drive Canister

Figure 7 ST2500 M2 Array Module with 24 Drives – Front View



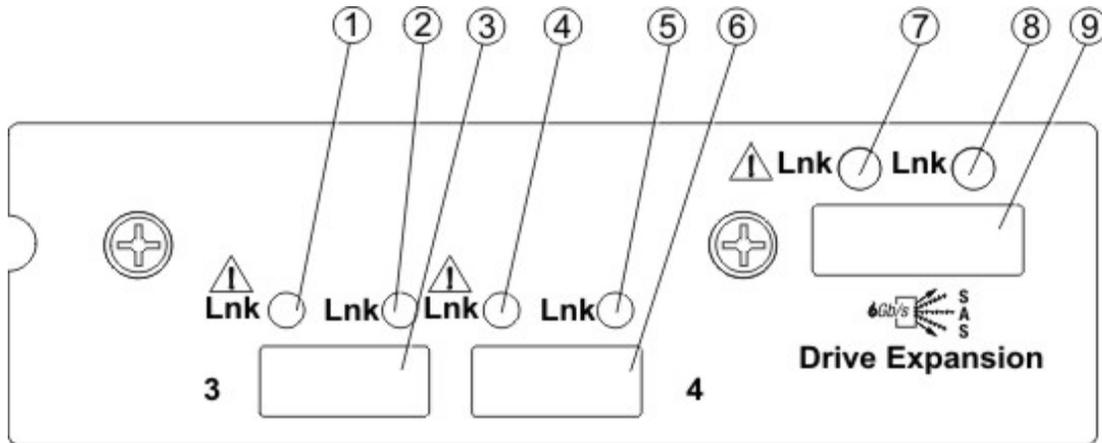
1. Controller A CRU
2. Seven-Segment Display
3. Host Interface Card Connector 1
4. Host Interface Card Connector 2
5. Serial Connector
6. Ethernet Connector 1
7. Ethernet Link Active LED
8. Ethernet Link Rate LED
9. Ethernet Connector 2
10. Host SFF-8088 Connector 2
11. Host Link 2 Fault LED
12. Host Link 2 Active LED
13. Base Host SFF-8088 Connector 1
14. ESM Expansion Fault LED
15. ESM Expansion Active LED
16. Expansion SFF-8088 Port Connector
17. Power-Fan CRU
18. Standby Power LED
19. Power-Fan DC Power LED
20. Power-Fan Service Action Allowed LED
21. Power-Fan Service Action Required LED
22. Power-Fan AC Power LED
23. AC Power Connector

Figure 8 ST2500 M2 Array Module Duplex Configuration – Rear View



1. ESM Expansion Fault LED
2. ESM Expansion Active LED
3. Expansion SFF-8088 Port Connector

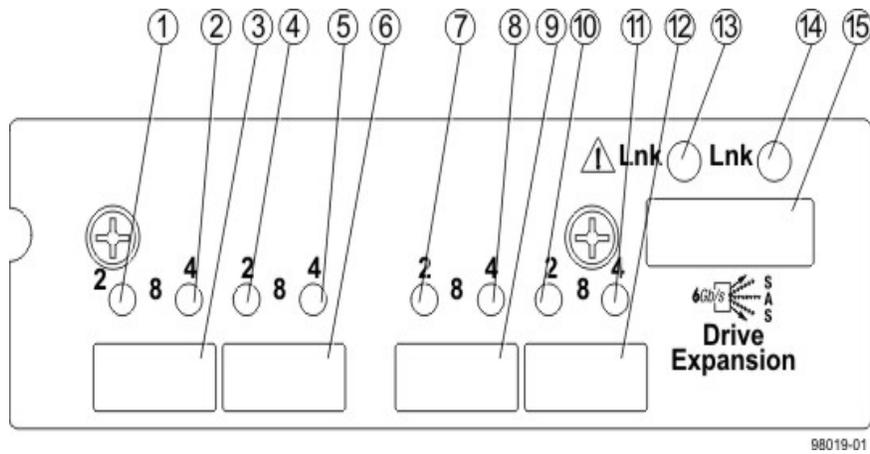
Figure 9 ST2500 M2 Right-Rear Subplate with No Host Interface Card



98019-03

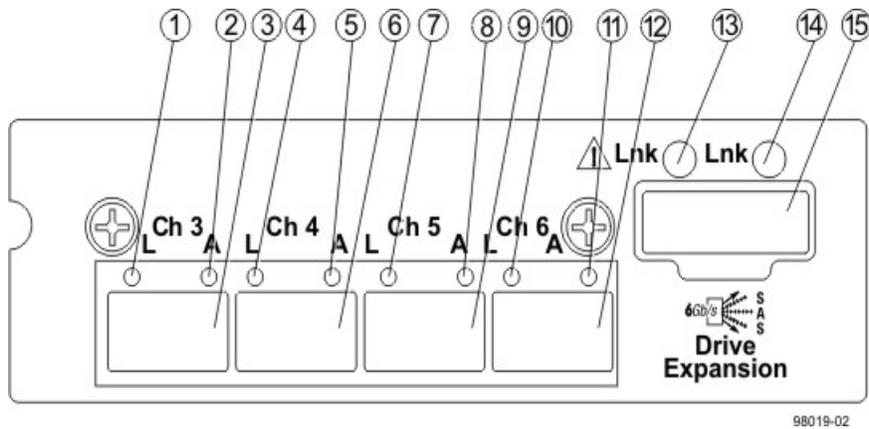
1. Host Interface Card Link 3 Up LED
2. Host Interface Card Link 3 Active LED
3. SFF-8088 Host Interface Card Connector 3
4. Host Interface Card Link 4 Up LED
5. Host Interface Card Link 4 Active LED
6. SFF-8088 Host Interface Card Connector 4
7. ESM Expansion Fault LED
8. ESM Expansion Active LED
9. Expansion SFF-8088 Port Connector

Figure 10 ST2500 M2 Right-Rear Subplate with a SAS Host Interface Card



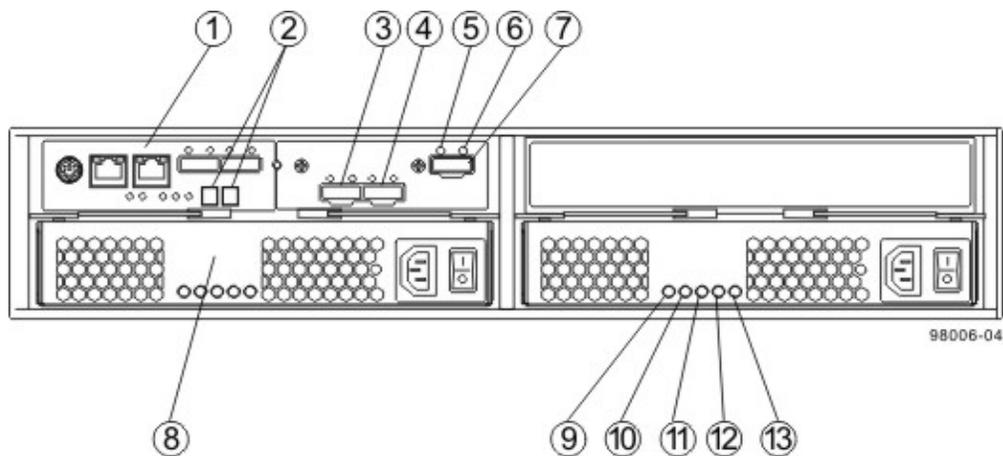
1. Host Interface Card Link 3 Up LED
2. Host Interface Card Link 3 Active LED
3. FC Host Interface Card Connector 3
4. Host Interface Card Link 4 Up LED
5. Host Interface Card Link 4 Active LED
6. FC Host Interface Card Connector 4
7. Host Interface Card Link 5 Up LED
8. Host Interface Card Link 5 Active LED
9. FC Host Interface Card Connector 5
10. Host Interface Card Link 6 Up LED
11. Host Interface Card Link 6 Active LED
12. FC Host Interface Card Connector 6
13. ESM Expansion Fault LED
14. ESM Expansion Active LED
15. Expansion SFF-8088 Port Connector

Figure 11 ST2500 M2 Right-Rear Subplate with an FC Host Interface Card



1. Host Interface Card Link 3 Up LED
2. Host Interface Card Link 3 Active LED
3. iSCSI Host Interface Card Connector 3
4. Host Interface Card Link 4 Up LED
5. Host Interface Card Link 4 Active LED
6. iSCSI Host Interface Card Connector 4
7. Host Interface Card Link 5 Up LED
8. Host Interface Card Link 5 Active LED
9. iSCSI Host Interface Card Connector 5
10. Host Interface Card Link 6 Up LED
11. Host Interface Card Link 6 Active LED
12. iSCSI Host Interface Card Connector 6
13. ESM Expansion Fault LED
14. ESM Expansion Active LED
15. Expansion SFF-8088 Port Connector

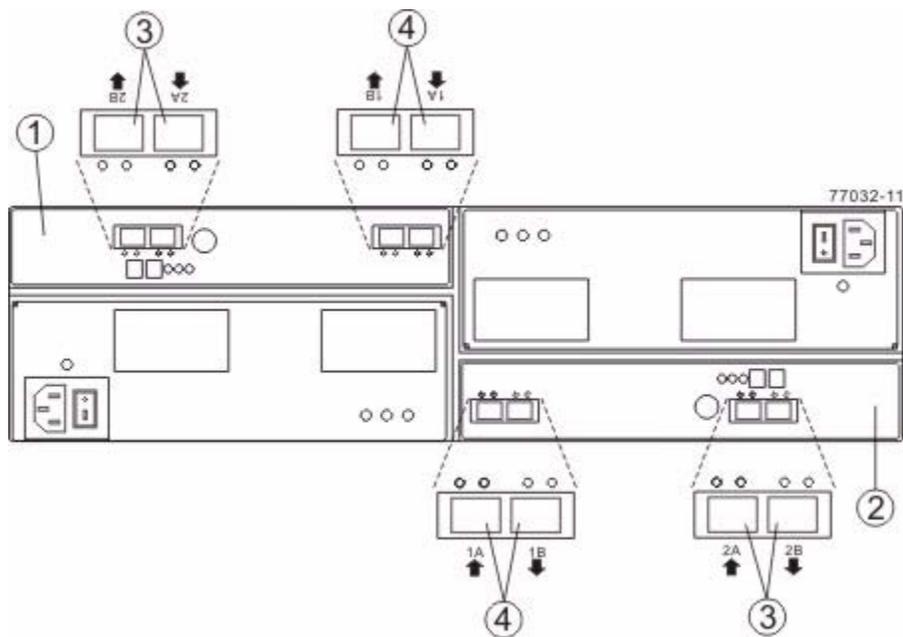
Figure 12 ST2500 M2 Right-Rear Subplate with an iSCSI Host Interface Card



1. Controller A CRU
2. Seven-Segment Display
3. Host Interface Card Connector 1
4. Host Interface Card Connector 2
5. ESM Expansion Fault LED
6. ESM Expansion Active LED
7. Expansion Port SFF-8088 Connector
8. Power-Fan A CRU
9. Standby Power LED
10. Power-Fan DC Power LED
11. Power-Fan Service Action Allowed LED
12. Power-Fan Service Action Required LED
13. Power-Fan AC Power LED

Figure 13 ST2500 M2 Array Module Simplex Configuration – Rear View

Component Locations on the CSM200 Drive Module

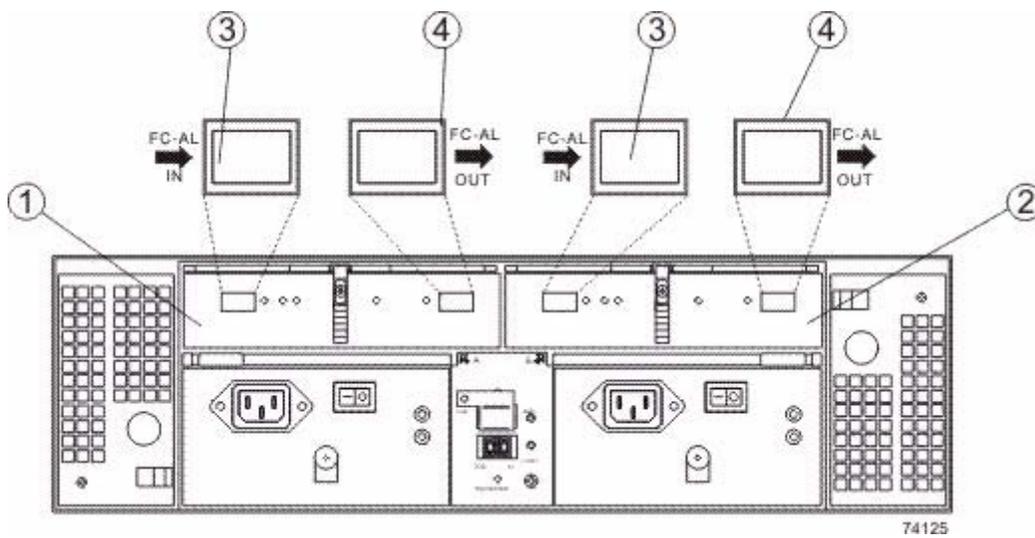


1. Left ESM
2. Right ESM
3. Secondary SFP Ports
4. Primary SFP Ports

Figure 14 Component Locations on the CSM200 Drive Module – Rear View

The ESM on the CSM200 drive module has four SFP ports. The two primary ports are active. The secondary ports are reserved for future use. If SFP transceivers are placed in the secondary ports, the SFP Port LEDs blink, as a reminder that these ports are not functioning.

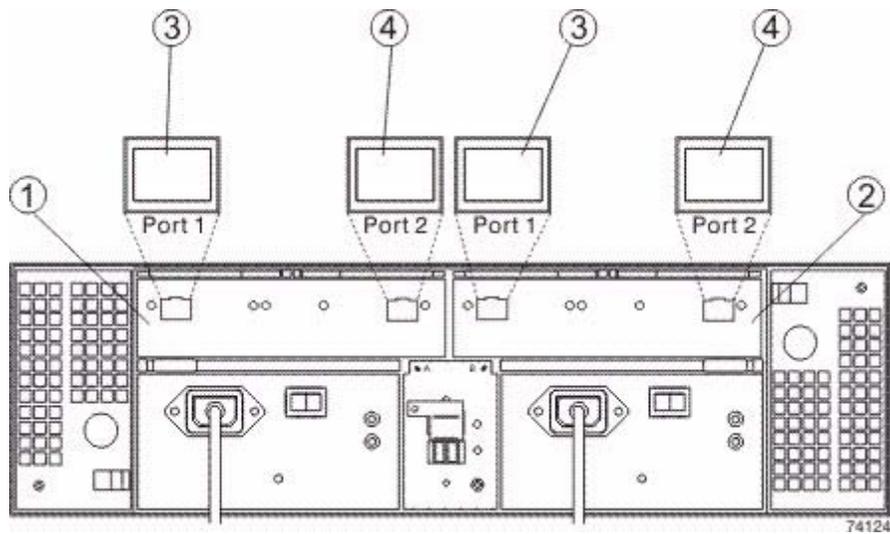
Component Locations on the CSM100 Drive Module



1. Left ESM
2. Right ESM
3. In Ports
4. Out Ports

Figure 15 Component Locations on the CSM100 Drive Module – Rear View

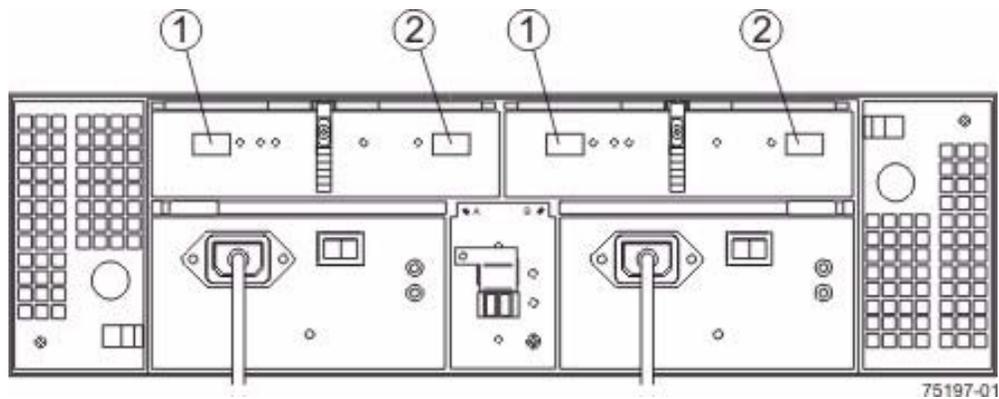
Component Locations on the CSM100 Drive Module



1. Left ESM
2. Right ESM
3. In Ports
4. Out Ports

Figure 16 Component Locations on the CSM100 Drive Module – Rear View

Component Locations on the FLA200 Drive Module

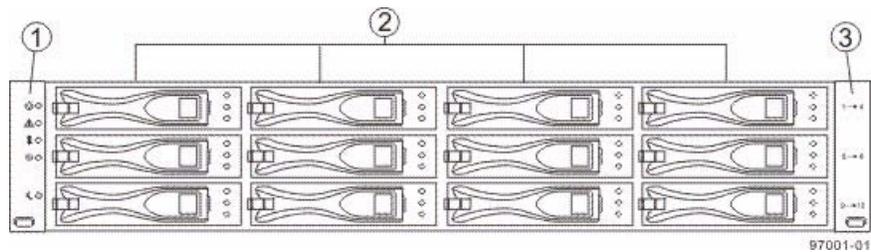


- 1. In Ports
- 2. Out Ports

Figure 17 Component Locations on the FLA200 Drive Module – Rear View

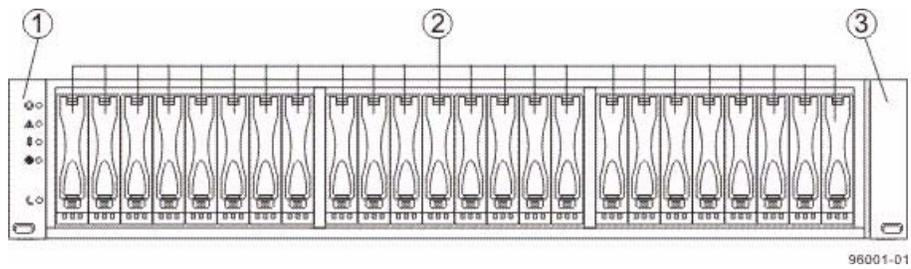
Component Locations on the DE1600 Drive Module and the DE5600 Drive Module

The DE1600 drive module can have two to twelve 3.5-in. drives. The DE5600 drive module can have two to twenty-four 2.5-in. drives. The component locations on the rear of these drive modules are the same. The following figures show the AC power option.



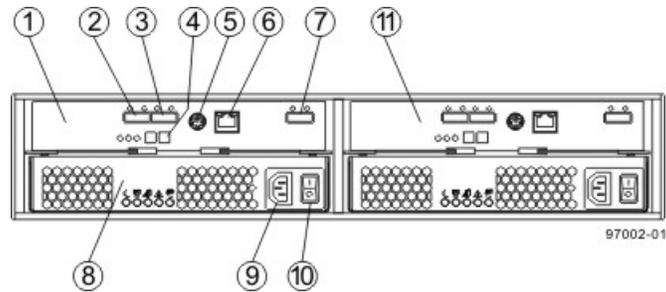
- 1. Left End Cap (Has the Drive Module LEDs)
- 2. Drives
- 3. Right End Cap

Figure 18 DE1600 Drive Module – Front View



1. Left End Cap (Has the Drive Module LEDs)
2. Drives
3. Right End Cap

Figure 19 DE5600 Drive Module – Front View



1. ESM A CRU
2. Host Connector 1
3. Host Connector 2
4. Seven-Segment Display Indicators
5. Serial Connector
6. Ethernet Connector
7. Expansion Port SFF-8088 Connector
8. Power-Fan CRU
9. Power Connector
10. Power Switch
11. ESM B CRU

Figure 20 DE1600 Drive Module or DE5600 Drive Module – Rear View

Chapter 7: Adding a Drive Module to an Existing System

This chapter provides information about adding a drive module to an existing system.

Getting Ready

If you need to add another drive module to an existing storage array, contact your Sun Customer Care Center representative before proceeding. Your Sun Customer Care Center representative might direct you to complete preparatory tasks before installing and cabling the new drive module. Some of these tasks might include:

- Creating, saving, and printing a storage array profile for all of the storage arrays that will be affected by the upgrade
- Performing a complete backup of all of the drives in the storage array
- Making sure that the pools and associated volumes on the storage array have an Optimal status

ATTENTION Possible loss of data access – Contact your Sun Customer Care Center representative if you plan to add a drive module to an existing storage array under either of the following conditions: The power is not turned off to the controller module or the array module or data transfer continues to the storage array.

HotScale Technology

HotScale™ technology lets you configure, reconfigure, add, or relocate storage array capacity without interrupting user access to data.

Port bypass technology automatically opens ports and closes ports when drive modules are added to or removed from your storage array. Fibre Channel loops stay intact so that system integrity is maintained throughout the process of adding and reconfiguring your storage array.

For more information about using the HotScale technology, contact your Sun Customer Care Center representative.

Adding Redundant Drive Channels

If you are working with a storage array that has redundant drive channels, it is easy to add drive modules. Make sure that you always maintain communication between a functioning controller and the existing drive modules by only interrupting the continuity of a single drive channel at any one point in time. This precaution avoids interruption of data availability.

Your Sun Customer Care Center representative can provide assistance in maintaining access to data during the upgrade of your storage array.

Adding One Non-Redundant Drive Channel

If you are working with a storage array that has only one drive channel, add the drive module to the end of the series of drive modules in the storage array. You do so while power is still applied to the other drive modules.

ATTENTION Risk of equipment damage – If your CSM200 drive module, ST2501 M2 drive module, or DE5600 drive module uses the optional DC power connection, a different procedure exists for turning on and turning off the power to a DC-powered drive module. Refer to the topics under *Storage Array Installation* for the hardware you are installing or refer to the corresponding PDF document on the SANtricity ES Storage Manager Installation DVD.

1. Add the new drive module to the end of the series of existing drive modules.
2. Install the additional cable.
3. Turn on the power to the new drive module.

Appendix A Hardware Installation for Data Replicator Software

This appendix provides information about these topics:

- Site preparation
- Hardware requirements
- Cabling

Review this information and complete the steps before starting any hardware installation procedures. Refer to the online help system for background information on the Data Replicator Software (DRS) premium feature and for software-related procedures to set the configuration of the feature and use it.

Site Preparation

The DRS premium feature can be used only with Fibre Channel host connections. You *must* have Fibre Channel switches to use DRS and to create a fabric environment for data replication. These switches require only minimal additional site preparation requirements beyond basic storage array operation.

For additional site preparation considerations for Fibre Channel switches, including power requirements and physical dimensions and requirements, refer to the documentation that is provided by the switch manufacturer.

Switch Zoning Overview

Because of possible restrictions at the host level, the supported Data Replicator Software configurations contain Fibre Channel switches. These Fibre Channel switches are zoned so that a single host adapter can access only one controller per storage array. Additionally, all configurations use a separate zone for the ports that are reserved for the Data Replicator Software premium feature.

NOTE Do not zone the uplink port (E_port) that connects (cascades) switches within a fabric.

Switch zoning configurations are typically set up by using the switch management software that is provided by the manufacturer of the Fibre Channel switch. This software should have been included with the materials that are provided when the switch was purchased.

When two or more Fibre Channel switches are cascaded together, the switch management software combines the ports for all of the switches that are linked. For example, if two 16-port Fibre Channel switches are cascaded with a physical connection using a Fibre Channel cable, the switch management software shows ports 0 through 31 participating in the fabric rather than two switches each with ports 0 through 15. Therefore, a zone that is created containing any of these ports can exist on multiple cascaded switches.

The following figure shows both cascaded and non-cascaded switches. The top-half of the figure shows a set of cascaded switches that are on the same network. Therefore, Zone 1 is the same zone on Switch 1A as Zone 1 is on Switch 1B. In a single-mode Fibre Channel environment, the two switches are connected by a single port on each switch that is designated as an E_port, which is not in a zone.

The set of switches in the bottom half of the following figure is on the same network but is not cascaded. Although both sets contain a Zone 1 (shown as Zone A in Switch 2), these zones are independent of each other.

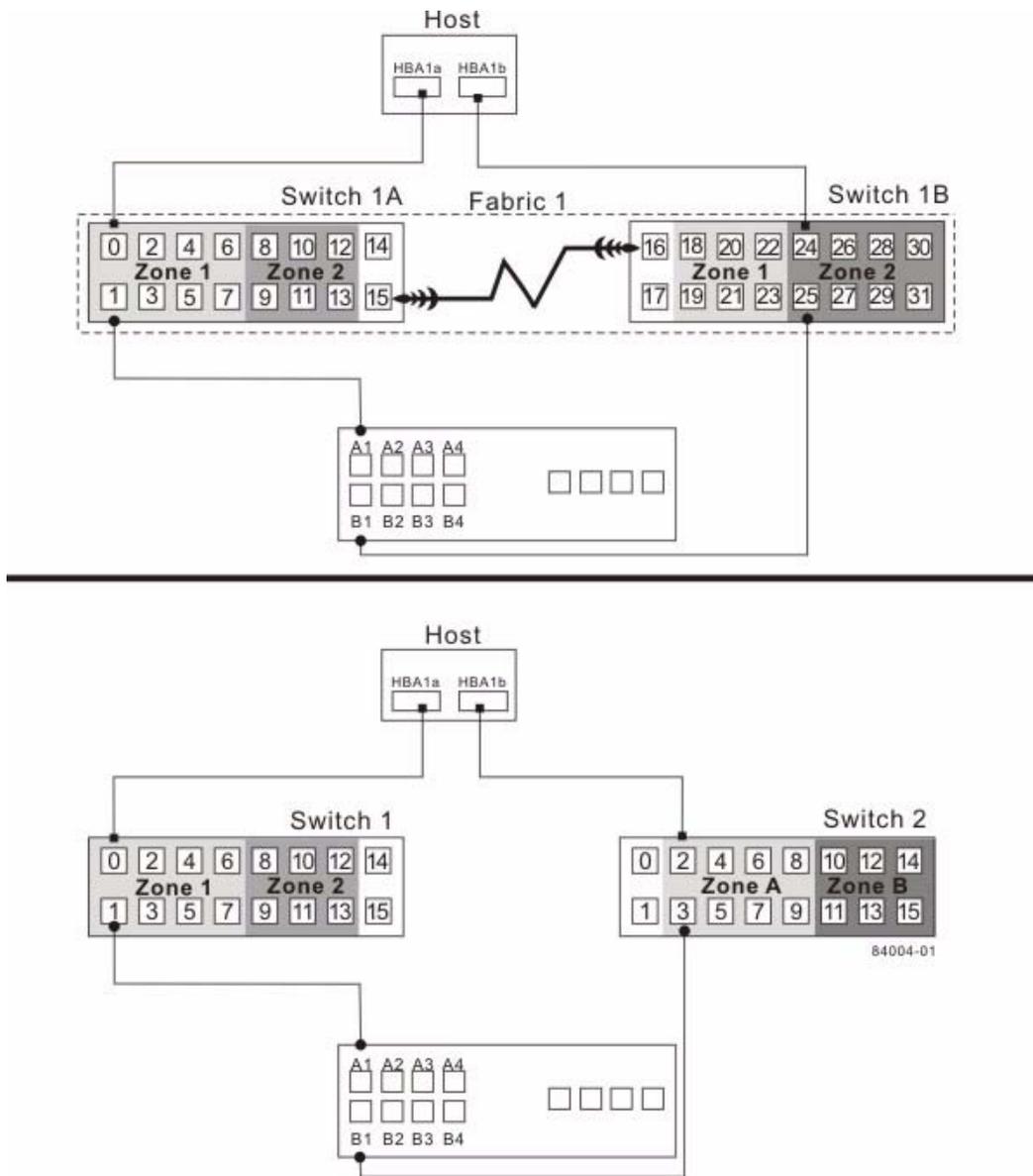


Figure 1 Switch Zoning in Cascaded and non-Cascaded Fibre Channel Switches

For more information about Fibre Channel switch zoning or setting up a zone configuration, refer to the manufacturer’s documentation that is provided with the switch.

Because of the varying Data Replicator Software configurations, the switch zone settings are presented preceding each configuration in this appendix.

Hardware Installation

Select one of the following configuration options to connect and configure one or more storage arrays for use with the Data Replicator Software premium feature.

Table 1 Configuration Options for Data Replicator Software

Configuration	Description
Highest availability campus configuration (recommended)	<p>This configuration has the greatest redundancy. It is the most stable of the three configurations.</p> <ul style="list-style-type: none"> Two Fibre Channel switches (for a total of four) at both the primary site and the secondary site provide for complete failover and redundancy in the Fibre Channel switches and fabrics, in addition to all storage array components and hosts. A single point of failure does not exist in this configuration, and it is the recommended configuration for the Data Replicator Software premium feature. <p>Go to Highest Availability Campus Configuration – Recommended.</p>
Campus configuration	<p>The campus configuration is a lower-cost configuration than the highest availability campus configuration. Only one Fibre Channel switch at the primary site and one at the secondary site exist, for a total of two switches. This configuration essentially allows the minimum required components to successfully operate the Data Replicator Software premium feature between two sites.</p> <ul style="list-style-type: none"> The number of Fibre Channel switches is reduced from four to two and the number of fabrics from two to one. This configuration is redundant for host bus adapters, controllers, and Data Replicator Software ports, but it has a single point of failure for switches and fabric. A switch failure does not usually result in a loss of data, but it does affect data synchronization until the error is corrected. Therefore, the highest availability campus configuration is the recommended configuration, because data synchronization can continue for any single switch failure. <p>Go to Campus Configuration.</p>
Intra-site configuration	<p>The intra-site configuration is the lowest-cost configuration of all three configurations. It is used in environments where a long-distance fabric is not required because of the close proximity of the hosts and storage arrays.</p> <ul style="list-style-type: none"> Because the intra-site configuration only has two switches, it is similar to the campus configuration. However, multiple-switch fabrics do not exist in this configuration. The configuration is redundant for host bus adapters, controllers, Data Replicator Software ports, and switches but is a single point of failure for the site because all of the equipment can be destroyed by the same disaster. The highest availability campus configuration is the recommended configuration, because it is fully redundant, which makes disaster recovery easier. <p>Go to Intra-Site Configuration.</p>

Highest Availability Campus Configuration – Recommended

NOTE The highest availability campus configuration is the recommended configuration for the Data Replicator Software premium feature.

This configuration has two Fibre Channel switches at the primary site and two Fibre Channel switches at the secondary site (four switches total), which provide for complete failover and redundancy. Failures could involve Fibre Channel switches, Fibre Channel cables, and any host or storage array. Two Fibre Channel switches at each site also provide redundancy to the local site in addition to a fully redundant remote configuration. No single point of failure exists in the hardware components.

The following figure shows the highest availability campus configuration. The controller modules are shown schematically with four host ports on each of two controllers in each controller module. In this configuration, use the A4 connection and the B4 connection for remote mirroring traffic instead of the A2 connection and the B2 connection. You can use controller ports A2, A3, B2, and B3 for additional host access if needed.

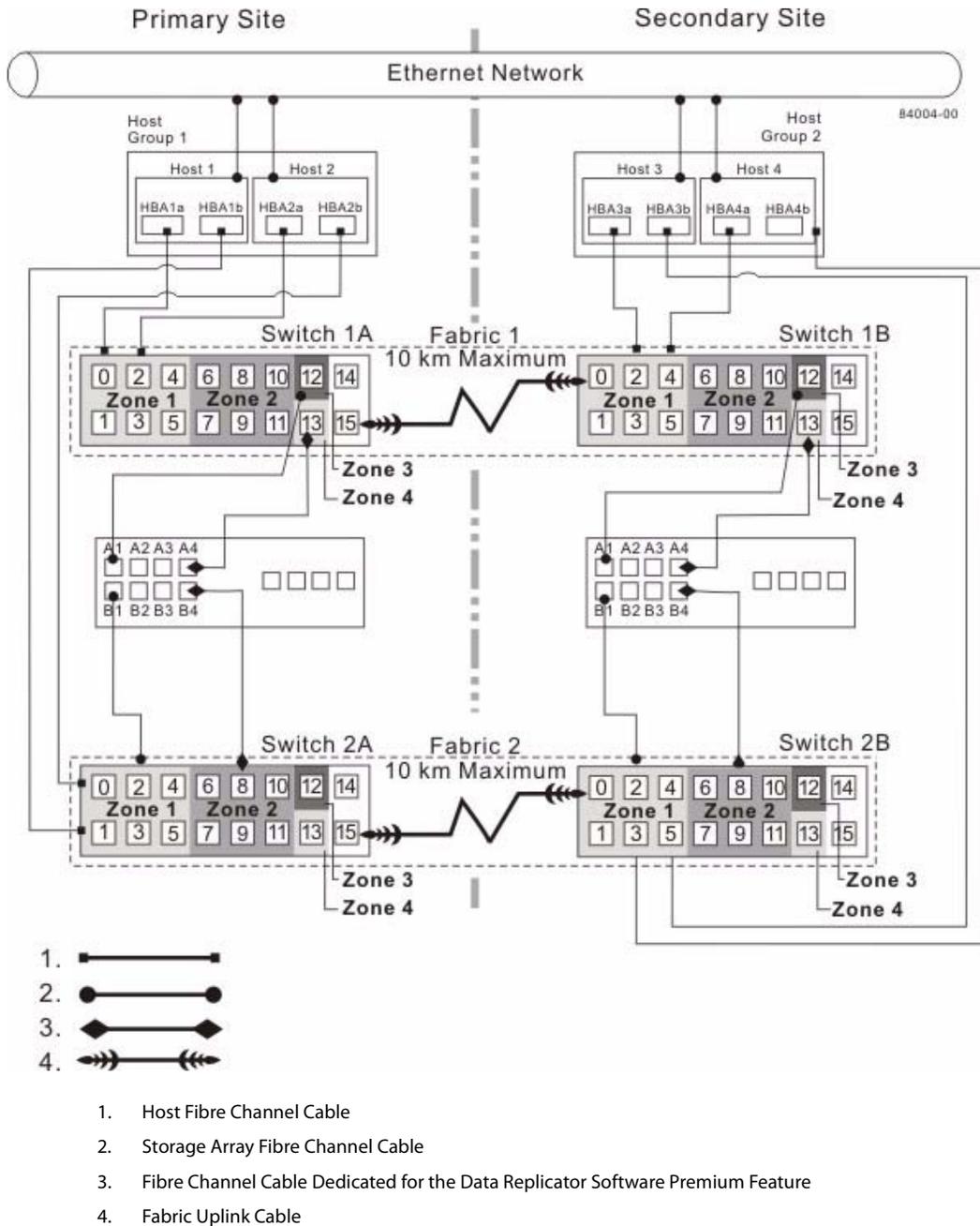


Figure 2 Highest Availability Campus Configuration Using 6540 Controller Modules

Switch Zoning for Highest Availability Campus Configuration

The highest availability campus configuration provides a separate zone for each reserved port for the Data Replicator Software premium feature.

The switches do not need to be zoned exactly as presented in this configuration. However, you must meet the following requirements when zoning switches for the highest availability campus configuration.

There are a total of four zones in this configuration.

- Zone 1 and zone 3 are on fabric 1 (switch 1A at the primary site, and switch 1B at the secondary site).
- Zone 2 and zone 4 are on fabric 2 (switch 2A at the primary site, and switch 2B at the secondary site).

Configure the zones on the switch so that there is one port per zone for a storage array connection and one port per zone for each host. Switches are zoned so that a single host bus adapter port can access only one controller per storage array.

Switches are zoned so that a single host bus adapter port can access only one controller for each storage array.

NOTE Do not zone the uplink ports (E_ports) on any of the Fibre Channel switches.

The following figure shows how the four switches are zoned for the highest availability campus configuration.

The switches have 16 ports each, which leaves unused ports on each switch when following the preceding requirements. The remaining ports can be distributed among the other zones. It is recommended, however, that most of the remaining ports be assigned to the zones containing the host connections: zone 1 and zone 2. This port assignment allows easy setup for additional hosts to connect to the environment.

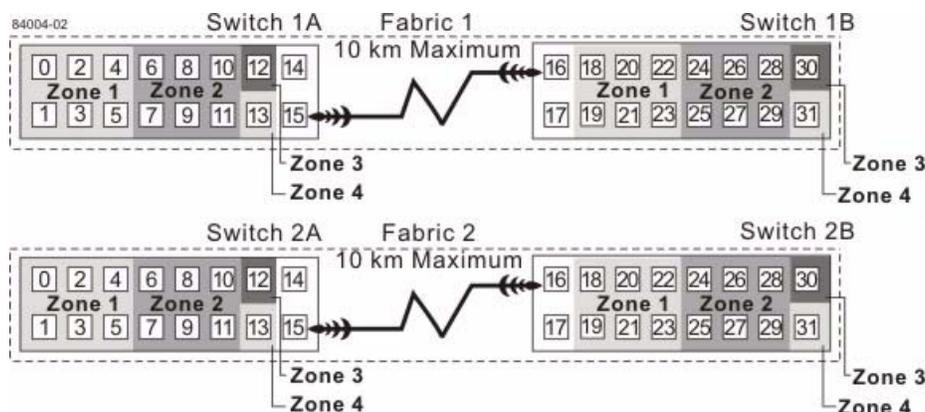


Figure 3 Switch Zoning for the Highest Availability Campus Configuration

Before you proceed, review the requirements listed in this section and the zoning shown in the figure to make sure that all four switches are correctly zoned. For more information, see the [Switch Zoning Overview](#).

Cabling for the Highest Availability Campus Configuration

NOTE Start the installation at the primary site. Repeat these steps for the secondary site when instructed to do so.

After the four Fibre Channel switches are correctly zoned, complete this procedure to set up the highest availability campus configuration for the Data Replicator Software premium feature.

NOTE Complete all connections by using Fibre Channel cables of the correct length.

1. Are you adding equipment for the Data Replicator Software premium feature to an existing storage array environment?
 - **Yes** – Stop I/O activity from all hosts before proceeding. Go to step 2.

- **No** – The storage array installation is new. Go to step 3.

ATTENTION Possible hardware damage – DC-powered array modules and drive modules have special power procedures that you *must* follow beyond the procedures for AC-powered modules. To get specific power-off and power-on procedures, refer to the topics under the storage array installation for the hardware that you are installing or to the corresponding PDF document on the SANtricity ES Storage Manager Installation DVD.

2. Turn off the power to all storage arrays, hosts, Fibre Channel switches, and any other equipment in the storage array environment.
3. Make sure that cabling between all of the controller modules or array modules and the drive modules is complete.

NOTE Depending on which site is being configured, switch 1 represents switch 1A for the primary site and switch 1B for the secondary site. This representation applies to switch 2 as well.

4. Connect the primary host bus adapter for each local host to an available port in zone 1 of switch 1. The following figure shows the cabling that is described in step 4 and step 5.

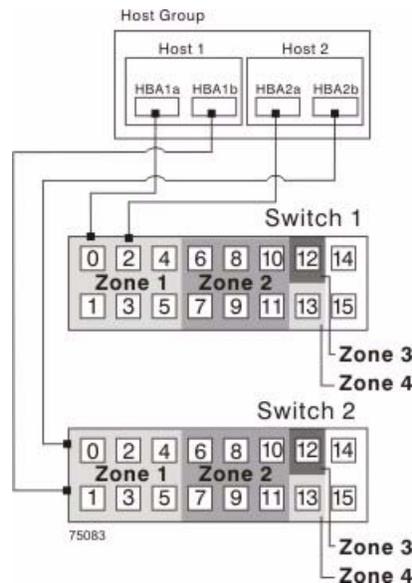


Figure 4 Host Bus Adapter Connections to Fibre Channel Switches

NOTE You can connect the cables to *any* port in the correct zone of the switch for all of the controller modules except the 6540 controller module. Host port 4 on each controller of the 6540 controller modules is reserved for using the Data Replicator Software premium feature. If you are not using the Data Replicator Software premium feature, host port 4 on a 6540 controller module is available for host connections.

5. Connect the secondary host bus adapter for each host at this site to an available port in zone 1 of switch 2.
6. Connect controller port A1 of the storage array to an available port in zone 1 of switch 1. The figure following step 9 shows the cabling for 6540 controller modules.
7. Connect controller port B1 of the storage array to an available port in zone 1 of switch 2.
8. Connect controller port A2 of the storage array to an available port in zone 2 of switch 1. In a four-host-port system, connect controller port A4 to an available port in zone 2 of switch 1.

9. Connect controller port B2 of the storage array to an available port in zone 2 of switch 2. In a four-host-port system, connect controller port B4 to an available port in zone 2 of switch 2.

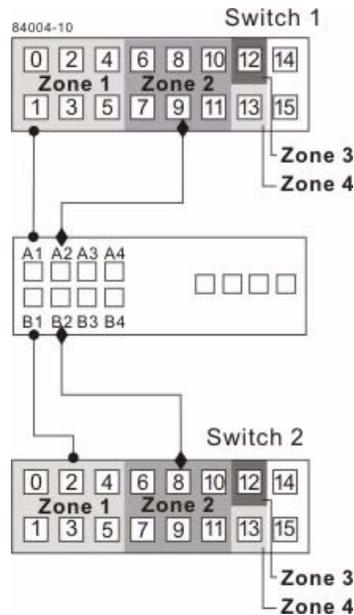


Figure 5 Storage Array Connections to Fibre Channel Switches in the 6540 Controller Module

NOTE Controller port A2 and controller port B2 are reserved for mirror relationship synchronization upon activation of the Data Replicator Software premium feature. In a four-host-port system, controller port A4 and controller port B4 are reserved.

10. The primary site cabling is now complete. Is the secondary site cabling complete?
 - **No** – Repeat step 1 through step 9 for the secondary site.
 - **Yes** – Go to step 11.
11. Complete the fabric environment for switch 1 by connecting switch 1A to switch 1B. The following figure shows the cabling that is described in step 11 and step 12.

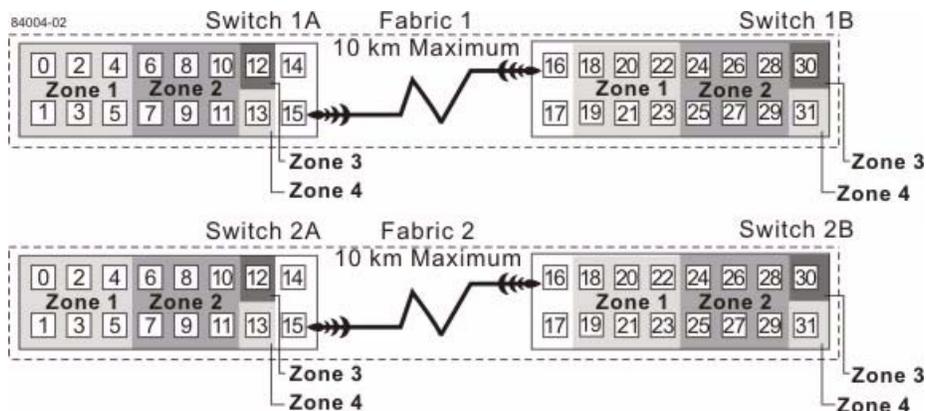


Figure 6 Connecting Remote Switches to Complete Fabric Environments

12. Repeat step 11 for switch 2A and switch 2B to complete the fabric environment for switch 2.

13. Cabling for the highest availability campus configuration is complete. Repeat step 4 through step 10 for other storage arrays that exist in the same cabinet that use the Data Replicator Software premium feature.

ATTENTION Possible hardware damage – DC-powered array modules and drive modules have special power procedures that you *must* follow beyond the procedures for AC-powered modules. To get specific power-off and power-on procedures, refer to the topics under the storage array installation for the hardware that you are installing or to the corresponding PDF document on the SANtricity ES Storage Manager Installation DVD.

14. Turn on the power to all of the storage array hosts, Fibre Channel switches, and any other hardware at both sites where the power was turned off.

The hardware installation is complete. To configure the storage management software to support mirror relationships, refer to the online help topics.

Campus Configuration

The campus configuration offers the same functionality as the highest availability campus configuration, but the campus configuration contains only one switch at each site, rather than two. The configuration is still redundant for host bus adapters, controllers, and remote mirroring ports, but the configuration has a single point of failure for switches. If a switch at either site fails, the Data Replicator Software premium feature cannot operate. For this reason, the highest availability campus configuration is highly recommended for total environment redundancy.

The following figure shows a complete campus configuration. The controller modules are shown schematically with four host ports on each of two controllers in each controller module.

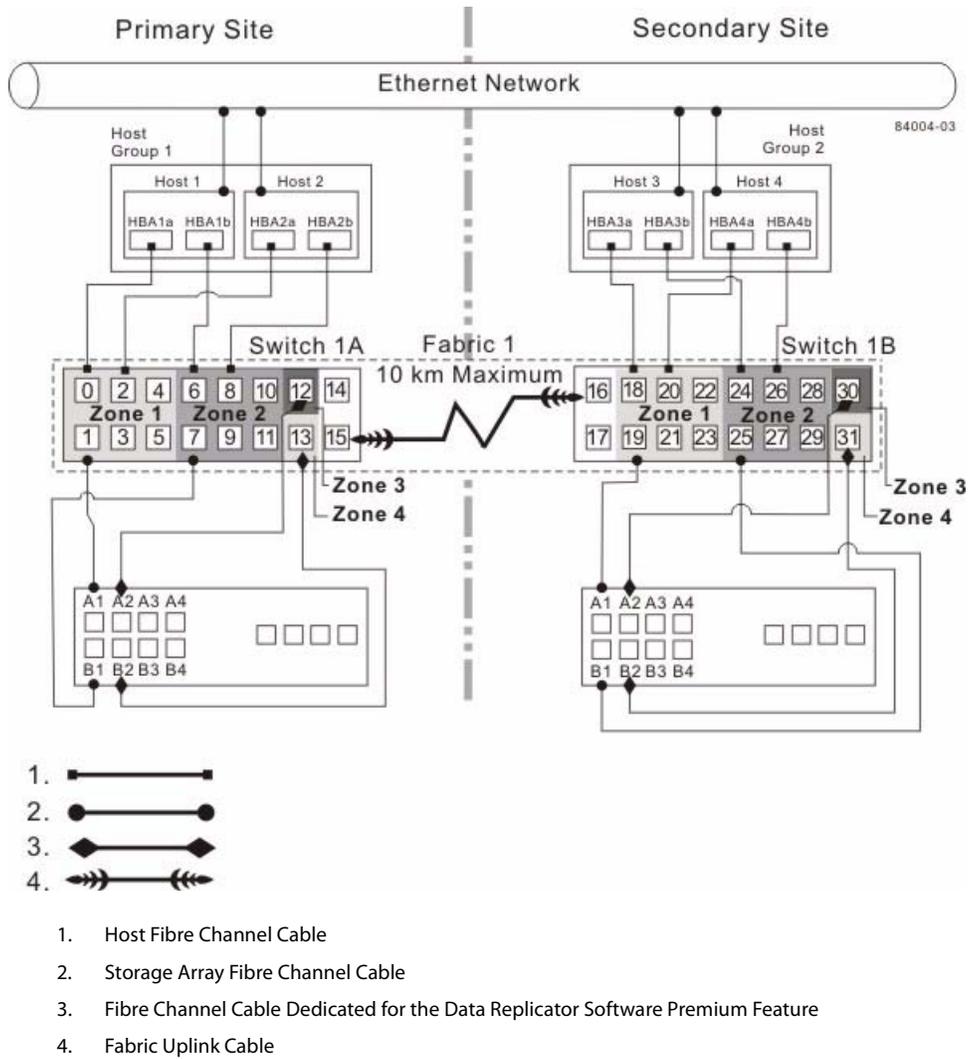


Figure 7 Campus Configuration

Switch Zoning for the Campus Configuration

The campus configuration allows for a separate zone for each reserved port for the Data Replicator Software premium feature.

The switches do not need to be zoned exactly as presented in this configuration. However, you must meet the following requirements when you zone switches for the campus configuration.

NOTE Do not zone the uplink ports (E_ports) on any of the Fibre Channel switches.

You must have a total of four zones in this configuration.

- All zones exist on fabric 1 (switch 1A at the primary site, and switch 1B at the secondary site).
- Zone 3 and zone 4 are reserved for the dedicated Data Replicator Software premium feature connections.

You must configure the zones on the switches so that there is one port per zone for a storage array connection and one port per zone for each host.

You must zone the switches so that a single host adapter can access only one controller per storage array.

The switches in the following figure contain 16 ports each, which leaves many unused ports per switch. The remaining ports can be distributed among the other zones. However, it is recommended that most remaining ports be assigned to the zones that contain the host connections (zone 1). This setup allows connections for additional hosts.

The following figure shows how the two switches are zoned for the campus configuration.

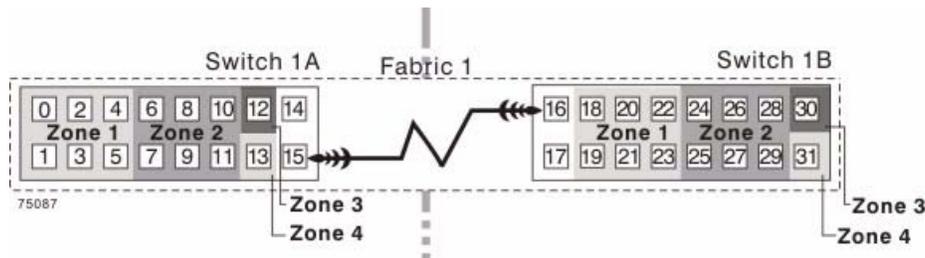


Figure 8 Switch Zoning for the Campus Configuration

Review the requirements in this section and the zoning example in the figure above to make sure that both switches are correctly zoned before proceeding. For more information, see [Switch Zoning Overview](#).

Cabling for the Campus Configuration

NOTE Start the installation at the primary site. Repeat these steps for the secondary site when instructed to do so.

After both Fibre Channel switches are correctly zoned, complete this procedure to set up the campus configuration for the Data Replicator Software premium feature.

NOTE Complete all connections by using Fibre Channel cables of the correct length.

1. Are you adding equipment for the Data Replicator Software premium feature to an existing storage array environment?
 - **Yes** – Stop I/O activity from all hosts before proceeding. Go to step 2.
 - **No** – This is a new storage array installation. Go to step 3.

ATTENTION Possible hardware damage – DC-powered array modules and drive modules have special power procedures that you *must* follow beyond the procedures for AC-powered modules. To get specific power-off and power-on procedures, refer to the topics under the storage array installation for the hardware that you are installing or to the corresponding PDF document on the SANtricity ES Storage Manager Installation DVD.

2. Turn off the power to all storage arrays, hosts, Fibre Channel switches, and any other equipment in the storage array environment.
3. Make sure that basic cabling between all of the controller modules or array modules and the drive modules on both storage arrays is complete.

NOTE Depending on which site is being configured, switch 1 represents switch 1A for the primary site and switch 1B for the secondary site.

NOTE You can connect the cables to any port in the correct zone of the switch.

4. Connect the primary host bus adapter for each host at this site to an available port in zone 1 of switch 1A.

The following figure shows the cabling that is described in step 4 and step 5.

5. Connect the secondary host bus adapter for each host at this site to an available port in zone 2 of switch 1A.

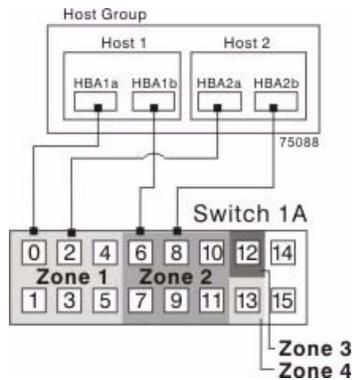


Figure 9 Host Bus Adapter Connections to Fibre Channel Switches

6. Connect controller port A1 of the storage array to an available port in zone 1 of switch 1A.
The first figure following step 9 shows the storage array connected to Fibre Channel switches that is described in step 6 through step 9. The second figure following step 9 shows the cabling configuration schematically with four host ports on each of two controllers in each controller module.
7. Connect controller port B1 of the storage array to an available port in zone 2 of switch 1A.
8. Connect controller port A2 of the storage array to an available port in zone 3 of switch 1A. In a four-host-port system, connect controller port A4.
9. Connect controller port B2 of the storage array to an available port in zone 4 of switch 1A. In a four-host-port system, connect controller port B4.

NOTE Controller ports A2 and B2 are reserved for mirror relationship synchronization upon activation of the Data Replicator Software premium feature. In a four-host-port system, controller port A4 and controller port B4 are reserved.

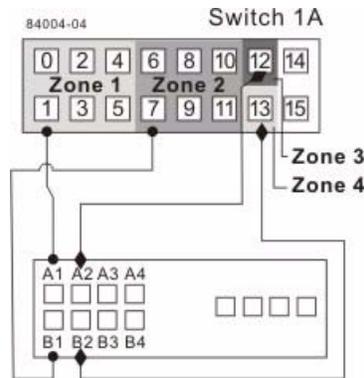


Figure 10 Storage Array Connections to Fibre Channel Switches

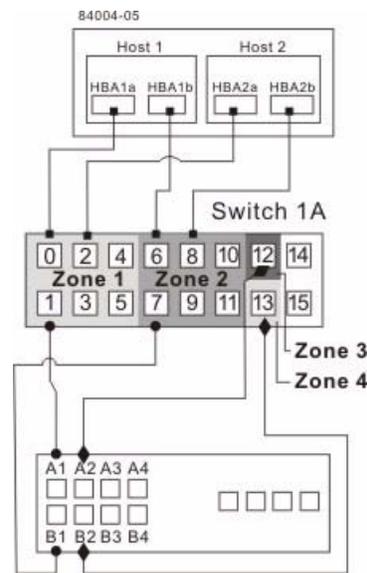


Figure 11 Storage Array Connections to Fibre Channel Switches

10. The primary site cabling is now complete. Is the secondary site cabling complete?
- **No** – Repeat step 1 through step 9 for the secondary site.
 - **Yes** – Go to step 11.
11. Complete fabric 1 by connecting switch 1A to switch 1B.
- The following figure shows the cabling that is described in this step.

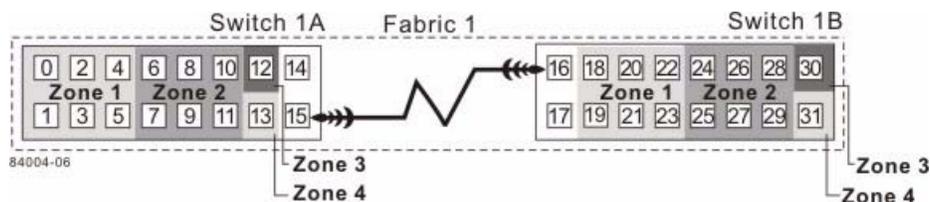


Figure 12 Connecting Remote Switches to Complete the Fabric Environment

12. Cabling for the campus configuration is complete. Repeat step 4 through step 10 for any additional storage arrays that exist in the same cabinet that will use the Data Replicator Software premium feature.

ATTENTION Possible hardware damage – DC-powered array modules and drive modules have special power procedures that you *must* follow beyond the procedures for AC-powered modules. To get specific power-off and power-on procedures, refer to the topics under the storage array installation for the hardware that you are installing or to the corresponding PDF document on the SANtricity ES Storage Manager Installation DVD.

13. Turn on the power to all storage arrays, hosts, Fibre Channel switches, and any other hardware at both sites where the power was turned off.
14. Hardware installation is complete. Refer to the online help topics for procedures to configure the storage management software to support mirror relationships.

Intra-Site Configuration

The intra-site configuration is used in environments where a long-distance fabric is not required because of the close proximity of the hosts and storage arrays. The configuration is still redundant for host bus adapters, controllers, remote mirroring ports, and switches, but the configuration is a single point of failure for the site because all of the equipment can be destroyed by the same disaster. For this reason, the highest availability campus configuration is highly recommended for total environment redundancy.

The following figure shows a complete installation of the intra-site configuration.

NOTE A switch failure in this configuration does not affect data access; however, as a result, an Unsynchronized state might occur for all of the mirror relationships on both the primary storage arrays and the secondary storage arrays.

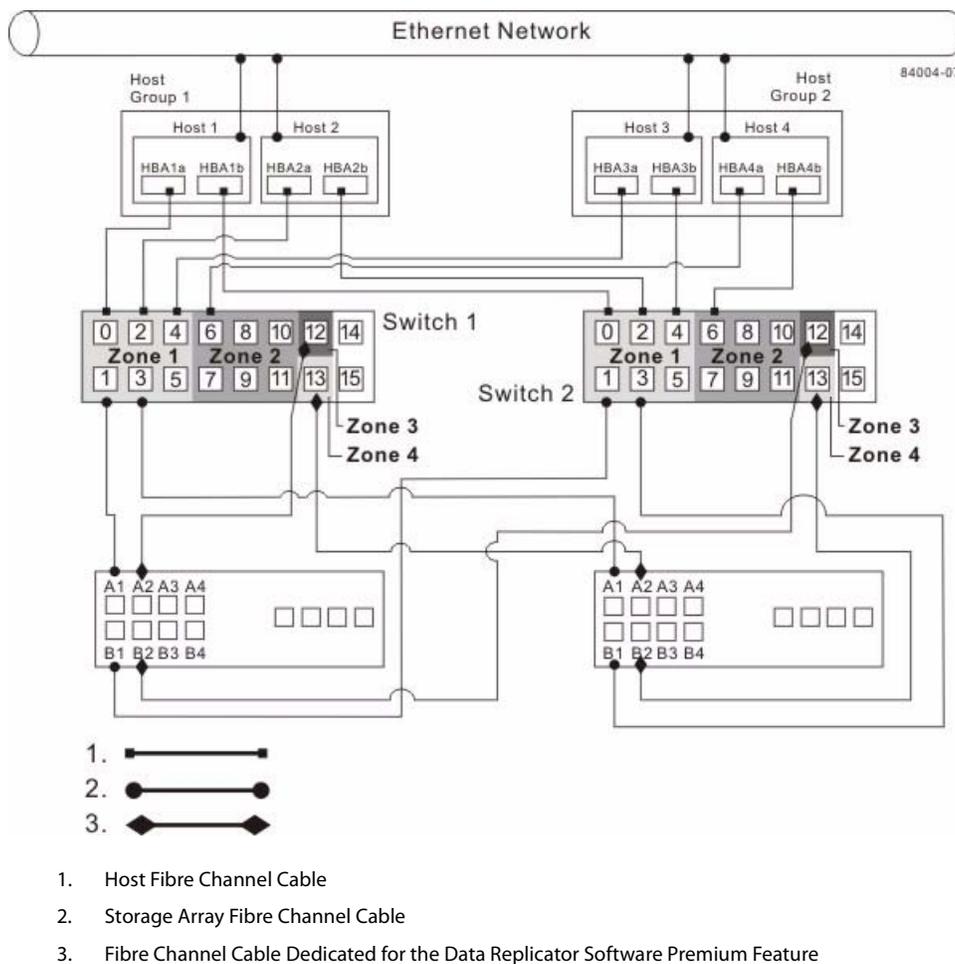


Figure 13 Intra-Site Configuration Following a Complete Installation

Switch Zoning for the Intra-Site Configuration

The intra-site configuration provides switch redundancy, but the switches are not cascaded and are independent of each other.

NOTE The switches do not need to be zoned exactly as presented in this configuration. However, you must meet the following requirements when zoning switches for the intra-site configuration.

You must have a total of four zones on each controller in this configuration.

You must configure the zones on the switch so that there is one port per zone for a storage array connection and one port per zone for each host.

You must zone the switches so that a single host adapter can only access one controller per storage array.

The switches in the following figure contain 16 ports each, which leaves many unused ports per switch. The remaining ports can be distributed among the other zones. However, it is recommended that most of the remaining ports be assigned to the zones that contain the host connections: zone 1 and zone 2. This assignment allows for easy setup for connecting additional hosts.

For simplicity, in this example, the switches use one-half of the ports for each zone, although zone 3 and zone 4 require fewer ports.

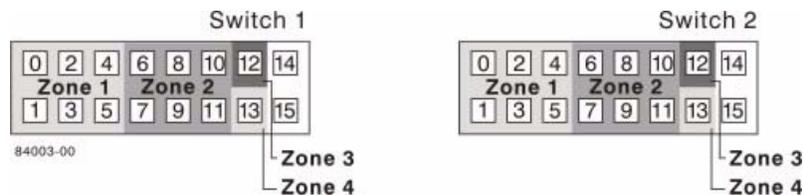


Figure 14 Switch Zoning for the Intra-Site Configuration

Before proceeding, review the requirements in this section and the zoning example in the figures to make sure that both switches are correctly zoned. For more information, see [Switch Zoning Overview](#).

Cabling for the Intra-Site Configuration

After both Fibre Channel switches are correctly zoned, complete this procedure to set up the intra-site configuration for the Data Replicator Software premium feature.

NOTE Complete all connections by using Fibre Channel cables of the correct length.

1. Are you adding equipment for the Data Replicator Software premium feature to an existing storage array environment?
 - **Yes** – Stop I/O activity from all hosts before proceeding. Go to step 2.
 - **No** – This is a new storage array installation. Go to step 3.

ATTENTION Possible hardware damage – DC-powered array modules and drive modules have special power procedures that you *must* follow beyond the procedures for AC-powered modules. To get specific power-off and power-on procedures, refer to the topics under the storage array installation for the hardware that you are installing or to the corresponding PDF document on the SANtricity ES Storage Manager Installation DVD.

2. Turn off the power to all storage arrays, hosts, Fibre Channel switches, and any other equipment in the storage array environment.
3. Make sure that basic cabling between all of the controller modules or array modules and the drive modules is complete on both storage arrays as described in this document.
4. Connect the primary host bus adapter for each host to an available port in zone 1 of switch 1.

The following figure shows the cabling that is described in step 4.

NOTE You can connect the cables to any port in the correct zone of the switch.

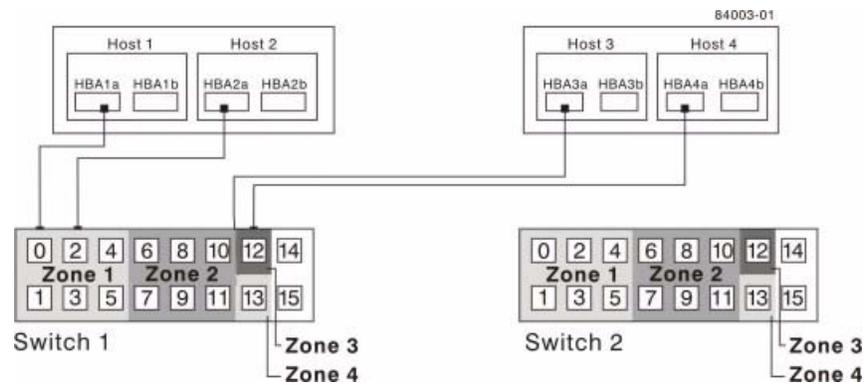


Figure 15 Primary Host Bus Adapter Connections to Fibre Channel Switches

5. Connect the secondary host bus adapter for each host to an available port in zone 1 of switch 2. The following figure shows the cabling that is described in this step.

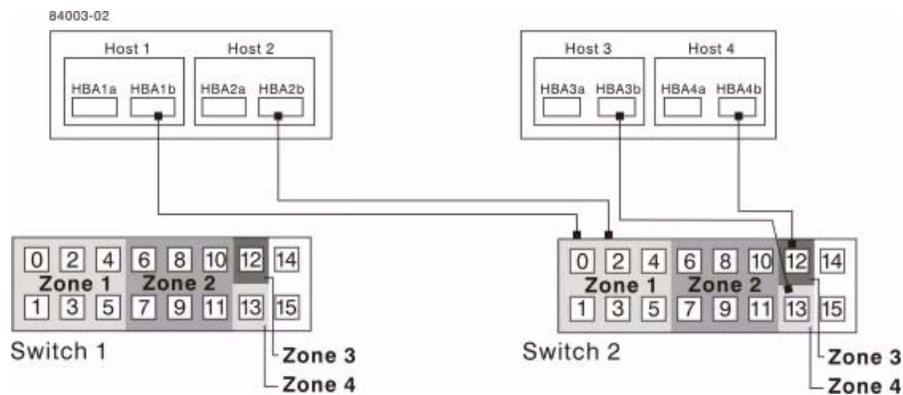


Figure 16 Secondary Host Bus Adapter Connections to Fibre Channel Switches

6. Connect controller port A1 of the primary storage array to an available port in zone 1 of switch 1. The following figure shows the cabling that is described in step 6 through step 9.

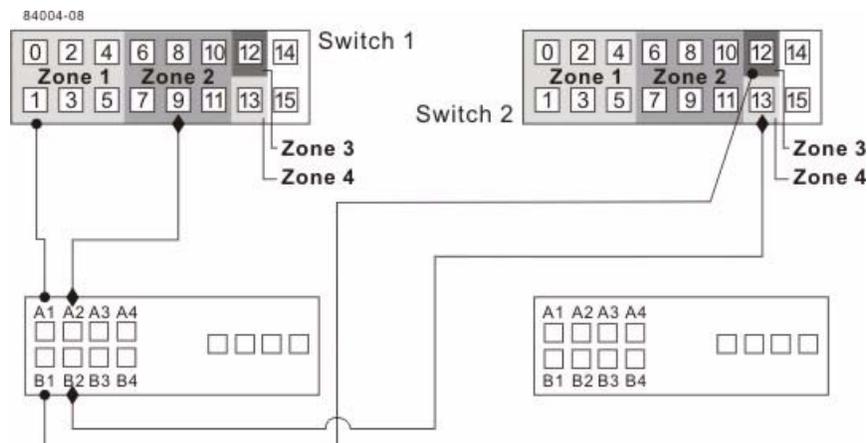


Figure 17 Primary Storage Array Connections to Fibre Channel Switches

7. Connect controller port B1 of the primary storage array to an available port in zone 3 of switch 2.
8. Connect controller port A2 of the primary storage array to an available port in zone 2 of switch 1. In a four-host-port system, connect controller port A4 to an available port in zone 2 of switch 1.
9. Connect controller port B2 of the primary storage array to an available port in zone 4 of switch 2. In a four-host-port system, connect controller port B4 to an available port in zone 4 of switch 2.

NOTE Upon activation of the Data Replicator Software premium feature, controller port A2 and controller port B2 are reserved for mirror relationship synchronization. In a four-host-port system, controller port A4 and controller port B4 are reserved.

10. Connect controller port A1 of the secondary storage array to an available port in zone 1 of switch 1.
The figure following step 13 shows the cabling described in step 10 through step 13.
11. Connect controller port B1 of the secondary storage array to an available port in zone 3 of switch 2.
12. Connect controller port A2 of the secondary storage array to an available port in zone 2 of switch 1. In a four-host-port system, connect controller port A4 to an available port in zone 2 of switch 1.
13. Connect controller port B2 of the secondary storage array to an available port in zone 4 of switch 2. In a four-host-port system, connect controller port B4 to an available port in zone 4 of switch 2.

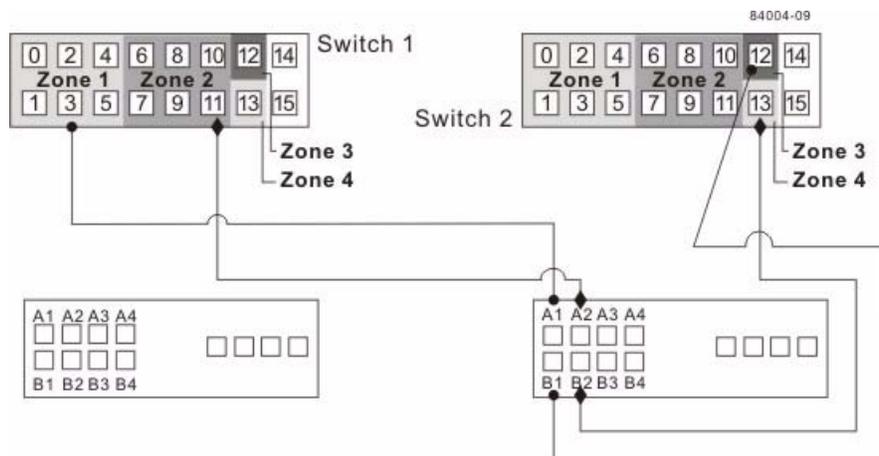


Figure 18 Secondary Storage Array Connections to Fibre Channel Switches

14. Cabling for the intra-site configuration is complete. Repeat step 4 through step 13 for any additional storage arrays that exist in the same cabinet that will use the Data Replicator Software premium feature.

ATTENTION Possible hardware damage – DC-powered array modules and drive modules have special power procedures that you *must* follow beyond the procedures for AC-powered modules. To get specific power-off and power-on procedures, refer to the topics under the storage array installation for the hardware that you are installing or to the corresponding PDF document on the SANtricity ES Storage Manager Installation DVD.

15. Turn on the power to all storage arrays, hosts, Fibre Channel switches, and any other hardware where power was turned off.
16. The hardware installation is complete. Refer to the online help topics for procedures to configure the storage management software to support mirror relationships.

Installing and Using Data Replicator Software with a Wide Area Network

When installing and using the Data Replicator Software premium feature over a wide area network (WAN), keep these guidelines in mind:

- If you are setting up an FCIP router to perform asynchronous Data Replicator Software, go to the Compatibility Matrix. Select **Router-FCIP** in the **Product** field, and select the release of the storage management software that you use in the **Software Release** field. Verify that the maximum latency and distance are supported by referring to the vendor specifications for your router and by checking the Compatibility Matrix. The Compatibility Matrix is found at <http://www.lsi.com/compatibilitymatrix/>.
- FCIP router vendors and telecommunication vendors are responsible for setting up routing.
- The smaller the bandwidth on the WAN, the longer it takes an asynchronous mirror to synchronize.
- If the bandwidth does not exceed the average rate, you might not be able to synchronize the data at all. For example, if the system writes at 1 Mb/s, it needs 2 Mb/s of bandwidth available.
- If the mirroring is lagging far behind during production hours, suspend the mirror. During off-peak hours, resume the mirror.
- If you need to keep the Data Replicator Software on at all times, keep the mirror physically as close as possible to the production site.
- To determine the average write rate, you should use the available system utilities and should take measurements during peak times.

- If you anticipate adding any applications, determine the bandwidth needs for any future applications.
- Acceptable lag times vary depending on the environment and should be determined on an individual basis.

Line Capacities

Table 2 Line Capacities and Line Speeds

Line Type	Capacity in Mb/s	Speed in MB/s
T-1	1.544	0.193
T-3	43.232	5.404
OC-3	155.6352	19.454
OC-12	622.5408	77.8176
OC-48	2490.1632	311.27
OC-192	9960.6528	1245.085

The following table shows average write operations in Mb/s with corresponding line capacity calculations. When the line capacity calculation is below 50 percent, the result is an adequate response-time performance and a limited need for delta logging (when the mirror lags behind the data). When the line capacity calculation is above 50 percent, the mirror can never catch up. Any transfers above 50 percent will start to lag.

Table 3 Line Capacity Calculation for Various Write I/O Rates

Average Write Time in Mb/s	T-1	T-3	OC-3	OC-12	OC-18	OC-192
0.01	5.2%	0.2%	0.1%	0.0%	0.0%	0.0%
0.1	51.8%	1.9%	0.5%	0.1%	0.0%	0.0%
1	518.1%	18.5%	5.1%	1.3%	0.3%	0.1%
10	5181.3%	185.3%	51.4%	12.9%	3.2%	0.8%

Copyright © 2011 LSI Corporation. All rights reserved.
Copyright © 2011 Sun Microsystems, Inc. All rights reserved.
Printed in U.S.A.

