Hardware Cabling Guide

for all SANtricity Storage Manager users

EH1712-1-E2, Second Edition

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Chapter 6: COMPONENT LOCATIONS

Document Conventions

Definitions of Safety Notices

DANGER Indicates an imminently hazardous situation that will result in death or severe personal injury.

WARNING Indicates a potentially hazardous situation that could result in death or severe personal injury.

CAUTION Indicates a potentially hazardous situation that could result in moderate or minor personal injury.

Definitions of Informational Notices

CAUTION Indicates a potentially hazardous situation that could result in data loss (or other interruption) or equipment damage.

IMPORTANT Indicates information or criteria that is necessary to perform a procedure correctly.

NOTE Indicates a clarification of a concept or presents a maintenance tip.

Typographic Conventions

Italic indicates the title of documents, variables and placeholders in text, emphasized words, and new terms.

Bold indicates choices in procedures and other emphasized text.

`Monospace` indicates arguments, code examples, command-line text, command options, commands, directories, error messages, file names, folders, on-screen text, and user input.

`Monospace italic` indicates command variables in code, parameters, and placeholders and variables in code.

`Monospace bold` indicates keywords and values.

Revision Record

Edition or Revision	Date	Affected Pages or Remarks
First edition	September 2005	New document
Second edition	March 2006	Add information about the new 6140 storage system. Add more information about zoning and switches.

Part Number: EH1712-1-E2

About This Document

This document provides conceptual and procedural information for cabling various combinations of the following components that make up a storage system:

- Control modules:
  - 6540 control module
  - FLX280 control module
  - FLX240 control module
- Storage systems:
  - 6140 storage system
  - FLX240 storage system
  - FLX240 Drive Limited storage system
- Drive modules:
  - CSM200 drive module
  - FLA200 drive module
  - FLA300 drive module
  - FLC200 drive module

Prerequisites

This document assumes that system planning and site preparation are complete.

Intended Readers

This document is intended for end users, system operators, system administrators, and service personnel who install and configure the hardware. This document assumes that the user has experience with storage array network (SAN) hardware and management. Readers must also be familiar with computer system operation, maintenance, and repair. In addition, they should understand storage system, Redundant Array of Independent Disks (RAID), network, and Fibre Channel (FC) technologies.

Related Publications

These publications contain additional information about cabling:

- *SANtricity Storage Manager Remote Volume Mirroring Feature Guide for Version 9.x*
- *SANtricity Storage Manager Concepts Guide for Version 9.1x*
- *6540 Control Module Initial Setup Guide*
- *6140 Control Module Initial Setup Guide*

Web Address

For information related to the products mentioned in this document, go to www.engenio.com/products.

Additional Information

Refer to the *Storage System Product Release Notes for Version 9.1*x for late-breaking information that is not contained in this document.

Chapter 1

Cabling Concepts and Best Practices

This chapter is divided into three sections.

The first section, "Cabling Concepts," provides definitions of the terms used in this document. This section is intended primarily for reference. Although you may skip definitions of terms you are already familiar with, reading the entire section might increase your overall understanding of the storage system and help you to optimize your storage system.

The second section, "Best Practices," contains information that might affect your choice of cabling topologies. It is recommended reading.

The third section, "Common Procedures," contains procedures that you will need to perform while you are cabling the storage system. It is also recommended reading.

Cabling Concepts

This section provides definitions of terms and concepts that are used in this document.

Fabric (Switched) Topologies Compared to Direct-Attach Topologies

All topologies described in this document are Fibre Channel (FC) topologies. Fabric topologies use a switch. Direct-attach topologies do not use a switch. Either way, the topologies assume that you are using FC-compatible devices.

Drive Module

A drive module contains multiple drives but no controllers. Drive modules are usually attached to either a control module or an storage system so that the storage space in the drive module can be configured, accessed, and managed by the controller in the control module or storage system. Drive modules (aka Expansion Trays) can be differentiated by type, as discussed in the following subsections.

Just a Bunch of Disks (JBOD)

Originally used to mean a collection of disks without the coordinated control provided by control software; today, the term JBOD most often refers to a cabinet of disks, whether or not Redundant Array of Independent Disks (RAID) functionality is present.

In this guide, the FLA200 drive module is referred to as JBOD in the cabling diagrams.

Switched Bunch of Disks (SBOD)

A device that takes all of the drives that are operating in a single Fibre Channel Arbitrated Loop (FC-AL) segment. SBOD then 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, no system firmware changes are needed.

In this guide, the FLA300 drive modules and the CSM200 drive modules are referred to as SBODs in the cabling diagrams. To see an example of this type of labeling for drive modules, refer to Figure 1-5 on page 1-14.

Serial Advanced Technology Attachment (SATA)

An evolution of the Parallel Advanced Technology Attachment (PATA) physical storage interface. SATA is a serial link that uses a single cable with a minimum of four wires to create a point-to-point connection between devices. Transfer rates for SATA begin at 150 MB/s. Transfer rates for SATA II begin at 300 MB/s. One of the main advantages of SATA is that the thinner serial cables facilitate more efficient airflow inside a form factor and also allow for smaller chassis designs. In contrast, Integrated Device Electronics (IDE) cables used in PATA systems are bulkier than SATA cables. In addition, IDE cables can only extend to 40 cm (15.7 in.) long, while SATA cables can extend up to 1 m (39.6 in.).

In this guide, the FLC200 drive module is referred to as SATA in the cabling diagrams.

Control Module

A control module contains controllers but no drives. Control modules are capable of configuring, accessing, and managing the storage space of attached drive modules.

Storage System

An storage system contains both controllers and drives. The controllers are capable of configuring, accessing, and managing the storage space of the drives in the storage system. An storage system might be capable of configuring, accessing, and managing 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 and control information between the host and the controller, or between the drives and the controller. The path from the host to the controller is the “host channel,” and the path from the drives to the controller is the “drive channel.” Each drive channel is defined by a single Fibre Channel Arbitrated Loop. Controllers have between two and eight available host channels, and between one and four available drive channels, depending upon the model. Each drive channel can support up to 112 drives, and each host channel can support up to 512 hosts, depending upon the model. See Table 2-1 on page 2-2, Table 2-2 on page 2-3, and Table 2-3 on page 2-4 for model-specific information.

IMPORTANT When mixing different drive modules, consider the total number of drives that are available in the final configuration of the storage system. For example, mixing CSM200 drive modules with FLA300 drive modules might provide a total number of drives that is greater than the maximum number that each drive channel can support.

Host Ports and Drive Ports

The ports are the physical connectors on the control module or storage system that, along with the cabling, enable the transfer of data. If the port is intended for communicating with the host server, it is a *host port*. If the port is intended for communicating with a drive module, it is a *drive port*.

The connectors used for host ports and drive ports look identical. The figures in Chapter 6, “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 storage system or a drive module is dual ported. Circuitry in the drive module or storage system connects one drive port to one channel and the other port to another channel. Therefore, if one drive port or channel fails, the data on the drive is accessible through the other drive port or channel.[1]

Preferred and Alternate Controllers and Paths

The preferred controller is the controller that is designated as the owner of a volume or volume group. The preferred controller is automatically selected by SANtricity® Storage Manager when a volume is created, or the user can override the default selection.

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1. SATA drives are not dual ported; however, the electronics in the FLC200 drive module emulate the behavior of dual-ported drives, and each drive is available through two paths.

Several conditions will force the preferred controller to fail over to the alternate controller. When the preferred controller has failed over to the alternate controller, ownership of the volume is shifted to the alternate controller. The following 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 re-routes input/output (I/O) requests to the alternate path so that the system continues to operate without interruption.

You can obtain information about alternate path software from the Certified Compatibility Matrix. To check for current compatibility, refer to the Certified Compatibility Matrix at http://www.engenio.com/partners/certified_compatible.html, and click View Compatibility Matrix; or go to Powerport at http://portal.stortek.com/index_pport.html for the Interop Tool. The alternate path (failover) software tools are listed for each supported HBA.

Refer to the *SANtricity Storage Manager Concepts Guide for Version 9.1*x or to the CAM documentation to learn how alternate path software functions in cooperation with SANtricity Storage Manager or CAM features to provide data path protection.

Failover

Failover is an automatic operation that switches from a failed 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 or failed controller. Controller failover is possible only in control modules or in storage systems that contain two controllers.

In a system where 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.

Redundant and Non-Redundant

The term *redundant* means “more than one” and indicates the existence of something more than what is essential to accomplish a task. In RAID technology, redundancy means that there are duplicated components or data, or alternate means to provide essential services. This redundancy ensures the availability of data in case of a failure of a component. It is possible, and likely, that in most RAID systems, most of the components are redundant, but that the system is not 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 ensure 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

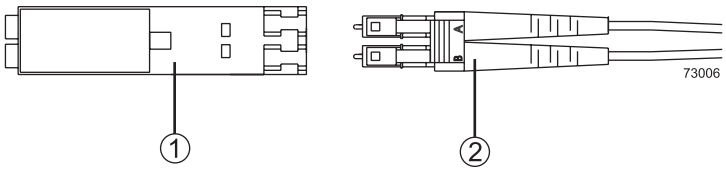
Any component or path that is not duplicated (redundant) or whose failure can cause loss of data access is termed a potential *single point of failure*. In the cabling scenarios that are presented in this document, the components that present a potential single point of failure are noted. Choose a cabling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

SFP Transceivers and Copper and Fiber-Optic Cables

Storage systems, control modules, and drive modules use either fiber-optic or copper cables. If your system will be cabled with copper cables, a passive copper Fibre Channel (FC) Small Form-factor Pluggable (SFP) transceiver is attached to each end of the cable. If your system will be cabled with fiber-optic cables, you must install active SFP transceivers into each port where a cable will be connected before plugging in the cable.

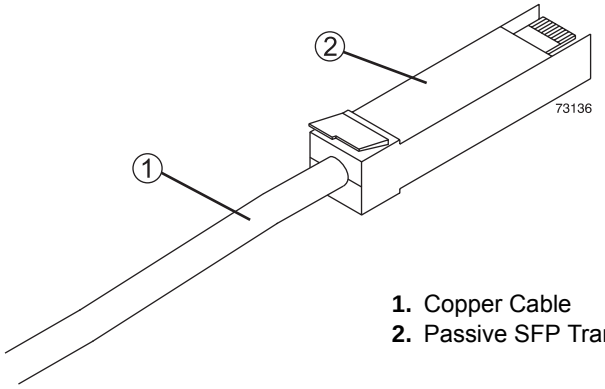
Figures 1-1 and 1-2 on page 1-6 show the two types of cables and SFP transceivers. Note that your SFP transceivers and cables might look slightly different from the ones shown. The difference does not affect performance.

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 1-1 Active SFP Transceiver with Fiber-Optic Cable



1. Copper Cable
2. Passive SFP Transceiver

Figure 1-2 Passive SFP Transceiver with Copper Cable

Host Bus Adapters

Each cable connection from a control module or an storage system to the host is made through a host bus adapter (HBA) that is installed in the host. The HBA provides the interface to the internal bus of the computer that serves as the host. Most HBAs have a single port, but dual-ported HBAs and quad-ported HBAs also exist. A common solution for redundancy is to use multiple HBAs in a single host computer. These HBAs can each be connected to a different switch to ensure that the server will be accessible even if an HBA fails.

CAUTION **Possible loss of data access** – Do not use a combination of QLogic and Hewlett-Packard (HP) HBAs in the same storage area network (SAN). Doing so can result in the QLogic HBA detecting the HP HBA as a volume (target) rather than as a host (initiator). To ensure proper performance, use only one manufacturer's HBA in a SAN.

You can obtain information about supported HBAs from the Certified Compatibility Matrix. To check for current compatibility, refer to the Certified Compatibility Matrix at http://www.engenio.com/partners/certified_compatible.html, and then click the View Compatibility Matrix link.

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 provides support for the Ethernet technology and is required for network communication. Each Ethernet cable connection for out-of-band storage system management is made through an NIC (see "In-Band Management and Out-of-Band Management" on page 1-8).

NOTE It is the customer's responsibility to obtain and install the required NICs.

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, communications among devices in each zone are independent of communications 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 Name (WWN) name server for all attached disks and drive modules, and their capabilities. Zoning is like a filter that is applied by the WWN name server to the query from the initiator that limits the information returned by the WWN name server to the initiator. A zone defines the WWN of the initiator, and the WWN 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 there are many targets 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. Zone configuration is managed on a per-fabric basis. While it is possible for you to administer zone configuration from any switch, the best practice is to select one switch for

all zone administration. You should give preference to 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

Requests and status information sent between a storage system and the storage management station are managed in one of two ways: in-band or out-of-band. The way that you define your storage system impacts the way that you configure your storage system.

When you use *in-band management*, the storage management software receives requests from the CAM or SANtricity Storage Manager Client workstation and processes them through the host I/O interface to the storage system (for example, Fibre Channel, SAS, or iSCSI). Access through an Ethernet connection is neither used nor required.

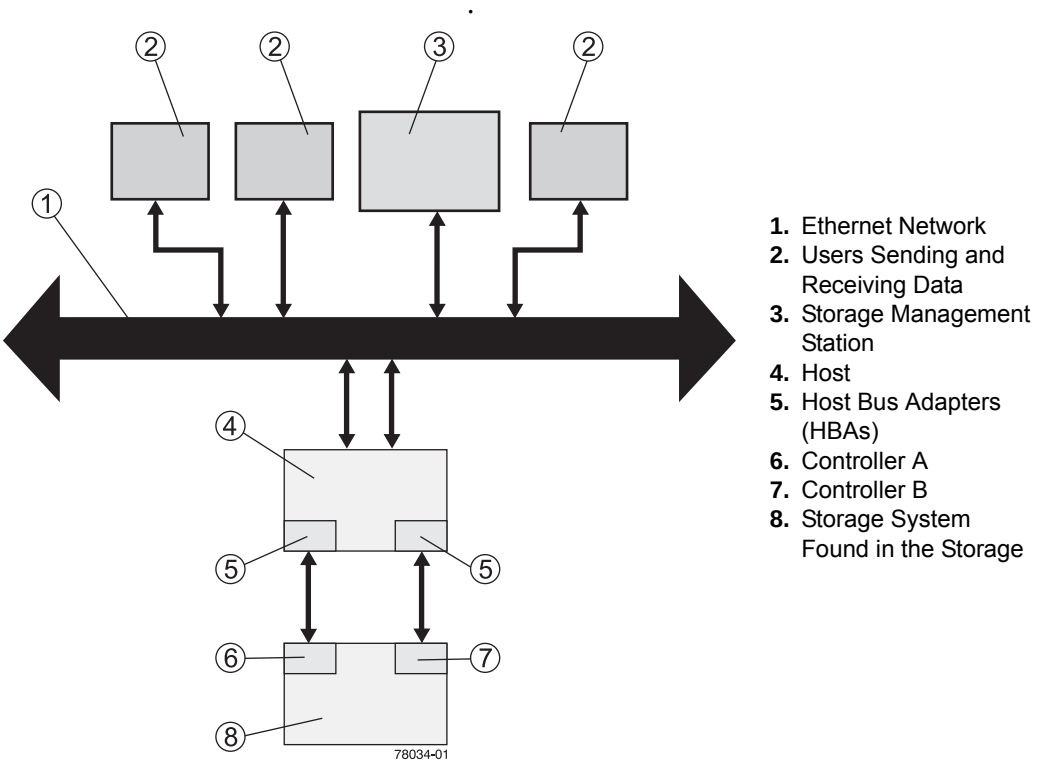
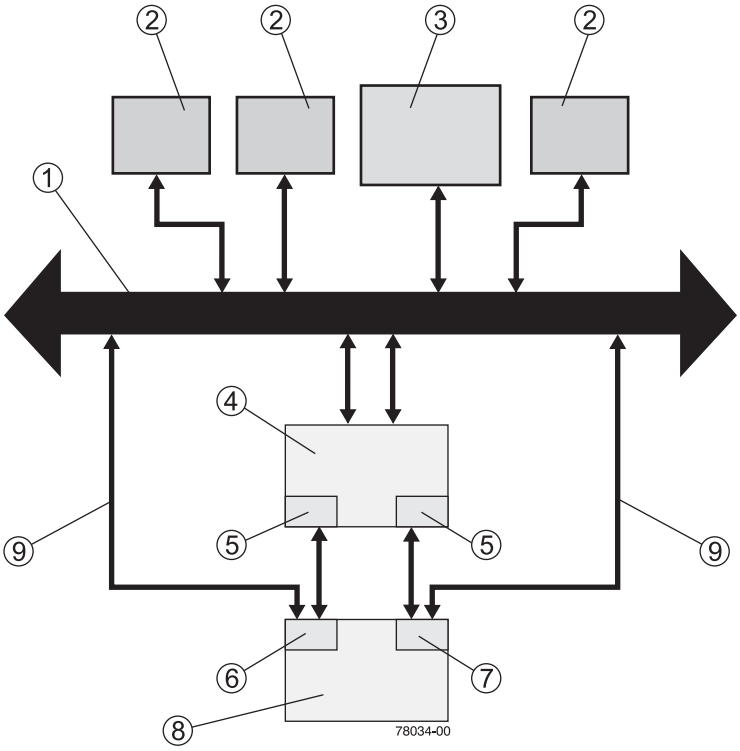


Figure 1-3 Sample In-Band Management Topology

When you use *out-of-band management*, the storage management (SSM/CAM) Client is installed and operates on a remote workstation. The remote workstation is connected (via the host) to each of the two controllers in the control module or storage system through an Ethernet port located on each controller. Figure 1-4 on page 1-9 provides an example of how a storage system can be cabled for out-of-band management.

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. Refer to the online help topic "Adding a Host or Storage System," in the Enterprise Management Window for more details.



1. Ethernet Network
2. Users Sending and Receiving Data
3. Storage Management Station
4. Host
5. Host Bus Adapters (HBAs)
6. Controller A
7. Controller B
8. Storage System Found in the Storage System
9. Ethernet Cable from the Controllers to the

Figure 1-4 Sample Out-of-Band Management Topology

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

IMPORTANT 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 Customer and Technical Support.

For information about how to create a redundant out-of-band topology, see Chapter 5, “Ethernet Cabling.”

Best Practices

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

IMPORTANT If your existing storage system cabling does not comply with the best practices described in this section, do not recable your storage system unless specifically requested to do so by a Customer and Technical Support representative.

Drive Cabling for Redundancy

When attaching drive modules, use a cabling topology that does not create a single point of failure. A single point of failure might manifest itself as a drive module failure or another component failure in the middle of a grouping of drive modules. If a drive module fails, all drive modules beyond the point of failure are no longer accessible. Creating an alternate path ensures accessibility in the event of a drive module failure.

Cabling topologies that are not exactly symmetrical create an alternate path of access to the drive modules. The first path is created by cabling the drive modules sequentially from Controller A. For example, Controller A is connected to Drive Module 1, which is connected to Drive Module 2, which is connected to Drive Module 3, which is connected to Drive Module 4. (This is the *top-down cabling path*.) The alternate path is created by cabling the drive modules in the reverse order from Controller B. For example, Controller B is connected to Drive Module 4, which is connected to Drive Module 3, which is connected to Drive Module 2, which is connected to Drive Module 1. (This is the *bottom-up cabling path*.) In the event that Drive Module 2 fails, Drive Modules 3 and 4 are still accessible through the alternate path.

Figure 4-11 on page 4-19 shows a typical cabling scenario that combines both top-down and bottom-up cabling. Note how the control module is conveniently situated in the middle of the arrangement, which enables you to use cables that are all the same length.

NOTE See Chapter 4, “Drive Cabling,” for numerous cabling examples, ranging from simple to complex, that use different types of drive modules.

Host Cabling for Redundancy

To ensure that, in the event of a host channel failure, the storage system will remain 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, ensures a redundant path from the host to the controllers.

CAUTION **Potential 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.

See Chapter 3, "Host Cabling," for examples of redundant topologies. See "Alternate Path Software" on page 1-4 for more information about how to ensure complete data path protection.

Host Cabling for Remote Volume Mirroring

The Remote Volume Mirroring feature is used for online, real-time replication of data between storage systems over a remote distance. In the event of a disaster or catastrophic failure at one storage system, you can promote a second storage system to take over responsibility for computing services.

The Remote Volume Mirroring feature requires a dedicated host port for mirroring data between storage systems. After the Remote Volume Mirroring feature has been activated, one host I/O port on each controller is solely dedicated to mirroring operations. Refer to the *SANtricity Storage Manager Remote Volume Mirroring Feature Guide for Version 9*.x for more information on Remote Volume Mirroring cabling configurations.

NOTE One of the host ports on *each* controller needs to be dedicated for the communication that occurs between the two storage systems (primary and secondary volumes). If you are not using the RVM feature, these host ports are available for ordinary host connections.

Cabling for Performance

Generally speaking, performance is enhanced by maximizing bandwidth, or 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. Refer to the *SANtricity Storage Manager Concepts Guide for Version 9.1*x for information on RAID levels.

Considerations for Drive Channel Speed

When multiple drive modules are connected to the same drive channel, all 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 drive modules to operate at the lowest common speed. See Table 2-3 on page 2-4 for a list of the operating speeds of each supported drive module.

Multiple Types of Drive Modules (Expansion Trays)

IMPORTANT Before creating a topology that combines multiple drive module types, verify that your control module or storage system supports this feature. You must configure the control module or storage system to support multiple drive module types.

Beginning with the release of SANtricity Storage Manager Version 9.1, you can combine multiple drive module types in a single storage system topology. Consider the following rules and guidelines before planning and cabling your storage system with more than one drive module type:

- Distribute drive modules across redundant drive channels in a control module or an storage system to achieve maximum throughput performance.
- Configure FLA300 and CSM200 drive modules (SBOD) in series as described in "Cabling for Drive Modules that Support Loop Switch Technology" on page 1-13.
- Do not create multiple series of FLA300 drive modules and CSM200 drive modules (SBOD) separated by other drive modules, such as JBOD or SATA.
- Do not combine 2-Gb/s drive modules with 1-Gb/s drive modules in a single storage system topology. 1-Gb/s drive module models cannot be combined with 2-Gb/s drive module models in a single storage system topology unless the 2-Gb/s drive modules have been configured to run at 1 Gb/s.[2]
- Whenever possible, and with consideration of the previously stated rules and guidelines, place all like drive modules on the same drive channel.
- 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 supported on a drive channel.

See Chapter 4, "Drive Cabling," for specific examples of recommended cabling topologies with multiple drive module types for each control module and storage system. Chapter 4 also contains additional rules specific to each control module and storage system model.

2. SANtricity Storage Manager Version 9.14 and later does not support 1-Gb/s drive modules.

Single-Controller Topologies and Dual-Controller Topologies

If you are creating a topology for a control module or an storage system 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 control module or a single-controller storage system.

Copper and Fiber-Optic Cables

Beginning with the release of SANtricity Storage Manager 9.10, you can use a combination of 2-Gb copper and fiber-optic cables to connect the drive modules to a control module or an storage system. Prior to this release, either copper or fiber-optic cables could be used, but they could not be used in combination. Host connections require the use of fiber-optic cables.

NOTE Mixing cable types might create erroneous data in the error statistics.

Cabling for Drive Modules that Support Loop Switch Technology

The FLA300 drive modules and CSM200 drive modules operate internally as an array of drives connected in a point-to-point configuration by a FC-AL Loop Switch. Drive modules without Loop Switch support operate as a string of drives on an arbitrated loop. These drive modules are referred to as a Switched Bunch of Disks (SBOD). This design allows SBOD drive modules to 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, SBOD drive modules must be clustered together when combined with other types of drive modules in a storage system topology.

When an SBOD drive module is connected either singly to a control module or an storage system, or when multiple SBOD drive modules are connected in series to a control module or an storage system, the SBOD drive modules operate in *switch 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 module operates 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 modules also operate in *hub mode*. 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 this cluster restriction is not met, the SANtricity Storage Manager software displays 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 the cabling topology is changed.

To maximize the performance of SBOD drive modules, always cable the SBOD drive modules in a series.

Figure 1-5 on page 1-14 shows a simple block diagram of three recommended topologies for SBOD drive modules. All three scenarios shown in Figure 1-5 are arranged to maximize performance. The scenario on the left (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 Fibre Channel Arbitrated Loop feature.

In Figure 1-5, the FLA300 drive modules or CSM200 drive modules are identified as SBODs. The FLC200 drive module is identified as SATA (Serial Advanced Technology Attachment). All other drive module types, including the FLA200 drive module, are identified as OTHER.

IMPORTANT When mixing different drive modules, consider the total number of drives that are available in the final configuration of the storage system. For example, mixing CSM200 drive modules with FLA300 drive modules might provide a total number of drives that is greater than the maximum number that each drive channel can support.

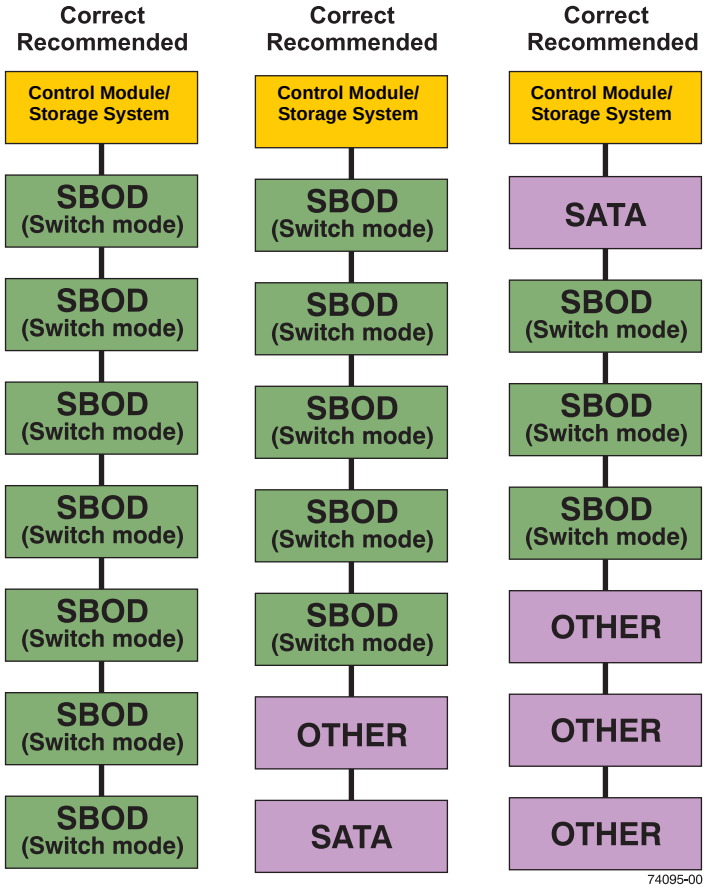


Figure 1-5 Suitable Cabling Topologies for Multiple SBOD Drive Modules

Labeling Cables

Cabling is an important part of creating a robust storage system. Labeling the cables provides identification of system components, drive channels, or loops. System maintenance is easier when the cables are properly identified. Labeling both ends of the cables is recommended. 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 Chapter 3 and Chapter 4, label each cable with the channel number noted in the table that you are following. Additionally, using color-coded cable straps (or ties) to group all the cables associated with one component, drive channel, or loop provides additional identification.

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

Cabling Information Provided by SANtricity Storage Manager

After you have completed your cabling topology and installed the SANtricity Storage Manager software, you can view cabling information through the SANtricity Storage Manager software. The SANtricity Storage Manager software displays a table that shows the cabling topology and incorrectly cabled or non-redundant drive channels. Refer to the online help topics in the SANtricity Storage Manager software for more information.

Adding New Drive Modules to an Existing Storage System

HotScale™ technology enables you to add drive modules to an existing storage system without interrupting power or data transfer to the storage system.

See Chapter 7, “Adding a Drive Module to an Existing System,” for details.

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 that they came in.
- 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 a Fiber-Optic Cable and an SFP Transceiver

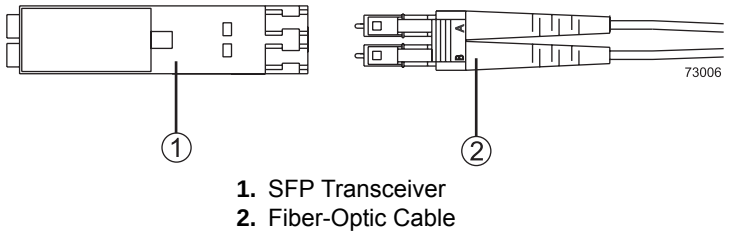
You must install SFP transceivers into each connector to which you will connect a fiber-optic cable. To install an SFP transceiver, follow this procedure.

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.

CAUTION **Potential damage to fiber-optic cables** – Fiber-optic cables are fragile. Bending, twisting, folding, or pinching fiber-optic cables can cause damage to the cables, degraded performance, or loss of data access. To prevent damage, do not twist, fold, pinch, or step on the cables. Do not bend the cables to less than a 2-inch radius.

CAUTION **Potential loss of data access –** If you are installing an FLX280 control module, ensure that you install SFP transceivers only in the host minihub ports that are used in your cabling topology. Installing an SFP transceiver in an unused minihub port can result in temporary loss of access to data.

1 Verify that your cables are fiber-optic cables by comparing them to the cable shown in Figure 1-6. Your SFP transceivers might look slightly different from the one shown in Figure 1-6. The difference does not affect performance.

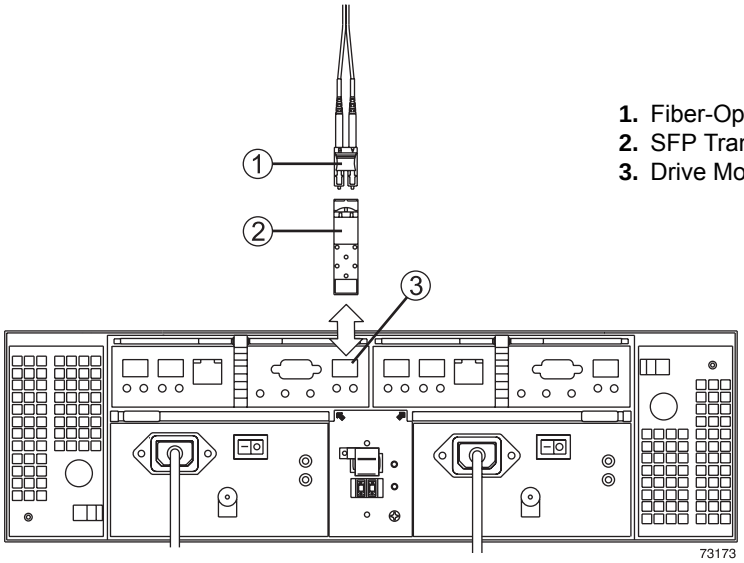


1. SFP Transceiver
2. Fiber-Optic Cable

Figure 1-6 SFP Transceiver and Fiber-Optic Cable

2 Insert an SFP transceiver into the port in which the fiber-optic cable will be installed. Figure 1-7 shows how to install an SFP transceiver.

IMPORTANT Ensure that the SFP transceiver installs with an audible click.



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

Figure 1-7 Installing an SFP Transceiver

3 Install the fiber-optic cable. Figure 1-7 shows how to install the fiber-optic cable in the SFP transceiver.

Installing a Copper Cable with a Passive SFP Transceiver

CAUTION **Electrostatic discharge can damage sensitive components** – Touching the control module, storage system, drive module, or its components without using a proper ground might damage the equipment. To avoid damage, use proper antistatic protection when handling any component. For more information, see "Handling Static-Sensitive Components" on page 1-16.

1 Verify that your cables are copper cables by comparing them to the cable shown in Figure 1-8. Your passive SFP transceivers might look slightly different from the one shown in Figure 1-8. These differences are insignificant, and do not affect SFP transceiver performance.

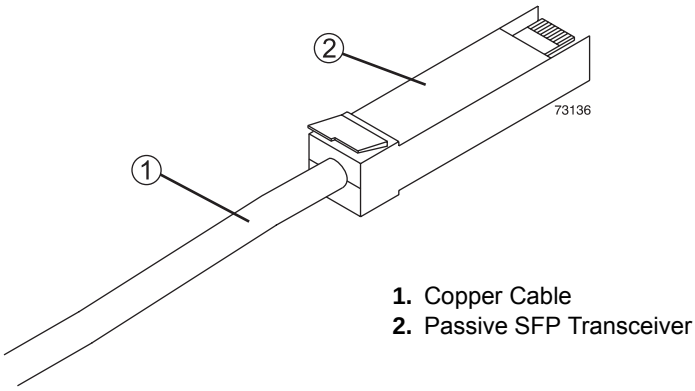


Figure 1-8 Passive SFP Transceiver and Copper Cable

IMPORTANT Ensure that the passive SFP transceiver installs with an audible click.

2 Insert the passive SFP transceiver into the port in which the copper cable will be installed. Figure 1-7 on page 1-17 shows how to install an SFP transceiver.

Chapter 2

Product Compatibility

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

Host Channel Information by Model

Table 2-1 lists the specifications and restrictions that affect host-cabling topologies. Ensure that your planned control module topology or your planned storage system topology is compatible with these specifications and restrictions.

Table 2-1 Host Channel Information for a Control Module and an Storage System

Product	Maximum Host Port Speed	Number of Host Ports per Controller	Maximum Number of Hosts per Cluster	Maximum Number of Hosts	Cable Type
6540 control module	4 Gb/s	4	16	512	Fiber-optic
FLX280 control module	2 Gb/s	4	16	512	Fiber-optic
FLX240 control module	2 Gb/s	2	16	256	Fiber-optic
6140 storage system	4 Gb/s	2 or 4 (depending on model)	16	512	Fiber-optic
FLX240 storage system	2 Gb/s	2	16	256	Fiber-optic
FLX240 Drive Limited storage system	2 Gb/s	2	16	256	Fiber-optic

Drive Channel Information by Model

Table 2-2 lists the specifications and restrictions that affect control module or storage system-to-drive cabling topologies. Ensure that your planned drive module topology is compatible with these specifications and restrictions.

IMPORTANT When mixing different drive modules, consider the total number of drives that are available in the final configuration of the storage system. For example, mixing CSM200 drive modules with FLA300 drive modules might provide a total number of drives that is greater than the maximum number that each drive channel can support.

Table 2-2 Drive Channel Information for a Control Module and an Storage System (1 of 2)

Product	Drive Port Speeds	Maximum Number of Drives	Supported Drive Modules	Cable Type	Notes
6540 control module	2 Gb/s or 4 Gb/s	224	CSM200 FLA200 FLA300 FLC200	Copper/ fiber-optic	If you are using the CSM200 drive module in your configuration, design for a limit of 7 drive modules per dual-ported drive channel. For other drive modules, the limit is 8 per channel pair.
FLX280 control module	1 Gb/s 2 Gb/s	224	CSM200 FLA200 FLA300 FLC200	Copper/ fiber-optic	If you are using the CSM200 drive module in your configuration, design for a limit of 7 drive modules per dual-ported drive channel.
FLX240 control module	1.5 Gb/s	112	FLC200	Copper/ fiber-optic	

Table 2-2 Drive Channel Information for a Control Module and an Storage System (2 of 2)

Product	Drive Port Speeds	Maximum Number of Drives	Supported Drive Modules	Cable Type	Notes
6140 storage system	2 Gb/s or 4 Gb/s	112	CSM200 FLA200 FLA300 FLC200	Copper/ fiber-optic	If you are using the CSM200 drive module in your configuration, design for a limit of 6 drive modules per dual-ported drive channel.
FLX240 storage system	2 Gb/s	98 expansion 112 total	FLA200 FLA300	Copper/ fiber-optic	The FLX240 storage system includes 14 drives.
FLX240 Drive Limited storage system	2 Gb/s	14	None	Not applicable	The FLX240 Drive Limited storage system includes 14 drives. The FLX240 Drive Limited storage system cannot be expanded to support additional drives.

Drive Module Information by Model

Table 2-3 lists the drive module specifications that might affect your topology. Ensure that your planned topology is compatible with these specifications and restrictions.

IMPORTANT When mixing different drive modules, consider the total number of drives that are available in the final configuration of the storage system. For example, mixing CSM200 drive modules with FLA300 drive modules might provide a total number of drives that is greater than the maximum number that each drive channel can support.

Table 2-3 Drive Module Specifications (1 of 2)

Model	Port Speed	Drives per Enclosure	Maximum Number of Drive Modules per Loop
CSM200 drive module	4 Gb/s	16	7

Table 2-3 Drive Module Specifications (2 of 2)

Model	Port Speed	Drives per Enclosure	Maximum Number of Drive Modules per Loop
FLA200 drive module	2 Gb/s	14	8
FLA300 drive module	2 Gb/s	14	8
FLC200 drive module	2 Gb/s	14	8

Chapter 3

Host Cabling

This chapter provides examples of possible cabling topologies between one or more hosts and a control module or an storage system. Direct-attach topologies, fabric topologies, and mixed topologies are addressed. You are not limited to using only these topologies; the examples are included to provide basic concepts to help you define an optimal host-cabling topology. A table listing the maximum supported number of hosts is included. This chapter contains these sections:

See Chapter 6, "Component Locations," for host port locations on the specific control module or storage system model that you are installing.

IMPORTANT If you are using the Remote Volume Mirroring feature, refer to the *SANtricity Storage Manager Remote Volume Mirroring Feature Guide for Version 9.*x for for cabling information using a host port between the two storage systems. After the host cabling for Remote Volume Mirroring is complete, go to Chapter 4, "Drive Cabling" to see examples of drive cabling topologies.

Maximum Number of Host Connections

Table 3-1 lists the maximum number of hosts that can be connected to a single control module or storage system.

Table 3-1 Maximum Number of Host Connections by Model

Model	Maximum Number of Hosts
6540 control module	512
FLX280 control module	512
FLX240 control module	256
6140 storage system	512
FLX240 storage system	256
FLX240 Drive Limited storage system	256

CAUTION **Potential loss of data access** – If you are installing an FLX280 control module, do not connect more than a single manufacturer's HBA to any one minihub. Connecting different manufacturers' HBAs to a single minihub can result in an HBA communication failure.

CAUTION **Potential loss of data access** – Do not use a combination of QLogic and Hewlett-Packard (HP) HBAs in the same storage area network (SAN). Doing so can result in the QLogic HBA detecting the HP HBA as a volume (target) rather than as a host (initiator). To ensure proper performance, use only one manufacturer's HBA in a SAN.

Direct-Attach Topologies

The host-to-control module topologies and host-to-storage system topologies presented in this section do not use switches.

One Single-HBA Host to a Single-Controller Control Module or Storage System

Figure 3-1 shows an example of a direct-attach topology with one host and a single-controller control module or storage system. Table 3-2 defines which of the components in this topology are non-redundant and present a risk of a single point of failure.

Table 3-2 Redundant and Non-Redundant Components in a Single-HBA Host to a Single-Controller Control Module or Storage System

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

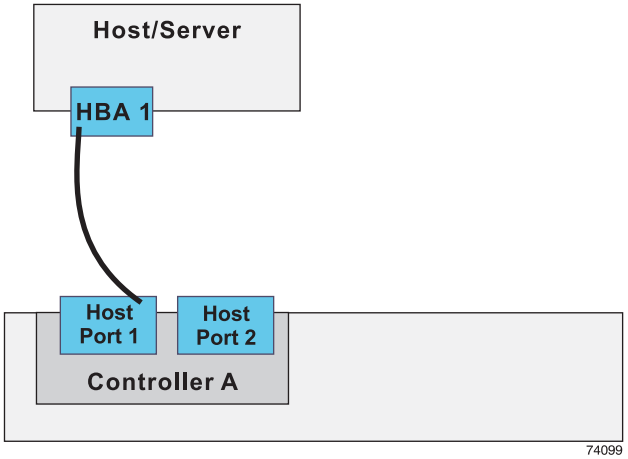


Figure 3-1 Direct-Attach Topology – One Host and a Single-Controller Control Module or Storage System

One Dual-HBA Host to a Dual-Controller Control Module or Storage System

Figure 3-2 shows an example of a direct-attach topology with one host and a dual-controller control module or storage system. Table 3-3 defines which of the components in this topology are non-redundant and present a risk of a single point of failure.

CAUTION **Potential 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 3-3 Redundant and Non-Redundant Components in a Dual-HBA Host to a Single-Controller Control Module or Storage System

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

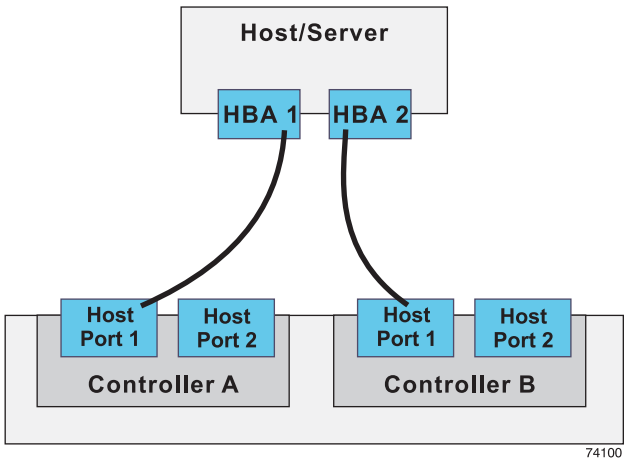


Figure 3-2 Direct-Attach Topology – One Host and a Dual-Controller Control Module or Storage System

Two Dual-HBA Hosts to a Dual-Controller Control Module or Storage System

Figure 3-3 shows an example of a direct-attach topology with two hosts and a dual-controller control module or storage system. Table 3-4 defines which of the components in this topology are non-redundant and present a risk of a single point of failure.

CAUTION **Potential 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 3-4 Redundant and Non-Redundant Components in Two Dual-HBA Hosts to a Dual-Controller Control Module or Storage System

Component	Redundant	Non-Redundant
Host/server[a]	✔	
HBA	✔	
Host-to-controller cable	✔	
Controller	✔	

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

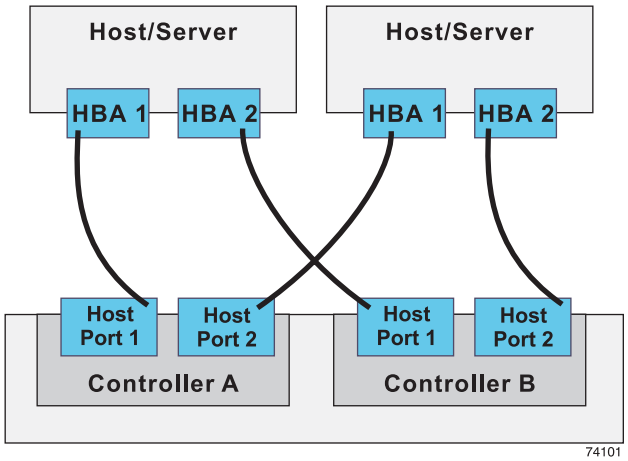


Figure 3-3 Direct-Attach Topology – Two Hosts and a Dual-Controller Control Module or Storage System

Fabric (Switched) Topologies

The host-to-control module topologies and host-to-storage system topologies presented in this section include one or more switches.

One Dual-HBA Host to a Dual-Controller Control Module or Storage System

Figure 3-4 on page 3-7 shows an example of a fabric topology with one host, a dual-controller control module or storage system, and a zoned switch. Table 3-5 defines which of the components in this topology are non-redundant and present a risk of a single point of failure.

CAUTION **Potential 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 3-5 Redundant and Non-Redundant Components in a Dual-HBA Host to a Dual-Controller Control Module or Storage System with a Switch

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

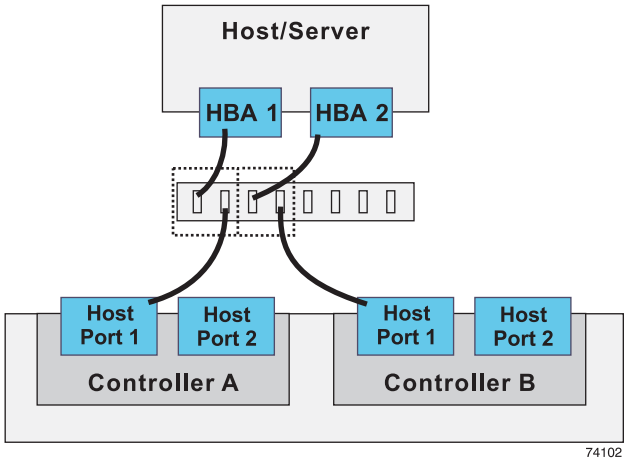


Figure 3-4 Fabric Topology – One Dual-HBA Host and a Dual-Controller Control Module or Storage System with a Switch

Two Dual-HBA Hosts to a Dual-Controller Control Module or Storage System

Figure 3-5 shows an example of a fabric topology with two hosts, a dual-controller control module or storage system, and a zoned switch. Table 3-6 defines which of the components in this topology are non-redundant and present a risk of a single point of failure.

CAUTION **Potential 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 3-6 Redundant and Non-Redundant Components in Two Dual-HBA Hosts to a Dual-Controller Control Module or Storage System with a Zoned Switch

Component	Redundant	Non-Redundant
Host/server[a]	✔	
HBA	✔	
Host-to-controller cable	✔	
Switch		✔
Controller	✔	

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

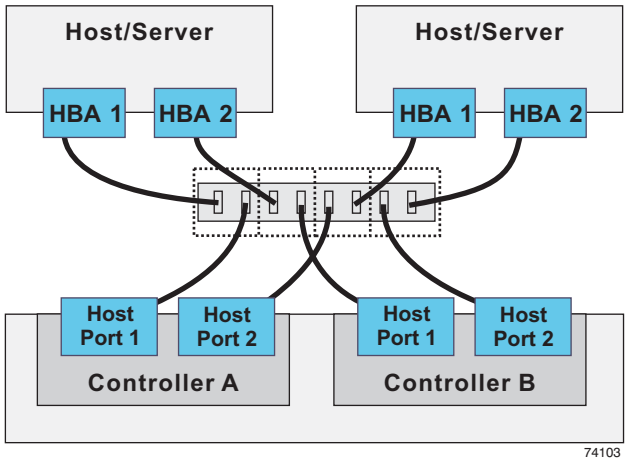


Figure 3-5 Fabric Topology – Two Dual-HBA Hosts and a Dual-Controller Control Module or Storage System with a Zoned Switch

Four Dual-HBA Hosts to a Dual-Controller Control Module or Storage System

Figure 3-6 shows an example of a fabric topology with four hosts, a dual-controller control module or storage system, and two zoned switches. Table 3-7 defines which of the components in this topology are non-redundant and present a risk of a single point of failure.

CAUTION **Potential 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 3-7 Redundant and Non-Redundant Components in Four Dual-HBA Hosts to a Dual-Controller Control Module or Storage System with Two Zoned Switches

Component	Redundant	Non-Redundant
Host/server[a]	✔	
HBA	✔	
Host-to-controller cable	✔	
Switch	✔	
Controller	✔	

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

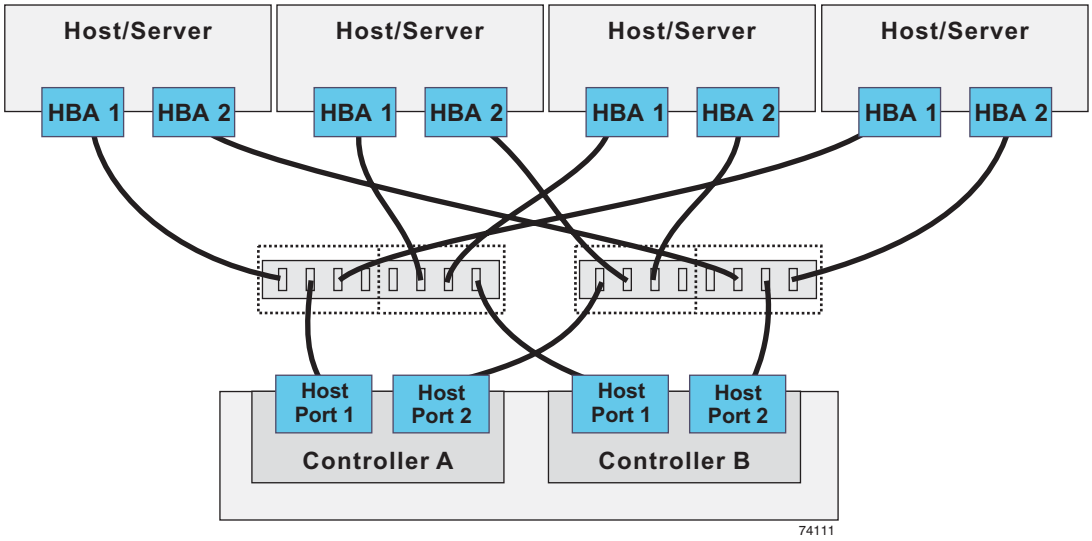


Figure 3-6 Fabric Topology – Four Dual-HBA Hosts and a Dual-Controller Control Module or Storage System with Two Zoned Switches

Mixed Topologies

Figure 3-7 shows an example of a mixed topology; that is, a topology that combines both fabric and direct-attach topologies. The example shows three hosts, a dual-controller control module or storage system, and two switches. Table 3-8 defines which of the components in this topology are non-redundant and present a risk of a single point of failure.

CAUTION **Potential 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 3-8 Redundant and Non-Redundant Components in Three Dual-HBA Hosts to a Dual-Controller Control Module or Storage System with Two Switches

Component	Redundant	Non-Redundant
Host/servers 1 and 2[a]	✔	
Host/server 3		✔
HBA	✔	
Host-to-controller cable	✔	
Switch	✔	
Controller	✔	

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

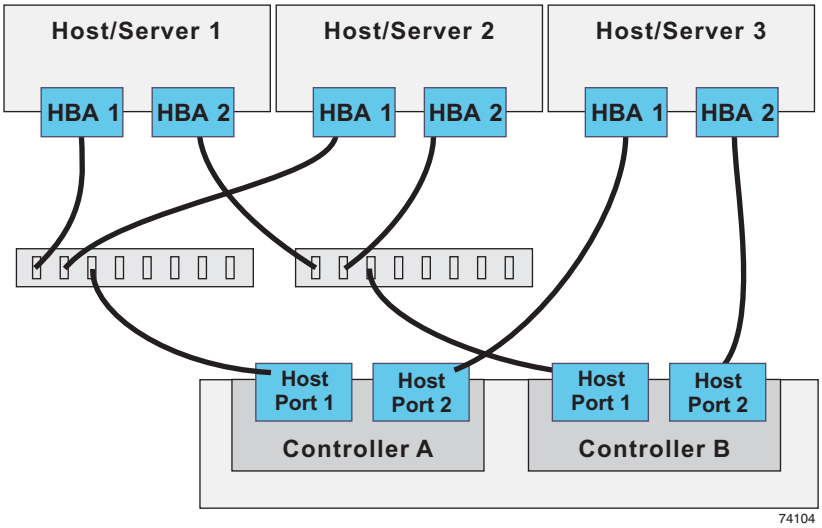


Figure 3-7 Mixed Topology – Three Dual-HBA Hosts and a Dual-Controller Control Module or Storage System

Chapter 4

Drive Cabling

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

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

See Chapter 6, "Component Locations," for drive port locations on the specific control module or storage system and drive module models you are installing.

Refer to the section that applies to the control module or storage system to which you are cabling the drive modules:

A Comparison of ESM CRU Arrangements

Many of the figures in this chapter show storage systems that use drive modules with side-by-side ESMs. Each ESM CRU has one In port and one Out port, and the CRUs are located adjacent to one another, as shown in Figure 4-1. The arrows pointing in opposite directions provide a visual indicator of data direction, and aid you as you attach the various cables.

Figure 4-2 shows another type of drive module that your storage system might use. This type of drive module has inverted and flipped-over ESM CRUs. Other figures in this chapter show this type of drive module. The arrows are not included with this type of ESM, because the drive modules themselves are not labeled with arrows.

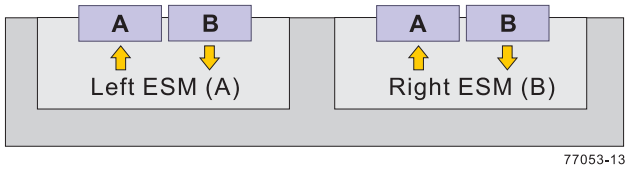


Figure 4-1 Drive Module with Side-by-Side ESMs

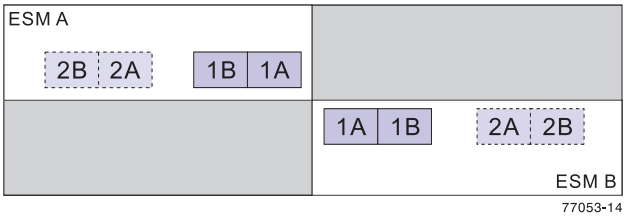


Figure 4-2 Drive Module with Inverted ESMs

If you are connecting a control module or an storage system to a drive module with side-by-side or inverted ESM CRUs, use Table 4-1, Figure 4-1, and Figure 4-2 for reference.

Table 4-1 Applicable Drive Ports on ESMs – A Comparison

Port	Side-by-Side ESM	Inverted ESM
ESM A	Port A	Port 1A
ESM B	Port B	Port 1B

IMPORTANT Ports 2A and 2B are reserved for future use, and are not available for use at this time.

Drive Cabling Topologies for the 6540 Control Module

This section provides five cabling examples for the 6540 control module. 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 practices described in “Drive Cabling for Redundancy” on page 1-10 to ensure full data availability.

- If you are cabling FLC200 drive modules into your storage system, follow the guidelines provided in “Cabling for Drive Modules that Support Loop Switch Technology” on page 1-13.
- If you are using fiber-optic cables, install SFP transceivers into the ports that will receive the fiber-optic cables before installing the fiber-optic cables. To install the SFP transceivers, see “Installing a Fiber-Optic Cable and an SFP Transceiver” on page 1-16.

One Control Module and One Drive Module

If you are cabling one 6540 control module to one drive module, use the cabling topology described in Table 4-2 and Figure 4-3.

Table 4-2 One 6540 Control Module and One Drive Module

Drive Channel	Connection Point		Connection Point	
	Module/ Component	Port Number/ Location	Module/ Component	Port Number/ Location
1	Controller A	4	Drive Module 1	Left ESM, Port B
3	Controller B	1	Drive Module 1	Right ESM, Port B

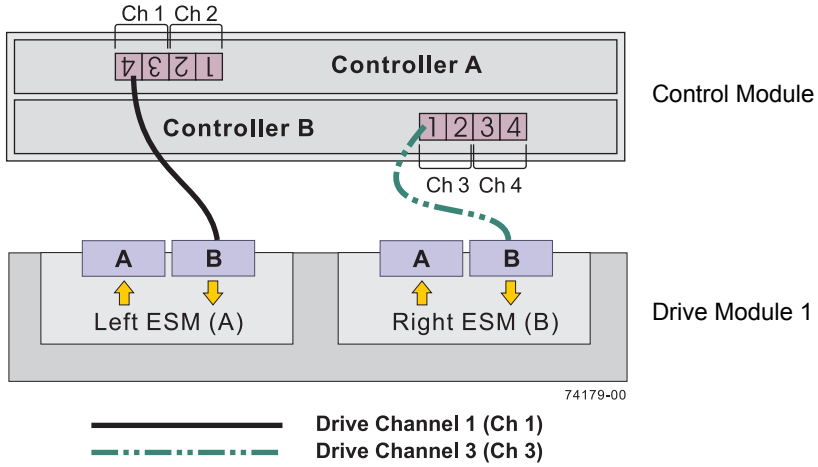


Figure 4-3 One 6540 Control Module and One Drive Module

NOTE If you have drive modules with inverted ESM CRUs, see "A Comparison of ESM CRU Arrangements" on page 4-2.

One Control Module and Two Drive Modules

If you are cabling one 6540 control module to two drive modules, use the cabling topology described in Table 4-3 and Figure 4-4.

Table 4-3 One 6540 Control Module and Two Drive Modules

Drive Channel	Connection Point		Connection Point	
	Module/ Component	Port Number/ Location	Module/ Component	Port Number/ 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

In Figure 4-4, the drive module below the control module is numbered 1 and the drive module above the control module is numbered 2.

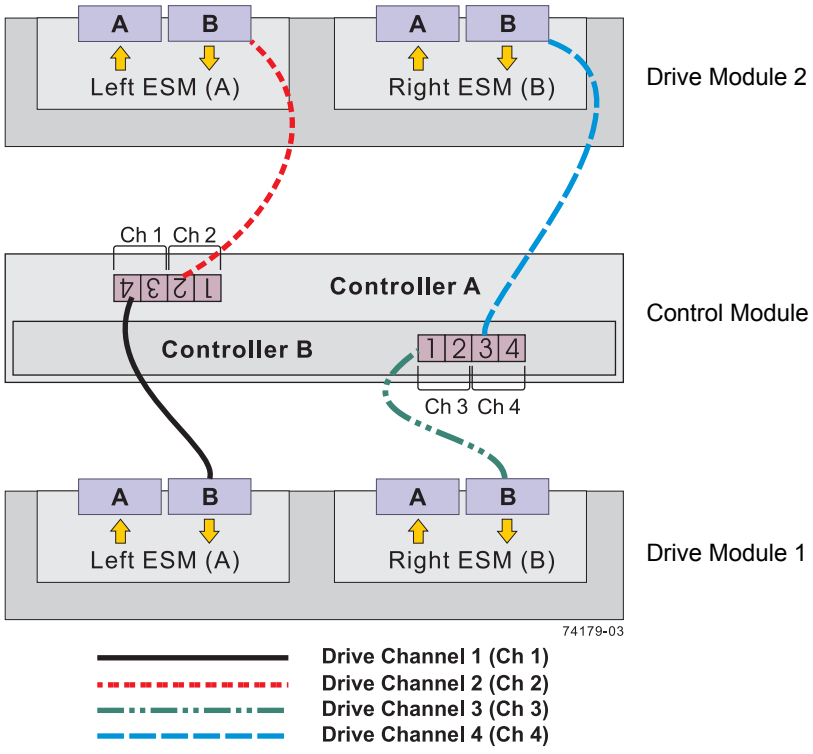


Figure 4-4 One 6540 Control Module and Two Drive Modules

NOTE If you have drive modules with inverted ESM CRUs, see "A Comparison of ESM CRU Arrangements" on page 4-2.

One Control Module and Four Drive Modules

If you are cabling one 6540 control module to four drive modules, use the cabling topology described in Table 4-4 and Figure 4-5 on page 4-7.

Table 4-4 One 6540 Control Module and Four Drive Modules

Drive Channel	Connection Point		Connection Point	
	Module/ Component	Port Number/ Location	Module/ Component	Port Number/ 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

In Figure 4-5 on page 4-7, the drive modules below the control module are numbered 1 and 2, with Drive Module 1 directly below the control module. The drive modules above the control module are numbered 3 and 4, with Drive Module 3 directly above the control module.

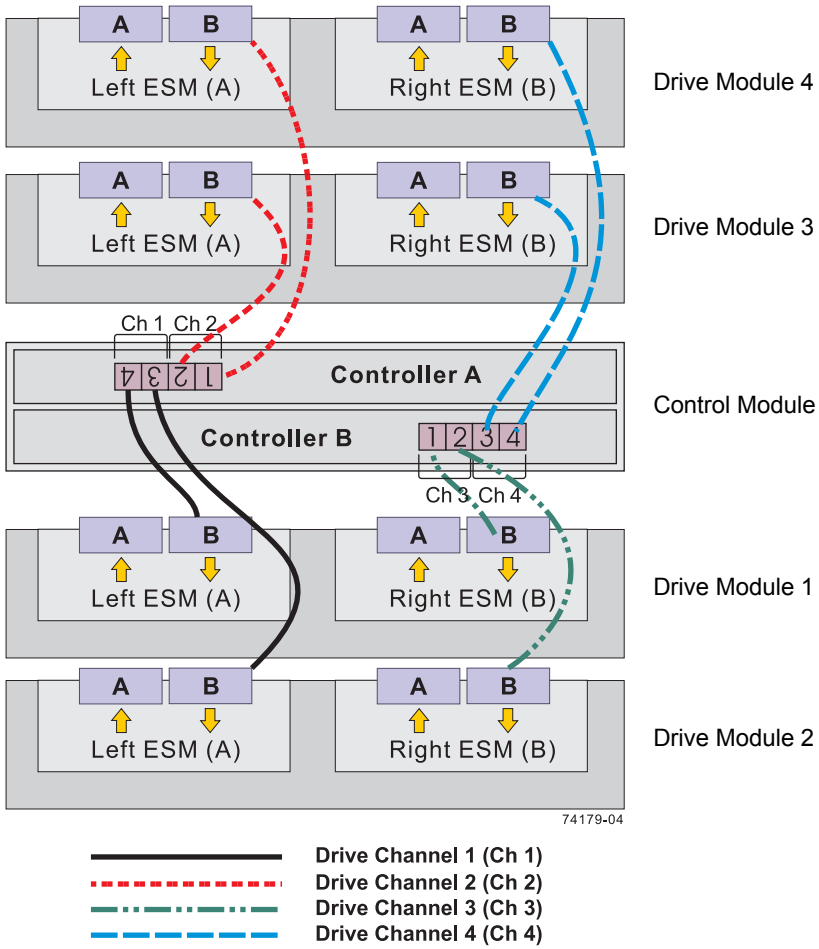


Figure 4-5 One 6540 Control Module and Four Drive Modules

NOTE If you have drive modules with inverted ESM CRUs, see "A Comparison of ESM CRU Arrangements" on page 4-2.

One Control Module and Eight Drive Modules

If you are cabling one 6540 control module to eight drive modules, use the cabling topology described in Table 4-5 and Figure 4-6 on page 4-9.

Table 4-5 One 6540 Control Module and Eight Drive Modules

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

In Figure 4-6 on page 4-9, the drive modules below the control module are numbered 1 through 4, with Drive Module 1 directly below the control module. The drive modules above the control module are numbered 5 through 8, with Drive Module 5 directly above the control module.

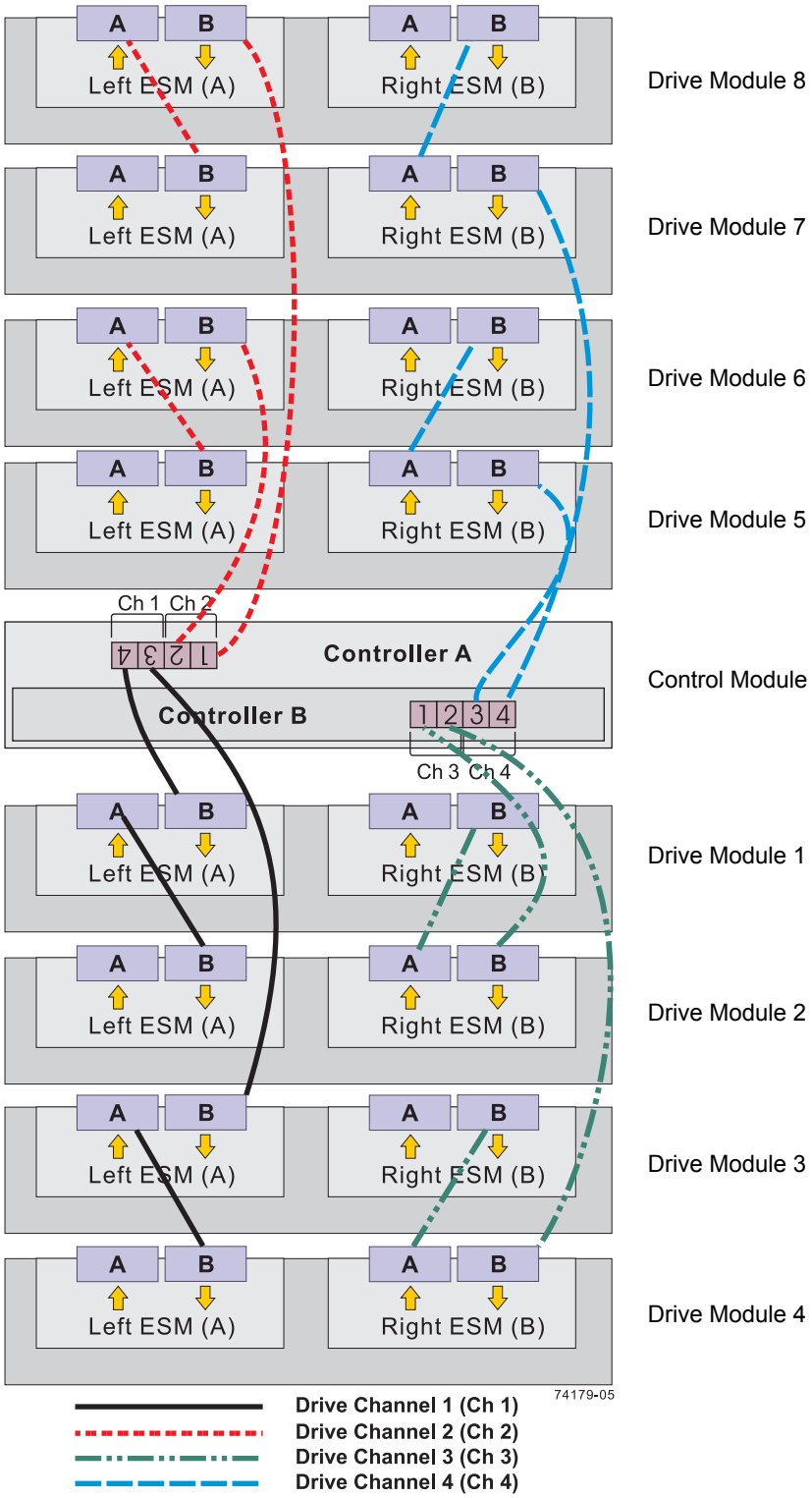


Figure 4-6 One 6540 Control Module and Eight Drive Modules

NOTE If you have drive modules with inverted ESM CRUs, see "A Comparison of ESM CRU Arrangements" on page 4-2.

One Control Module and Multiple Drive Module Types

If you are cabling more than one type of drive module to the 6540 control module, be sure to review the following information before choosing a cabling topology:

- "Multiple Types of Drive Modules" on page 1-12
- "Cabling for Drive Modules that Support Loop Switch Technology" on page 1-13

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

Guidelines for Cabling FLA300 Drive Modules or CSM200 Drive Modules

Follow these guidelines for cabling a topology with multiple drive module types, including FLA300 drive modules or CSM200 drive modules.

- If your storage system includes FLA300 drive modules or CSM200 drive modules, cable the FLA300 drive modules or CSM200 drive modules so that they are the first devices on the drive channel (after Controller A).[3]
- Evenly distribute FLA300 drive modules or CSM200 drive modules in pairs or multiples across redundant pairs of the available drive channels.
- Do not cable a single FLA300 drive module or CSM200 drive module on a drive channel unless it is the only FLA300 drive module or CSM200 drive module in the storage system.

Guidelines for Cabling FLA200 Drive Modules

Follow these guidelines for cabling a topology with multiple drive module types, including FLA200 drive modules.

- If your storage system includes FLA300 drive modules or CSM200 drive modules, cable the FLA200 drive modules next on the drive channel after the FLA300 drive modules or CSM200 drive modules.

3. 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 control 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.

- If your storage system does not include FLA300 drive modules or CSM200 drive modules, place the FLA200 drive modules first in the drive channel (after Controller A).
- Distribute FLA200 drive modules across redundant pairs of drive channels to equalize the number of drive modules on the available drive channels.

Guidelines for Cabling FLC200 Drive Modules

Follow these guidelines for cabling a topology with multiple drive module types, including FLC200 drive modules.

- If your storage system includes FLC200 drive modules, cable the FLC200 drive modules so that they are the last devices on the drive channel (farthest from Controller A).
- Distribute FLC200 drive modules across redundant pairs of drive channels to equalize the number of drive modules on the available channels.

Figure 4-7 on page 4-12 provides an example of how to cable multiple drive module types to an 6540 control module for maximum performance and redundancy. In Figure 4-7, the FLA300 drive modules or CSM200 drive modules are identified as SBODs (Switched Bunch of Disks). The FLC200 drive module is identified as SATA (Serial Advanced Technology Attachment). All other drive module types, including FLA200 drive modules, are identified as OTHER.

IMPORTANT When mixing different drive modules, consider the total number of drives that are available in the final configuration of the storage system. For example, mixing CSM200 drive modules with FLA300 drive modules might provide a total number of drives that is greater than the maximum number that each drive channel can support.

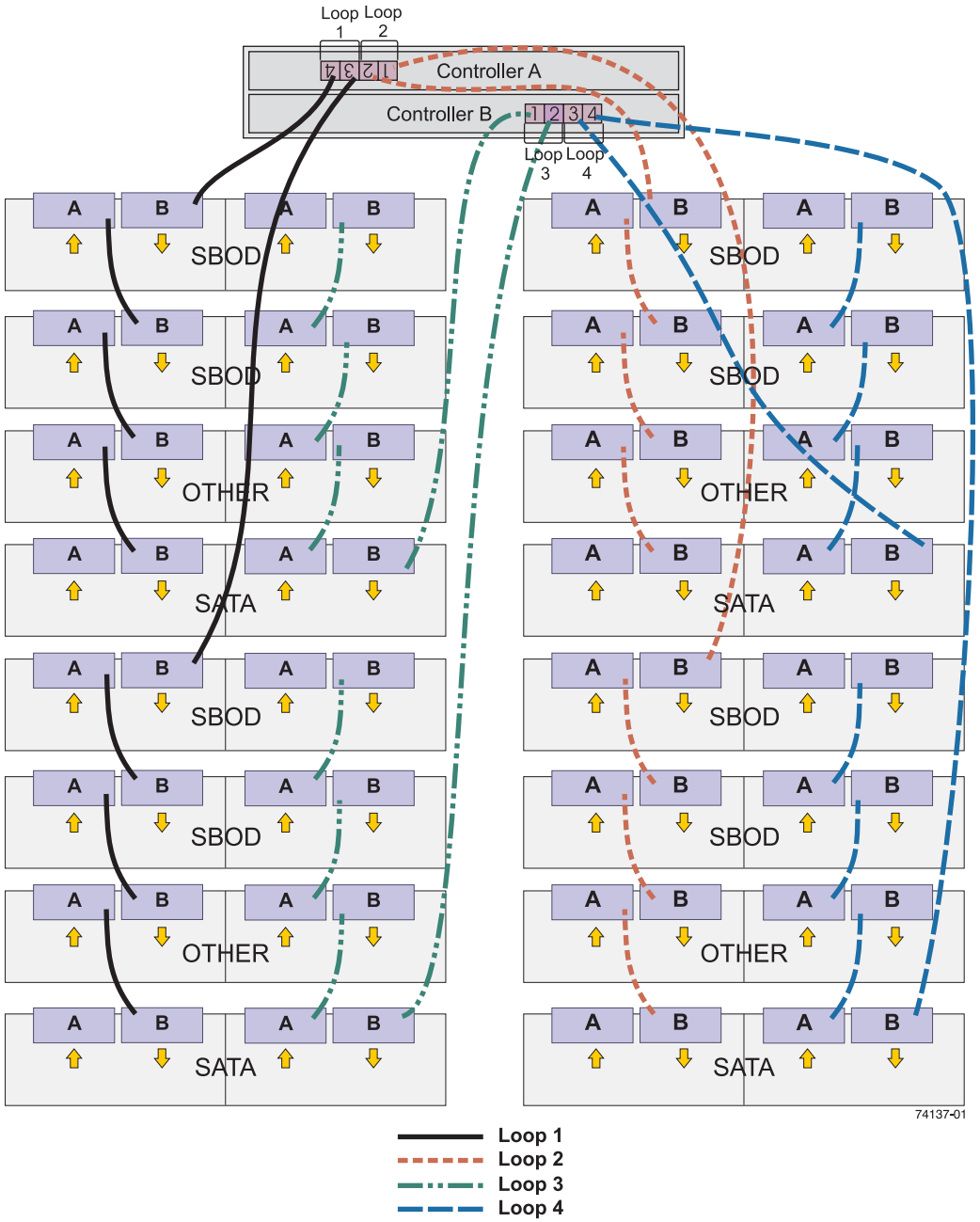


Figure 4-7 One 6540 Control Module and Multiple Drive Module Types

NOTE If you have drive modules with inverted ESM CRUs, see "A Comparison of ESM CRU Arrangements" on page 4-2.

Drive Cabling Topologies for the FLX280 Control Module

This section provides five examples of drive cabling topologies that can be used for the FLX280 control module. 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 practices described in “Drive Cabling for Redundancy” on page 1-10 to ensure full availability of data. If you are cabling FLC200 drive modules into your storage system, follow the guidelines provided in “Cabling for Drive Modules that Support Loop Switch Technology” on page 1-13.

One Control Module and One Drive Module

If you are cabling one FLX280 control module to one drive module, use the cabling topology described in Table 4-6 and Figure 4-8.

Table 4-6 One FLX280 Control Module and One Drive Module

Drive Channel	Connection Point		Connection Point	
	Module/ Component	Port Number/ Location	Module/ Component	Port Number/ Location
1	Drive Minihub	Drive Channel 1 In	Drive Module 1	Right ESM Out
3	Drive Minihub	Drive Channel 3 In	Drive Module 1	Left ESM Out

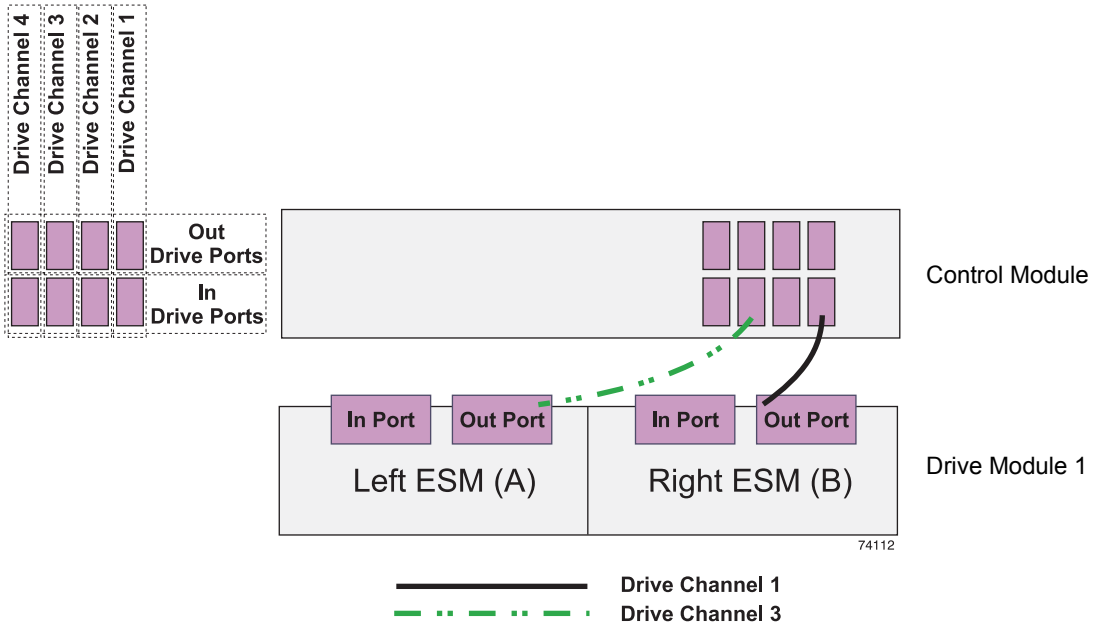


Figure 4-8 One FLX280 Control Module and One Drive Module

NOTE If you have drive modules with inverted ESM CRUs, see "A Comparison of ESM CRU Arrangements" on page 4-2.

One Control Module and Two Drive Modules

If you are cabling one FLX280 control module to two drive modules, use the cabling topology described in Table 4-7 and Figure 4-9.

Table 4-7 One FLX280 Control Module and Two Drive Modules

Drive Channel	Connection Point		Connection Point	
	Module/ Component	Port Number/ Location	Module/ Component	Port Number/ Location
1	Drive Minihub	Drive Channel 1 In	Drive Module 2	Right ESM Out
2	Drive Minihub	Drive Channel 2 In	Drive Module 1	Right ESM Out
3	Drive Minihub	Drive Channel 3 In	Drive Module 2	Left ESM Out
4	Drive Minihub	Drive Channel 4 In	Drive Module 1	Left ESM Out

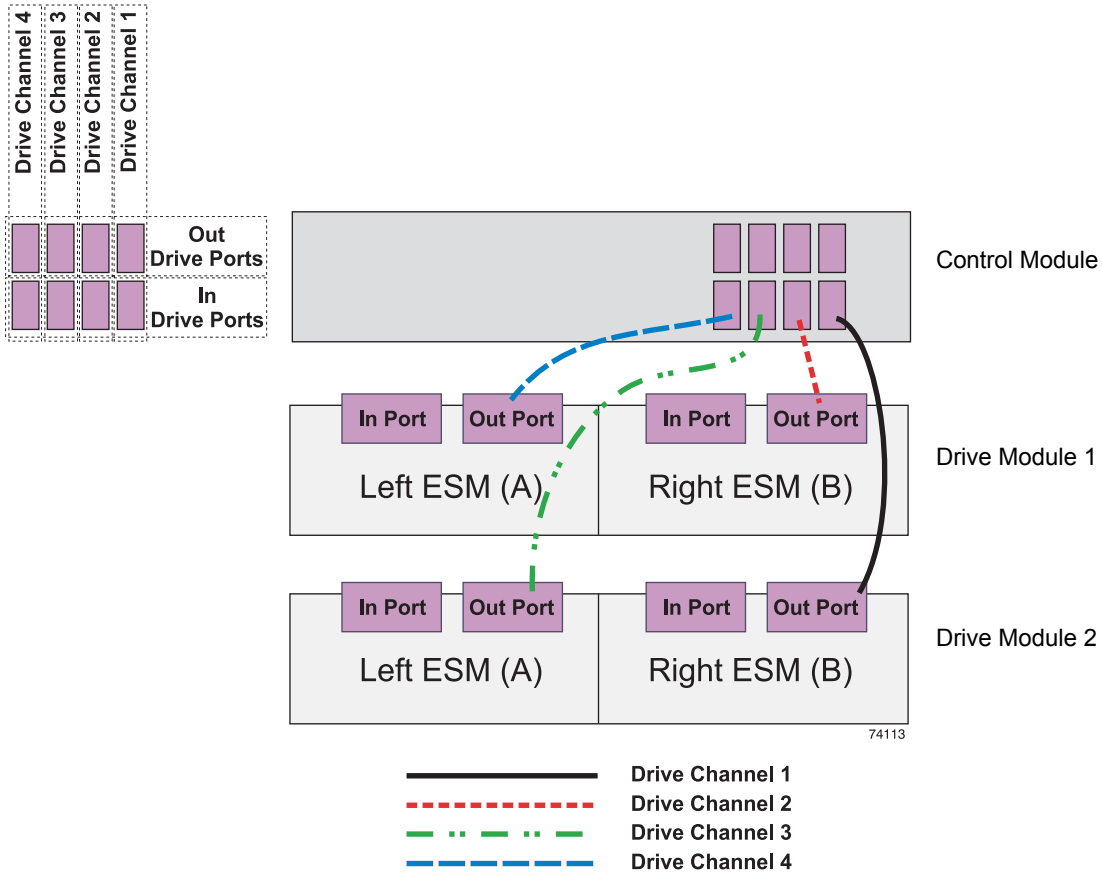


Figure 4-9 One FLX280 Control Module and Two Drive Modules

NOTE If you have drive modules with inverted ESM CRUs, see "A Comparison of ESM CRU Arrangements" on page 4-2.

One Control Module and Four Drive Modules

If you are cabling one FLX280 control module to four drive modules, use the cabling topology described in Table 4-8 and Figure 4-10 on page 4-17.

Table 4-8 One FLX280 Control Module and Four Drive Modules

Drive Channel	Connection Point		Connection Point	
	Module/ Component	Port Number/ Location	Module/ Component	Port Number/ Location
1	Drive Minihub	Drive Channel 1 In	Drive Module 2	Right ESM Out
	Drive Module 2	Right ESM In	Drive Module 1	Right ESM Out
2	Drive Minihub	Drive Channel 2 In	Drive Module 4	Right ESM Out
	Drive Module 4	Right ESM In	Drive Module 3	Right ESM Out
3	Drive Minihub	Drive Channel 3 In	Drive Module 1	Left ESM Out
	Drive Module 1	Left ESM In	Drive Module 2	Left ESM Out
4	Drive Minihub	Drive Channel 4 In	Drive Module 3	Left ESM Out
	Drive Module 3	Left ESM In	Drive Module 4	Left ESM Out

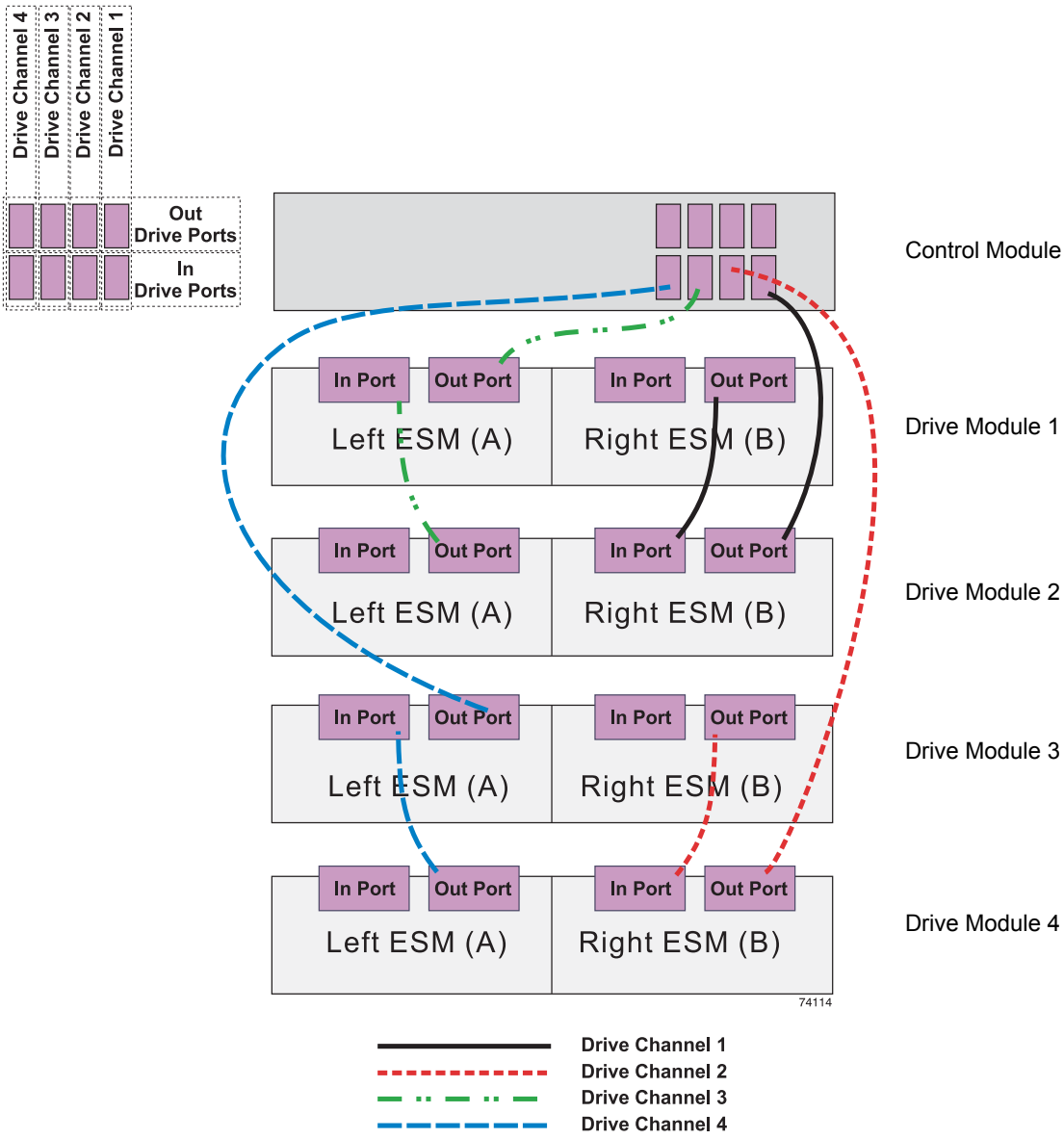


Figure 4-10 One FLX280 Control Module and Four Drive Modules

NOTE If you have drive modules with inverted ESM CRUs, see "A Comparison of ESM CRU Arrangements" on page 4-2.

One Control Module and Eight Drive Modules

If you are cabling one FLX280 control module to eight drive modules, use the cabling topology described in Table 4-9 and Figure 4-11 on page 4-19.

Table 4-9 One FLX280 Control Module and Eight Drive Modules

Drive Channel	Connection Point		Connection Point	
	Module/ Component	Port Number/ Location	Module/ Component	Port Number/ Location
1	Drive Minihub	Drive Channel 1 In	Drive Module 4	Right ESM Out
	Drive Module 4	Right ESM In	Drive Module 3	Right ESM Out
	Drive Module 3	Right ESM In	Drive Module 2	Right ESM Out
	Drive Module 2	Right ESM In	Drive Module 1	Right ESM Out
2	Drive Minihub	Drive Channel 2 In	Drive Module 5	Right ESM Out
	Drive Module 5	Right ESM In	Drive Module 6	Right ESM Out
	Drive Module 6	Right ESM In	Drive Module 7	Right ESM Out
	Drive Module 7	Right ESM In	Drive Module 8	Right ESM Out
3	Drive Minihub	Drive Channel 3 In	Drive Module 1	Left ESM Out
	Drive Module 1	Left ESM In	Drive Module 2	Left ESM Out
	Drive Module 2	Left ESM In	Drive Module 3	Left ESM Out
	Drive Module 3	Left ESM In	Drive Module 4	Left ESM Out
4	Drive Minihub	Drive Channel 4 In	Drive Module 8	Left ESM Out
	Drive Module 8	Left ESM In	Drive Module 7	Left ESM Out
	Drive Module 7	Left ESM In	Drive Module 6	Left ESM Out
	Drive Module 6	Left ESM In	Drive Module 5	Left ESM Out

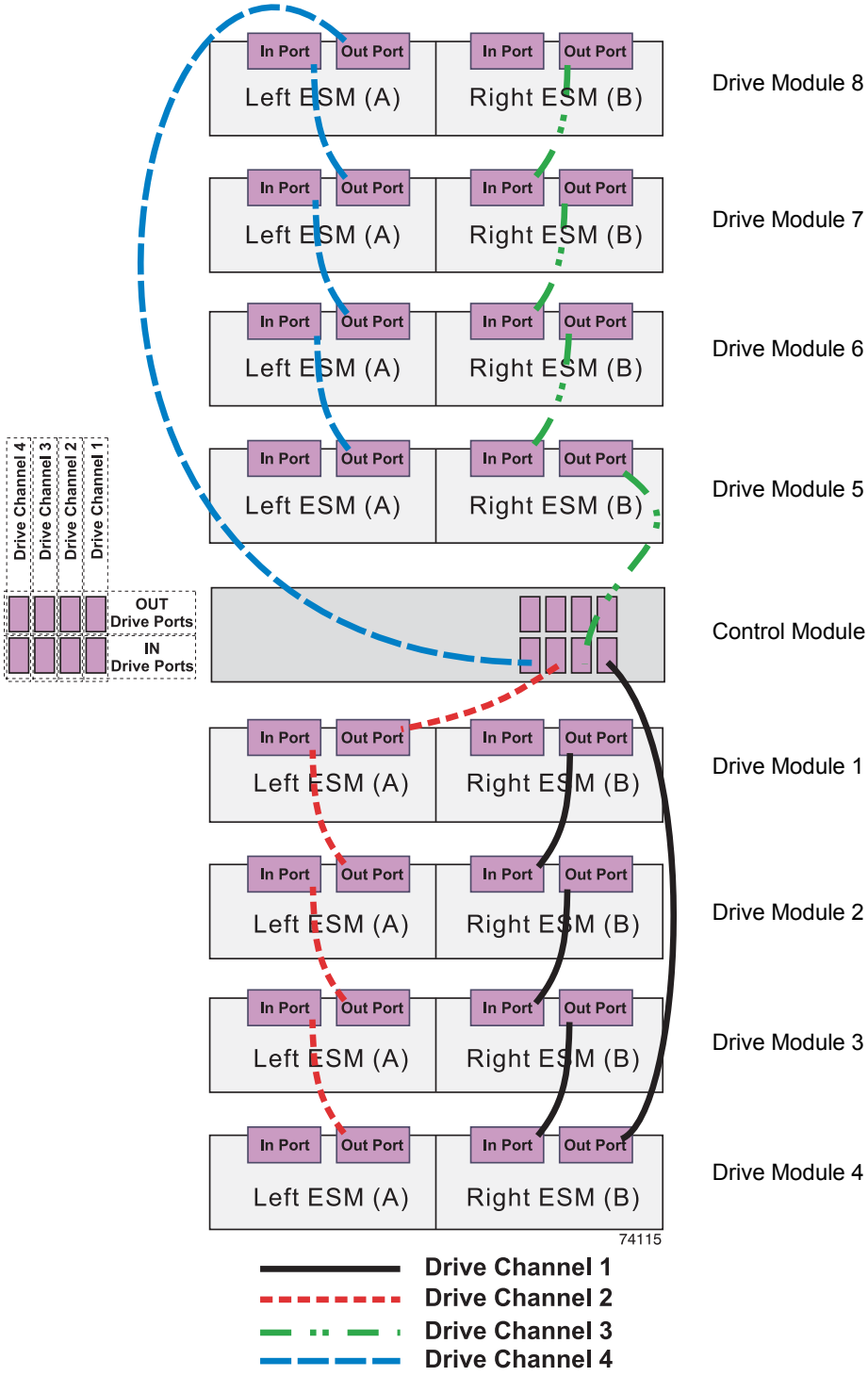


Figure 4-11 One FLX280 Control Module and Eight Drive Modules

NOTE If you have drive modules with inverted ESM CRUs, see "A Comparison of ESM CRU Arrangements" on page 4-2.

One Control Module and Multiple Drive Module Types

If you are cabling more than one type of drive module to the FLX280 control module, be sure to review the following information before choosing a cabling topology:

- "Multiple Types of Drive Modules" on page 1-12
- "Cabling for Drive Modules that Support Loop Switch Technology" on page 1-13

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

Guidelines for Cabling FLA300 Drive Modules or CSM200 Drive Modules

Follow these guidelines for cabling a topology with multiple drive module types, including FLA300 drive modules or CSM200 drive modules.

- If your storage system includes FLA300 drive modules or CSM200 drive modules, cable the FLA300 drive modules or CSM200 drive modules so that they are the first devices on the drive channel from a top-down cabling perspective. See "Drive Cabling for Redundancy" on page 1-10 for an explanation of top-down and bottom-up cabling.[4]
- Evenly distribute FLA300 drive modules or CSM200 drive modules in pairs or multiples across redundant pairs of the available drive channels.
- Do not cable a single FLA300 drive module or CSM200 drive module on a drive channel unless it is the only FLA300 drive module or CSM200 drive module in the storage system.

Guidelines for Cabling FLA200 Drive Modules

Follow these guidelines for cabling a topology with multiple drive module types, including FLA200 drive modules.

- If your storage system includes FLA300 drive modules or CSM200 drive modules, cable the FLA200 drive modules next on the drive channel after the FLA300 drive modules or CSM200 drive modules.

4. The first device on the drive channel is distinguished by the fact that the left ESM of the first device is cabled directly to a minihub. Because an optimal redundant cabling topology requires that the redundant drive channel be cabled in the opposite order, this same drive module will be the last in the redundant drive channel.

- If your storage system does not include FLA300 drive modules or CSM200 drive modules, place the FLA200 drive modules first in the drive channel (after Controller A).
- Distribute FLA200 drive modules across redundant pairs of drive channels to equalize the number of drive modules on the available drive channels.

Guidelines for Cabling FLC200 Drive Modules

Follow these guidelines for cabling a topology with multiple drive module types, including FLC200 drive modules.

- If your storage system includes FLC200 drive modules, cable the FLC200 drive modules so that they are the last devices on the drive channel (from a top-down cabling perspective).
- Distribute FLC200 drive modules across redundant pairs of drive channels to equalize the number of drive modules on the available channels.

Figure 4-12 on page 4-22 provides an example of how to cable multiple drive module types to an FLX280 control module for maximum performance and redundancy. In Figure 4-12, the FLA300 drive modules or CSM200 drive modules are identified as SBODs (Switched Bunch of Disks). The FLC200 drive module is identified as SATA (Serial Advanced Technology Attachment). All other drive module types are identified as OTHER.

IMPORTANT When mixing different drive modules, consider the total number of drives that are available in the final configuration of the storage system. For example, mixing CSM200 drive modules with FLA300 drive modules might provide a total number of drives that is greater than the maximum number that each drive channel can support.

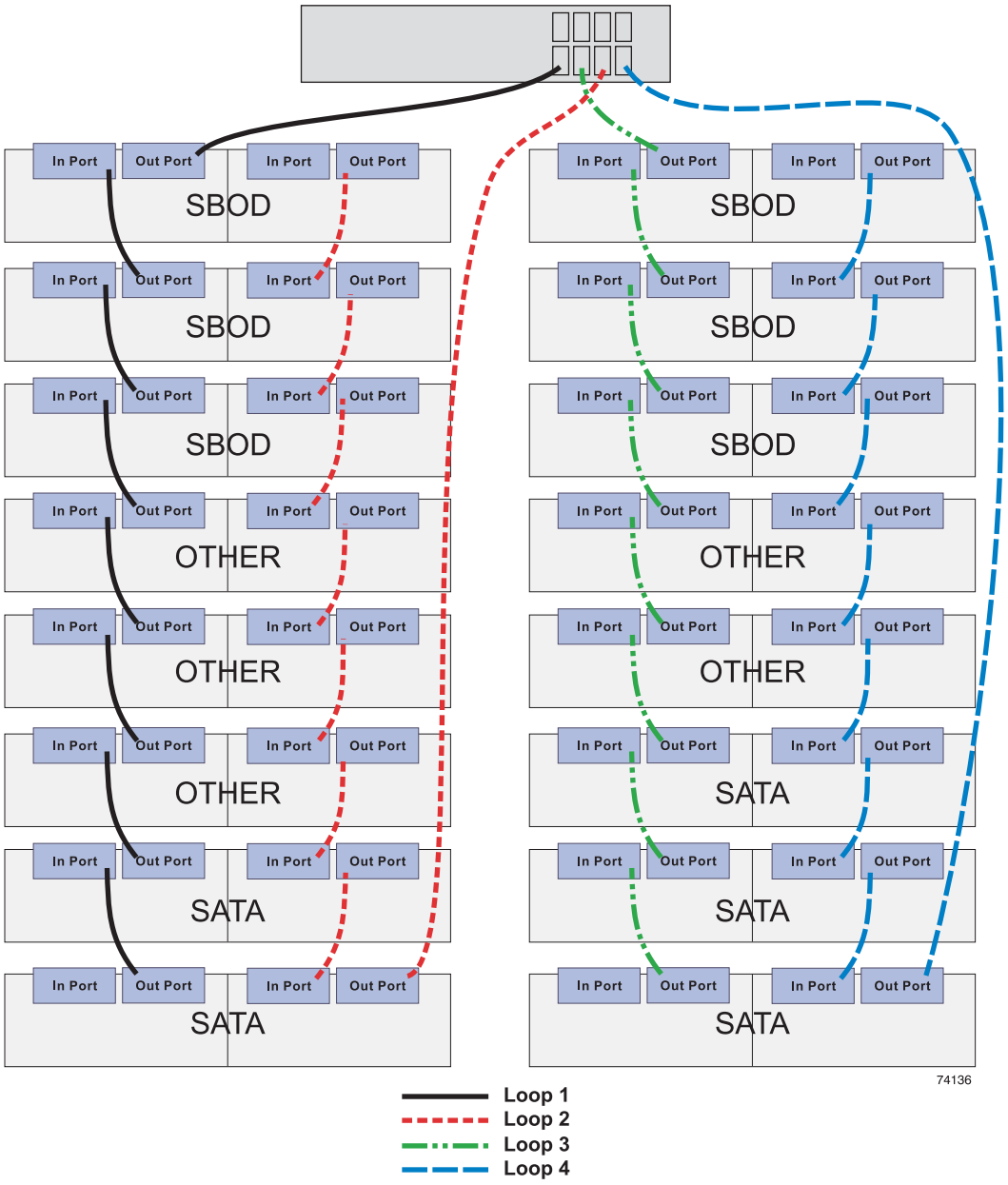


Figure 4-12 One FLX280 Control Module and Multiple Drive Module Types

NOTE If you have drive modules with inverted ESM CRUs, see "A Comparison of ESM CRU Arrangements" on page 4-2.

Drive Cabling Topologies for the FLX240 Control Module and the FLX240 Storage System

This section provides five examples of drive cabling topologies that can be used for the FLX240 control module and the FLX240 storage system. 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 practices described in “Drive Cabling for Redundancy” on page 1-10 to ensure full availability of data. If you are cabling FLC200 drive modules into your storage system, follow the guidelines provided in “Cabling for Drive Modules that Support Loop Switch Technology” on page 1-13.

One Control Module or Storage System and One Drive Module

If you are cabling one FLX240 control module or one FLX240 storage system to one drive module, use the cabling topology described in Table 4-10 and Figure 4-13.

Table 4-10 One FLX240 Control Module or FLX240 Storage System and One Drive Module

Drive Channel	Connection Point		Connection Point	
	Module/ Component	Port Number/ Location	Module/ Component	Port Number/ Location
1	Controller A	Expansion Port	Drive Module 1	Left ESM Out
2	Controller B	Expansion Port	Drive Module 1	Right ESM Out

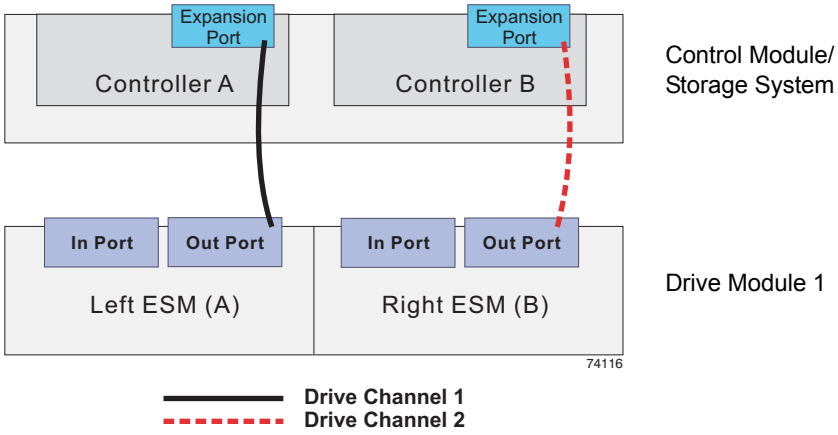


Figure 4-13 One FLX240 Control Module or FLX240 Storage System and One Drive Module

NOTE If you have drive modules with inverted ESM CRUs, see "A Comparison of ESM CRU Arrangements" on page 4-2.

One Control Module or Storage System and Two Drive Modules

If you are cabling one FLX240 control module or one FLX240 storage system to two drive modules, use the cabling topology described in Table 4-11 and Figure 4-14.

Table 4-11 One FLX240 Control Module or FLX240 Storage System and Two Drive Modules

Drive Channel	Connection Point		Connection Point	
	Module/ Component	Port Number/ Location	Module/ Component	Port Number/ Location
1	Controller A	Expansion Port	Drive Module 1	Left ESM Out
	Drive Module 1	Left ESM In	Drive Module 2	Left ESM Out
2	Controller B	Expansion Port	Drive Module 2	Right ESM Out
	Drive Module 2	Right ESM In	Drive Module 1	Right ESM Out

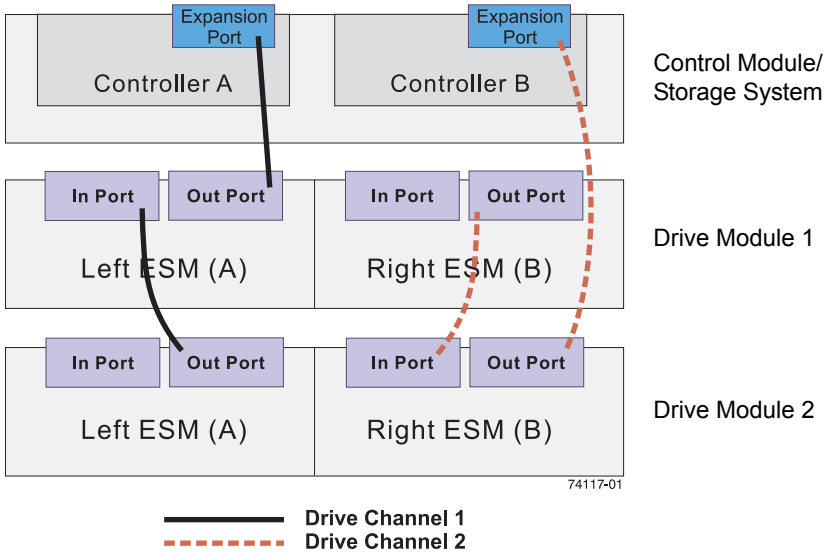


Figure 4-14 One FLX240 Control Module or FLX240 Storage System and Two Drive Modules

NOTE If you have drive modules with inverted ESM CRUs, see "A Comparison of ESM CRU Arrangements" on page 4-2.

One Control Module or Storage System and Four Drive Modules

If you are cabling one FLX240 control module or one FLX240 storage system to four drive modules, use the cabling topology described in Table 4-12 and Figure 4-15 on page 4-27.

Table 4-12 One FLX240 Control Module or FLX240 Storage System and Four Drive Modules

Drive Channel	Connection Point		Connection Point	
	Module/ Component	Port Number/ Location	Module/ Component	Port Number/ Location
1	Controller A	Expansion Port	Drive Module 1	Left ESM Out
	Drive Module 1	Left ESM In	Drive Module 2	Left ESM Out
	Drive Module 2	Left ESM In	Drive Module 3	Left ESM Out
	Drive Module 3	Left ESM In	Drive Module 4	Left ESM Out
2	Controller B	Expansion Port	Drive Module 4	Right ESM Out
	Drive Module 4	Right ESM In	Drive Module 3	Right ESM Out
	Drive Module 3	Right ESM In	Drive Module 2	Right ESM Out
	Drive Module 2	Right ESM In	Drive Module 1	Right ESM Out

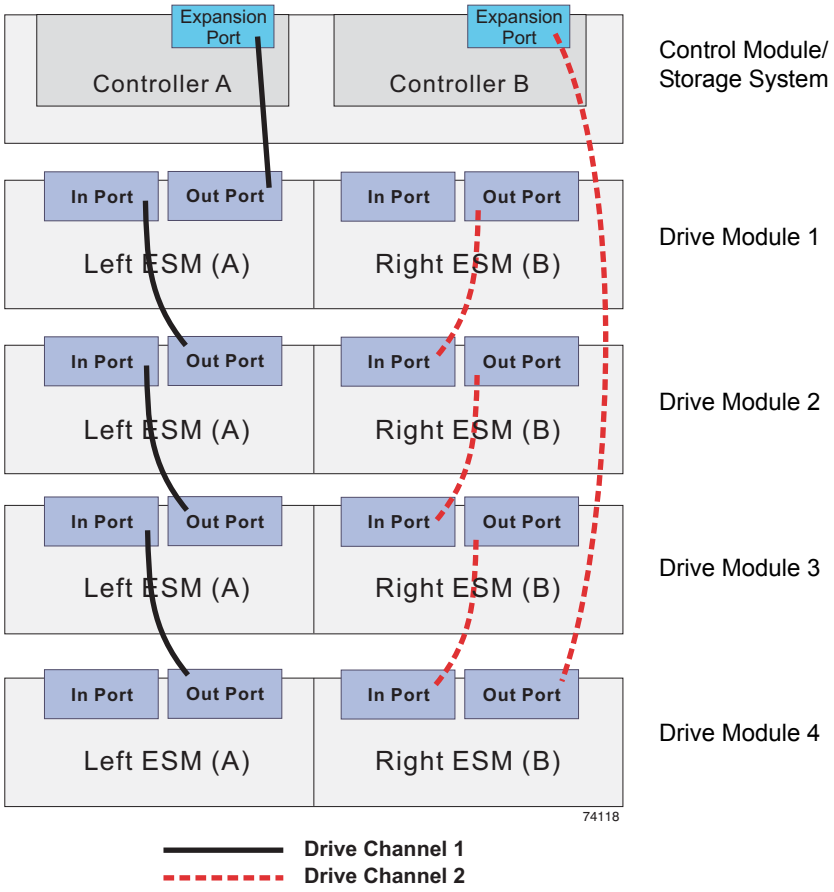


Figure 4-15 One FLX240 Control Module or FLX240 Storage System and Four Drive Modules

NOTE If you have drive modules with inverted ESM CRUs, see "A Comparison of ESM CRU Arrangements" on page 4-2.

One Control Module or Storage System and Seven Drive Modules

If you are cabling one FLX240 control module or one FLX240 storage system to seven drive modules, use the cabling topology described in Table 4-13 and Figure 4-16 on page 4-29.

IMPORTANT The FLX240 control module and the FLX240 storage system support a maximum of seven drive modules.

Table 4-13 One FLX240 Control Module or FLX240 Storage System and Seven Drive Modules

Drive Channel	Connection Point		Connection Point	
	Module/ Component	Port Number/ Location	Module/ Component	Port Number/ Location
1	Controller A	Expansion Port	Drive Module 1	Left ESM Out
	Drive Module 1	Left ESM In	Drive Module 2	Left ESM Out
	Drive Module 2	Left ESM In	Drive Module 3	Left ESM Out
	Drive Module 3	Left ESM In	Drive Module 4	Left ESM Out
	Drive Module 4	Left ESM In	Drive Module 5	Left ESM Out
	Drive Module 5	Left ESM In	Drive Module 6	Left ESM Out
	Drive Module 6	Left ESM In	Drive Module 7	Left ESM Out
2	Controller B	Expansion Port	Drive Module 7	Right ESM Out
	Drive Module 7	Right ESM In	Drive Module 6	Right ESM Out
	Drive Module 6	Right ESM In	Drive Module 5	Right ESM Out
	Drive Module 5	Right ESM In	Drive Module 4	Right ESM Out
	Drive Module 4	Right ESM In	Drive Module 3	Right ESM Out
	Drive Module 3	Right ESM In	Drive Module 2	Right ESM Out
	Drive Module 2	Right ESM In	Drive Module 1	Right ESM Out

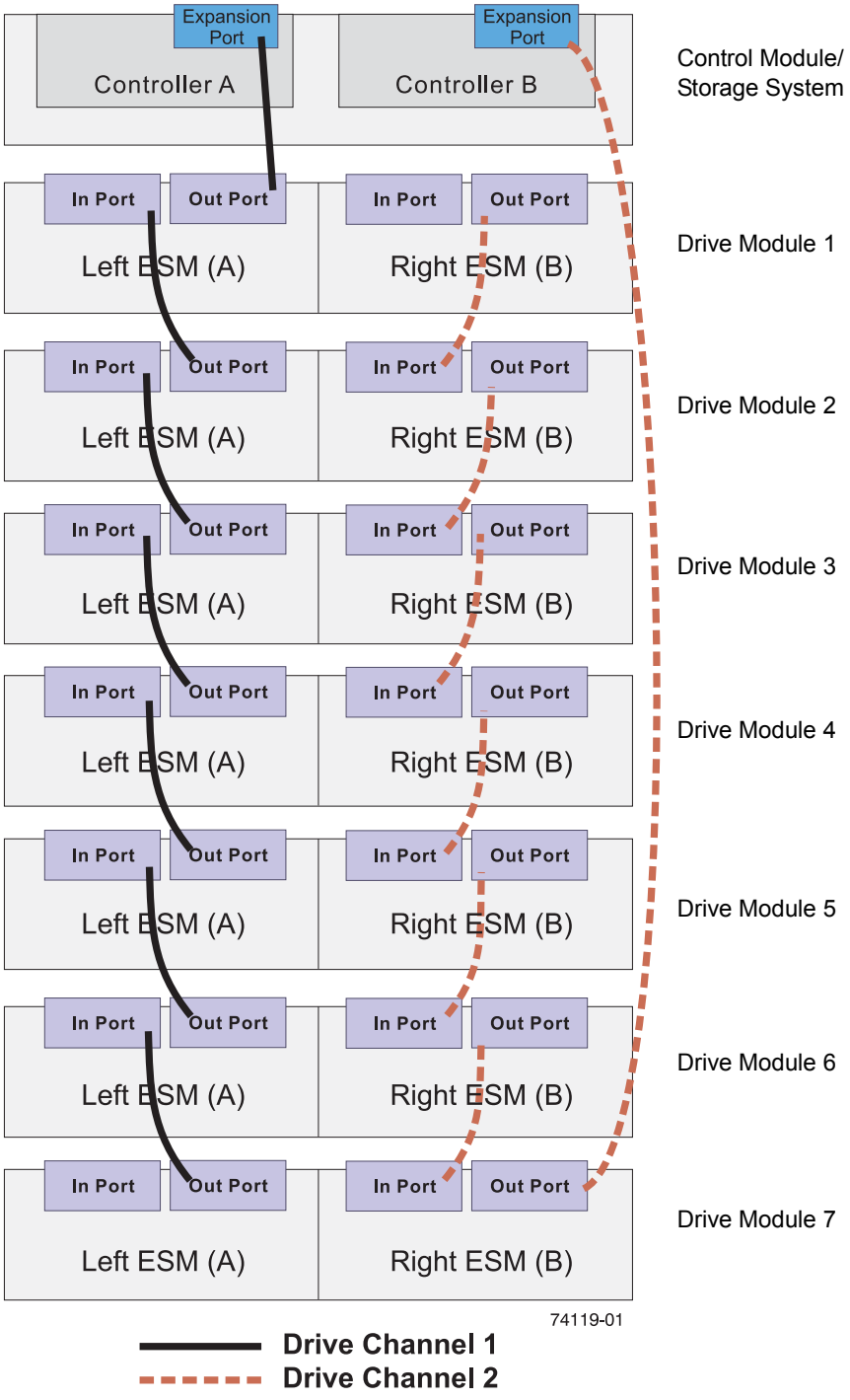


Figure 4-16 One FLX240 Control Module or FLX240 Storage System and Seven Drive Modules

NOTE If you have drive modules with inverted ESM CRUs, see "A Comparison of ESM CRU Arrangements" on page 4-2.

One Control Module or Storage System and Multiple Drive Module Types

If you are cabling more than one type of drive module to the FLX240 control module or the FLX240 storage system, be sure to review the following information before choosing a cabling topology:

- "Multiple Types of Drive Modules" on page 1-12
- "Cabling for Drive Modules that Support Loop Switch Technology" on page 1-13

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

Guidelines for Cabling FLA300 Drive Modules or CSM200 Drive Modules

Follow these guidelines for cabling a topology with multiple drive module types, including FLA300 drive modules or CSM200 drive modules.

- If your storage system includes FLA300 drive modules or CSM200 drive modules, cable the FLA300 drive modules or CSM200 drive modules so that they are the first devices on the drive channel (after Controller A)[5].
- Do not cable a single FLA300 drive module or CSM200 drive module on a drive channel unless it is the only FLA300 drive module or CSM200 drive module in the storage system.

Guidelines for Cabling FLA200 Drive Modules

Follow these guidelines for cabling a topology with multiple drive module types, including FLA200 drive modules.

- If your storage system includes FLA300 drive modules or CSM200 drive modules, cable the FLA200 drive modules next on the drive channel after the FLA300 drive modules or CSM200 drive modules.

5. 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 control module or storage system. 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.

- If your storage system does not include FLA300 drive modules or CSM200 drive modules, place the FLA200 drive modules first in the drive channel (after Controller A).

Guidelines for Cabling FLC200 Drive Modules

Follow these guidelines for cabling a topology with multiple drive module types, including FLC200 drive modules.

- If your storage system includes FLC200 drive modules, cable the FLC200 drive modules so that they are the last devices on the drive channel (farthest from Controller A).

Figure 4-17 provides an example of how to cable multiple drive module types to an FLX240 control module or an FLX240 storage system for maximum performance and redundancy. In Figure 4-17, the FLA300 drive modules or CSM200 drive modules are identified as SBODs (Switched Bunch of Disks). The FLC200 drive module is identified as SATA (Serial Advanced Technology Attachment). All other drive module types are identified as OTHER.

IMPORTANT When mixing different drive modules, consider the total number of drives that are available in the final configuration of the storage system. For example, mixing CSM200 drive modules with FLA300 drive modules might provide a total number of drives that is greater than the maximum number that each drive channel can support.

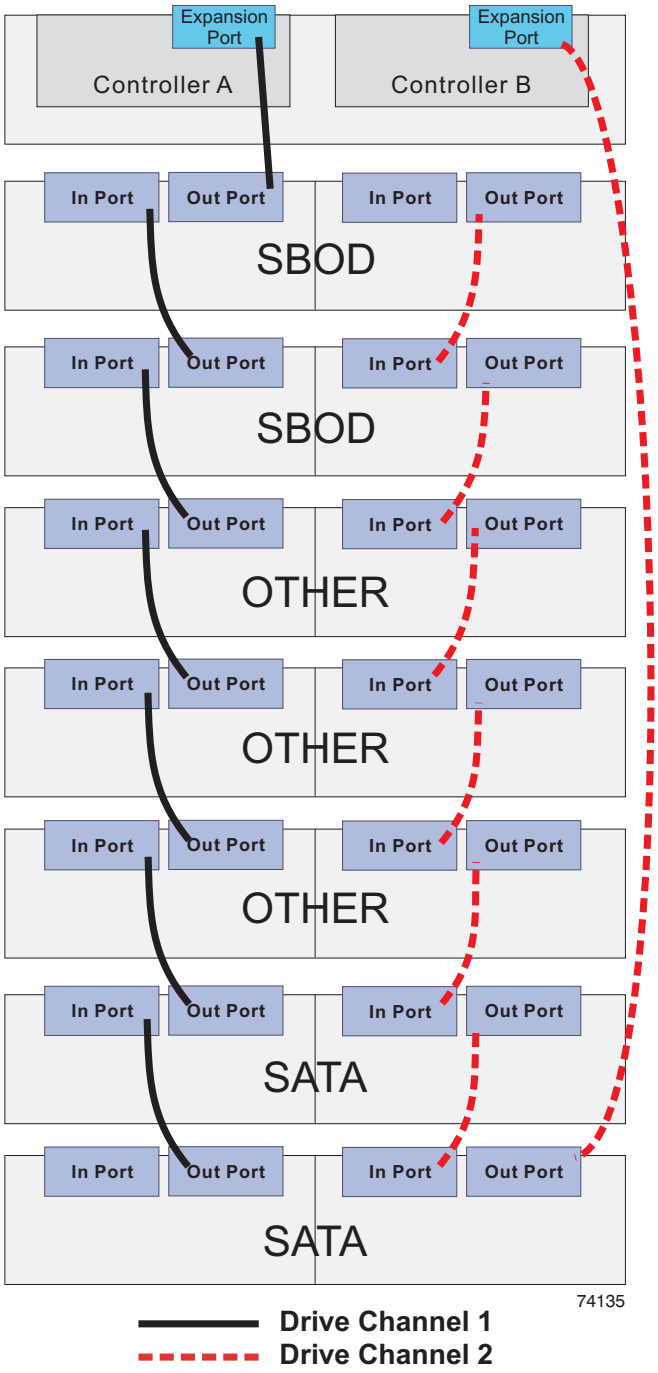


Figure 4-17 One FLX240 Control Module or FLX240 Storage System and Multiple Drive Module Types

NOTE If you have drive modules with inverted ESM CRUs, see "A Comparison of ESM CRU Arrangements" on page 4-2.

Drive Cabling Topologies for the 6140 Storage System

This section provides numerous examples of drive cabling topologies that can be used for the 6140 storage system. The controllers on the lower cost storage system have two host ports and two drive ports. The controllers on the higher cost storage system 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 practices described "Drive Cabling for Redundancy" on page 1-10 to ensure full availability of data.

One Storage System and One Drive Module

If you are cabling one 6140 storage system to one drive module, and that drive module has inverted ESM CRUs, use the cabling topology described in Table 4-14 and Figure 4-18.

Table 4-14 One 6140 Storage System and One Inverted Drive Module

Drive Channel	Connection Point		Connection Point	
	Module/ Component	Port Number/ Location	Module/ Component	Port Number/ Location
1	Controller A	2	Drive Module 1	ESM A, Port 1B
2	Controller B	1	Drive Module 1	ESM B, Port 1B

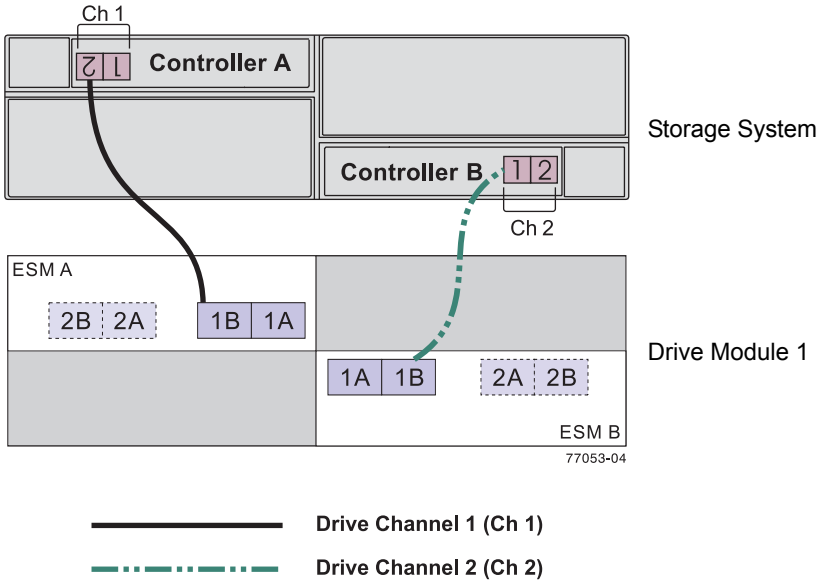


Figure 4-18 One 6140 Storage System and One Inverted Drive Module

NOTE If you have drive modules with side-by-side ESM CRUs, see "A Comparison of ESM CRU Arrangements" on page 4-2.

One Storage System and Two Drive Modules

If you are cabling one 6140 storage system to two drive modules, and those drive modules have inverted ESM CRUs, use the cabling topology described in Table 4-15 and Figure 4-19.

Table 4-15 One 6140 Storage System and Two Inverted Drive Modules

Drive Channel	Connection Point		Connection Point	
	Module/ Component	Port Number/ Location	Module/ Component	Port Number/ Location
1	Controller A	1	Drive Module 2	ESM A, Port 1B
	Controller A	2	Drive Module 1	ESM A, Port 1B
2	Controller B	1	Drive Module 1	ESM B, Port 1B
	Controller B	2	Drive Module 2	ESM B, Port 1B

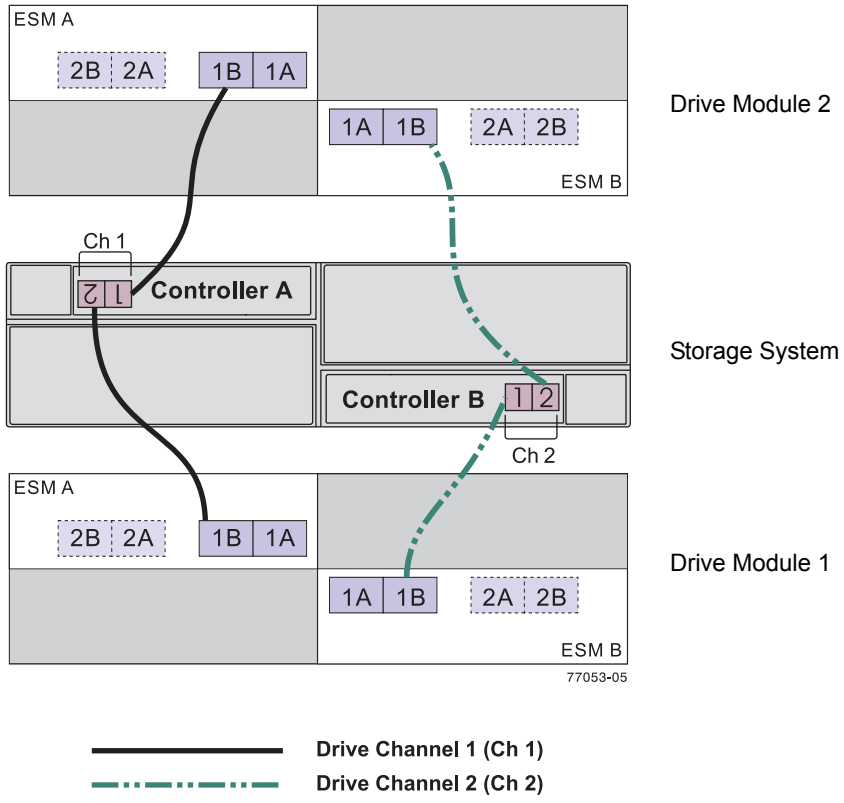


Figure 4-19 One 6140 Storage System and Two Inverted Drive Modules

NOTE If you have drive modules with side-by-side ESM CRUs, see "A Comparison of ESM CRU Arrangements" on page 4-2.

If you are cabling one 6140 storage system to three drive modules, and those drive modules have side-by-side ESM CRUs, use the cabling topology described in Table 4-16 and Figure 4-20 on page 4-37.

Table 4-16 One 6140 Storage System and Three Side-by-Side Style Drive Modules

Drive Channel	Connection Point		Connection Point	
	Module/ Component	Port Number/ Location	Module/ Component	Port Number/ Location
1	Controller A	1	Drive Module 2*	Left ESM, Port B
	Controller A	2	Drive Module 1*	Left ESM, Port B
	Drive Module 1*	Left ESM, Port A	Drive Module 3*	Left ESM, Port B
2	Controller B	1	Drive Module 3*	Right ESM, Port B
	Drive Module 3*	Right ESM, Port A	Drive Module 1*	Right ESM, Port B
	Controller B	2	Drive Module 2*	Right ESM, Port B

*The firmware controlling the storage system will automatically assign drive module tray IDs to CSM200 drive modules that will usually *not* match the drive module numbers shown in this table and the subsequent illustration. The cabling is not affected by the firmware's choice of drive tray IDs.

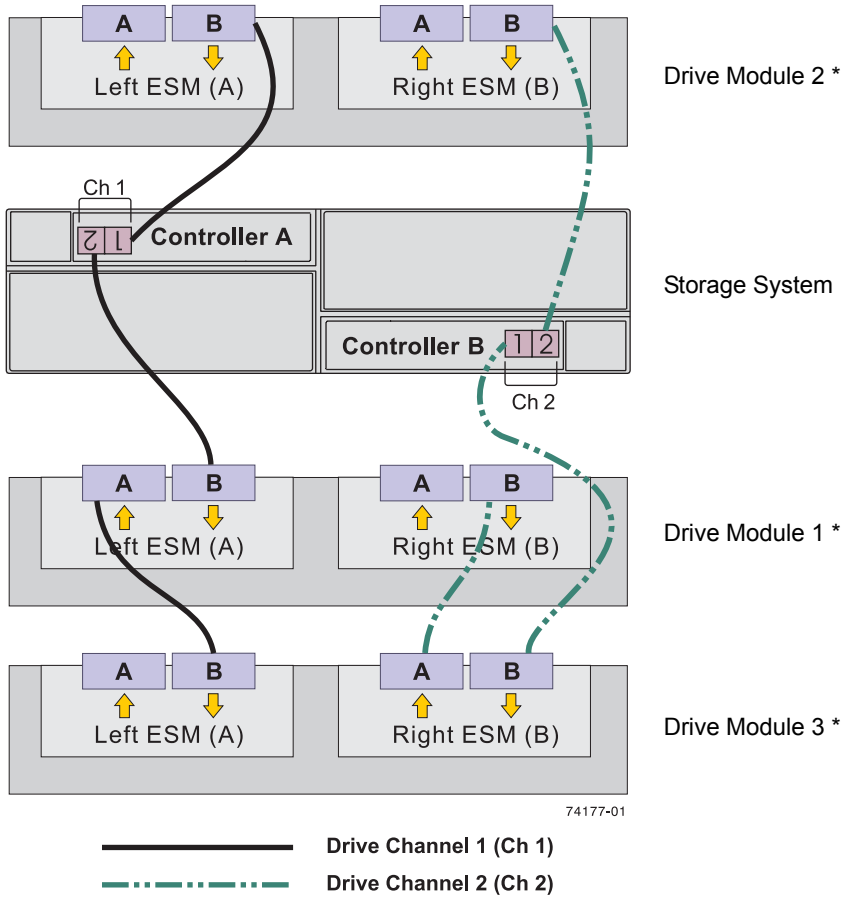


Figure 4-20 One 6140 Storage System and Three Side-by-Side Style Drive Modules

NOTE If you have drive modules with inverted ESM CRUs, see "A Comparison of ESM CRU Arrangements" on page 4-2.

One Storage System and Four Drive Modules

If you are cabling one 6140 storage system to four drive modules, and those drive modules have inverted ESM CRUs, use the cabling topology described in Table 4-17 and Figure 4-21 on page 4-39.

Table 4-17 One 6140 Storage System and Four Inverted Drive Modules

Drive Channel	Connection Point		Connection Point	
	Module/ Component	Port Number/ Location	Module/ Component	Port Number/ 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 controlling the storage system will automatically assign drive module tray IDs to CSM200 drive modules that will usually *not* match the drive module numbers shown in this table and the subsequent illustration. The cabling is not affected by the firmware's choice of drive tray IDs.

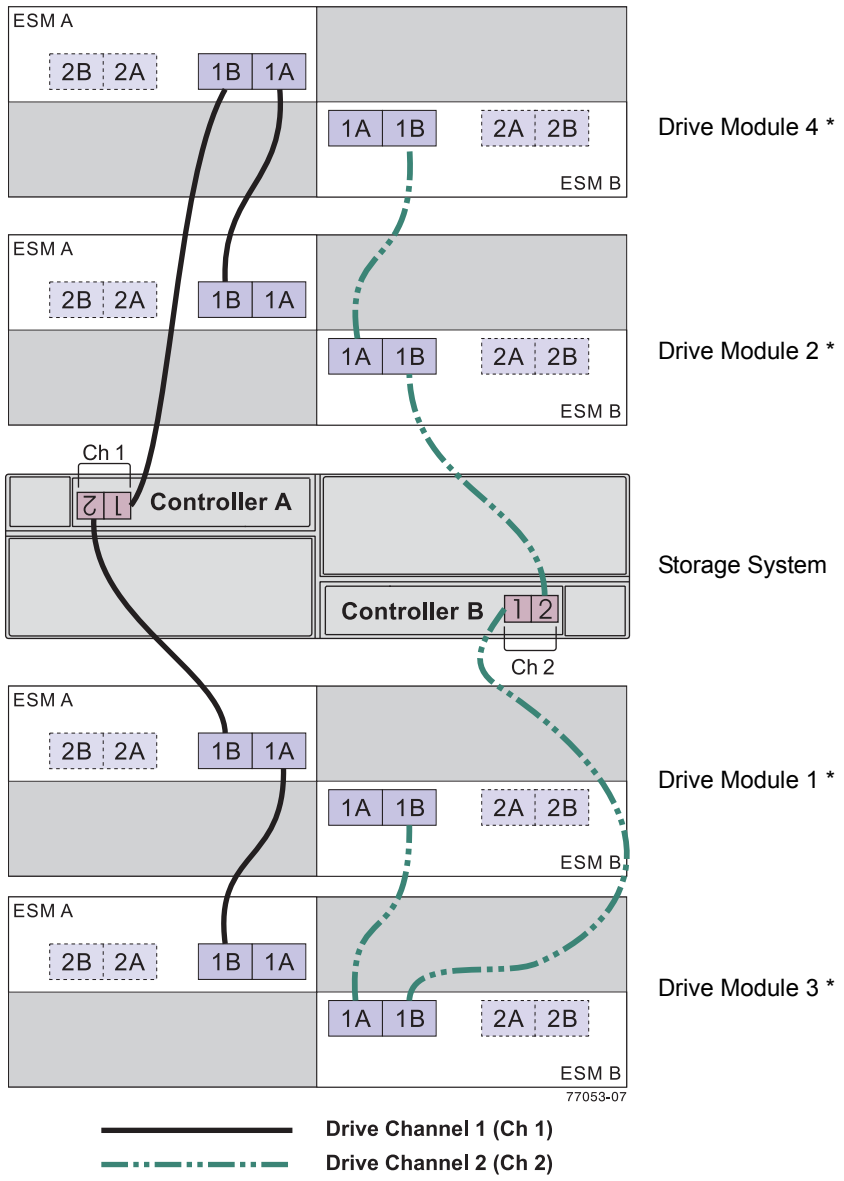


Figure 4-21 One 6140 Storage System and Four Inverted Drive Modules

NOTE If you have drive modules with side-by-side ESM CRUs, see "A Comparison of ESM CRU Arrangements" on page 4-2.

One Storage System and Five Drive Modules

If you are cabling one 6140 storage system to five drive modules, and those drive modules have side-by-side ESM CRUs, use the cabling topology described in Table 4-18 and Figure 4-22.

Table 4-18 One 6140 Storage System and Five Side-by-Side Style Drive Modules

Drive Channel	Connection Point		Connection Point	
	Module/ Component	Port Number/ Location	Module/ Component	Port Number/ Location
1	Controller A	1	Drive Module 4*	Left ESM, Port B
	Drive Module 4*	Left ESM, Port A	Drive Module 2*	Left ESM, Port B
	Controller A	2	Drive Module 1*	Left ESM, Port B
	Drive Module 1*	Left ESM, Port A	Drive Module 3*	Left ESM, Port B
	Drive Module 3*	Left ESM, Port A	Drive Module 5*	Left ESM, Port B
2	Controller B	1	Drive Module 5*	Right ESM, Port B
	Drive Module 5*	Right ESM, Port A	Drive Module 3*	Right ESM, Port B
	Drive Module 3*	Right ESM, Port A	Drive Module 1*	Right ESM, Port B
	Controller B	2	Drive Module 2*	Right ESM, Port B
	Drive Module 2*	Right ESM, Port A	Drive Module 4*	Right ESM, Port B

*The firmware controlling the storage system will automatically assign drive module tray IDs to CSM200 drive modules that will usually *not* match the drive module numbers shown in this table and the subsequent illustration. The cabling is not affected by the firmware's choice of drive tray IDs.

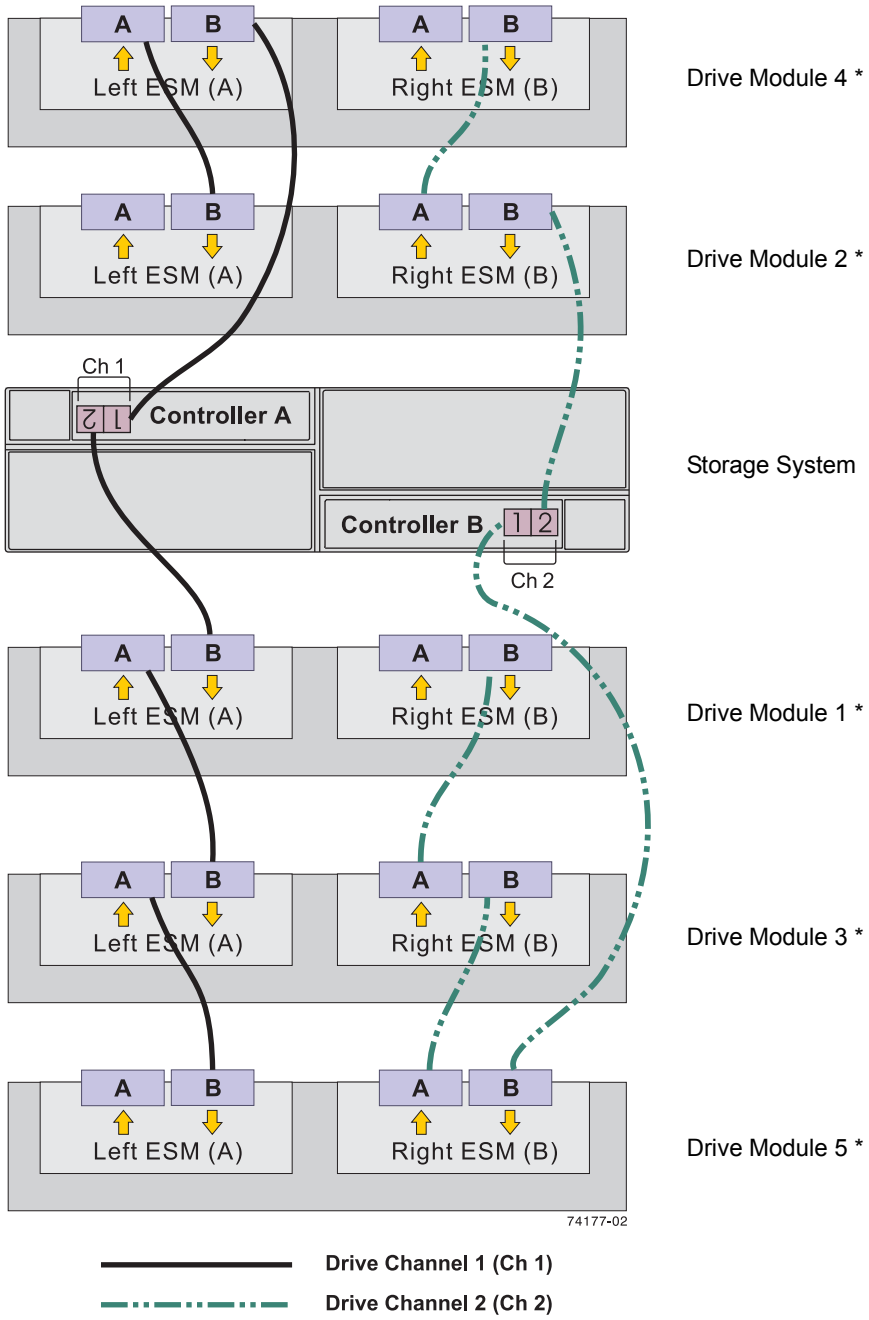


Figure 4-22 One 6140 Storage System and Five Side-by-Side Style Drive Modules

NOTE If you have drive modules with inverted ESM CRUs, see "A Comparison of ESM CRU Arrangements" on page 4-2.

One Storage System and Six Drive Modules

If you are cabling one 6140 storage system to six drive modules, and those drive modules have inverted ESM CRUs, use the cabling topology described in Table 4-19 and Figure 4-23 on page 4-43.

IMPORTANT The 6140 storage system supports a maximum of seven drive modules. However, if you are using the CSM200 drive module in your configuration, design for a limit of *six* drive modules. Seven drive modules fully populated with drives exceeds the maximum number of drives supported on a single drive channel.

Table 4-19 One 6140 Storage System and Six Inverted Drive Modules

Drive Channel	Connection Point		Connection Point	
	Module/ Component	Port Number/ Location	Module/ Component	Port Number/ 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 controlling the storage system will automatically assign drive module tray IDs to CSM200 drive modules that will usually *not* match the drive module numbers shown in this table and the subsequent illustration. The cabling is not affected by the firmware's choice of drive tray IDs.

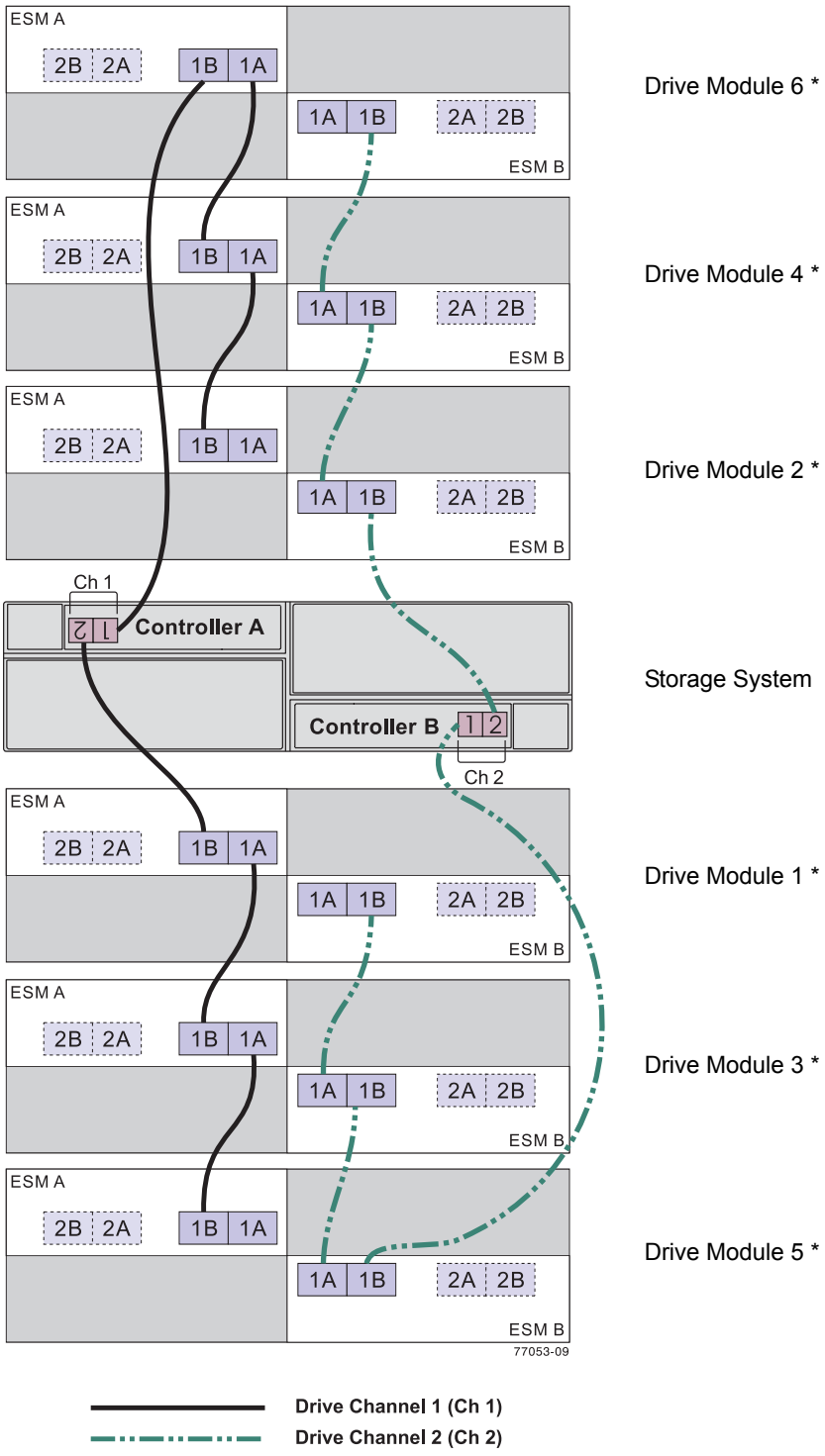


Figure 4-23 One 6140 Storage System and Six Inverted Drive Modules

NOTE If you have drive modules with side-by-side ESM CRUs, see "A Comparison of ESM CRU Arrangements" on page 4-2.

One Storage System and Multiple Drive Module Types

If you are cabling more than one type of drive module to the 6140 storage system, be sure to review the following information before choosing a cabling topology:

- "Multiple Types of Drive Modules" on page 1-12
- "Cabling for Drive Modules that Support Loop Switch Technology" on page 1-13

Follow these guidelines for cabling multiple types of drive modules to maximize performance and accessibility.[6]

Figure 4-24 on page 4-45 provides an example of how flexible the cabling can be when you use an 6140 storage system as the controller. The firmware is able to detect, and properly 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 system includes FLC200 drive modules, it is still advisable to cable the FLC200 drive modules so that they are the last devices on the drive channel (farthest from Controller A).

IMPORTANT When mixing different drive modules, consider the total number of drives that are available in the final configuration of the storage system. For example, mixing CSM200 drive modules with FLA300 drive modules might provide a total number of drives that is greater than the maximum number that each drive channel can support.

6. 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 control module or storage system. 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.

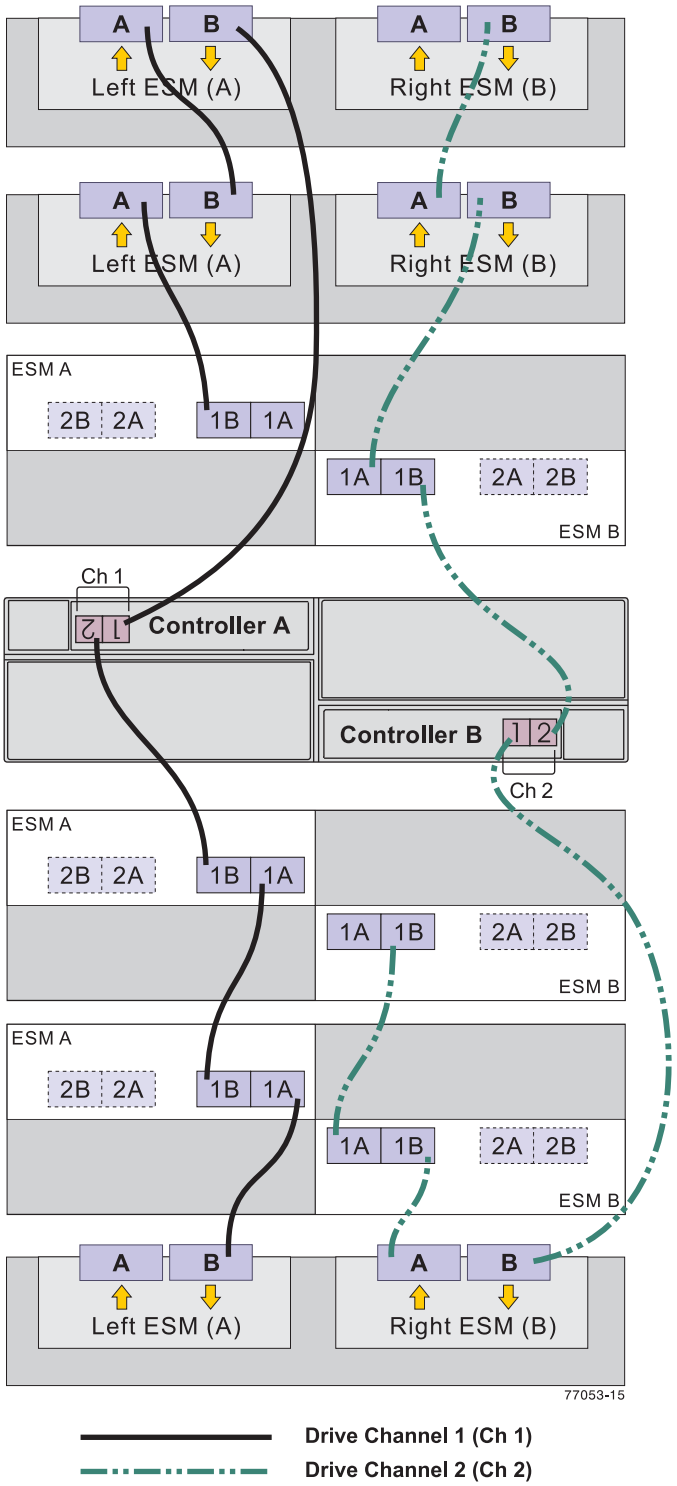


Figure 4-24 One 6140 Storage System and Multiple Drive Module Types

Chapter 5

Ethernet Cabling

This chapter provides examples of how to connect your storage system to an Ethernet network for out-of-band storage system management. If you plan to use in-band storage system management, Ethernet cabling is unnecessary. This chapter contains these sections:

See Chapter 6, "Component Locations," for illustrations showing the Ethernet port locations on the specific control module or storage system model you are installing.

CAUTION **Potential loss of data access –** If out-of-band management is used, connect the control module or storage system Ethernet ports to a private network segment behind a firewall. If the Ethernet connection is not protected by a firewall, your storage system might be at risk of being accessed from outside your network.

Direct Out-of-Band Ethernet Topology

Figure 5-1 shows connections from the control module or storage system to the Ethernet. In this topology, you must install a network interface card (NIC) in the storage management station where the client software resides. For dual controllers, you must install two NICs in the storage management station.

NOTE For more information about NICs, refer to "Network Interface Cards" on page 1-7.

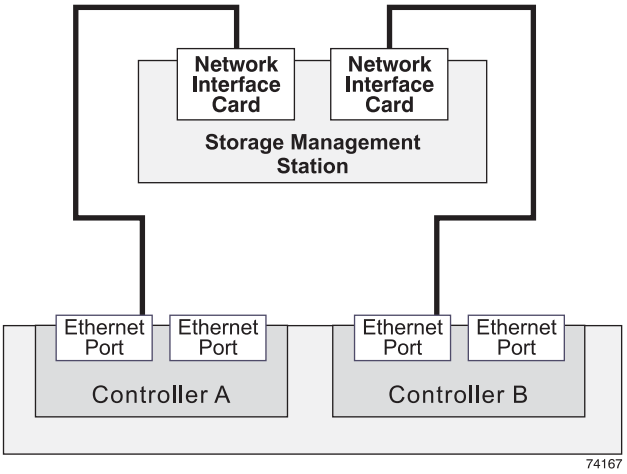


Figure 5-1 Network Out-of-Band Ethernet Topology

IMPORTANT In certain limited situations where the storage management station is connected directly to the control module or storage system, you must use an Ethernet crossover cable to cable 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

Figure 5-2 shows two connections from the control module or storage system to two ports on an Ethernet switch. In this topology, you must install an NIC in the storage management station where the client software resides and an Ethernet switch, and you must use Ethernet cables for all cabling.

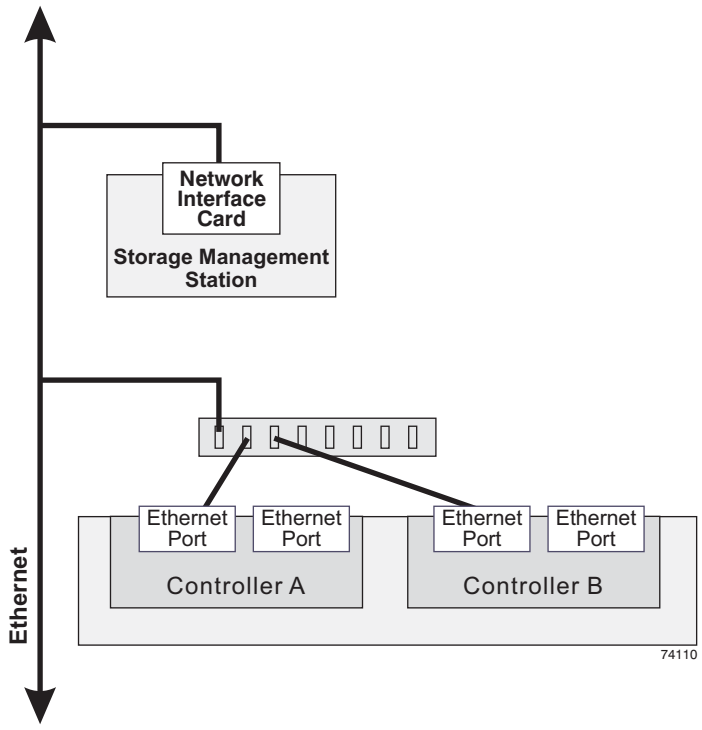


Figure 5-2 Fabric Redundant Out-of-Band Ethernet Topology

See "In-Band Management and Out-of-Band Management" on page 1-8 for more information.

IMPORTANT If you have a total of four available Ethernet ports on your control module or storage system (two per controller), reserve one port on each controller for Customer and Technical Support access to the storage system.

Chapter 6

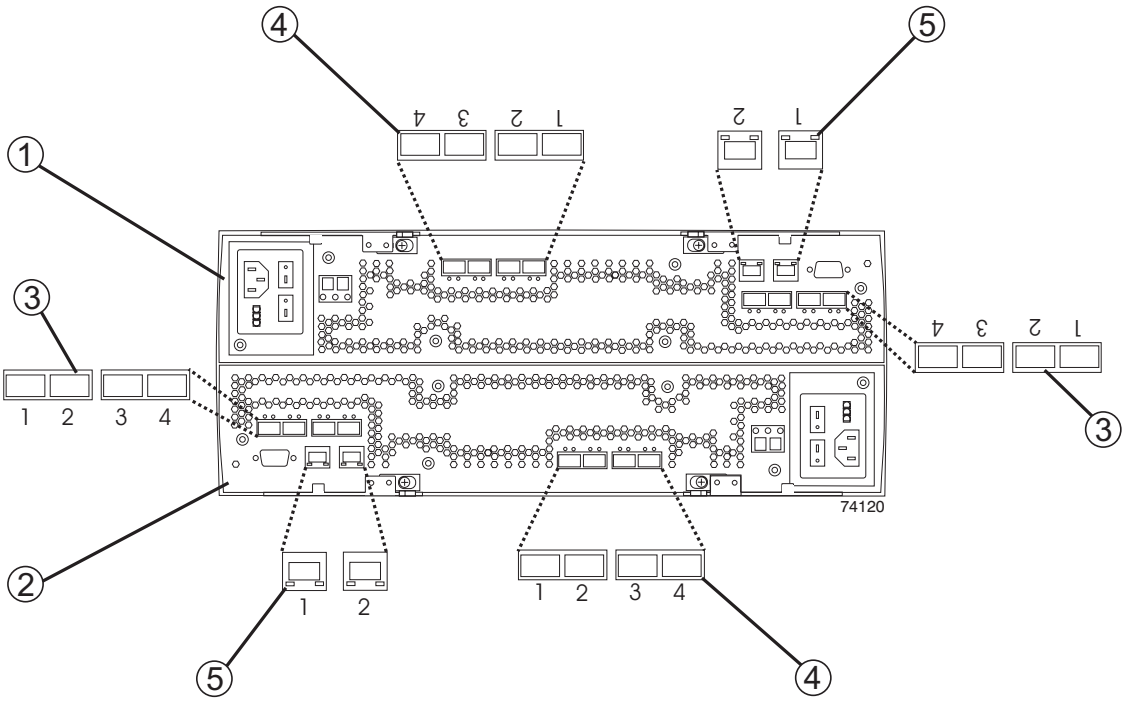
Component Locations

This chapter provides illustrations of the back of each control module, storage system, and drive module. The illustrations identify controller and environmental services monitor (ESM) locations, and host port, drive port, and Ethernet port locations and their port identifiers. This chapter contains these sections:

Use these illustrations to ensure that you have correctly identified the cable connection points described in Chapter 3, "Host Cabling," Chapter 4, "Drive Cabling," and Chapter 5, "Ethernet Cabling."

Component Locations on the 6540 Control Module

Figure 6-1 shows the physical location of various components on the back of the 6540 control module.



1. Controller A
2. Controller B
3. Host Ports
4. Drive Ports
5. Ethernet Ports

Figure 6-1 Component Locations on the 6540 Control Module

NOTE Host Port 4 on each controller of the 6540 control module is reserved for using the Remote Volume Mirroring (RVM) feature. If you are not using the RVM feature, these host ports are available for host connections.

Table 6-1 on page 6-3 lists the drive channels associated with each of the 6540 control module controller drive ports.

Table 6-1 Drive Ports and Drive Channels on the 6540 Control 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

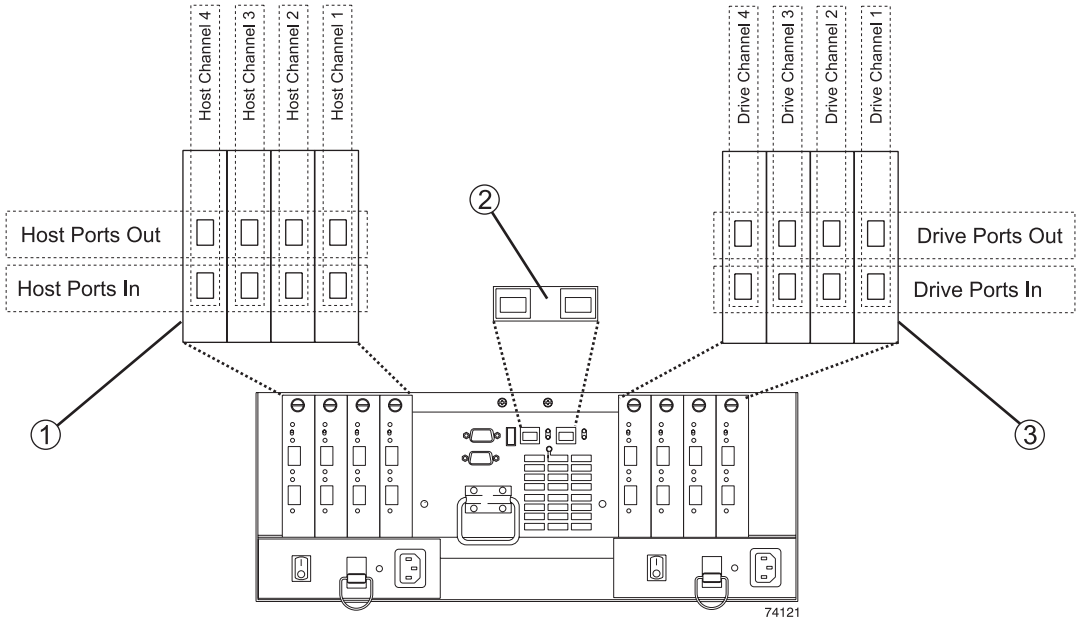
NOTE When cabling the 6540 control module, it is important to note that Drive Channels 1 and 3 are a redundant pair, and Drive Channels 2 and 4 are a redundant pair. In other words, if a failure occurred in Drive Channel 1, Drive Channel 3 would allow communication with the drives; if a failure occurred in Drive Channel 2, Drive Channel 4 would allow communication with the drives.

Component Locations on the FLX280 Control Module

Figure 6-2 shows the physical location of various components on the back of the FLX280 control module. Figure 6-2 also shows the host channels and drive channels that are associated with each of the minihub ports.

IMPORTANT If you are connecting to a switch (fabric), you must remove any unused SFP transceivers from the host channel ports of the FLX280 control module.

To see an illustration showing the distinction between the SFP transceiver and the fiber-optic cable to which it attaches, refer to Figure 1-6 on page 1-17.



1. Host Ports
2. Ethernet Ports
3. Drive Ports

Figure 6-2 Component Locations on the FLX280 Control Module

Component Locations on the FLX240 Control Module

Figure 6-3 shows the physical location of various components on the back of the FLX240 control module.

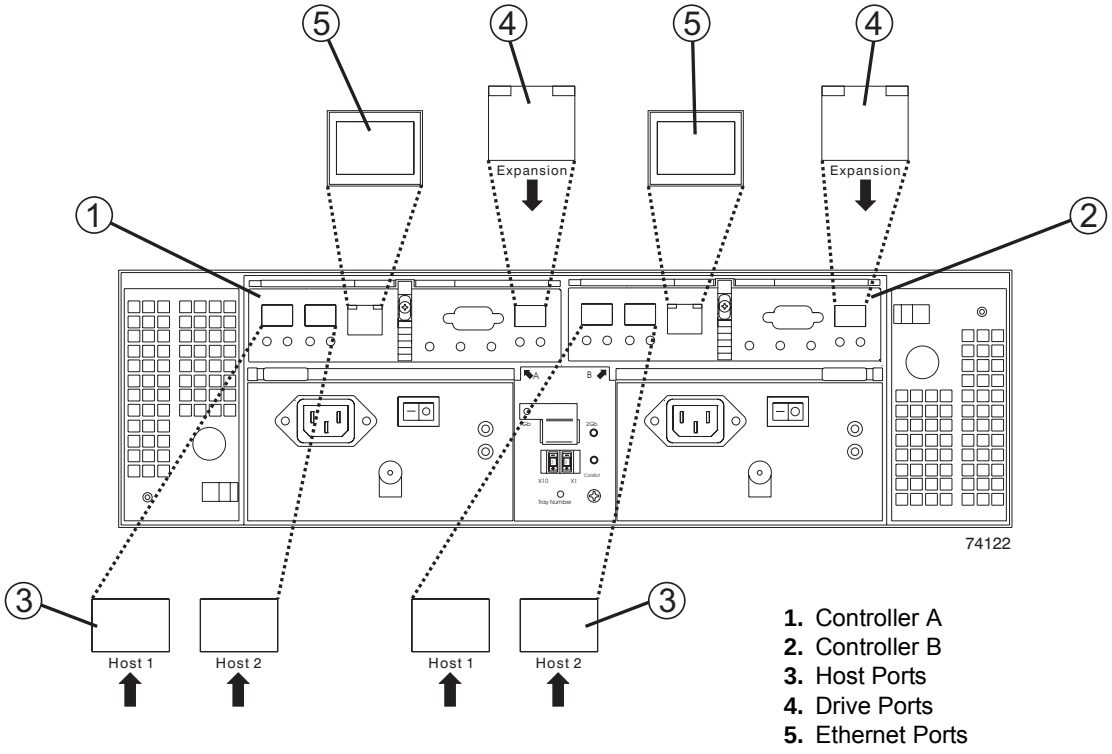


Figure 6-3 Component Locations on the FLX240 Control Module

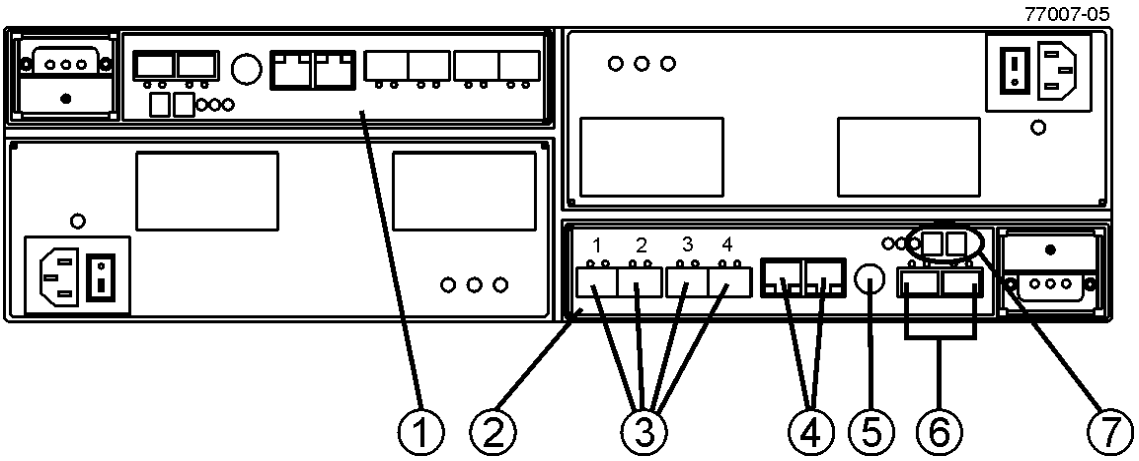
Table 6-2 lists the drive channels that are associated with each of the controller drive ports.

Table 6-2 Drive Ports and Drive Channels on the FLX240 Control Module

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

Component Locations on the 6140 Storage System

Figure 6-4 shows the physical location of various components on the back of the 6140 storage system.



1. Controller A
2. Controller B
3. Host Ports
   (2 ports or 4 ports, depending on model)
4. Ethernet Ports
5. Serial Port
6. Dual-Ported Drive Ports
7. Seven-Segment Display

Figure 6-4 Component Locations on the 6140 Storage System

Table 6-3 lists the drive channels that are associated with each of the controller drive ports.

Table 6-3 Drive Ports and Drive Channels on the 6140 Storage System

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

Component Locations on the FLX240 Storage System

Figure 6-5 shows the physical location of various components on the back of the FLX240 storage system.

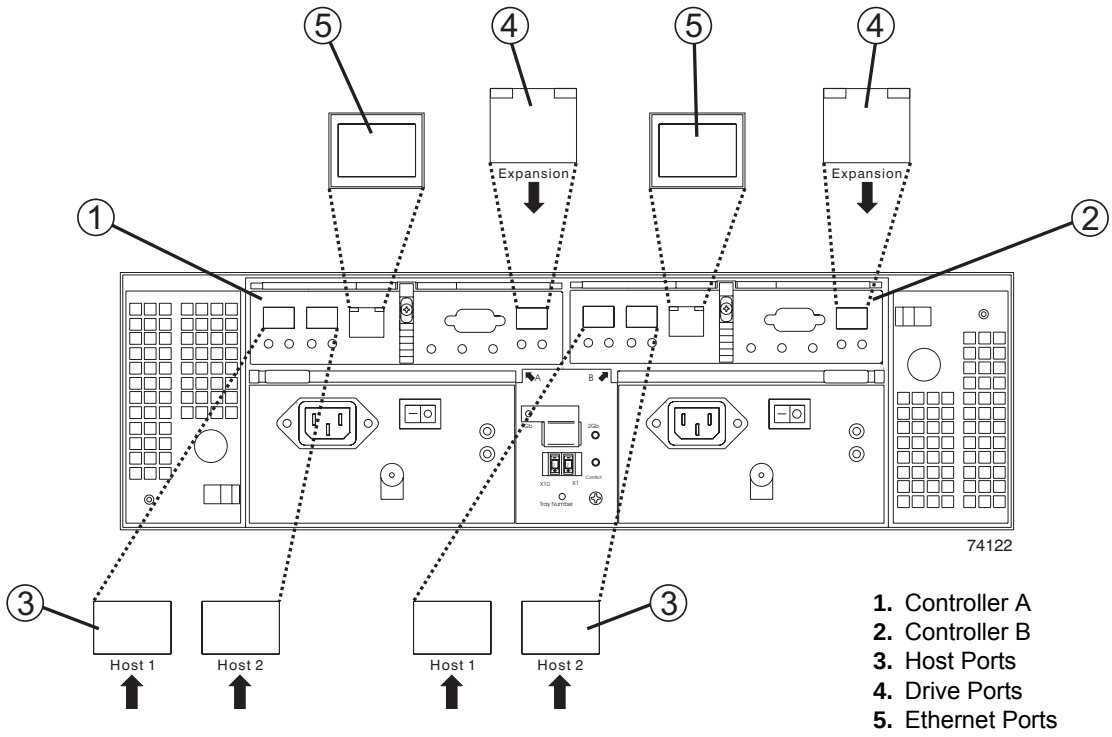


Figure 6-5 Component Locations on the FLX240 Storage System

Table 6-4 lists the drive channels that are associated with each of the controller drive ports.

Table 6-4 Drive Ports and Drive Channels on the FLX240 Storage System

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

Component Locations on the FLX240 Drive Limited Storage System

NOTE The FLX240 Drive Limited storage system supports only the 14 drives that are contained within the storage system enclosure; therefore, this model is not equipped with expansion drive ports.

Figure 6-6 shows the physical location of various components on the back of the FLX240 Drive Limited storage system.

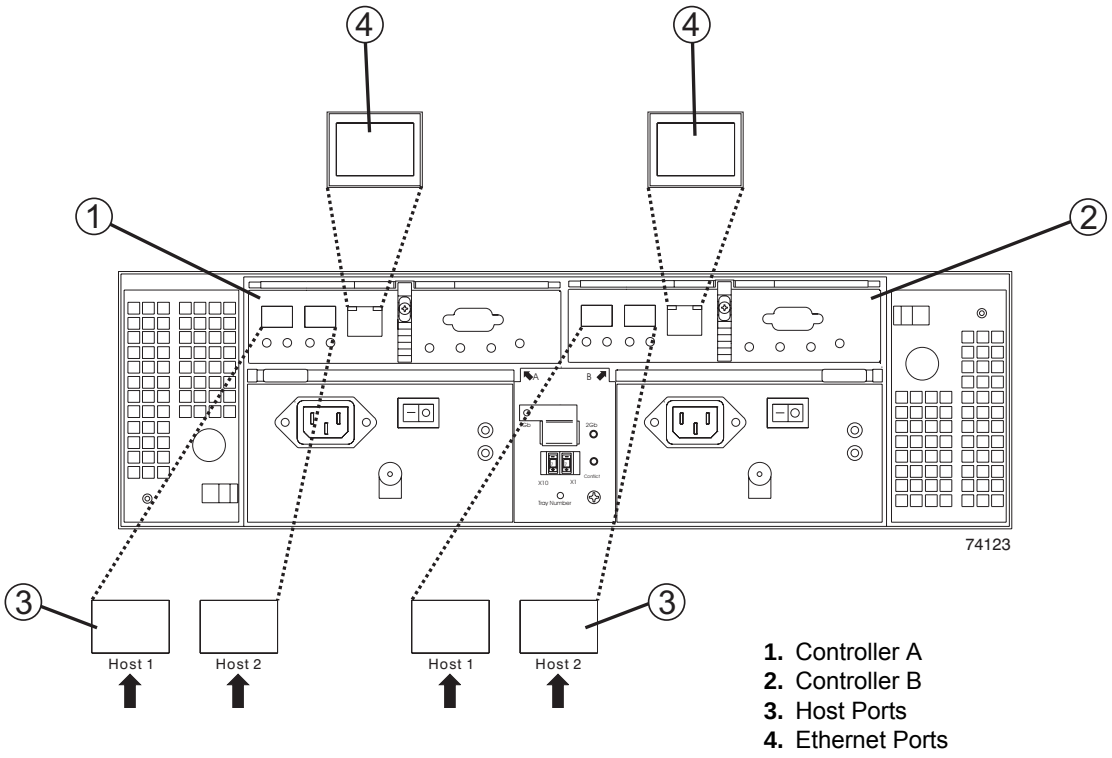
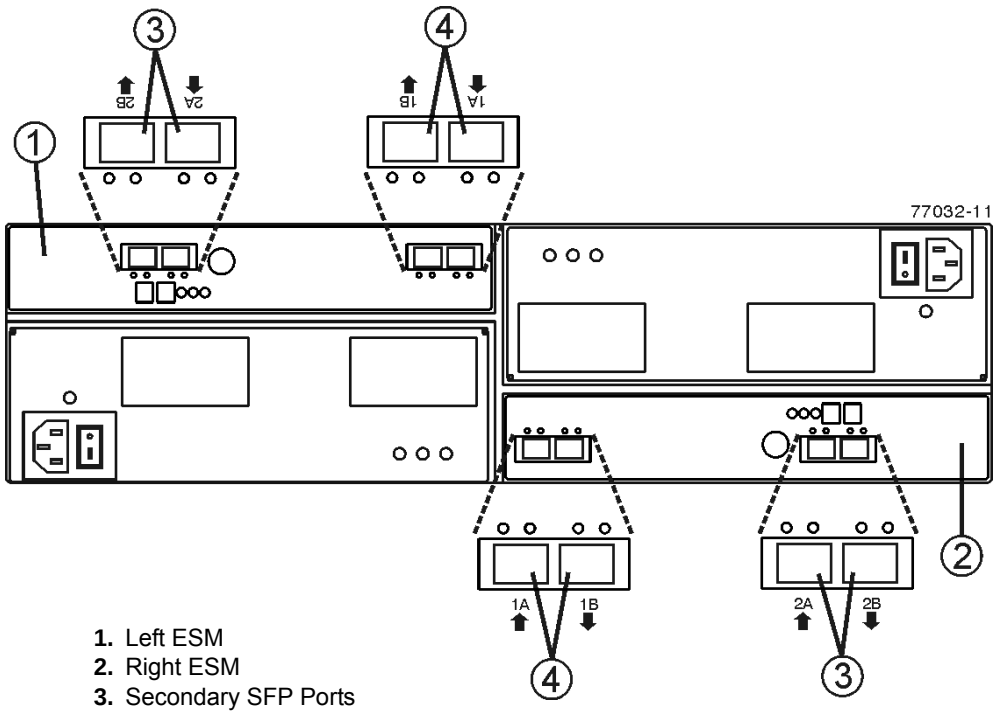


Figure 6-6 Component Locations on the FLX240 Drive Limited Storage System

Component Locations on the CSM200 Drive Module

Figure 6-7 shows the physical location of various components on the back of the CSM200 drive module.



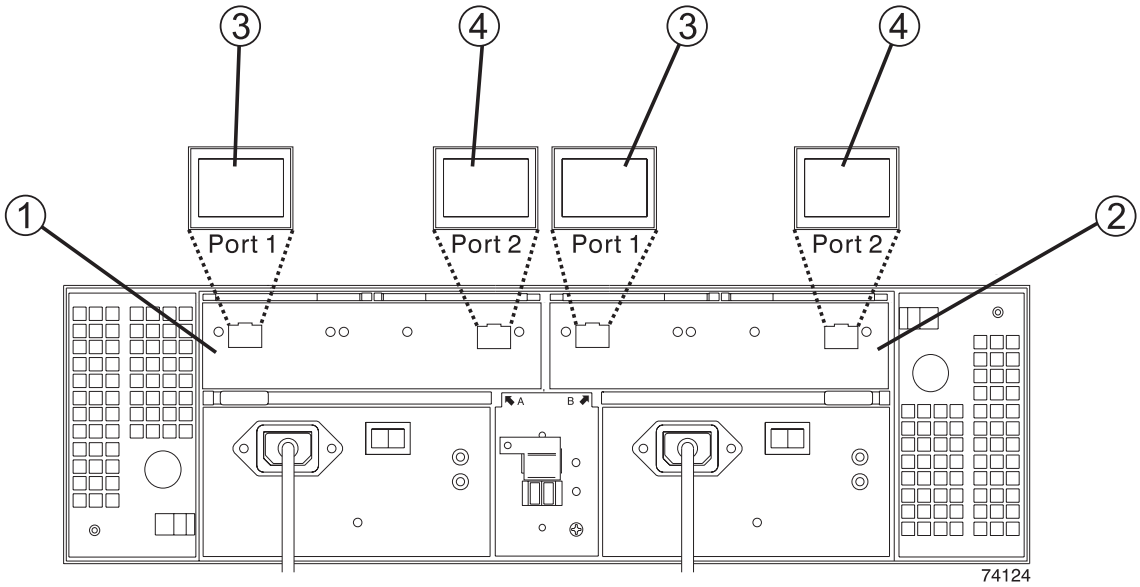
1. Left ESM
2. Right ESM
3. Secondary SFP Ports
4. Primary SFP Ports

Figure 6-7 Component Locations on the CSM200 Drive Module

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 tranceivers are placed in the secondary ports, the SFP Port lights blink, as a reminder that these ports are not functioning.

Component Locations on the FLA300 Drive Module

Figure 6-8 shows the physical location of various components on the back of the FLA300 drive module.

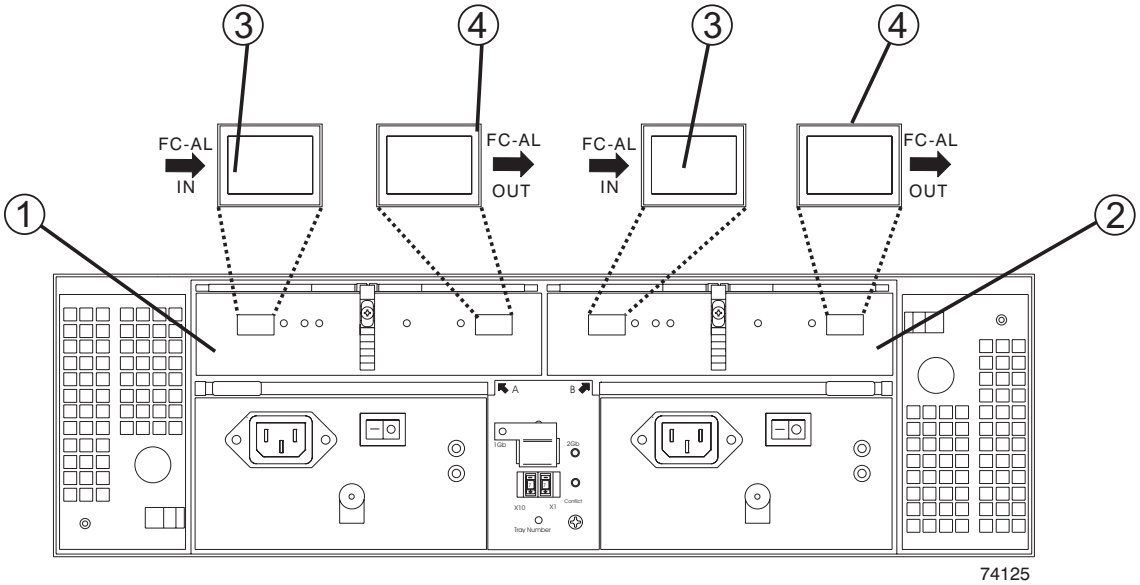


1. Left ESM
2. Right ESM
3. In Ports
4. Out Ports

Figure 6-8 Component Locations on the FLA300 Drive Module

Component Locations on the FLC200 Drive Module

Figure 6-9 shows the physical location of various components on the back of the FLC200 drive module.

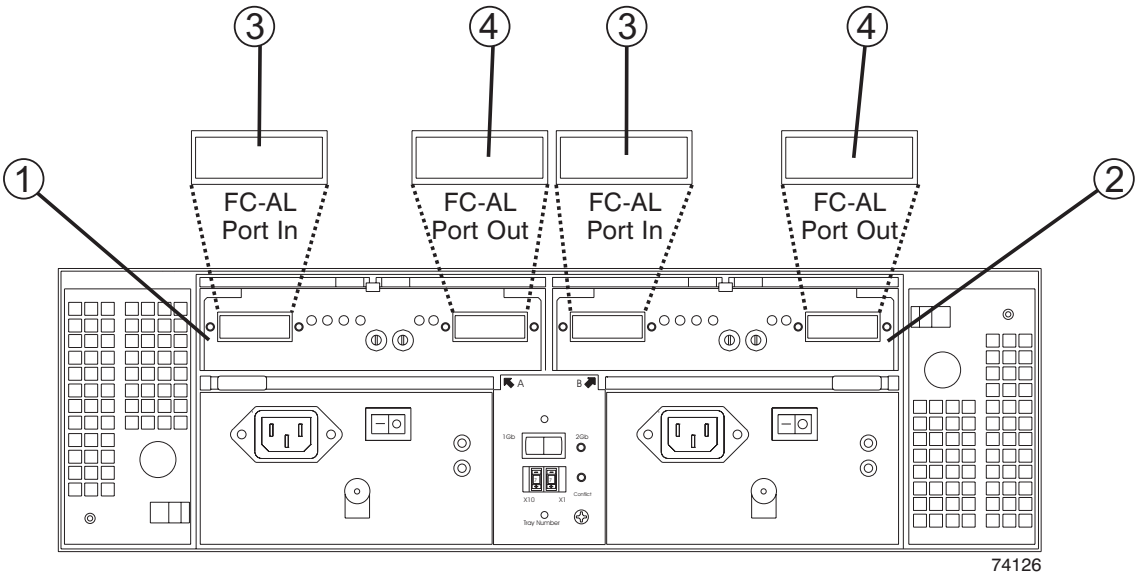


1. Left ESM
2. Right ESM
3. In Ports
4. Out Ports

Figure 6-9 Component Locations on the FLC200 Drive Module

Component Locations on the FLA200 Drive Module

Figure 6-10 shows the physical location of various components on the back of the FLA200 drive module.



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

Figure 6-10 Component Locations on the FLA200 Drive Module

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 system, contact a Customer and Technical Support representative before proceeding. A Customer and Technical Support 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 system profile for all storage systems that will be affected by the upgrade.
- Performing a complete backup of all the drives in the storage system.
- Verifying that the volume groups and associated volumes on the storage system have an Optimal status.

CAUTION **Potential loss of data access –** Contact a Customer and Technical Support representative if you plan to add a drive module to an existing storage system under either of the following conditions:

The power is not turned off to the control module or storage system.

Data transfer continues to the storage system.

HotScale Technology

By using the HotScale™ technology, you can add one or more drive modules to an existing topology without removing power from the storage system. This feature enables your storage system to be fully available, without interruption, as you install new equipment.

Redundant Drive Channels

If you are working with a storage system that has redundant drive channels, it is easy to add additional drive modules. Ensure 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.

A Customer and Technical Support representative can provide assistance in maintaining access to data during the upgrade of your storage system.

One Non-Redundant Drive Channel

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

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.

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