IBM System Storage N series

Fibre Channel and iSCSI Configuration Guide for the Data ONTAP 7.3 Release Family

GC53-1300-06

Contents

Preface

Supported features

IBM System Storage N series storage systems are driven by NetApp Data ONTAP software. Some features described in the product software documentation are neither offered nor supported by IBM. Please contact your local IBM representative or reseller for further details.

Information about supported features can also be found on the N series support website, which is accessed and navigated as described in *Websites* on page 7.

Websites

IBM maintains pages on the World Wide Web where you can get the latest technical information and download device drivers and updates. The following web pages provide N series information:

- A listing of currently available N series products and features can be found at the following web page:
  www.ibm.com/storage/nas/
- The IBM System Storage N series support website requires users to register in order to obtain access to N series support content on the web. To understand how the N series support web content is organized and navigated, and to access the N series support website, refer to the following publicly accessible web page:
  www.ibm.com/storage/support/nseries/
  This web page also provides links to AutoSupport information as well as other important N series product resources.
- IBM System Storage N series products attach to a variety of servers and operating systems. To determine the latest supported attachments, go to the IBM N series interoperability matrix at the following web page:
  www.ibm.com/systems/storage/network/interophome.html
- For the latest N series hardware product documentation, including planning, installation and setup, and hardware monitoring, service and diagnostics, see the IBM N series Information Center at the following web page:
  publib.boulder.ibm.com/infocenter/nasinfo/nseries/index.jsp

Getting information, help, and service

If you need help, service, or technical assistance or just want more information about IBM products, you will find a wide variety of sources available from IBM to assist you. This section contains

information about where to go for additional information about IBM and IBM products, what to do if you experience a problem with your IBM N series product, and whom to call for service, if it is necessary.

Before you call

Before you call, make sure you have taken these steps to try to solve the problem yourself:

- Check all cables to make sure they are connected.
- Check the power switches to make sure the system is turned on.
- Use the troubleshooting information in your system documentation and use the diagnostic tools that come with your system.
- Refer to the IBM N series support website for information on known problems and limitations.

Using the documentation

The latest versions of N series software documentation, including Data ONTAP and other software products, are available on the IBM N series support website, which is accessed and navigated as described in *Websites* on page 7.

Current N series hardware product documentation is shipped with your hardware product in printed documents or as PDF files on a documentation CD. For the latest N series hardware product documentation PDFs, go to the IBM N series support website.

Hardware documentation, including planning, installation and setup, and hardware monitoring, service, and diagnostics, is also provided in an IBM N series Information Center at the following web page:

publib.boulder.ibm.com/infocenter/nasinfo/nseries/index.jsp

Hardware service and support

You can receive hardware service through IBM Integrated Technology Services. Visit the following web page for support telephone numbers:

www.ibm.com/planetwide/

Firmware updates

IBM N series product firmware is embedded in Data ONTAP. As with all devices, it is recommended that you run the latest level of firmware. Any firmware updates are posted to the IBM N series support website, which is accessed and navigated as described in *Websites* on page 7.

Note: If you do not see new firmware updates on the IBM N series support website, you are running the latest level of firmware.

Verify that the latest level of firmware is installed on your machine before contacting IBM for technical support.

How to send your comments

Your feedback helps us to provide the most accurate and high-quality information. If you have comments or suggestions for improving this document, please send them by e-mail to *starpubs@us.ibm.com*.

Be sure to include the following:

- Exact publication title
- Publication form number (for example, GC26-1234-02)
- Page, table, or illustration numbers
- A detailed description of any information that should be changed

iSCSI topologies

Supported iSCSI configurations include direct-attached and network-attached topologies. Both single-controller and active/active configurations are supported.

In an iSCSI environment, all methods of connecting Ethernet switches to a network approved by the switch vendor are supported. Ethernet switch counts are not a limitation in Ethernet iSCSI topologies. For specific recommendations and best practices, see the Ethernet switch vendor's documentation.

For Windows iSCSI multipathing options, please see Technical Report 3441: *Windows Multipathing Options with Data ONTAP: FCP and iSCSI*.

Note: This technical report contains information about NetApp products that IBM licenses and in some cases customizes. Technical reports might contain information about models and features that are not supported by IBM.

Related information

IBM NAS support site - www.ibm.com/storage/support/nas/

Technical Report 3441: Windows Multipathing Options with Data ONTAP: FCP and iSCSI - media.netapp.com/documents/tr-3441.pdf

Single-network active/active configuration in an iSCSI SAN

You can connect hosts using iSCSI to active/active configuration controllers using a single IP network. The network can consist of one or more switches, and the controllers can be attached to multiple switches. Each controller can have multiple iSCSI connections to the network. The number of ports is based on the storage controller model and the number of supported Ethernet ports.

The following figure shows two Ethernet connections to the network per storage controller. Depending on the controller model, more connections are possible.

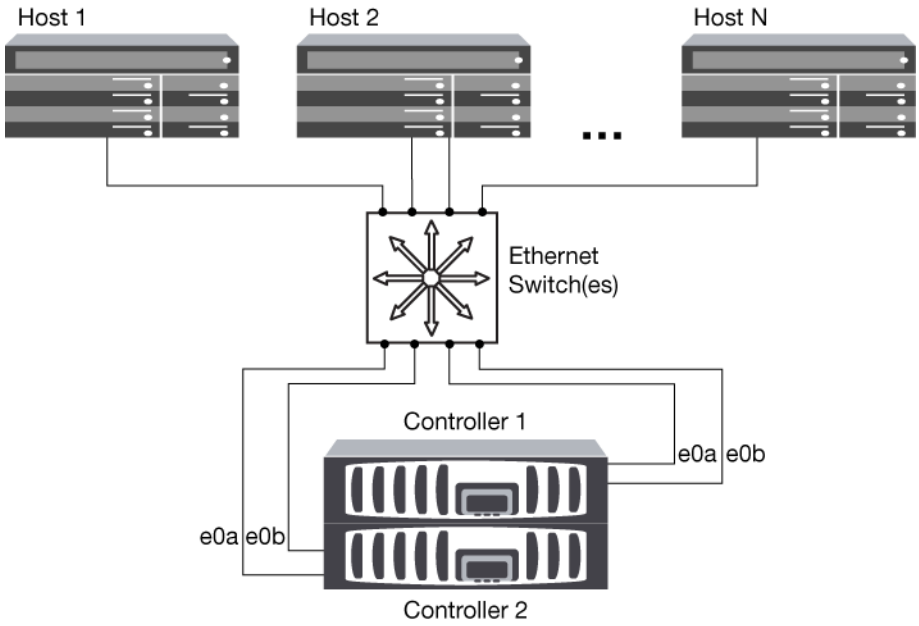

Figure 1: iSCSI single network active/active configuration

Attribute	Value
Fully redundant	No, due to the single network
Type of network	Single network
Different host operating systems	Yes, with multiple-host configurations
Multipathing required	Yes
Type of configuration	Active/active configuration

Multinetwork active/active configuration in an iSCSI SAN

You can connect hosts using iSCSI to active/active configuration controllers using multiple IP networks. To be fully redundant, a minimum of two connections to separate networks per controller is necessary to protect against NIC, network, or cabling failure.

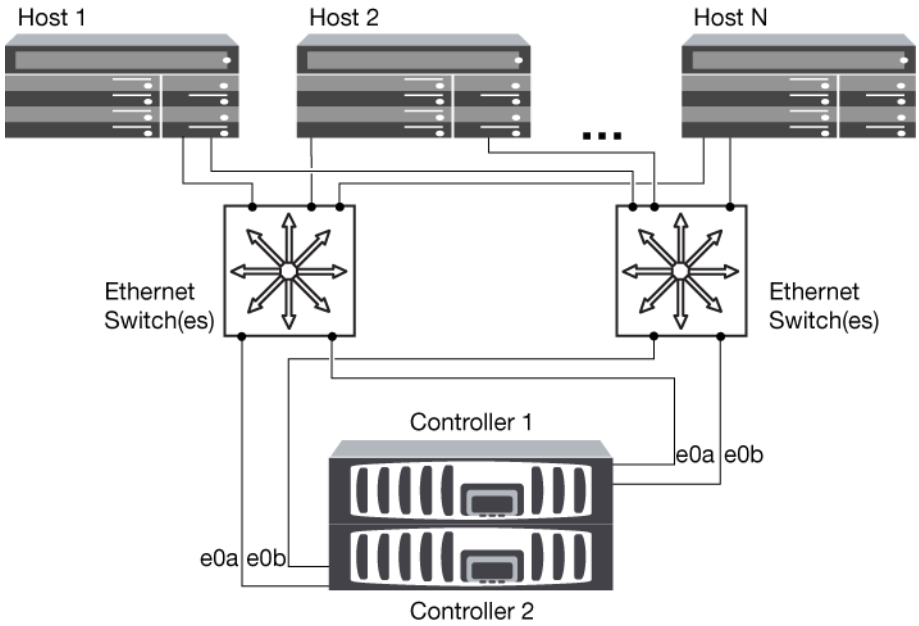

Figure 2: iSCSI multinetwork active/active configuration

Attribute	**Value**
Fully redundant	Yes
Type of network	Multinetwork
Different host operating systems	Yes, with multiple-host configurations
Multipathing required	Yes
Type of configuration	Active/active configuration

Direct-attached single-controller configurations in an iSCSI SAN

You can connect hosts using iSCSI directly to controllers. The number of hosts that can be directly connected to a controller or pair of controllers depends on the number of available Ethernet ports.

Note: Direct-attached configurations are not supported in active/active configurations.

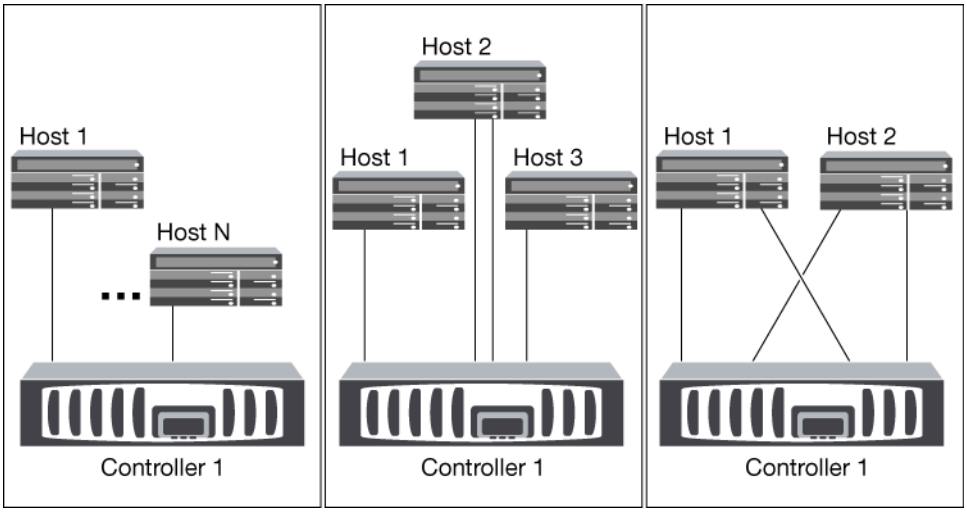

Figure 3: iSCSI direct-attached single-controller configurations

Attribute	Value
Fully redundant	No, due to the single controller
Type of network	None, direct-attached
Different host operating systems	Yes, with multiple-host configurations
Multipathing required	Yes
Type of configuration	Single controller

VLANs

A VLAN consists of a group of switch ports, optionally across multiple switch chassis, grouped together into a broadcast domain. Static and dynamic VLANs enable you to increase security, isolate problems, and limit available paths within your IP network infrastructure.

Reasons for implementing VLANs

Implementing VLANs in larger IP network infrastructures has the following benefits.

- VLANs provide increased security because they limit access between different nodes of an Ethernet network or an IP SAN. VLANs enable you to leverage existing infrastructure while still providing enhanced security.
- VLANs improve Ethernet network and IP SAN reliability by isolating problems.
- VLANs can also help reduce problem resolution time by limiting the problem space.
- VLANs enable you to reduce the number of available paths to a particular iSCSI target port.
- VLANs enable you to reduce the maximum number of paths to a manageable number. You need to verify that only one path to a LUN is visible if a host does not have a multipathing solution available.

Static VLANs

Static VLANs are port-based. The switch and switch port are used to define the VLAN and its members.

Static VLANs offer improved security because it is not possible to breach VLANs using media access control (MAC) spoofing. However, if someone has physical access to the switch, replacing a cable and reconfiguring the network address can allow access.

In some environments, static VLANs are also easier to create and manage because only the switch and port identifier need to be specified, instead of the 48-bit MAC address. In addition, you can label switch port ranges with the VLAN identifier.

Dynamic VLANs

Dynamic VLANs are MAC address based. You can define a VLAN by specifying the MAC address of the members you want to include.

Dynamic VLANs provide flexibility and do not require mapping to the physical ports where the device is physically connected to the switch. You can move a cable from one port to another without reconfiguring the VLAN.

Fibre Channel topologies

Supported FC configurations include single-fabric, multifabric, and direct-attached topologies. Both single-controller and active/active configurations are supported.

For multiple-host configurations, hosts can use different operating systems, such as Windows or UNIX.

Active/active configurations with multiple, physically independent storage fabrics (minimum of two) are recommended for SAN solutions. This provides redundancy at the fabric and storage system layers, which is particularly important because these layers typically support many hosts.

The use of heterogeneous FC switch fabrics is not supported, except in the case of embedded blade switches. For specific exceptions, see the N series Interoperability Matrices website on the N series support site.

Cascade, mesh, and core-edge fabrics are all industry-accepted methods of connecting FC switches to a fabric, and all are supported.

A fabric can consist of one or multiple switches, and the storage arrays can be connected to multiple switches.

Note: The following sections show detailed SAN configuration diagrams for each type of storage system. For simplicity, the diagrams show only a single fabric or, in the case of the dual-fabric configurations, two fabrics. However, it is possible to have multiple fabrics connected to a single storage system. In the case of dual-fabric configurations, even multiples of fabrics are supported. This is true for both active/active configurations and single-controller configurations.

Related information

IBM NAS support site - www.ibm.com/storage/support/nas/

FC onboard and expansion port combinations

You can use storage controller onboard FC ports as both initiators and targets. You can also add storage controller FC ports on expansion adapters and use them as initiators and targets.

The following table lists FC port combinations and specifies which combinations are supported.

Onboard ports	Expansion ports	Supported?
Initiator + Target	None	Yes
Initiator + Target	Target only	Yes with Data ONTAP 7.3.2 and later
Initiator + Target	Initiator only	Yes

Onboard ports	Expansion ports	Supported?
Initiator + Target	Initiator + Target	Yes with Data ONTAP 7.3.2 and later
Initiator only	Target only	Yes
Initiator only	Initiator + Target	Yes
Initiator only	Initiator only	Yes, but no FC SAN support
Initiator only	None	Yes, but no FC SAN support
Target only	Initiator only	Yes
Target only	Initiator + Target	Yes with Data ONTAP 7.3.2 and later
Target only	Target only	Yes with Data ONTAP 7.3.2 and later, but no FC disk shelf or gateway configurations or tape support
Target only	None	Yes, but no FC disk shelf or gateway configurations or FC tape support

Related concepts

Configuration limits on page 85

Related references

FCoE initiator and target combinations on page 63

Fibre Channel supported hop count

The maximum supported FC hop count between a particular host and storage system depends on the hop count that the switch supplier and storage system support for FC configurations.

The hop count is the number of switches in the path between the initiator (host) and target (storage system). Cisco also refers to this value as the *diameter of the SAN fabric*.

The following table shows the supported hop count for each switch supplier.

Switch supplier	Supported hop count
Brocade	6

Switch supplier	Supported hop count
Cisco	7 Up to 3 of the switches can be FCoE switches.
McData	3
QLogic	4

Fibre Channel supported speeds

Fibre Channel target ports can be configured to run at different speeds. You should set the target port speed to match the speed of the device to which it connects.

The recommended best practice is to set the port speed to match the speed of the device connected to the port and not use autonegotiation. A port set to autonegotiation can take longer to reconnect after a takeover/giveback or other interruption.

It is also recommended to set all ports used by a given host to the same speed.

4-Gb target ports

You can configure both 4-Gb onboard ports and 4-Gb expansion adapters to run at the following speeds. Each controller and expansion adapter port can be individually configured with a different speed from the other ports as needed.

- 4 Gb
- 2 Gb
- 1 Gb

8-Gb target ports

You can configure both 8-Gb onboard ports and 8-Gb expansion adapters to run at the following speeds. Each controller and expansion adapter port can be individually configured with a different speed from the other ports as needed.

- 8 Gb
- 4 Gb
- 2 Gb

Fibre Channel switch configuration best practices

A fixed link speed setting is highly recommended, especially for large fabrics, because it provides the best performance for fabric rebuild times. In large fabrics, this can create significant time savings.

Although autonegotiation provides the greatest flexibility, it does not always perform as expected. Also, it adds time to the overall fabric-build sequence because the FC port has to autonegotiate.

Note: Where supported, it is recommended to set the switch port topology to F (point-to-point).

The cfmode setting

The cfmode setting controls how the FC adapters of a storage system in an active/active configuration log in to the fabric, handle local and partner traffic in normal operation and during takeover, and provide access to local and partner LUNs. The cfmode setting of your storage system and the number of paths available to the storage system must align with cabling, configuration limits, and zoning requirements.

Both controllers in an active/active configuration must have the same cfmode setting.

A cfmode setting is not available on single-controller configurations. You can change the cfmode setting from the storage system console by setting privileges to `advanced` and then using the `fcp set` command.

The Data ONTAP 7.3 release family only supports single_image cfmode, unless you are upgrading from an earlier release. The mixed cfmode is not supported even when upgrading; you must change from mixed to single_image.

Detailed descriptions of port behavior with each cfmode are available in the *Data ONTAP Block Access Management Guide for iSCSI and FC*.

For details about migrating to single_image cfmode and reconfiguring hosts, see *Changing the Cluster cfmode Setting in Fibre Channel SAN Configurations*.

Host multipathing software requirements

Multipathing software is required on a host computer any time it can access a LUN through more than one path.

The multipathing software presents a single disk to the operating system for all paths to a LUN. Without multipathing software, the operating system could see each path as a separate disk, which can lead to data corruption.

Multipathing software is also known as multipath I/O (MPIO) software. Supported multipathing software for an operating system is listed in the Interoperability Matrix.

For single-fabric single-controller configurations, multipathing software is not required if you have a single path from the host to the controller. You can use zoning to limit paths.

For an active/active configuration in single_image cfmode, host multipathing software is required unless you use zoning to limit the host to a single path.

N7000 series supported topologies

N7000 series controllers are available in single-controller and active/active configurations.

The N7600 and N7800 systems have eight onboard 2-Gb FC ports per controller and each one can be configured as either a target or initiator FC port. 2-Gb target connections are supported with the onboard 2-Gb ports. 4-Gb and 8-Gb target connections are supported with 4-Gb and 8-Gb target expansion adapters. If you use 4-Gb or 8-Gb target expansion adapters, then you can only configure the onboard ports as initiators. You cannot use both 2-Gb and 4-Gb or 8-Gb targets on the same controller or on two different controllers in an active/active configuration.

The N7600 and N7800 systems are supported by single_image cfmode.

The N7700 and N7900 systems have eight onboard 4-Gb FC ports per controller and each one can be configured as either a target or initiator FC port. 4-Gb target connections are supported with the onboard 4-Gb ports configured as targets.

Additional target connections can be supported using 4-Gb target expansion adapters with Data ONTAP 7.3 and later.

The N7700 and N7900 systems are only supported by single_image cfmode.

Note: The N7000 series systems support the use of 8-Gb target expansion adapters beginning with Data ONTAP version 7.3.1.

N7000 series target port configuration recommendations

For best performance and highest availability, use the recommended FC target port configuration.

The port pairs on a N7000 series controller that share an ASIC are 0a+0b, 0c+0d, 0e+0f, and 0g+0h.

The following table shows the preferred port usage order for onboard FC target ports. For target expansion adapters, the preferred slot order is given in the appropriate hardware and service guide and the N series Interoperability Matrices website at *www.ibm.com/systems/storage/network/interophome.html* for the version of Data ONTAP software being used by the controllers.

Number of target ports	Ports
1	0h
2	0h, 0d
3	0h, 0d, 0f

Number of target ports	Ports
4	0h, 0d, 0f, 0b
5	0h, 0d, 0f, 0b, 0g
6	0h, 0d, 0f, 0b, 0g, 0c
7	0h, 0d, 0f, 0b, 0g, 0c, 0e
8	0h, 0d, 0f, 0b, 0g, 0c, 0e, 0a

N7000 series: Single-fabric single-controller configuration

You can connect hosts to a single controller using a single FC switch. If you use multiple paths, multipathing software is required on the host.

FC switch zoning is recommended to limit the number of paths between hosts and LUNs in configurations with multiple target ports connected to the same fabric.

Note: The FC target port numbers in the following figure are examples. The actual port numbers might vary depending on whether you are using onboard ports or FC target expansion adapters. If you are using FC target expansion adapters, the target port numbers also depend on the expansion slots into which your target expansion adapters are installed.

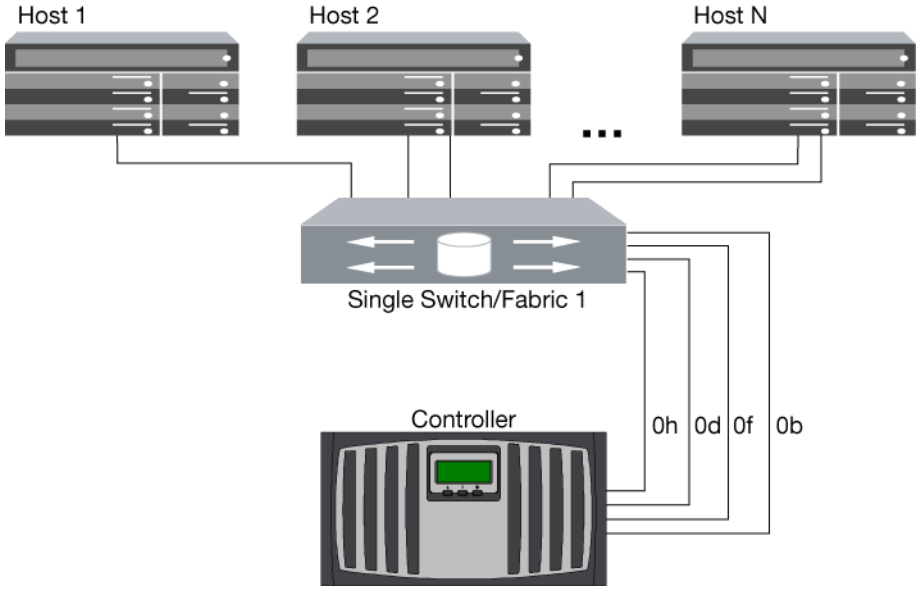

Figure 4: N7000 series single-fabric single-controller configuration

Attribute	Value
Fully redundant	No, due to the single fabric and single controller
Type of fabric	Single fabric
Different host operating systems	Yes, with multiple-host configurations
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller One to the maximum number of supported 4-Gb or 8-Gb FC target expansion adapters
Type of configuration	Single-controller configuration

Related references

N7000 series target port configuration recommendations on page 21

N7000 series: Single-fabric active/active configuration

You can connect hosts to both controllers in an active/active configuration using a single FC switch.

If you use multiple paths to a LUN, multipathing software is required on the host. FC switch zoning is recommended to limit the number of paths between hosts and LUNs in configurations with multiple target ports connected to the same fabric.

Note: The FC target port numbers in the following figure are examples. The actual port numbers might vary depending on whether you are using onboard ports or FC target expansion adapters. If you are using FC target expansion adapters, the target port numbers also depend on the expansion slots into which your target expansion adapters are installed.

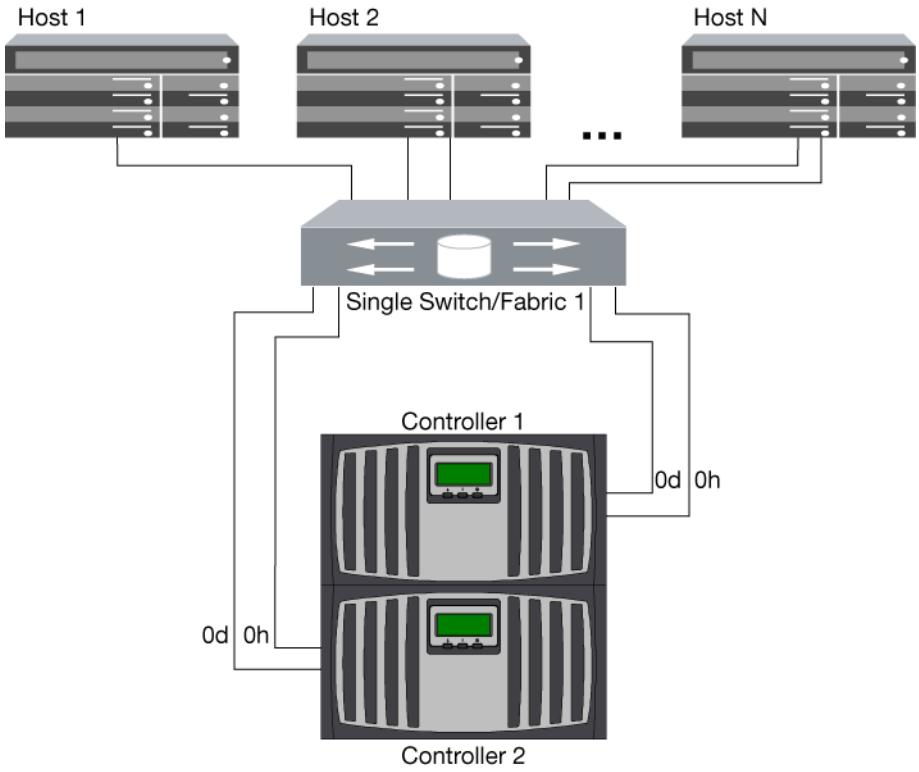

Figure 5: N7000 series single-fabric active/active configuration

Attribute	Value
Fully redundant	No, due to the single fabric
Type of fabric	Single fabric
Different host operating systems	Yes, with multiple-host configurations
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller One to the maximum number of supported 4-Gb or 8-Gb FC ports using target expansion adapters per controller
Type of configuration	Active/active configuration

Related references

N7000 series target port configuration recommendations on page 21

N7000 series: Multifabric active/active configuration

You can connect hosts to both controllers in an active/active configuration using two or more FC switch fabrics for redundancy.

If you use multiple paths to a LUN, multipathing software is required on the host. FC switch zoning is recommended to limit the number of paths between hosts and LUNs in configurations with multiple target ports connected to the same fabric.

Note: The FC target port numbers in the following figure are examples. The actual port numbers might vary depending on whether you are using onboard ports or FC target expansion adapters. If you are using FC target expansion adapters, the target port numbers also depend on the expansion slots into which your target expansion adapters are installed.

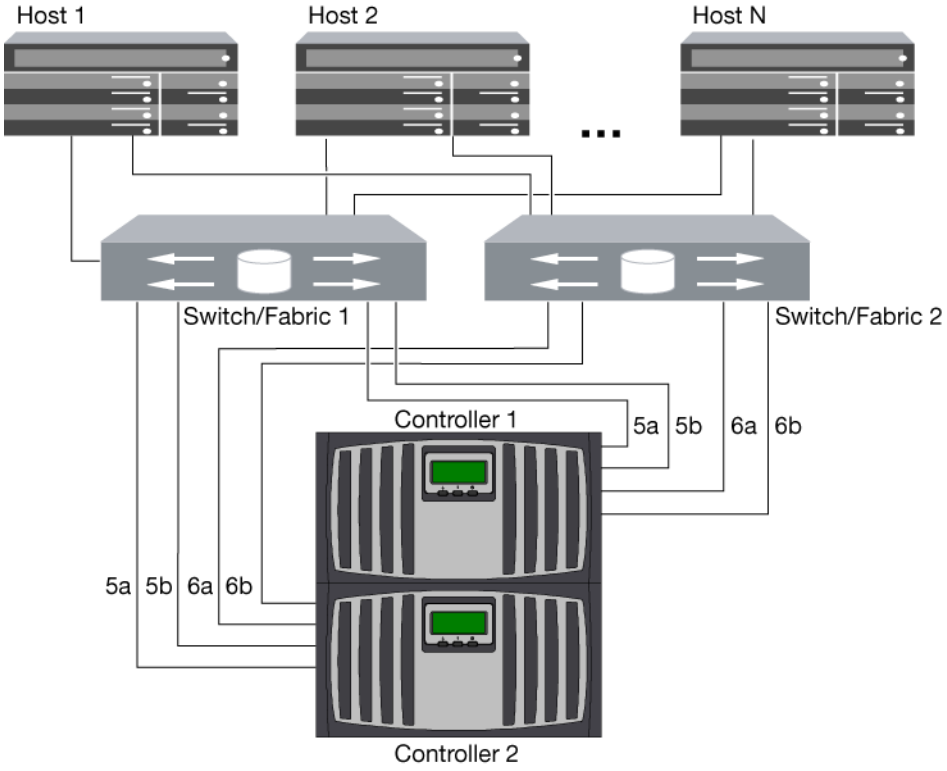

Figure 6: N7000 series multifabric active/active configuration

Attribute	Value
Fully redundant	Yes
Type of fabric	Multifabric
Different host operating systems	Yes, with multiple-host configurations

Attribute	Value
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller One to the maximum number of supported 4-Gb or 8-Gb FC ports using target expansion adapters per controller
Type of configuration	Active/active configuration

Related references

N7000 series target port configuration recommendations on page 21

N7000 series: Direct-attached single-controller configuration

You can connect hosts directly to FC target ports on a single controller. Each host can connect to one port, or to two ports for redundancy. The number of hosts is limited by the number of available target ports.

If you use multiple paths to a LUN, multipathing software is required on the host.

Direct-attached configurations typically need the FC ports set to loop mode. Be sure to follow the recommendation of your host operating system provider for FC port settings. You can use the Data ONTAP `fcp config mediatype` command to set the target ports.

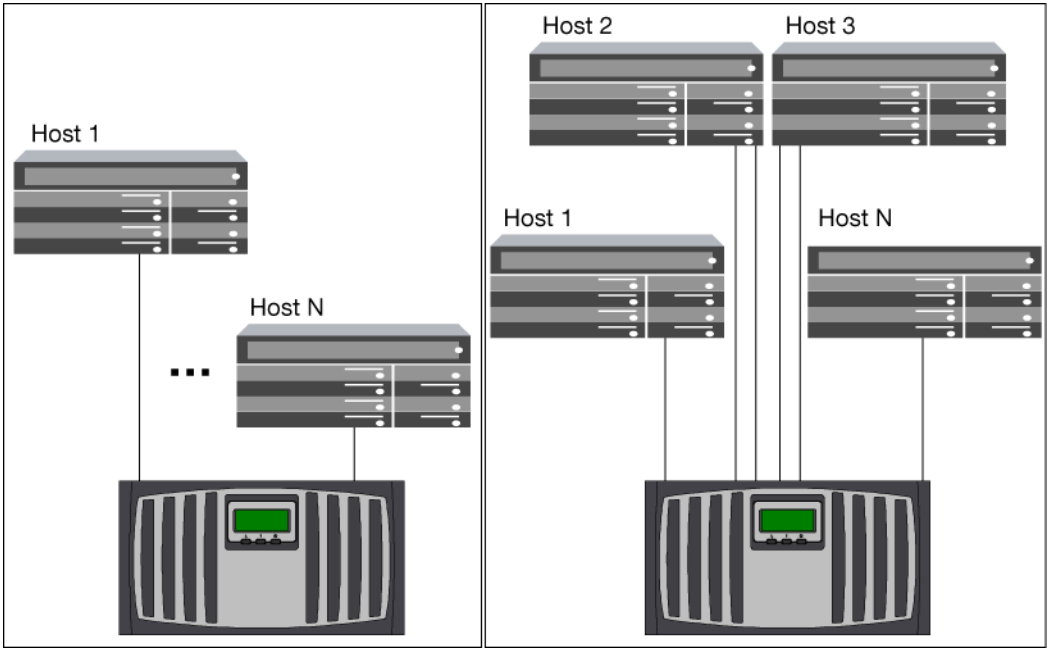

Figure 7: N7000 series direct-attached single-controller configuration

Attribute	Value
Fully redundant	No, due to the single controller
Type of fabric	None
Different host operating systems	Yes, with multiple-host configurations
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller One to the maximum number of supported 4-Gb or 8-Gb FC target expansion adapters
Type of configuration	Single-controller configuration

Related references

N7000 series target port configuration recommendations on page 21

N7000 series: Direct-attached active/active configuration

You can connect hosts directly to FC target ports on both controllers in an active/active configuration. The number of hosts is limited by the number of available target ports.

If you use multiple paths to a LUN, multipathing software is required on the host.

Direct-attached configurations typically need the FC ports set to loop mode. Be sure to follow the recommendation of your host operating system provider for FC port settings. You can use the Data ONTAP `fcp config mediatype` command to set the target ports.

Note: The FC target port numbers in the following figure are examples. The actual port numbers might vary depending on whether you are using onboard ports or FC target expansion adapters. If you are using FC target expansion adapters, the target port numbers also depend on the expansion slots into which your target expansion adapters are installed.

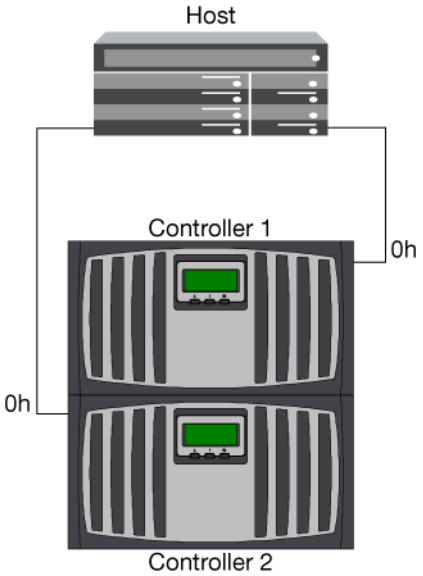

Figure 8: N7000 series direct-attached active/active configuration

Attribute	Value
Fully redundant	Yes
Type of fabric	None
Different host operating systems	Yes, with multiple-host configurations
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller One to the maximum number of supported 4-Gb or 8-Gb FC target expansion adapters
Type of configuration	Active/active configuration

Related references

N7000 series target port configuration recommendations on page 21

N6200 series supported topologies

N6200 series systems are available in single-controller and active/active configurations.

The N6200 series systems have two onboard 4-Gb FC ports per controller that can be configured as FC target ports. There are also two SAS ports for connecting disk shelves.

Each N6200 series controller supports 4-Gb and 8-Gb FC target expansion adapters.

N6200 series target port configuration recommendations

For best performance and highest availability, use the recommended FC target port configuration.

The following table shows the preferred port usage order for N6200 series onboard FC target ports. For target expansion adapters, the preferred slot order is given in the appropriate hardware and service guide and the N series Interoperability Matrices website at *www.ibm.com/systems/storage/network/interophome.html* for the version of Data ONTAP software being used by the controllers.

Number of target ports	Ports
1	0c
2	0c, 0d

N6200 series: Single-fabric single-controller configuration

You can connect hosts to a single controller using a single FC switch.

If you use multiple paths to a LUN, multipathing software is required on the host. FC switch zoning is recommended to limit the number of paths between hosts and LUNs in configurations with multiple target ports connected to the same fabric.

Note: The FC target port numbers in the following figure are examples. The actual port numbers might vary depending on whether you are using onboard ports or FC target expansion adapters. If you are using FC target expansion adapters, the target port numbers also depend on the expansion slots into which your target expansion adapters are installed.

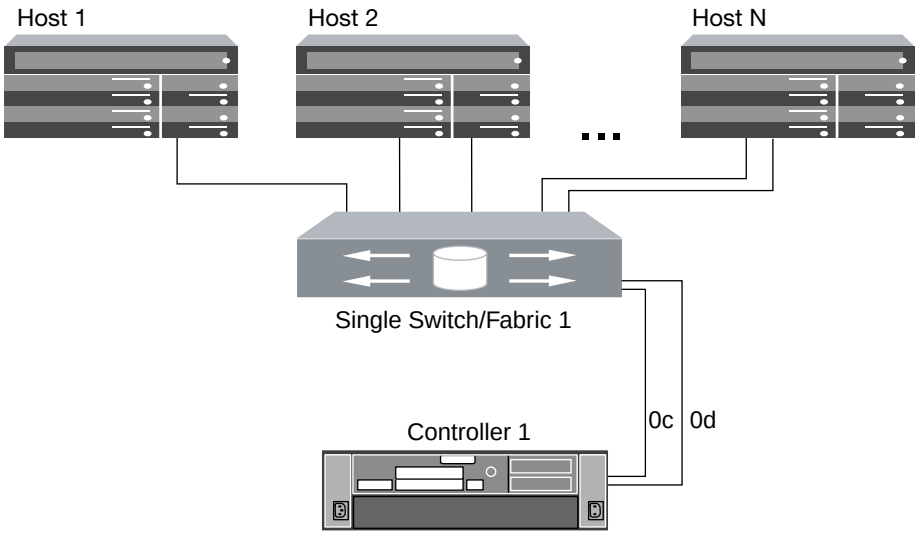

Figure 9: N6200 series single-fabric single-controller configuration

Attribute	Value
Fully redundant	No, due to the single fabric and single controller
Type of fabric	Single fabric
Different host operating systems	Yes, with multiple-host configurations
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller One to the maximum number of supported 4-Gb or 8-Gb FC target expansion adapters
Type of configuration	Single-controller configuration

N6200 series: Single-fabric active/active configurations

You can connect hosts to both controllers in an active/active configuration using a single FC switch.

If you use multiple paths to a LUN, multipathing software is required on the host. FC switch zoning is recommended to limit the number of paths between hosts and LUNs in configurations with multiple target ports connected to the same fabric.

Note: The FC target port numbers in the following figure are examples. The actual port numbers might vary depending on whether you are using onboard ports or FC target expansion adapters. If you are using FC target expansion adapters, the target port numbers also depend on the expansion slots into which your target expansion adapters are installed.

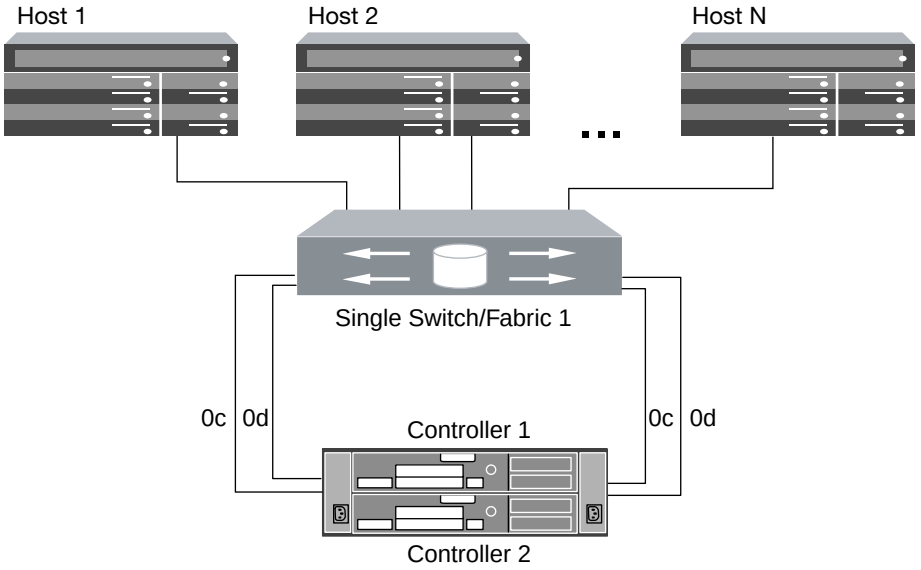

Figure 10: N6200 series single-fabric active/active configuration

Attribute	Value
Fully redundant	No, due to the single fabric
Type of fabric	Single fabric
Different host operating systems	Yes, with multiple-host configurations
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller One to the maximum number of supported 4-Gb or 8-Gb FC target expansion adapters
Type of configuration	active/active configuration

N6200 series: Multifabric active/active configurations

You can connect hosts to both controllers in an active/active configuration using two or more FC switch fabrics for redundancy.

If you use multiple paths to a LUN, multipathing software is required on the host. FC switch zoning is recommended to limit the number of paths between hosts and LUNs in configurations with multiple target ports connected to the same fabric.

Note: The FC target port numbers in the following figure are examples. The actual port numbers might vary depending on whether you are using onboard ports or FC target expansion adapters. If you are using FC target expansion adapters, the target port numbers also depend on the expansion slots into which your target expansion adapters are installed.

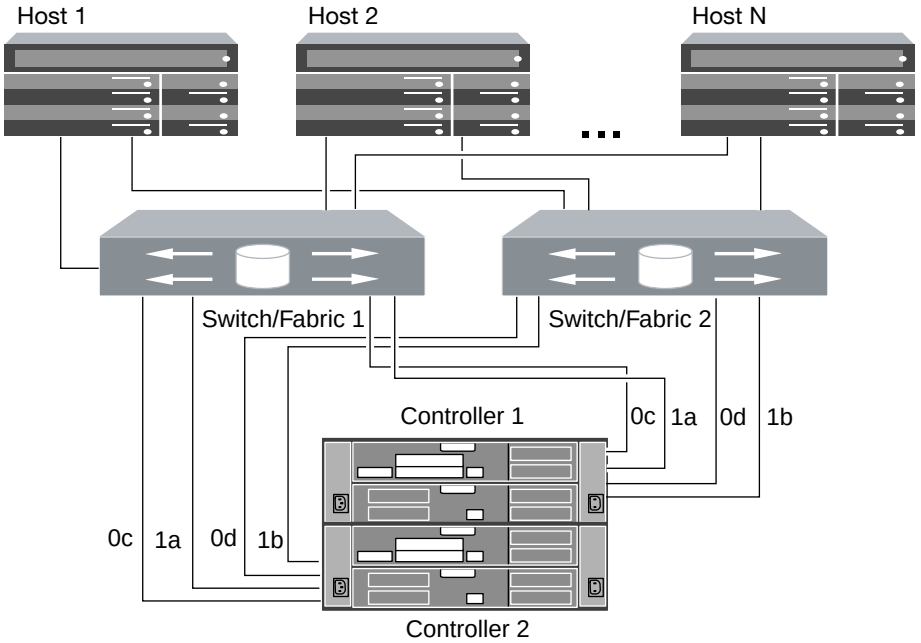

Figure 11: N6200 series multifabric active/active configuration

Attribute	Value
Fully redundant	Yes
Type of fabric	Multifabric
Different host operating systems	Yes, with multiple-host configurations
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller One to the maximum number of supported 4-Gb or 8-Gb FC target expansion adapters
Type of configuration	active/active configuration

N6200 series: Direct-attached single-controller configurations

You can connect hosts directly to FC target ports on a single controller. Each host can connect to one port, or to two ports for redundancy. The number of hosts is limited by the number of available target ports.

If you use multiple paths to a LUN, multipathing software is required on the host.

Direct-attached configurations typically need the FC ports set to loop mode. Be sure to follow the recommendation of your host operating system provider for FC port settings. You can use the Data ONTAP `fcp config mediatype` command to set the target ports.

Note: The FC target port numbers in the following figure are examples. The actual port numbers might vary depending on whether you are using onboard ports or FC target expansion adapters. If you are using FC target expansion adapters, the target port numbers also depend on the expansion slots into which your target expansion adapters are installed.

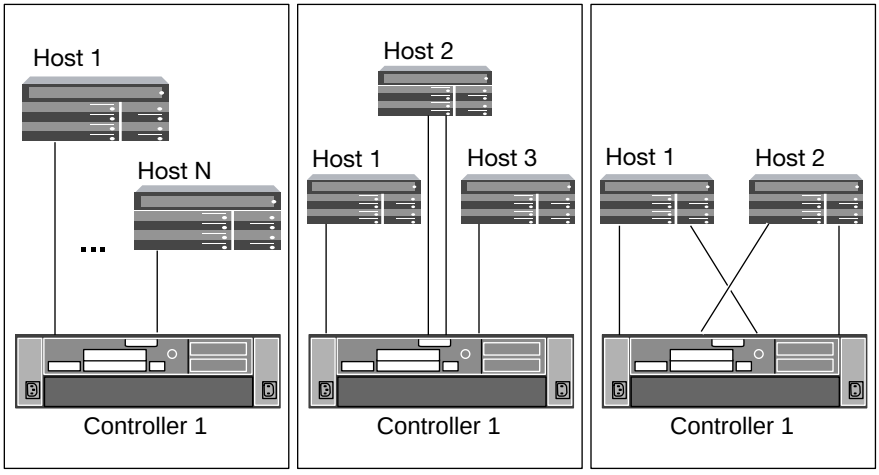

Figure 12: N6200 series direct-attached single-controller configurations

Attribute	Value
Fully redundant	No, due to the single controller
Type of fabric	None
Different host operating systems	Yes, with multiple-host configurations
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller One to the maximum number of supported 4-Gb or 8-Gb FC target expansion adapters
Type of configuration	Single-controller configuration

N6200 series: Direct-attached active/active configurations

You can connect hosts directly to FC target ports on both controllers in an active/active configuration. The number of hosts is limited by the number of available target ports.

If you use multiple paths to a LUN, multipathing software is required on the host.

Direct-attached configurations typically need the FC ports set to loop mode. Be sure to follow the recommendation of your host operating system provider for FC port settings. You can use the Data ONTAP `fcp config mediatype` command to set the target ports.

Note: The FC target port numbers in the following figure are examples. The actual port numbers might vary depending on whether you are using onboard ports or FC target expansion adapters. If you are using FC target expansion adapters, the target port numbers also depend on the expansion slots into which your target expansion adapters are installed.

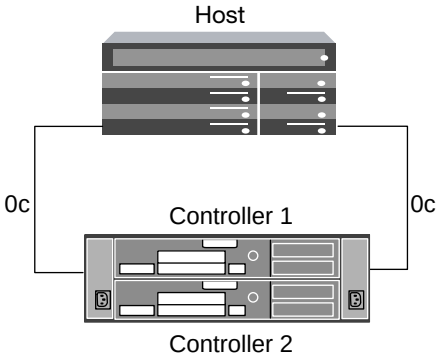

Figure 13: N6200 series direct-attached active/active configuration

Attribute	Value
Fully redundant	Yes
Type of fabric	None
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller One to the maximum number of supported 4-Gb or 8-Gb FC target expansion adapters
Type of configuration	Active/active configuration

N6000 series supported topologies

N6000 series systems are available in single-controller and active/active configurations.

The N6000 series systems have four onboard 4-Gb FC ports per controller and each port can be configured as either an FC target port or an initiator port. For example, you can configure two ports as SAN targets and two ports as initiators for disk shelves.

Each N6000 series controller supports 4-Gb FC target expansion adapters.

The N6000 series systems are only supported by single_image cfmode.

Note: N6000 series controllers support the use of 8-Gb target expansion adapters beginning with Data ONTAP 7.3.1.

N6000 series target port configuration recommendations

For best performance and highest availability, use the recommended FC target port configuration.

The port pairs on a N6000 series controller that share an ASIC are 0a+0b and 0c+0d.

The following table shows the preferred port usage order for onboard FC target ports. For target expansion adapters, the preferred slot order is given in the appropriate hardware and service guide and the N series Interoperability Matrices website at *www.ibm.com/systems/storage/network/interophome.html* for the version of Data ONTAP software being used by the controllers.

Number of target ports	Ports
1	0d
2	0d, 0b
3	0d, 0b, 0c
4	0d, 0b, 0c, 0a

N6000 series: Single-fabric single-controller configuration

You can connect hosts to a single controller using a single FC switch. If you use multiple paths, multipathing software is required on the host.

FC switch zoning is recommended to limit the number of paths between hosts and LUNs in configurations with multiple target ports connected to the same fabric.

Note: The FC target port numbers in the following figure are examples. The actual port numbers might vary depending on whether you are using onboard ports or FC target expansion adapters. If you are using FC target expansion adapters, the target port numbers also depend on the expansion slots into which your target expansion adapters are installed.

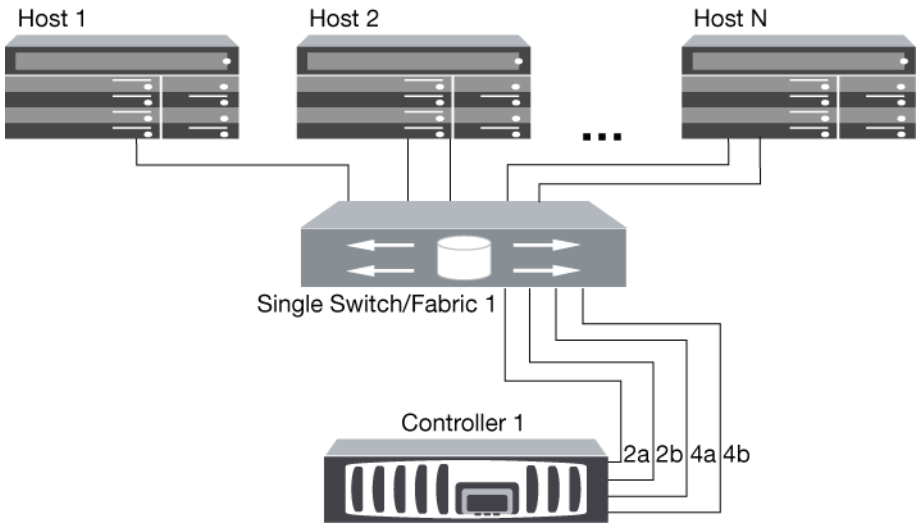

Figure 14: N6000 series single-fabric single-controller configuration

Attribute	Value
Fully redundant	No, due to the single fabric and single controller
Type of fabric	Single fabric
Different host operating systems	Yes, with multiple-host configurations
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller One to the maximum number of supported 4-Gb or 8-Gb FC target expansion adapters
Type of configuration	Single-controller configuration

Related references

N6000 series target port configuration recommendations on page 35

N6000 series: Single-fabric active/active configuration

You can connect hosts to both controllers in an active/active configuration using a single FC switch.

If you use multiple paths to a LUN, multipathing software is required on the host. FC switch zoning is recommended to limit the number of paths between hosts and LUNs in configurations with multiple target ports connected to the same fabric.

Note: The FC target port numbers in the following figure are examples. The actual port numbers might vary depending on whether you are using onboard ports or FC target expansion adapters. If

you are using FC target expansion adapters, the target port numbers also depend on the expansion slots into which your target expansion adapters are installed.

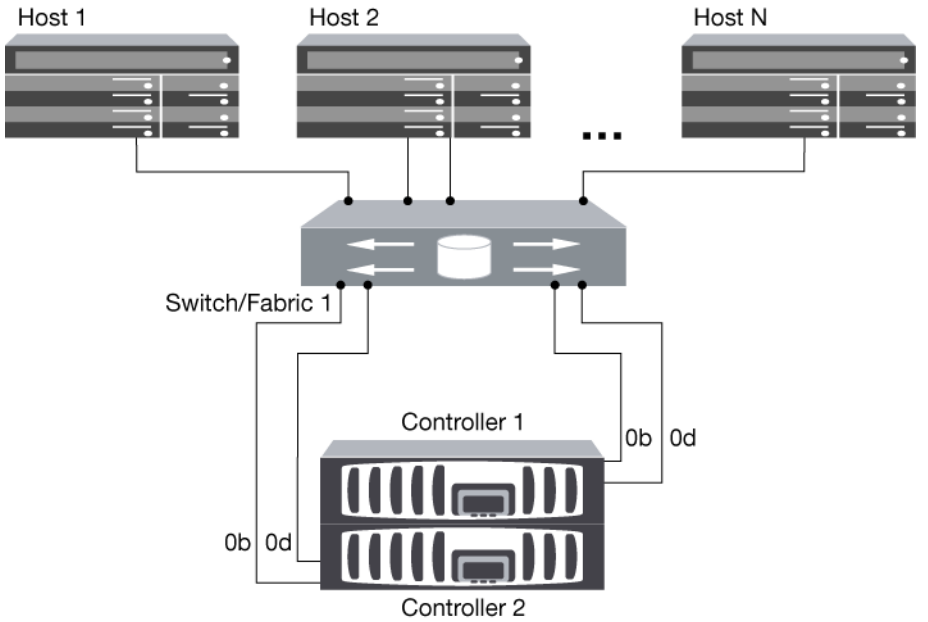

Figure 15: N6000 series single-fabric active/active configuration

Attribute	Value
Fully redundant	No, due to the single fabric
Type of fabric	Single fabric
Different host operating systems	Yes, with multiple-host configurations
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller One to the maximum number of supported 4-Gb or 8-Gb FC target expansion adapters
Type of configuration	Active/active configuration

Related references

N6000 series target port configuration recommendations on page 35

N6000 series: Multifabric active/active configuration

You can connect hosts to both controllers in an active/active configuration using two or more FC switch fabrics for redundancy.

If you use multiple paths to a LUN, multipathing software is required on the host. FC switch zoning is recommended to limit the number of paths between hosts and LUNs in configurations with multiple target ports connected to the same fabric.

Note: The FC target port numbers in the following figure are examples. The actual port numbers might vary depending on whether you are using onboard ports or FC target expansion adapters. If you are using FC target expansion adapters, the target port numbers also depend on the expansion slots into which your target expansion adapters are installed.

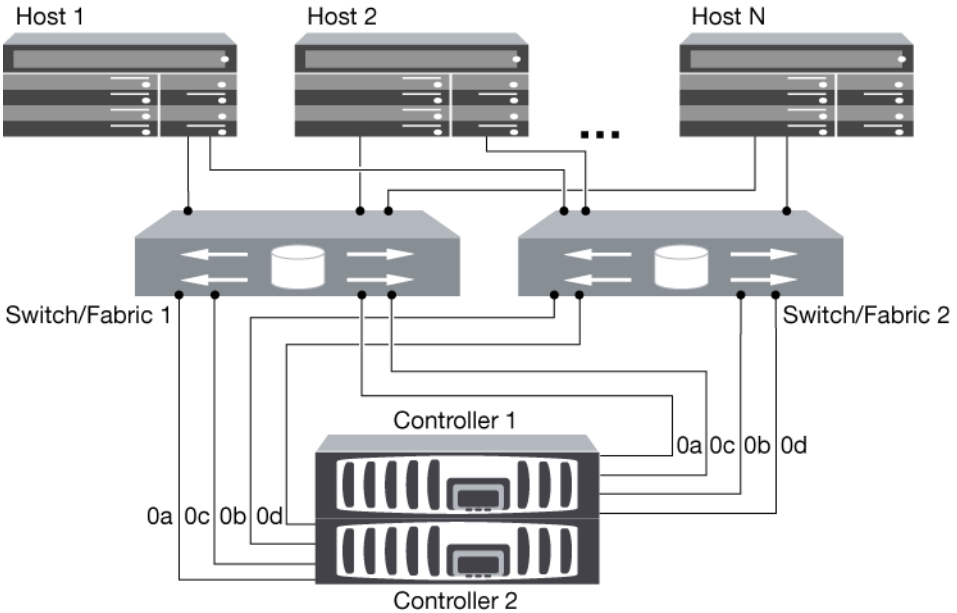

Figure 16: N6000 series multifabric active/active configuration

Attribute	Value
Fully redundant	Yes
Type of fabric	Multifabric
Different host operating systems	Yes, with multiple-host configurations

Attribute	Value
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller One to the maximum number of supported 4-Gb or 8-Gb FC target expansion adapters
Type of configuration	Active/active configuration

Related references

N6000 series target port configuration recommendations on page 35

N6000 series: Direct-attached single-controller configurations

You can connect hosts directly to FC target ports on a single controller. Each host can connect to one port, or to two ports for redundancy. The number of hosts is limited by the number of available target ports.

If you use multiple paths to a LUN, multipathing software is required on the host.

Direct-attached configurations typically need the FC ports set to loop mode. Be sure to follow the recommendation of your host operating system provider for FC port settings. You can use the Data ONTAP `fcp config mediatype` command to set the target ports.

Note: The FC target port numbers in the following figure are examples. The actual port numbers might vary depending on whether you are using onboard ports or FC target expansion adapters. If you are using FC target expansion adapters, the target port numbers also depend on the expansion slots into which your target expansion adapters are installed.

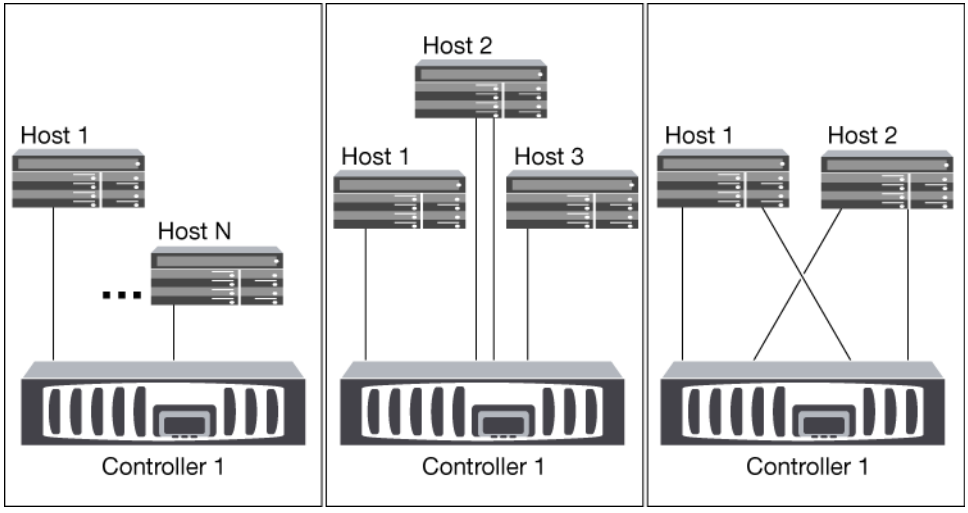

Figure 17: N6000 series direct-attached single-controller configurations

Attribute	Value
Fully redundant	No, due to the single controller
Type of fabric	None
Different host operating systems	Yes, with multiple-host configurations
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller One to the maximum number of supported 4-Gb or 8-Gb FC target expansion adapters
Type of configuration	Single-controller configuration

Related references

N6000 series target port configuration recommendations on page 35

N6000 series: Direct-attached active/active configuration

You can connect hosts directly to FC target ports on both controllers in an active/active configuration. The number of hosts is limited by the number of available target ports.

If you use multiple paths to a LUN, multipathing software is required on the host.

Direct-attached configurations typically need the FC ports set to loop mode. Be sure to follow the recommendation of your host operating system provider for FC port settings. You can use the Data ONTAP `fcp config mediatype` command to set the target ports.

Note: The FC target port numbers in the following figure are examples. The actual port numbers might vary depending on whether you are using onboard ports or FC target expansion adapters. If you are using FC target expansion adapters, the target port numbers also depend on the expansion slots into which your target expansion adapters are installed.

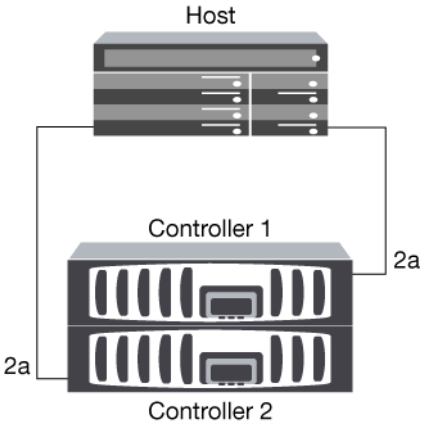

Figure 18: N6000 series direct-attached active/active configuration

Attribute	Value
Fully redundant	Yes
Type of fabric	None
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller One to the maximum number of supported 4-Gb or 8-Gb FC target expansion adapters
Type of configuration	Active/active configuration

Related references

N6000 series target port configuration recommendations on page 35

N5000 series supported topologies

N5000 series systems are available in single-controller and active/active configurations.

Note: N5300 and N5600 controllers support the use of 8-Gb target expansion adapters beginning with Data ONTAP 7.3.1. N5200 and N5500 controllers do not support the use of 8-Gb target expansion adapters.

N5200 and N5500 controllers support 2-Gb or 4-Gb FC target connections, but you cannot use both on the same controller or on two different controllers in an active/active configuration. If you use target expansion adapters, then you can only use onboard adapters as initiators.

Only single_image cfmode is supported with new installations of the Data ONTAP 7.3 release family software. For N5200 and N5500 controllers running partner or standby cfmode with earlier versions

of Data ONTAP, those cfmodes continue to be supported when upgrading the controllers to Data ONTAP 7.3. However, converting to single_image cfmode is recommended.

N5000 series target port configuration recommendations

For best performance and highest availability, use the recommended FC target port configuration.

The port pairs on a N5000 series controller that share an ASIC are 0a+0b, 0c+0d.

The following table shows the preferred port usage order for onboard FC target ports. For target expansion adapters, the preferred slot order is given in the appropriate hardware and service guide and the N series Interoperability Matrices website at *www.ibm.com/systems/storage/network/interophome.html* for the version of Data ONTAP software being used by the controllers.

Number of target ports	Ports
1	0d
2	0d, 0b
3	0d, 0b, 0c
4	0d, 0b, 0c, 0a

N5300 and N5600 supported topologies

N5300 and N5600 systems are available in single-controller and active/active configurations.

The N5300 and N5600 controllers have four onboard 4-Gb FC ports per controller and each port can be configured as either an FC target port or an initiator port. For example, you can configure two ports as SAN targets and two ports as initiators for disk shelves.

N5300 and N5600: Single-fabric single-controller configuration

You can connect hosts to single controllers using a single FC switch. If you use multiple paths, multipathing software is required on the host.

FC switch zoning is recommended to limit the number of paths between hosts and LUNs in configurations with multiple target ports connected to the same fabric.

Note: The FC target port numbers in the following figure are examples. The actual port numbers might vary depending on whether you are using onboard ports or FC target expansion adapters. If you are using FC target expansion adapters, the target port numbers also depend on the expansion slots into which your target expansion adapters are installed.

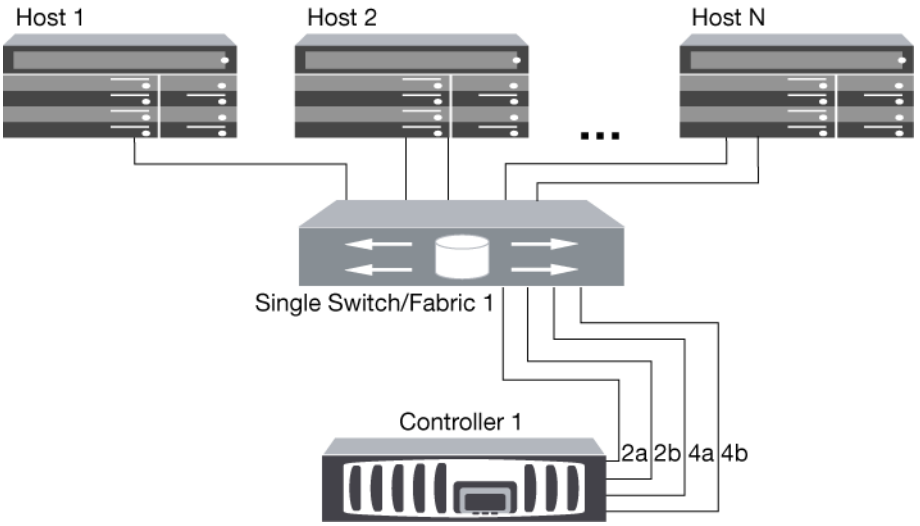

Figure 19: N5300 and N5600 single-fabric single-controller configuration

Attribute	Value
Fully redundant	No, due to the single fabric and single controller
Type of fabric	Single fabric
Different host operating systems	Yes, with multiple-host configurations
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller One to the maximum number of supported 4-Gb or 8-Gb FC target expansion adapters
Type of configuration	Single-controller configuration

Related references

N5000 series target port configuration recommendations on page 42

N5300 and N5600: Single-fabric active/active configuration

You can connect hosts to both controllers in an active/active configuration using a single FC switch.

If you use multiple paths to a LUN, multipathing software is required on the host. FC switch zoning is recommended to limit the number of paths between hosts and LUNs in configurations with multiple target ports connected to the same fabric.

Note: The FC target port numbers in the following figure are examples. The actual port numbers might vary depending on whether you are using onboard ports or FC target expansion adapters. If

you are using FC target expansion adapters, the target port numbers also depend on the expansion slots into which your target expansion adapters are installed.

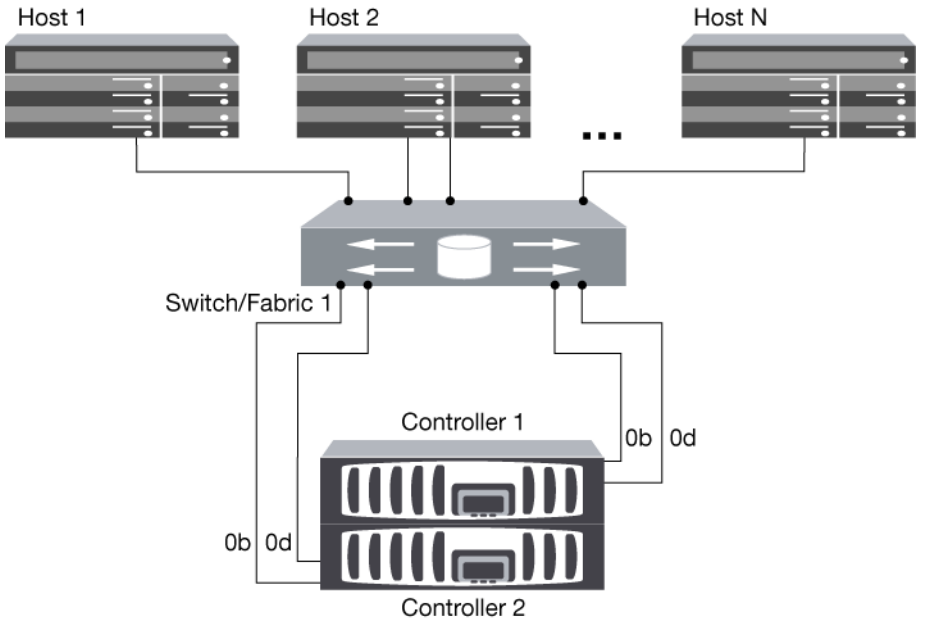

Figure 20: N5300 and N5600 single-fabric active/active configuration

Attribute	Value
Fully redundant	No, due to the single fabric
Type of fabric	Single fabric
Different host operating systems	Yes, with multiple-host configurations
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller One to the maximum number of supported 4-Gb or 8-Gb FC ports using target expansion adapters per controller
Type of configuration	Active/active configuration

Related references

N5000 series target port configuration recommendations on page 42

N5300 and N5600: Multifabric active/active configuration

You can connect hosts to both controllers in an active/active configuration using two or more FC switch fabrics for redundancy.

If you use multiple paths to a LUN, multipathing software is required on the host. FC switch zoning is recommended to limit the number of paths between hosts and LUNs in configurations with multiple target ports connected to the same fabric.

Note: The FC target port numbers in the following figure are examples. The actual port numbers might vary depending on whether you are using onboard ports or FC target expansion adapters. If you are using FC target expansion adapters, the target port numbers also depend on the expansion slots into which your target expansion adapters are installed.

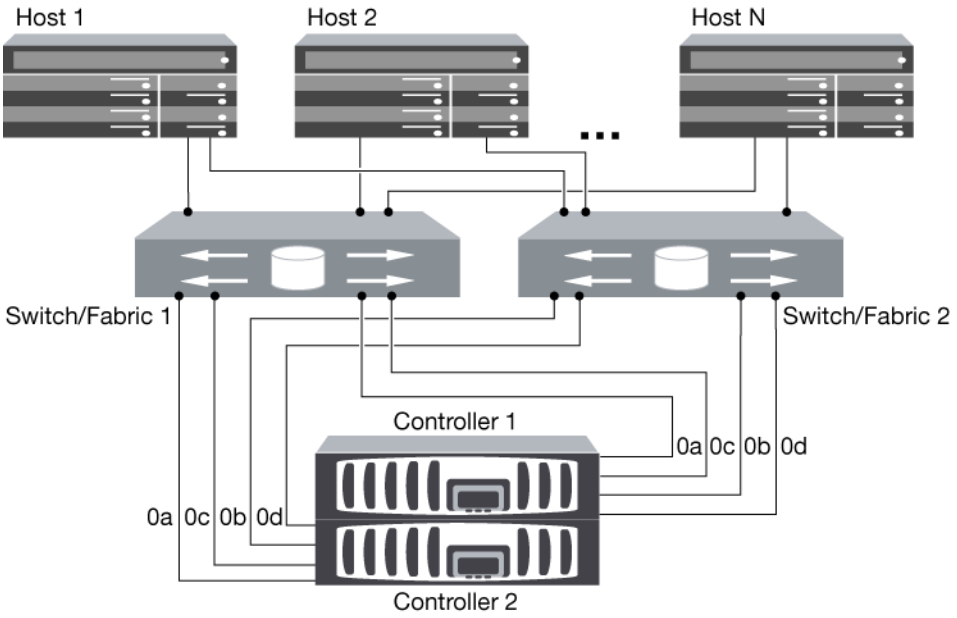

Figure 21: N5300 and N5600 multifabric active/active configuration

Attribute	Value
Fully redundant	Yes
Type of fabric	Multifabric
Different host operating systems	Yes, with multiple-host configurations

Attribute	Value
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller One to the maximum number of supported 4-Gb or 8-Gb FC ports using target expansion adapters per controller
Type of configuration	Active/active configuration

Related references

N5000 series target port configuration recommendations on page 42

N5300 and N5600: Direct-attached single-controller configurations

You can connect hosts directly to FC target ports on a single controller. Each host can connect to one port, or to two ports for redundancy. The number of hosts is limited by the number of available target ports.

If you use multiple paths to a LUN, multipathing software is required on the host.

Direct-attached configurations typically need the FC ports set to loop mode. Be sure to follow the recommendation of your host operating system provider for FC port settings. You can use the Data ONTAP `fcp config mediatype` command to set the target ports.

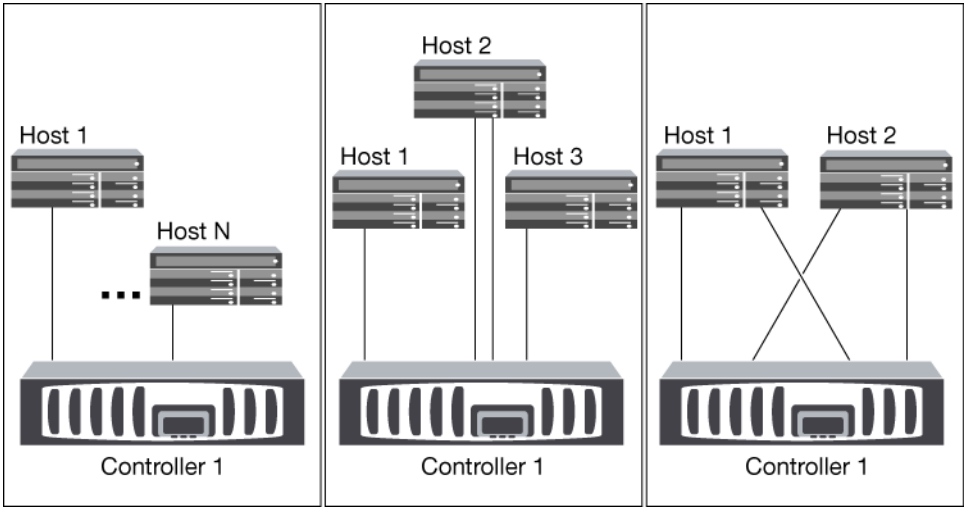

Figure 22: N5300 and N5600 direct-attached single-controller configurations

Attribute	Value
Fully redundant	No, due to the single controller
Type of fabric	None

Attribute	Value
Different host operating systems	Yes, with multiple-host configurations
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller One to the maximum number of supported 4-Gb or 8-Gb FC target expansion adapters
Type of configuration	Single-controller configuration

Related references

N5000 series target port configuration recommendations on page 42

N5300 and N5600: Direct-attached active/active configuration

You can connect hosts directly to FC target ports on both controllers in an active/active configuration. The number of hosts is limited by the number of available target ports.

If you use multiple paths to a LUN, multipathing software is required on the host.

Direct-attached configurations typically need the FC ports set to loop mode. Be sure to follow the recommendation of your host operating system provider for FC port settings. You can use the Data ONTAP `fcp config mediatype` command to set the target ports.

Note: The FC target port numbers in the following figure are examples. The actual port numbers might vary depending on whether you are using onboard ports or FC target expansion adapters. If you are using FC target expansion adapters, the target port numbers also depend on the expansion slots into which your target expansion adapters are installed.

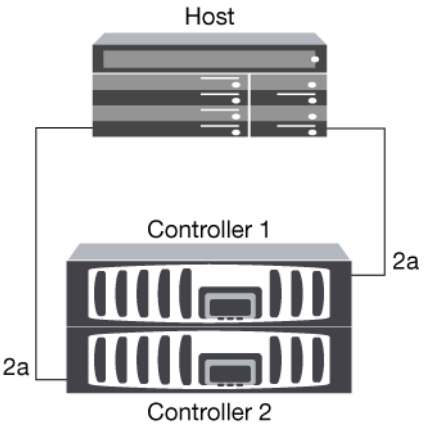

Figure 23: N5300 and N5600 direct-attached active/active configuration

Attribute	Value
Fully redundant	Yes
Type of fabric	None
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller One to the maximum number of supported 4-Gb or 8-Gb FC target expansion adapters
Type of configuration	Active/active configuration

Related references

N5000 series target port configuration recommendations on page 42

N5200 and N5500 supported topologies

N5200 and N5500 systems are available in single-controller and active/active configurations.

The N5200 and N5500 controllers have four onboard 2-Gb FC ports per controller and each port can be configured as either an FC target port or an initiator port.

2-Gb FC target ports are supported with the onboard 2-Gb FC ports on the N5200 and N5500 controllers. 4-Gb FC target connections are supported with 4-Gb FC target HBAs.

Each N5200 and N5500 controller supports 2-Gb or 4-Gb FC target HBAs, but you cannot use both on the same controller or on two different controllers in an active/active configuration. If you use target expansion HBAs, then you can only use onboard ports as initiators.

N5200 and N5500: Single-fabric single-controller configuration

You can connect hosts to single controllers using a single FC switch. If you use multiple paths, multipathing software is required on the host.

Note: The FC target port numbers in the following figure are examples. The actual port numbers might vary depending on whether you are using onboard ports or FC target expansion adapters. If you are using FC target expansion adapters, the target port numbers also depend on the expansion slots into which your target expansion adapters are installed.

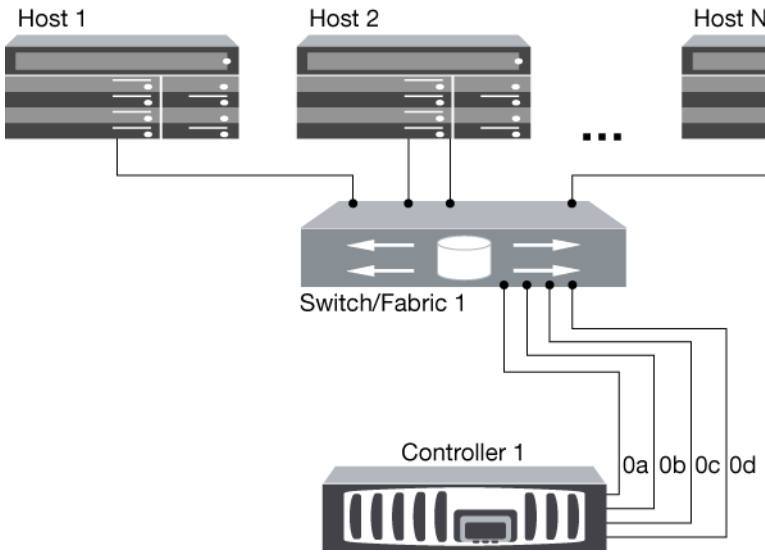

Figure 24: N5200 and N5500 single-fabric single-controller configuration

Attribute	Value
Fully redundant	No, due to the single fabric and single controller
Type of fabric	Single fabric
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller One to the maximum number of supported 2-Gb or 4-Gb FC target expansion adapters
Type of configuration	Single-controller configuration

Related references

N5000 series target port configuration recommendations on page 42

N5200 and N5500: Single-fabric active/active configuration

You can connect hosts to both controllers in an active/active configuration using a single FC switch.

Note: The FC target port numbers in the following figure are examples. The actual port numbers might vary depending on whether you are using onboard ports or FC target expansion adapters. If you are using FC target expansion adapters, the target port numbers also depend on the expansion slots into which your target expansion adapters are installed.

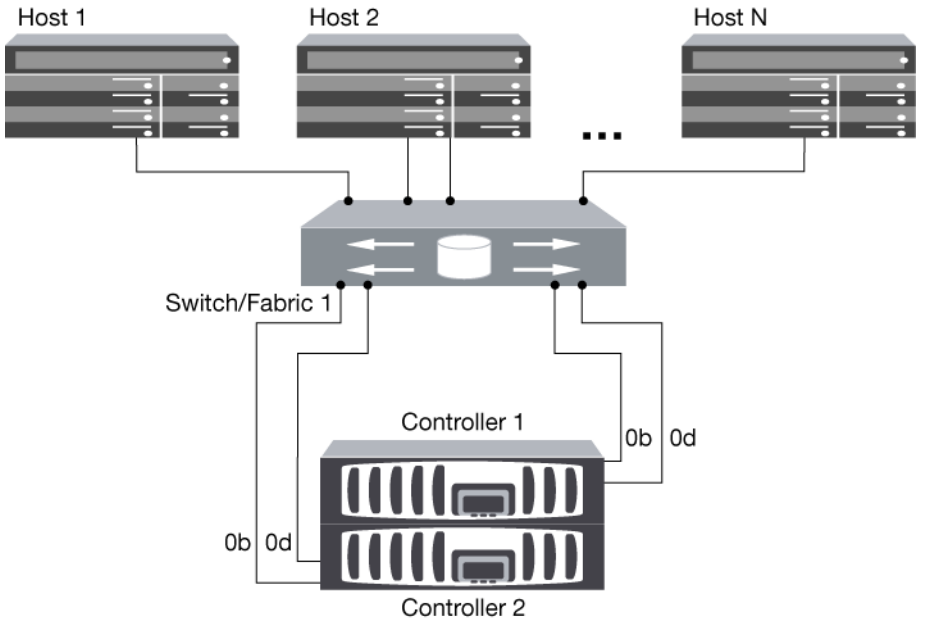

Figure 25: N5200 and N5500 single-fabric active/active configuration

Attribute	Value
Fully redundant	No, due to the single fabric
Type of fabric	Single fabric
Different host operating systems	Yes, with multiple-host configurations
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller One to the maximum number of supported 2-Gb or 4-Gb FC ports using target expansion adapters per controller
Type of configuration	Active/active configuration

Related references

N5000 series target port configuration recommendations on page 42

N5200 and N5500: Multifabric active/active configuration

You can connect hosts to both controllers in an active/active configuration using two or more FC switch fabrics for redundancy.

Note: The FC target port numbers in the following figure are examples. The actual port numbers might vary depending on whether you are using onboard ports or FC target expansion adapters. If

you are using FC target expansion adapters, the target port numbers also depend on the expansion slots into which your target expansion adapters are installed.

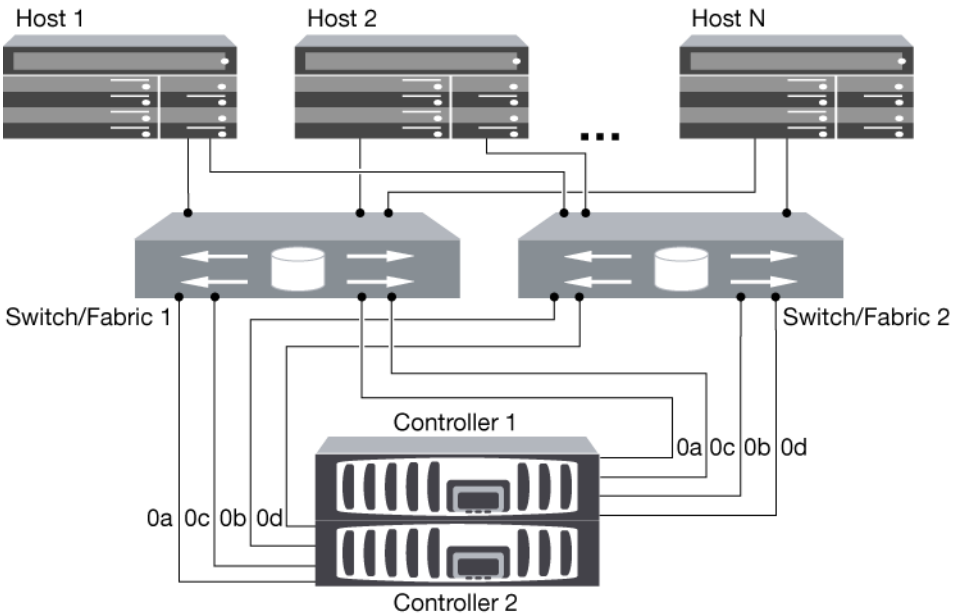

Figure 26: N5200 and N5500 multifabric active/active configuration

Attribute	Value
Fully redundant	Yes
Type of fabric	Multifabric
Different host operating systems	Yes, with multiple-host configurations
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller One to the maximum number of supported 2-Gb or 4-Gb FC ports using target expansion adapters per controller
Type of configuration	Active/active configuration

Related references

N5000 series target port configuration recommendations on page 42

N5200 and N5500: Direct-attached single-controller configurations

You can connect hosts directly to FC target ports on a single controller. Each host can connect to one port, or to two ports for redundancy. The number of hosts is limited by the number of available target ports.

Direct-attached configurations typically need the FC ports set to loop mode. Be sure to follow the recommendation of your host operating system provider for FC port settings. You can use the Data ONTAP `fcp config mediatype` command to set the target ports.

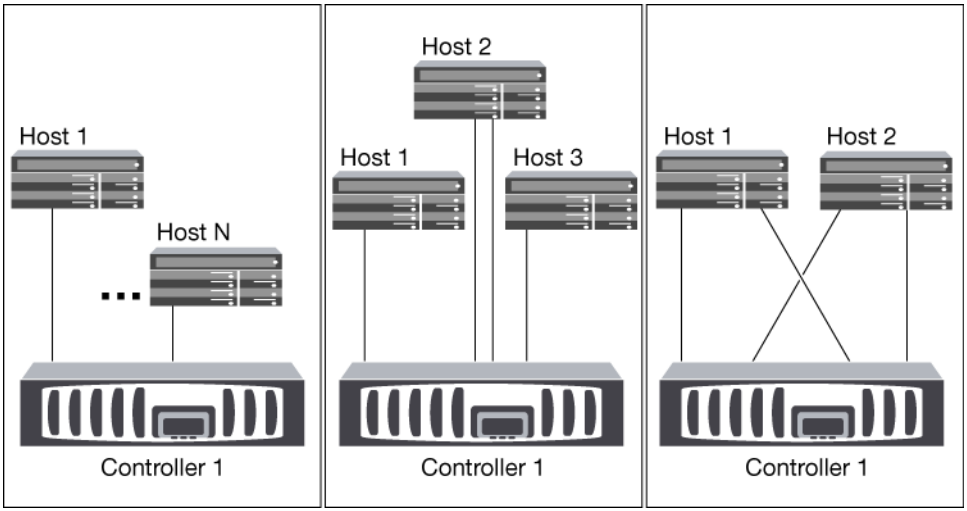

Figure 27: N5200 and N5500 direct-attached single-controller configurations

Attribute	Value
Fully redundant	No, due to the single controller
Type of fabric	None
Different host operating systems	Yes, with multiple-host configurations
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller One to the maximum number of supported 2-Gb or 4-Gb FC target expansion adapters
Type of configuration	Single-controller configuration

Related references

N5000 series target port configuration recommendations on page 42

N5200 and N5500: Direct-attached active/active configuration

You can connect hosts directly to FC target ports on both controllers in an active/active configuration. The number of hosts is limited by the number of available target ports.

Direct-attached configurations typically need the FC ports set to loop mode. Be sure to follow the recommendation of your host operating system provider for FC port settings. You can use the Data ONTAP `fcp config mediatype` command to set the target ports.

Note: The FC target port numbers in the following figure are examples. The actual port numbers might vary depending on whether you are using onboard ports or FC target expansion adapters. If you are using FC target expansion adapters, the target port numbers also depend on the expansion slots into which your target expansion adapters are installed.

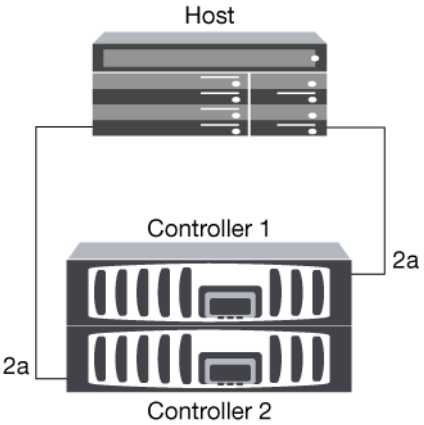

Figure 28: N5200 and N5500 direct-attached active/active configuration

Attribute	Value
Fully redundant	Yes, if configured with multipathing software
Type of fabric	None
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller One to the maximum number of supported 2-Gb or 4-Gb FC target expansion adapters
Type of configuration	Active/active configuration

Related references

N5000 series target port configuration recommendations on page 42

N3300, N3400, and N3600 supported topologies

N3300, N3400, and N3600 systems are available in single-controller and active/active configurations and are supported by single_image cfmode only.

The N3300, N3400, and N3600 have two onboard 4-Gb FC ports per controller. You can configure these ports as either target ports for FC SANs or initiator ports for connecting to disk shelves.

N3300, N3400, and N3600: Single-fabric single-controller configuration

You can connect hosts to a single controller using a single FC switch. If you use multiple paths, multipathing software is required on the host.

FC switch zoning is recommended to limit the number of paths between hosts and LUNs in configurations with multiple target ports connected to the same fabric.

Note: The FC target port numbers in the following illustration are examples. The actual port numbers might vary depending on whether you are using onboard ports or an FC target expansion adapter. The FC target expansion adapter is supported only for the N3600 controller.

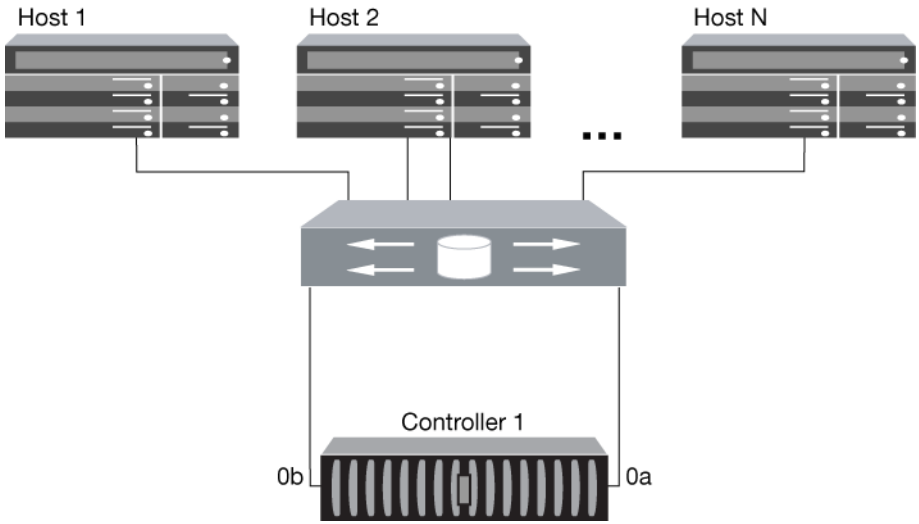

Figure 29: N3300, N3400, and N3600 single-fabric single-controller configuration

Attribute	Value
Fully redundant	No, due to the single fabric and single controller
Type of fabric	Single fabric
Different host operating systems	Yes, with multiple-host configurations

Attribute	Value
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller For N3600 only, one supported 4-Gb or 8-Gb FC target expansion adapter
Type of configuration	Single-controller configuration

N3300, N3400, and N3600: Single-fabric active/active configuration

You can connect hosts to both controllers in an active/active configuration using a single FC switch.

If you use multiple paths to a LUN, multipathing software is required on the host. FC switch zoning is recommended to limit the number of paths between hosts and LUNs in configurations with multiple target ports connected to the same fabric.

Note: The FC target port numbers in the following illustration are examples. The actual port numbers might vary depending on whether you are using onboard ports or an FC target expansion adapter. The FC target expansion adapter is supported only for the N3600 controller.

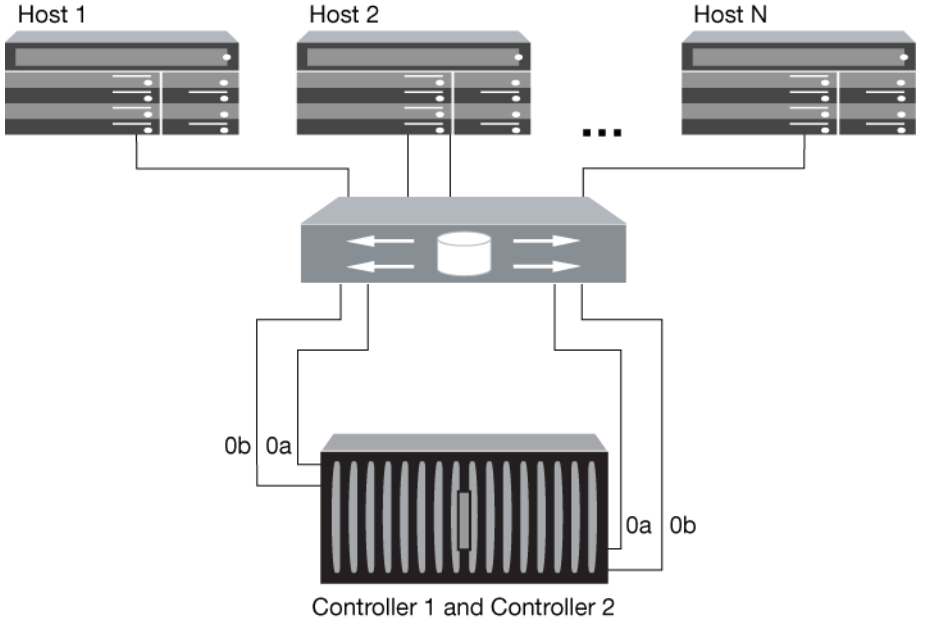

Figure 30: N3300, N3400, and N3600 single-fabric active/active configuration

Attribute	Value
Fully redundant	No, due to the single fabric
Type of fabric	Single fabric

Attribute	Value
Different host operating systems	Yes, with multiple-host configurations
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller For N3600 only, one supported 4-Gb or 8-Gb FC target expansion adapter
Type of configuration	Active/active configuration

N3300, N3400, and N3600: Multifabric single-controller configuration

You can connect hosts to one controller using two or more FC switch fabrics for redundancy.

If you use multiple paths to a LUN, multipathing software is required on the host. FC switch zoning is recommended to limit the number of paths between hosts and LUNs in configurations with multiple target ports connected to the same fabric.

Note: The FC target port numbers in the following illustration are examples. The actual port numbers might vary depending on whether you are using onboard ports or an FC target expansion adapter. The FC target expansion adapter is supported only for the N3600 controller.

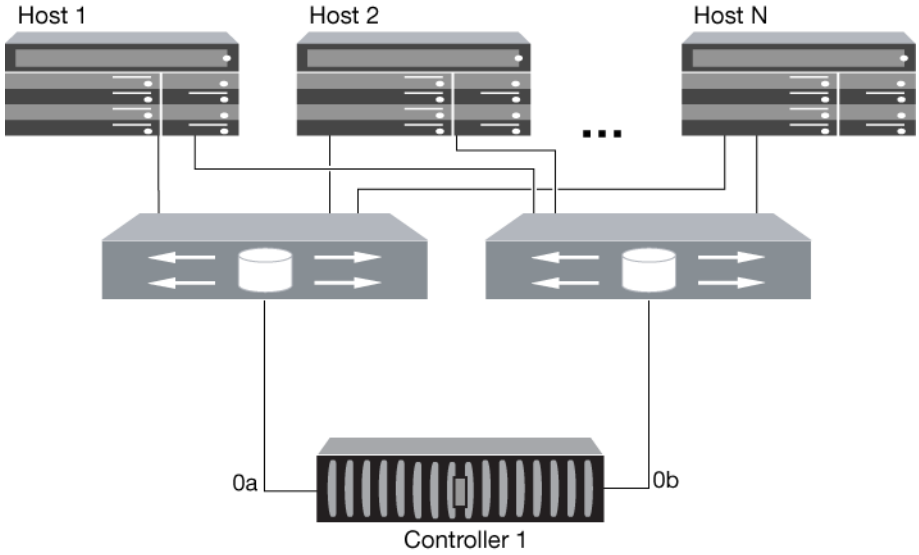

Figure 31: N3300, N3400, and N3600 multifabric single-controller configuration

Attribute	Value
Fully redundant	No, due to the single controller
Type of fabric	Multifabric

Attribute	Value
Different host operating systems	Yes, with multiple-host configurations
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller For N3600 only, one supported 4-Gb or 8-Gb FC target expansion adapter
Type of configuration	Single-controller configuration

N3300, N3400, and N3600: Multifabric active/active configuration

You can connect hosts to both controllers in an active/active configuration using two or more FC switch fabrics for redundancy.

If you use multiple paths to a LUN, multipathing software is required on the host. FC switch zoning is recommended to limit the number of paths between hosts and LUNs in configurations with multiple target ports connected to the same fabric.

Note: The FC target port numbers in the following illustration are examples. The actual port numbers might vary depending on whether you are using onboard ports or an FC target expansion adapter. The FC target expansion adapter is supported only for the N3600 controller.

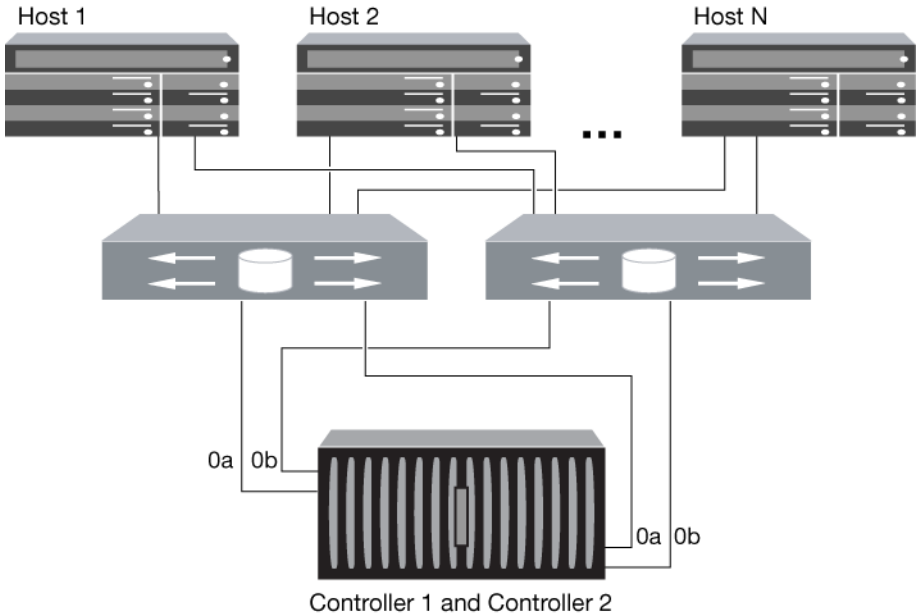

Figure 32: N3300, N3400, and N3600 multifabric active/active configuration

Attribute	Value
Fully redundant	Yes
Type of fabric	Multifabric
Different host operating systems	Yes, with multiple-host configurations
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller For N3600 only, one supported 4-Gb or 8-Gb FC target expansion adapter
Type of configuration	Active/active configuration

N3300, N3400, and N3600: Direct-attached single-controller configurations

You can connect hosts directly to FC target ports on a single controller. Each host can connect to one port, or to two ports for redundancy. The number of hosts is limited by the number of available target ports.

If you use multiple paths to a LUN, multipathing software is required on the host.

Direct-attached configurations typically need the FC ports set to loop mode. Be sure to follow the recommendation of your host operating system provider for FC port settings. You can use the Data ONTAP `fcp config mediatype` command to set the target ports.

Note: The FC target port numbers in the following illustration are examples. The actual port numbers might vary depending on whether you are using onboard ports or an FC target expansion adapter. The FC target expansion adapter is supported only for the N3600 controller.

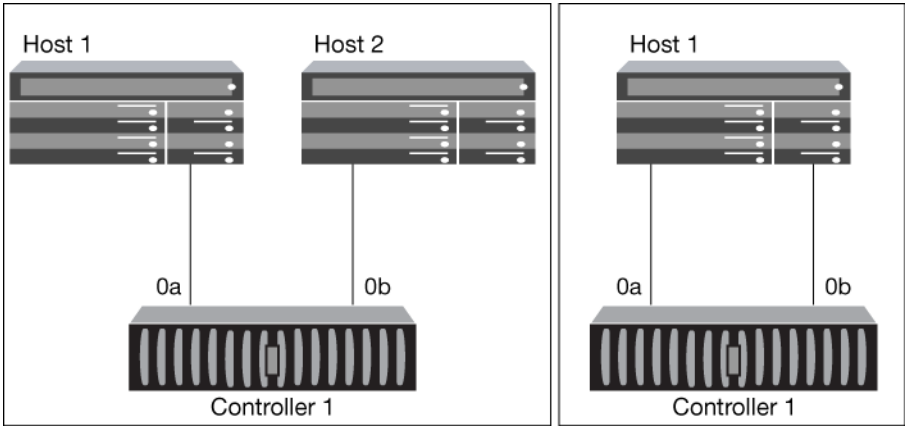

Figure 33: N3300, N3400, and N3600 direct-attached single-controller configurations

Attribute	Value
Fully redundant	No, due to the single controller
Type of fabric	None
Different host operating systems	Yes, with multiple-host configurations
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller For N3600 only, one supported 4-Gb or 8-Gb FC target expansion adapter
Type of configuration	Single-controller configuration

N3300, N3400, and N3600: Direct-attached active/active configuration

You can connect hosts directly to FC target ports on both controllers in an active/active configuration. The number of hosts is limited by the number of available target ports.

If you use multiple paths to a LUN, multipathing software is required on the host.

Direct-attached configurations typically need the FC ports set to loop mode. Be sure to follow the recommendation of your host operating system provider for FC port settings. You can use the Data ONTAP `fcp config mediatype` command to set the target ports.

Note: The FC target port numbers in the following illustration are examples. The actual port numbers might vary depending on whether you are using onboard ports or an FC target expansion adapter. The FC target expansion adapter is supported only for the N3600 controller.

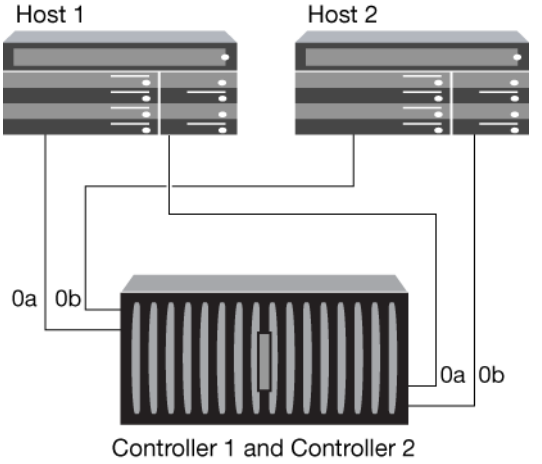

Figure 34: N3300, N3400, and N3600 direct-attached active/active configuration

Attribute	Value
Fully redundant	Yes
Type of fabric	None
Different host operating systems	Yes, with multiple-host configurations
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller For N3600 only, one supported 4-Gb or 8-Gb FC target expansion adapter
Type of configuration	Active/active configuration

N3700 supported topologies

N3700 systems are available in active/active configurations.

N3700: Single-fabric active/active configuration

You can connect hosts to both controllers in an active/active configuration using a single FC switch.

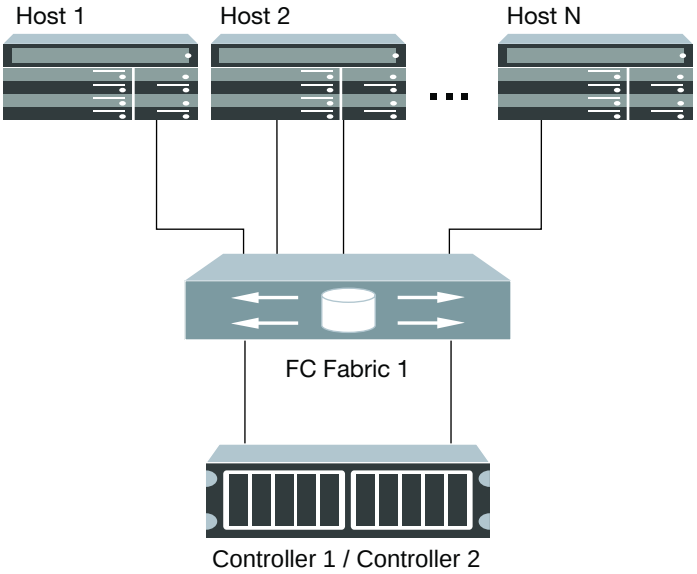

Figure 35: N3700 single-fabric active/active configuration

Attribute	Value
Fully Redundant	No, due to the single fabric
Type of fabric	Single fabric
Different host operating systems	Yes, with multiple-host configurations
Type of configuration	Active/active configuration

N3700: Multifabric active/active configuration

You can connect hosts to both controllers in an active/active configuration using two or more FC switch fabrics for redundancy.

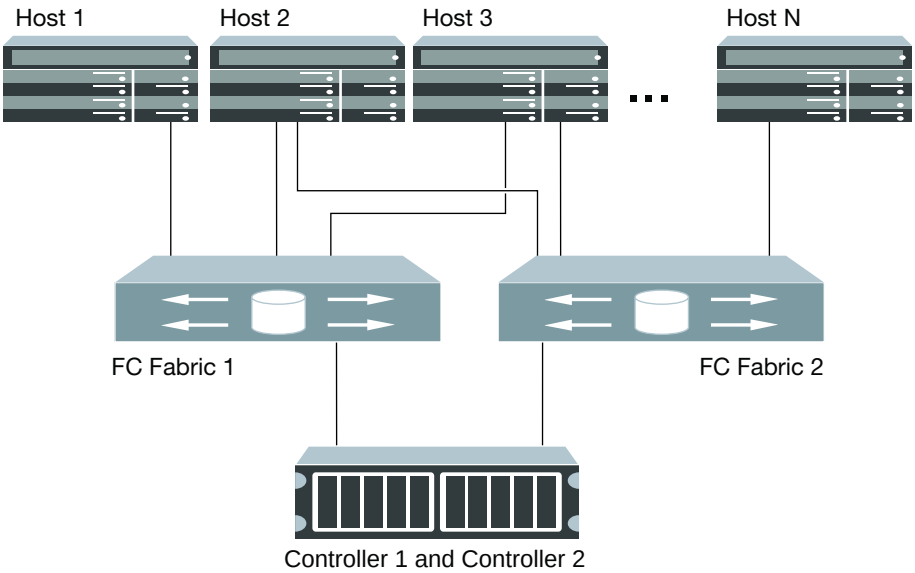

Figure 36: N3700 multifabric active/active configuration

Attribute	Value
Fully redundant	Yes, if a host is dual-attached No, if a host is single-attached
Type of fabric	Multifabric
Different host operating systems	Yes, with multiple-host configurations
Type of configuration	Active/active configuration

N3700: Direct-attached configurations

You can connect hosts directly to FC target ports on a single controller or an Active/active configuration. The number of hosts is limited by the number of available target ports.

Direct-attached configurations typically need the FC ports set to loop mode. Be sure to follow the recommendation of your host operating system provider for FC port settings. You can use the Data ONTAP `fcp config mediatype` command to set the target ports.

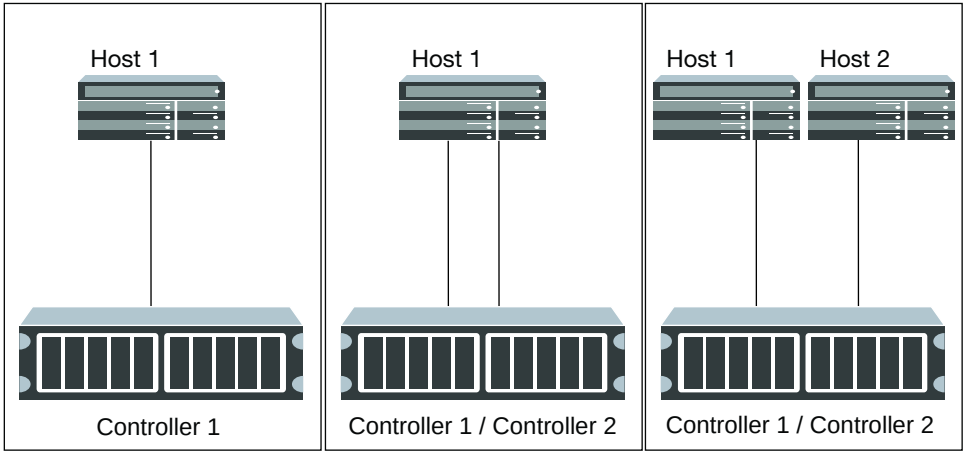

Figure 37: N3700 direct-attached configurations

Attribute	Value
Fully Redundant	First configuration: No, due to the single controller Second configuration: Yes Third configuration: No, due to a single connection from storage system to hosts
Type of fabric	None
Different host operating systems	Yes, with multiple-host configurations
Type of configuration	First configuration: Single controller configuration Second configuration: Active/active configuration Third configuration: Active/active configuration

Fibre Channel over Ethernet overview

Fibre Channel over Ethernet (FCoE) is a new model for connecting hosts to storage systems. FCoE is very similar to traditional Fibre Channel (FC), as it maintains existing FC management and controls, but the hardware transport is a lossless 10-Gb Ethernet network.

Setting up an FCoE connection requires one or more supported converged network adapters (CNAs) in the host, connected to a supported FCoE switch. The CNA is a consolidation point and effectively serves as both an FC HBA and an Ethernet adapter.

The CNA is presented to the host as both an FCoE HBA and a 10-Gb Ethernet adapter. The FCoE HBA portion of the CNA handles the FCoE traffic when traffic is sent and received as FC frames mapped into Ethernet packets (FC over Ethernet). The Ethernet adapter portion of the CNA handles the standard Ethernet host IP traffic for the host, such as iSCSI, CIFS, NFS, and HTTP. Both the FCoE and standard Ethernet portions of the CNA communicate over the same Ethernet port, which connects to the FCoE switch.

Note: Unified target adapters (UTAs) are 10-Gb converged network adapters that you install on your storage systems. Using UTAs for non-FCoE IP traffic such as NFS, CIFS, or iSCSI is *not* supported for Data ONTAP 7.3.

In general, you configure and use FCoE connections just like traditional FC connections.

Note: For detailed information about how to set up and configure your host to run FCoE, see your appropriate host documentation.

FCoE initiator and target combinations

Certain combinations of FCoE and traditional FC initiators and targets are supported.

FCoE initiators

You can use FCoE initiators in host computers with both FCoE and traditional FC targets in storage controllers. The FCoE initiator must connect to an FCoE DCB (data center bridging) switch; direct connection to a target is not supported.

The following table lists the supported combinations.

Initiator	Target	Supported?
FC	FC	Yes
FC	FCoE	Yes with Data ONTAP 7.3.2 and later
FCoE	FC	Yes

Initiator	Target	Supported?
FCoE	FCoE	Yes with Data ONTAP 7.3.2 and later

FCoE targets

You can mix FCoE target ports with 4-Gb or 8-Gb FC ports on the storage controller regardless of whether the FC ports are add-in target adapters or onboard ports. You can have both FCoE and FC target adapters in the same storage controller.

Note: The rules for combining onboard and expansion FC ports still apply.

Related references

FC onboard and expansion port combinations on page 17

Fibre Channel over Ethernet supported hop count

The maximum supported FCoE hop count between a particular host and storage system depends on the hop count that the switch supplier and storage system support for FCoE configurations.

The hop count is the number of switches in the path between the initiator (host) and target (storage system). Cisco also refers to this value as the *diameter of the SAN fabric*.

For FCoE, you can have FCoE switches connected to FC switches.

For end-to-end FCoE connections, the FCoE switches must be running a firmware version that support Ethernet inter-switch links (ISLs).

The following table shows the maximum supported hop count for each switch supplier.

Switch supplier	Supported hop count
Cisco	7 Up to 3 of the switches can be FCoE switches.

Fibre Channel over Ethernet supported topologies

Supported FCoE native configurations include single-fabric and multifabric topologies. Both single-controller and active/active configurations are supported.

Supported storage systems with native FCoE target expansion adapters are the N7000 series, N6200 series, N6000 series, N5300, and the N5600.

In active/active configurations, only single_image cfmode is supported.

The FCoE initiator with FC target configuration is also supported on all storage systems using an FCoE/DCB switch.

Note: The following configuration diagrams are examples only. Most supported FC and iSCSI configurations on supported storage systems can be substituted for the example FC or iSCSI configurations in the following diagrams. However, direct-attached configurations are not supported in FCoE.

Note: While iSCSI configurations allow any number of Ethernet switches, there must be no additional Ethernet switches in FCoE configurations. The CNA must connect directly to the FCoE switch.

FCoE: FCoE initiator to FC target configuration

You can connect hosts to both controllers in an active/active configuration using FCoE initiators through FCoE switches to FC target ports. This requires an FCoE switch that also has FC ports.

The FCoE initiator always connects to a supported FCoE switch. The FCoE switch can connect directly to an FC target, or can connect through FC switches to the FC target.

Note: The FC target expansion adapter port numbers (2a and 2b) in the following figure are examples. The actual port numbers might vary, depending on the expansion slot in which the FC target expansion adapter is installed.

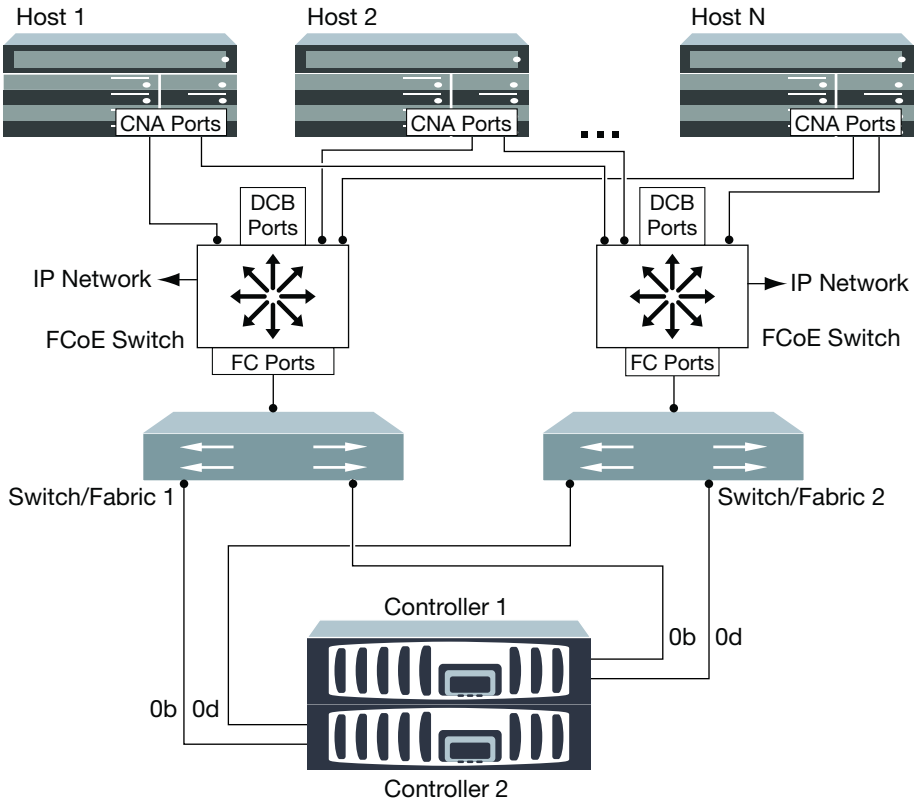

Figure 38: FCoE initiator to FC dual-fabric active/active configuration

Attribute	Value
Fully redundant	Yes
Type of fabric	Dual fabric
Different host operating systems	Yes, with multiple-host configurations
FC ports or adapters	One to the maximum number of supported onboard FC ports per controller One to the maximum number of supported 4-Gb or 8-Gb FC ports per controller using FC target expansion adapters
Multipathing required	Yes
Type of configuration	Active/active configuration

FCoE: FCoE end-to-end configuration

You can connect hosts to both controllers in an active/active configuration using FCoE initiators through DCB switches to FCoE target ports.

You can have multiple FCoE and FC switches in the path between the initiator and target, up to the maximum hop count limit. To connect FCoE switches to each other, the switches must run a firmware version that supports Ethernet ISLs.

Note: The FCoE target expansion adapter port numbers (2a and 2b) in the following figure are examples. The actual port numbers might vary, depending on the expansion slot in which the FCoE target expansion adapter is installed.

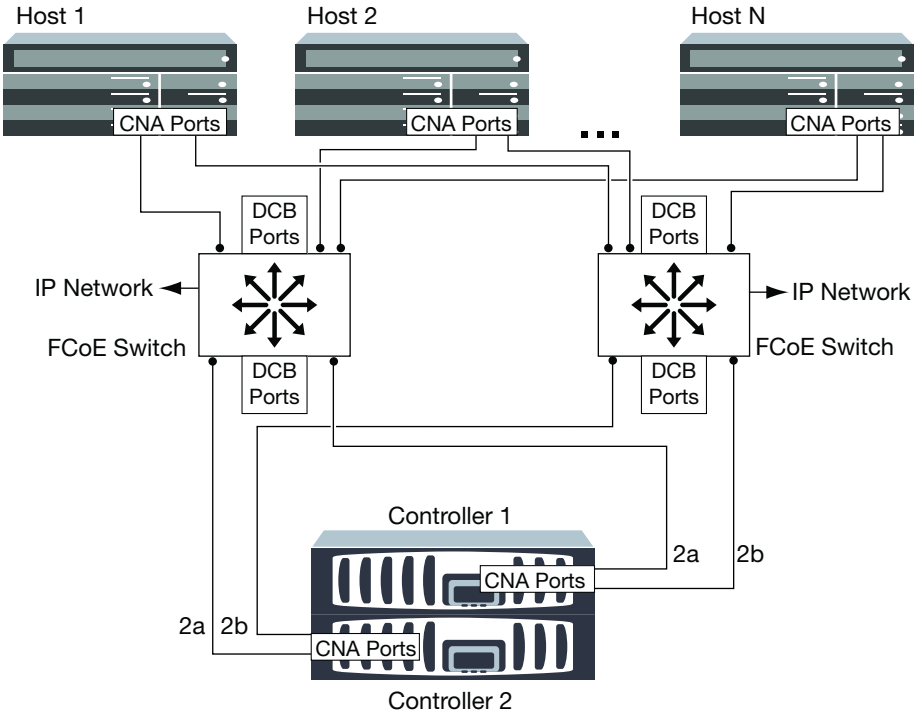

Figure 39: FCoE end-to-end

Attribute	Value
Fully redundant	Yes
Type of fabric	Dual fabric
Different host operating systems	Yes, with multiple host-configurations
FCoE ports or adapters	One or more FCoE target expansion adapters per controller

Attribute	Value
Multipathing required	Yes
Type of configuration	Active/active configuration

FCoE: FCoE mixed with FC

You can connect hosts to both controllers in an active/active configuration using FCoE initiators through FCoE switches to FCoE and FC mixed target ports.

You can have multiple FCoE and FC switches in the path between the initiator and target, up to the maximum hop count limit. To connect FCoE switches to each other, the switches must run a firmware version that supports Ethernet ISLs.

Note: The FCoE target expansion adapter port numbers (2a and 2b) and FC target port numbers (4a and 4b) are examples. The actual port numbers might vary, depending on the expansion slots in which the FCoE target expansion adapter and FC target expansion adapter are installed.

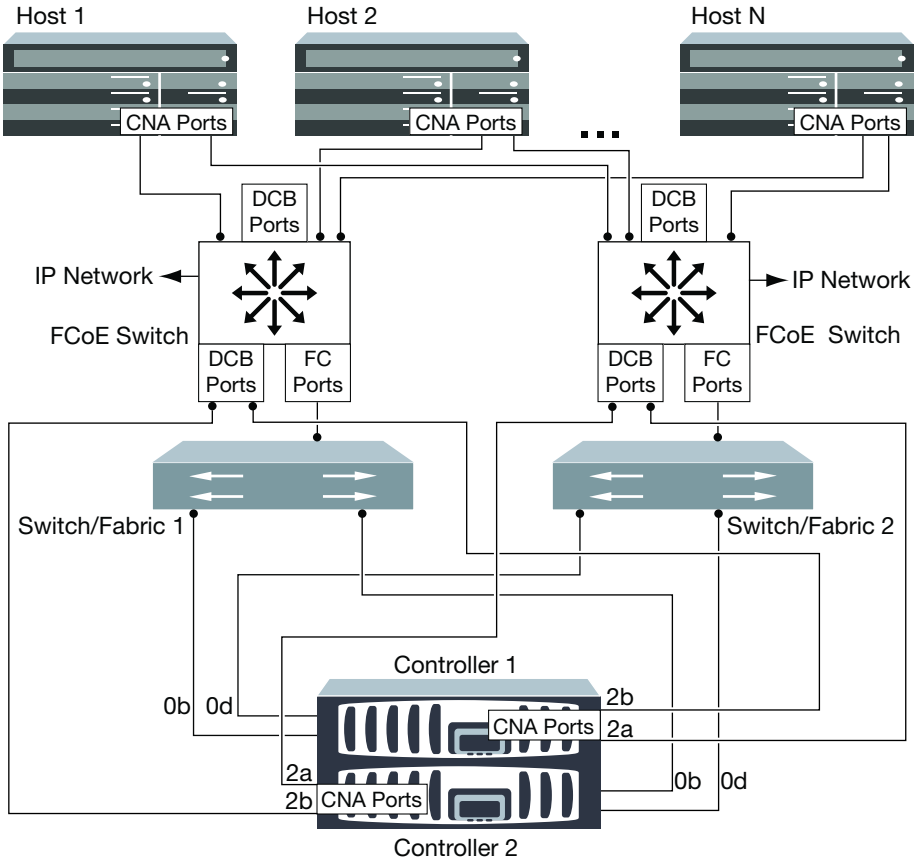

Figure 40: FCoE mixed with FC

Attribute	Value
Fully redundant	Yes
Type of fabric	Dual fabric
Different host operating systems	Yes, with multiple-host configurations
FC/FCoE ports or adapters	One to the maximum number of supported onboard FC ports per controller One or more FCoE target expansion adapters per controller At least one 4-Gb or 8-Gb FC target expansion adapter per controller
Multipathing required	Yes
Type of configuration	Active/active configuration

FCoE: FCoE mixed with IP storage protocols

You can connect hosts to both controllers in an active/active configuration using FCoE initiators through FCoE switches to FCoE target ports. You can also run non-FCoE Ethernet traffic through the same switches.

You can have multiple FCoE and FC switches in the path between the initiator and target, up to the maximum hop count limit. To connect FCoE switches to each other over Ethernet, the switches must run a firmware version that supports Ethernet ISLs. You can also connect switches using FC ISLs.

The FCoE ports are connected to DCB ports on the FCoE switches. FCoE ports cannot use traditional link aggregation to a single switch. Cisco switches support a special type of link aggregation called *Virtual Port Channel* that does support FCoE. A Virtual Port Channel aggregates individual links to two switches. You can also use the Virtual Port Channel for other Ethernet traffic. For more information about configuring Virtual Port Channels, see Technical Report TR-3800: *Fibre Channel over Ethernet (FCoE) End-to-End Deployment Guide* or your Cisco switch documentation.

Note: This technical report contains information about NetApp products that IBM licenses and in some cases customizes. Technical reports might contain information about models and features that are not supported by IBM.

Ports used for traffic other than FCoE, including NFS, CIFS, iSCSI, and other Ethernet traffic, can use regular Ethernet ports on the FCoE switches.

Note: The FCoE target expansion adapter port numbers (2a and 2b) and the Ethernet port numbers (e0a and e0b) in the following figure are examples. The actual port numbers might vary, depending on the expansion slots in which the FCoE target expansion adapters are installed.

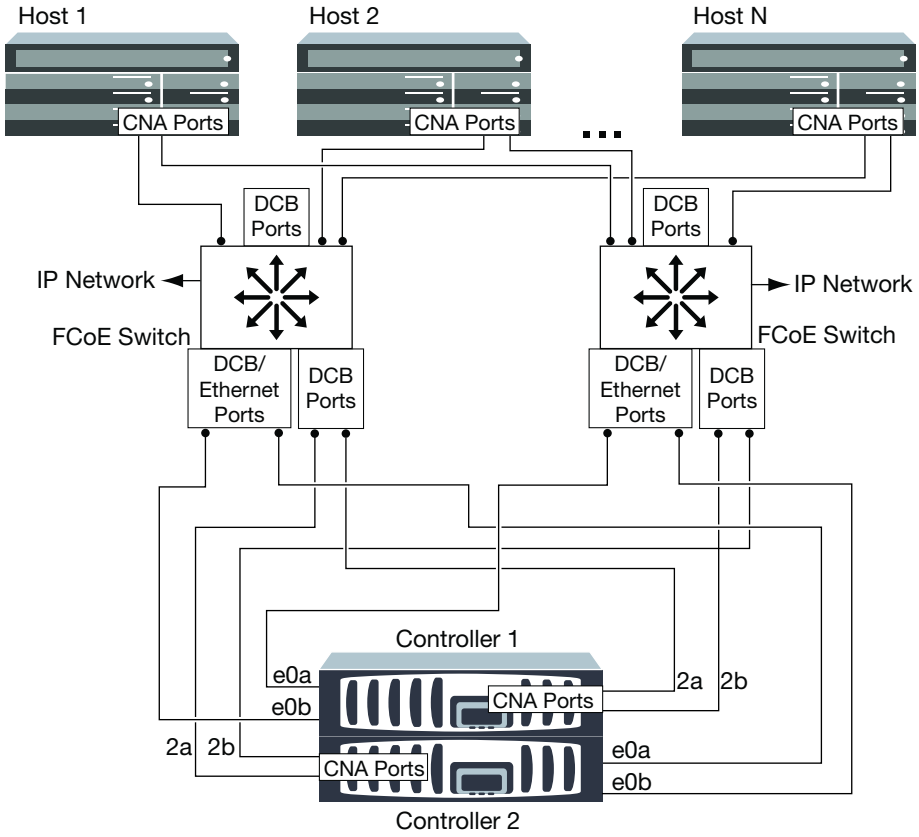

Figure 41: FCoE mixed with IP storage protocols

Attribute	Value
Fully redundant	Yes
Type of fabric	Dual fabric
Different host operating systems	Yes, with multiple-host configurations
FCoE ports or adapters	One or more FCoE target expansion adapters per controller
Multipathing required	Yes
Type of configuration	Active/active configuration

Related information

TR-3800: Fibre Channel over Ethernet (FCoE) End-to-End Deployment Guide - media.netapp.com/documents/TR-3800.pdf

Fibre Channel and FCoE zoning

An FC or FCoE zone is a subset of the fabric that consists of a group of FC or FCoE ports or nodes that can communicate with each other. You must contain the nodes within the same zone to allow communication.

Reasons for zoning

- Zoning reduces or eliminates *cross talk* between initiator HBAs. This occurs even in small environments and is one of the best arguments for implementing zoning. The logical fabric subsets created by zoning eliminate cross-talk problems.
- Zoning reduces the number of available paths to a particular FC or FCoE port and reduces the number of paths between a host and a particular LUN that is visible. For example, some host OS multipathing solutions have a limit on the number of paths they can manage. Zoning can reduce the number of paths that an OS multipathing driver sees. If a host does not have a multipathing solution installed, you need to verify that only one path to a LUN is visible.
- Zoning increases security because there is limited access between different nodes of a SAN.
- Zoning improves SAN reliability by isolating problems that occur and helps to reduce problem resolution time by limiting the problem space.

Recommendations for zoning

- You should implement zoning anytime four or more hosts are connected to a SAN.
- Although World Wide Node Name zoning is possible with some switch vendors, World Wide Port Name zoning is recommended.
- You should limit the zone size while still maintaining manageability. Multiple zones can overlap to limit size. Ideally, a zone is defined for each host or host cluster.
- You should use single-initiator zoning to eliminate crosstalk between initiator HBAs.

Port zoning

Port zoning, also referred to as *hard zoning*, specifies the unique fabric N_port IDs of the ports to be included within the zone. The switch and switch port are used to define the zone members.

Port zoning provides the following advantages:

- Port zoning offers improved security because it is not possible to breach the zoning by using WWN spoofing. However, if someone has physical access to the switch, replacing a cable can allow access.
- In some environments, port zoning is easier to create and manage because you only work with the switch or switch domain and port number.

World Wide Name based zoning

World Wide Name based zoning (WWN) specifies the WWN of the members to be included within the zone. Depending on the switch vendor, either World Wide Node Name or World Wide Port Names can be used. You should use World Wide Port Name zoning when possible.

WWN zoning provides flexibility because access is not determined by where the device is physically connected to the fabric. You can move a cable from one port to another without reconfiguring zones.

Individual zones

In the standard zoning configuration for a simple environment where each host is shown in a separate zone, the zones overlap because the storage ports are included in each zone to allow each host to access the storage.

Each host can see all of the FC target ports but cannot see or interact with the other host ports.

Using port zoning, you can do this zoning configuration in advance even if all of the hosts are not present. You can define each zone to contain a single switch port for the host and switch ports one through four for the storage system.

For example, Zone 1 would consist of switch ports 1, 2, 3, 4 (storage ports) and 5 (Host1 port). Zone 2 would consist of switch ports 1, 2, 3, 4 (storage ports) and 6 (Host2 port), and so forth.

This diagram shows only a single fabric, but multiple fabrics are supported. Each subsequent fabric has the same zone structure.

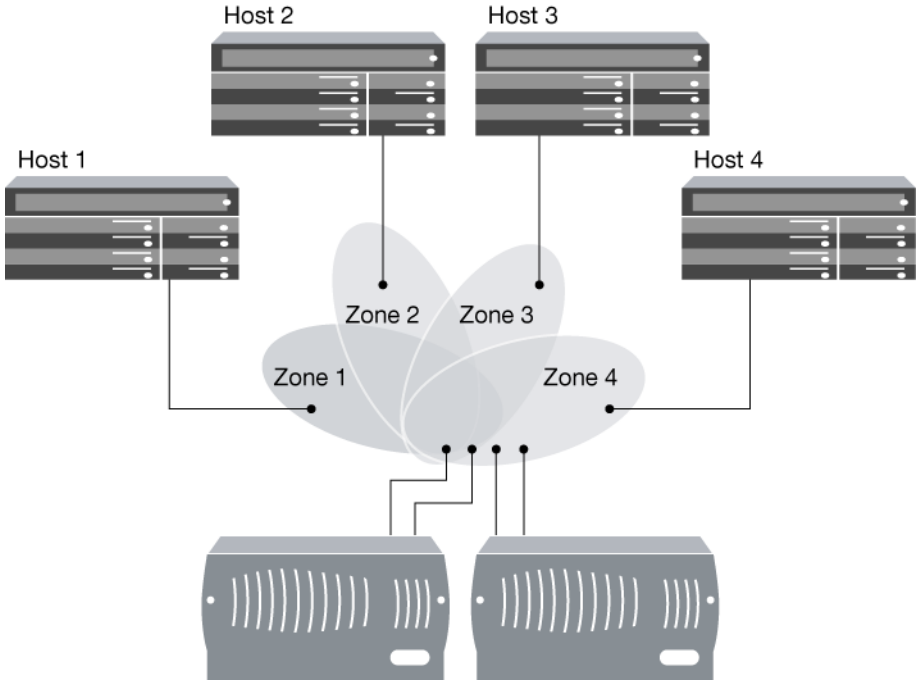

Figure 42: Hosts in individual zones

Single-fabric zoning

Zoning and multipathing software used in conjunction prevent possible controller failure in a single-fabric environment. Without multipathing software in a single-fabric environment, hosts are not protected from a possible controller failure.

In the following figure, Host1 and Host2 do not have multipathing software and are zoned so that there is only one path to each LUN (Zone 1). Therefore, Zone 1 contains only one of the two storage ports.

Even though the host has only one HBA, both storage ports are included in Zone 2. The LUNs are visible through two different paths, one going from the host FC port to storage port 0 and the other going from host FC port to storage port 1.

Because this figure contains only a single fabric, it is not fully redundant. However, as shown, Host3 and Host4 have multipathing software that protects against a possible controller failure. They are zoned so that a path to the LUNs is available through each of the controllers.

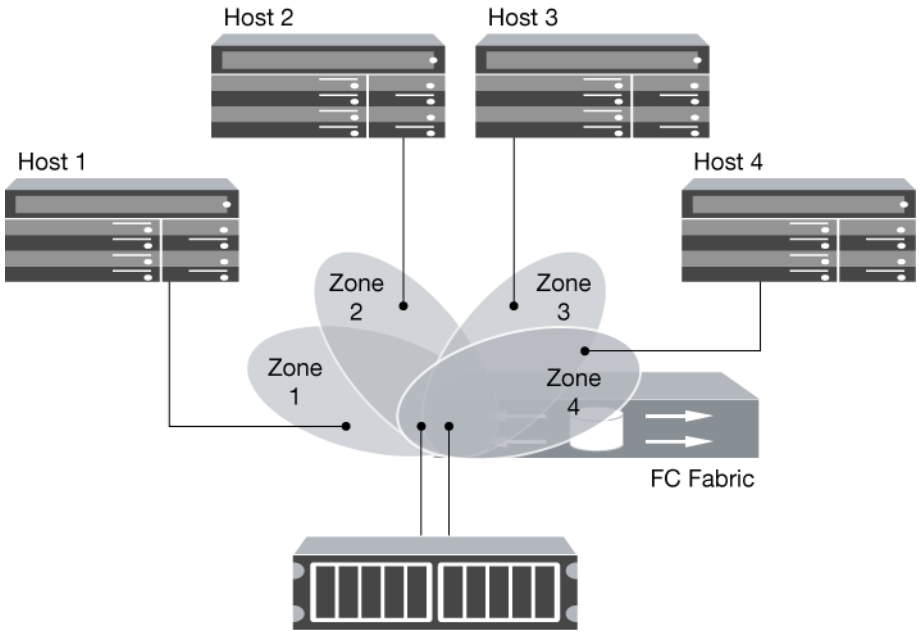

Figure 43: Single-fabric zoning

Dual-fabric active/active configuration zoning

Zoning can separate hosts in a topology to eliminate HBA cross talk. Zoning can also prevent a host from accessing LUNs from a storage system in a different zone.

The following figure shows a configuration where Host1 accesses LUNs from storage system 1 and Host2 accesses LUNs from storage system 2. Each storage system is an active/active configuration and both are fully redundant.

Multiple N3700 storage systems are shown in this figure, but they are not necessary for redundancy.

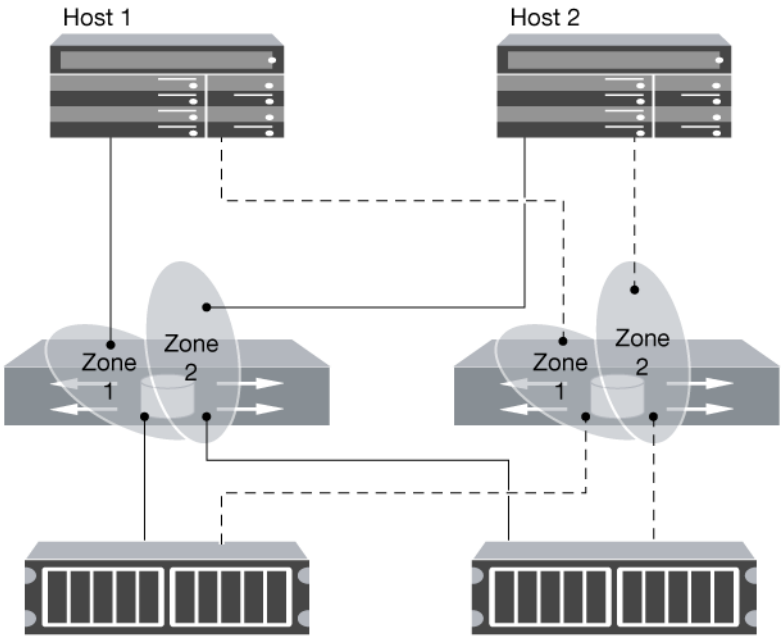

Figure 44: Dual-fabric zoning

Shared SAN configurations

Shared SAN configurations are defined as hosts that are attached to both N series and non-N series storage arrays. Accessing N series arrays and other vendors' arrays (including IBM) from a single host is supported as long as several requirements are met.

The following requirements must be met for support of accessing N series arrays and other vendors' arrays from a single host:

- Native Host OS multipathing or VERITAS DMP is used for multipathing (see exception for EMC PowerPath co-existence below)
- IBM configuration requirements (such as timeout settings) as specified in the appropriate IBM Host Utilities documents are met
- Single_image cfmode is used

Support for Native Host OS multipathing in combination with EMC PowerPath is supported for the following configurations. For configurations that do meet these requirements, an RPQ is required to determine supportability.

Host	**Supported configuration**
Windows	EMC CLARiiON CX3-20, CX3-40, CX3-80 w/ PowerPath 4.5+ and connected to an N series storage system using Data ONTAP DSM for Windows MPIO
Solaris	EMC CLARiiON CX3-20, CX3-40, CX3-80 / PowerPath 5+ and connected to an N series storage system using SUN Traffic Manager (MPxIO)
AIX	EMC CLARiiON CX3-20, CX3-40, CX3-80 / PowerPath 5+ and connected to an N series storage system using AIX MPIO

Asymmetric logical unit access configurations

ALUA (asymmetric logical unit access) is supported for certain combinations of host operating systems and Data ONTAP software.

ALUA is an industry standard protocol for identifying optimized paths between a storage system and a host computer. The administrator of the host computer does not need to manually select the paths to use.

ALUA is enabled or disabled on the igroup mapped to an N series LUN. The default ALUA setting in Data ONTAP is disabled.

For information about using ALUA on a host, see the Host Utilities *Installation and Setup Guide* for your host operating system. For information about enabling ALUA on the storage system, see the *Block Access Management Guide for iSCSI and FC* for your version of Data ONTAP software.

(FC) Specific AIX Host Utilities environments that support ALUA

You can use ALUA if you have an AIX Host Utilities FC environment running either AIX MPIO or Veritas Storage Foundation 5.1 and a version of Data ONTAP that supports ALUA.

The following AIX environments support ALUA when you are using the FC protocol and Data ONTAP 7.3.1 or later:

Host Utilities version	Host requirements
AIX Host Utilities 4.0, 4.1, 5.0, or 5.1 running on a system using either MPIO or Veritas Storage Foundation 5.1	One of the following or later: • 5.2 TL8 • 5.3 TL9 SP4 with APAR IZ53157 • 5.3 TL10 SP1 with APAR IZ53158 • 6.1 TL2 SP4 with APAR IZ53159 • 6.1 TL3 SP1 with APAR IZ53160 **Note:** It is strongly recommended that if you want to use ALUA, you use the latest levels of 5.3 TL9 or 6.1 TL2 listed in the support matrix. ALUA is supported on all AIX Service Streams that have the corresponding authorized program analysis report (APAR) installed. At the time this document was prepared, the Host Utilities supported AIX Service Streams with the APARs listed above as well as with APARs IZ53718, IZ53730, IZ53856, IZ54130, IZ57806, and IZ61549. If an APAR listed here has not been publicly released, contact IBM and request a copy.

Note: ALUA is not supported with the iSCSI protocol.

ESX configurations that support ALUA

ESX hosts support ALUA with certain combinations of ESX, Data ONTAP, and guest operating system configurations.

The following table lists which configurations support asymmetric logical unit access (ALUA). Use the Interoperability Matrix to determine a supported combination of ESX, Data ONTAP, and Host Utilities software. Then enable or disable ALUA based on the information in the table.

ESX version	Minimum Data ONTAP	Windows guest in Microsoft cluster	Supported ?
4.0 or later	7.3.1 with single_image cfmode	No	Yes
4.0 or later	7.3.1 with single_image cfmode	Yes	No
3.5 and earlier	any	any	No

Using ALUA is strongly recommend, but not required, for configurations that support ALUA. If you do not use ALUA, be sure to set an optimized path using the tools supplied with ESX Host Utilities or Virtual Storage Console.

HP-UX configurations that support ALUA

The HP-UX Host Utilities support ALUA in environments using the FC protocol with Native MPIO as long as both your version of the HP-UX operating system and Data ONTAP support ALUA. Certain environments running Veritas Storage Foundation also support ALUA.

ALUA defines a standard set of SCSI commands for discovering and managing multiple paths to LUNs on FC and iSCSI SANs. You should enable ALUA when your Host Utilities configuration supports it. ALUA is enabled on the igroup mapped to IBM N series the LUNs that are used by the HP-UX host.

The following table provides information about which versions of HP-UX using Native MPIO and which versions of Data ONTAP support ALUA:

HP-UX version	ALUA support	Minimum Data ONTAP version for ALUA
HP UX 11iv3 September 2007 and later	Yes **Note:** ALUA is mandatory with this version of HP-UX.	7.2.5 or later
HP-UX 11iv3 February 2007 release	No	Not applicable
HP-UX 11iv2	No	Not applicable

If you are using Veritas Storage Foundation 5.0.1 with HP-UX 11iv3, you must disable Native MPIO ALUA on Veritas LUNs to ensure that DMP functions properly. Otherwise, the `sanlun` utility does not correctly display information about the DMP node. For information on disabling ALUA, see the Symantec TechNote *How to Disable HP-UX 11iv3 Native Multi-Pathing ALUA mode for Storage Foundation 5.0 and 5.0.1.*

For information about which combinations of HP-UX, Data ONTAP, and Veritas Storage Foundation are supported with which versions of the Host Utilities, see the IBM Interoperability Matrix.

Related information

NAS Interoperability Matrices Web site - www.ibm.com/systems/storage/network/interophome.html

How to Disable HP-UX 11iv3 Native Multi-Pathing ALUA mode for Storage Foundation 5.0 and 5.0.1 - http://www.symantec.com/business/support/index?page=content&id=TECH87877&actp=search&viewlocale=en_US&searchid=1288708787175

Linux configurations that support ALUA

The Linux Host Utilities support asymmetric logical unit access (ALUA) on hosts running Red Hat Enterprise Linux or SUSE Linux Enterprise Server, the FC protocol, and a version of Data ONTAP that supports ALUA.

Note: ALUA is also known as Target Port Group Support (TPGS).

ALUA defines a standard set of SCSI commands for discovering path priorities to LUNs on FC SANs. When you have the host and storage controller configured to use ALUA, it automatically determines which target ports provide optimized and unoptionized access to LUNs.

Note: ALUA is not supported when you are running the iSCSI protocol. It is only supported with the FC protocol.

ALUA is automatically enabled for Linux operating system when you set up your storage.

The following configurations support ALUA:

Host Utilities Version	Host requirements	Data ONTAP versions
Host Utilities 4.0 and later	• Red Hat Enterprise Linux 5 Update 2 and later • SUSE Linux Enterprise Server 10 SP2 and later • SUSE Linux Enterprise Server 11 **Note:** Veritas Storage Foundation 5.1 and later support ALUA with the FC protocol.	7.2.4 and later

(FC) Solaris Host Utilities configurations that support ALUA

The Solaris Host Utilities support ALUA in both MPxIO environments and certain Veritas Storage Foundation environments as long as the environments are running the FC protocol. ALUA is not supported in environments running the iSCSI protocol.

If you are using MPxIO with FC and active/active storage controllers with any of the following configurations, you must have ALUA enabled:

Host Utilities version	Host requirements	Data ONTAP version
Host Utilities 4.1 through 5.1	Solaris 10 update 3 and later	7.2.1.1 and later

Host Utilities version	Host requirements	Data ONTAP version
Host Utilities 4.0	Solaris 10 update 2 only with QLogic drivers and SPARC processors	7.2.1 and later

If you are running the Host Utilities with Veritas Storage Foundation 5.1 P1 and the FC protocol, you can use ALUA.

Note: Earlier versions of Veritas Storage Foundation do not support ALUA.

Windows configurations that support ALUA

Windows hosts support ALUA with certain combinations of Windows, Data ONTAP, Host Utilities, and MPIO software.

The following table lists configurations that support ALUA (asymmetric logical unit access). Use the Interoperability Matrix to determine a supported combination of Windows, Data ONTAP, Host Utilities, and MPIO software. Then enable or disable ALUA based on the information in the table.

Windows version	MPIO software	Minimum Data ONTAP	Supported ?
Server 2008 Server 2008 R2	Microsoft DSM (msdsm)	7.3.0	Yes
Server 2008 SP2 Server 2008 R2	Data ONTAP DSM 3.4 and later	7.3.2	Yes
Server 2008 Server 2008 R2	Data ONTAP DSM 3.3.1 and earlier	none	No
Server 2008 Server 2008 R2	Veritas DSM from Storage Foundation for Windows 5.1 and earlier	none	No
Server 2003 SP2 Server 2003 R2	Data ONTAP DSM 3.4 and later	7.3.2	Yes
Server 2003	Data ONTAP DSM 3.3.1 and earlier	none	No
Server 2003	Veritas DSM from Storage Foundation for Windows 5.1 and earlier	none	No

Note: For MPIO software not listed in this table, see the documentation for that software for updated ALUA support and requirements.

ALUA is required for FC paths when using the Microsoft DSM (msdsm) or the Data ONTAP DSM 3.4 or later. ALUA is not currently supported for iSCSI paths.

Configuration limits

Configuration limits are available for FC, FCoE, and iSCSI topologies. In some cases, limits might be theoretically higher, but the published limits are tested and supported.

Configuration limit parameters and definitions

There are a number of parameters and definitions related to FC, FCoE, and iSCSI configuration limits.

Parameter	Definition
Visible target ports per host (iSCSI)	The maximum number of target iSCSI Ethernet ports that a host can see or access on iSCSI attached controllers.
Visible target ports per host (FC)	The maximum number of FC adapters that a host can see or access on the attached Fibre Channel controllers.
LUNs per host	The maximum number of LUNs that you can map from the controllers to a single host.
Paths per LUN	The maximum number of accessible paths that a host has to a LUN. **Note:** Using the maximum number of paths is not recommended.
Maximum LUN size	The maximum size of an individual LUN on the respective operating system.
LUNs per controller	The maximum number of LUNs that you can configure per controller, including cloned LUNs and LUNs contained within cloned volumes. LUNs contained in Snapshot copies do not count in this limit and there is no limit on the number of LUNs that can be contained within Snapshot copies.
LUNs per volume	The maximum number of LUNs that you can configure within a single volume. LUNs contained in Snapshot copies do not count in this limit and there is no limit on the number of LUNs that can be contained within Snapshot copies.
FC port fan-in	The maximum number of hosts that can connect to a single FC port on a controller. Connecting the maximum number of hosts is generally not recommended and you might need to tune the FC queue depths on the host to achieve this maximum value.
FC port fan-out	The maximum number of LUNs mapped to a host through a FC target port on a controller.

Parameter	Definition
iSCSI sessions per controller	The recommended maximum number of iSCSI sessions that you can connect to a single controller. The general formula to calculate this is as follows: Maximum sessions = 8 * System Memory divided by 512 MB.
Hosts per controller (FC)	The maximum number of hosts that you can connect to a controller. Connecting the maximum number of hosts is generally not recommended and you might need to tune the FC queue depths on the host to achieve this maximum value. This value assumes two initiators per host.
igroups per controller	The maximum number of initiator groups that you can configure per controller.
Initiators per igroup	The maximum number of FC initiators (HBA WWNs) or iSCSI initiators (host iqn/eui node names) that you can include in a single igroup.
LUN mappings per controller	The maximum number of LUN mappings per controller. For example, a LUN mapped to two igroups counts as two mappings.
LUN path name length	The maximum number of characters in a full LUN name. For example, /vol/abc/def has 12 characters.
LUN size	The maximum capacity of an individual LUN on a controller.
FC queue depth available per port	The usable queue depth capacity of each FC target port. The number of LUNs is limited by available FC queue depth.
FC target ports per controller	The maximum number of supported FC target ports per controller. FC initiator ports used for back-end disk connections, for example, connections to disk shelves, are not included in this number.

Host operating system configuration limits for iSCSI and FC

Each host operating system has host-based configuration limits for FC, FCoE, and iSCSI.

The following table lists the maximum supported value for each parameter based on testing. All values are for FC, FCoE, and iSCSI unless noted.

Note: The values listed are the maximum supported by IBM. The operating system vendor might support a different value. For best performance, do not configure your system at the maximum values.

Parameter	Windows	Linux	HP-UX	Solaris	AIX	ESX
Visible target ports per host	32	16	16	16	16	16

Parameter	Windows	Linux	HP-UX	Solaris	AIX	ESX
LUNs per host	64 (Windows 2000) 255 (Windows 2003) 255 (Windows 2008)	1024 devices max (where each path to a LUN is a device)	11iv2: 512 11iv3: 1024	512	1024	3.x: 256 4.x: 256 Local drives, CD-ROM, and so on count against this value.
Paths per LUN	8 (max of 1024 per host)	8 (max of 1024 per host)	11iv2: 8 11iv3: 32	16	16	3.x: 8 4.x: 8 (max of 1024 per host)
Max LUN size	2 TB (MBR) 16 TB (GPT) Server 2003 SP2 and later	16 TB	11iv2: 2 TB 11iv3: 16 TB	16 TB	16 TB	2 TB

Related references

Configuration limit parameters and definitions on page 85

N6200 series single-controller limits

Each system model has configuration limits for reliable operation. Do not exceed the tested limits.

The following table lists the maximum supported value for each parameter based on testing. All values are for FC, FCoE, and iSCSI unless noted.

Note: The values listed are the maximum that can be supported. For best performance, do not configure your system at the maximum values.

The maximum number of LUNs and the number of HBAs that can connect to an FC port is limited by the available queue depth on the FC target ports.

Parameter	N6210	N6240	N6270
LUNs per controller	2,048	2,048	2,048

Parameter	N6210	N6240	N6270
FC queue depth available per port	1966	1966	1966
LUNs per volume	2,048	2,048	2,048
Port fan-in	64	64	64
Connected hosts per storage controller (FC)	256	256	256
iSCSI sessions per controller	256	256	512
igroups per controller	256	256	512
Initiators per igroup	256	256	256
LUN mappings per controller	4,096	4,096	8,192
LUN path name length	255	255	255
LUN size	16 TB	16 TB	16 TB
FC target ports per controller	10	24	24

N6200 series active/active configuration limits

Each system model has configuration limits for reliable operation. Do not exceed the tested limits.

The following table lists the maximum supported value for each parameter based on testing. All values are for FC, FCoE, and iSCSI unless noted.

Limits for active/active configuration systems are *not* double the limits for single-controller systems. This is because one controller in the active/active configuration must be able to handle the entire system load during failover.

Note: The values listed are the maximum that can be supported. For best performance, do not configure your system at the maximum values.

The maximum number of LUNs and the number of HBAs that can connect to an FC port is limited by the available queue depth on the FC target ports.

Parameter	N6210	N6240	N6270
LUNs per active/active configuration	2,048	2,048	2,048 4,096 (with RPQ approval)
FC queue depth available per port	1,966	1,966	1,966
LUNs per volume	2,048	2,048	2,048
FC port fan-in	64	64	64
Connected hosts per active/active configuration (FC)	256	256	256 512 (with RPQ approval)
iSCSI sessions per active/active configuration	512	512	1,024
igroups per active/ active configuration	512	512	1024
Initiators per igroup	256	256	256
LUN mappings per active/active configuration	4,096	4,096	8,192
LUN path name length	255	255	255
LUN size	16 TB	16 TB	16 TB
FC target ports per active/active configuration	20	48	48

N7000 series and N6000 series single-controller limits

Each system model has configuration limits for reliable operation. Do not exceed the tested limits.

The following table lists the maximum supported value for each parameter based on testing. All values are for FC, FCoE, and iSCSI unless noted.

Note: The values listed are the maximum that can be supported. For best performance, do not configure your system at the maximum values.

The maximum number of LUNs and the number of HBAs that can connect to an FC port is limited by the available queue depth on the FC target ports.

Parameter	N6000 series	N7600 or N7700	N7800 or N7900
LUNs per controller	2,048	2,048	2,048
FC queue depth available per port	1,966	1,966	1,966
LUNs per volume	2,048	2,048	2,048
Port fan-in	64	64	64
Connected hosts per storage controller (FC)	256	256	256
iSCSI sessions per controller	256	256	512
igroups per controller	256	256	256
Initiators per igroup	256	256	256
LUN mappings per controller	4,096	8,192	8,192
LUN path name length	255	255	255
LUN size	16 TB (might require deduplication and thin provisioning)	16 TB (might require deduplication and thin provisioning)	16 TB (might require deduplication and thin provisioning)
FC target ports per controller	Data ONTAP 7.3.0: 8 7.3.1 and later: 16	Data ONTAP 7.3.0: 12 7.3.1 and later: 16	Data ONTAP 7.3.0: 12 7.3.1 and later: 16

Related references

Configuration limit parameters and definitions on page 85

N7000 series and N6000 series active/active configuration limits

Each system model has configuration limits for reliable operation. Do not exceed the tested limits.

The following table lists the maximum supported value for each parameter based on testing. All values are for FC, FCoE, and iSCSI unless noted.

Limits for active/active configuration systems are *not* double the limits for single-controller systems. This is because one controller in the active/active configuration must be able to handle the entire system load during failover.

Note: The values listed are the maximum that can be supported. For best performance, do not configure your system at the maximum values.

The maximum number of LUNs and the number of HBAs that can connect to an FC port is limited by the available queue depth on the FC target ports.

Parameter	N6000 series	N7600 or N7700	N7800 or N7900
LUNs per active/active configuration	2,048 4,096 (available on the N6060 and N6070 with RPQ approval)	2,048 4,096 (with RPQ approval)	2,048 4,096 (with RPQ approval)
FC queue depth available per port	1966	1966	1966
LUNs per volume	2,048	2,048	2,048
FC port fan-in	64	64	64
Connected hosts per active/active configuration (FC)	256 512 (available on the N6060 and N6070 with RPQ approval)	256 512 (with RPQ approval)	256 512 (with RPQ approval)
iSCSI sessions per active/active configuration	512	512	1,024
igroups per active/ active configuration	256 512 (available on the N6060 and N6070 with RPQ approval)	256 512 (with RPQ approval)	256 512 (with RPQ approval)
Initiators per igroup	256	256	256
LUN mappings per active/active configuration	4,096 8,192 (available on the N6060 and N6070 with RPQ approval)	8,192	8,192
LUN path name length	255	255	255
LUN size	16 TB (might require deduplication and thin provisioning)	16 TB (might require deduplication and thin provisioning)	16 TB (might require deduplication and thin provisioning)

Parameter	N6000 series	N7600 or N7700	N7800 or N7900
FC target ports per active/active configuration	Data ONTAP 7.3.0: 16 7.3.1 and later: 32	Data ONTAP 7.3.0: 24 7.3.1 and later: 32	16Data ONTAP 7.3.0: 24 7.3.1 and later: 32

Related references

Configuration limit parameters and definitions on page 85

N5000 series single-controller limits

Each system model has configuration limits for reliable operation. Do not exceed the tested limits.

The following table lists the maximum supported value for each parameter based on testing. All values are for FC, FCoE, and iSCSI unless noted.

Note: The values listed are the maximum that can be supported. For best performance, do not configure your system at the maximum values.

The maximum number of LUNs and the number of HBAs that can connect to an FC port is limited by the available queue depth on the FC target ports.

Parameter	N5200	N5500	N5300 and N5600
LUNs per controller	1,024	1,024	2,048
FC queue depth available per port	1,966	1,966	1,966
LUNs per volume	1,024	1,024	2,048
Port fan-in	64	64	64
Connected hosts per storage controller (FC)	256	256	256
iSCSI sessions per controller	64	128	256
igroups per controller	256	256	256
Initiators per igroup	256	256	256
LUN mappings per controller	4,096	4,096	4,096
LUN path name length	255	255	255

Parameter	N5200	N5500	N5300 and N5600
LUN size	16 TB (might require deduplication and thin provisioning)	16 TB (might require deduplication and thin provisioning)	16 TB (might require deduplication and thin provisioning)
FC target ports per controller	4	4	Data ONTAP 7.3.0: 8 7.3.1 and later: 12

Related references

Configuration limit parameters and definitions on page 85

N5000 series active/active configuration limits

Each system model has configuration limits for reliable operation. Do not exceed the tested limits.

The following table lists the maximum supported value for each parameter based on testing. All values are for FC, FCoE, and iSCSI unless noted.

Limits for active/active configuration systems are *not* double the limits for single-controller systems. This is because one controller in the active/active configuration must be able to handle the entire system load during failover.

Note: The values listed are the maximum that can be supported. For best performance, do not configure your system at the maximum values.

The maximum number of LUNs and the number of HBAs that can connect to an FC port is limited by the available queue depth on the FC target ports.

Parameter	N5200	N5500	N5300 and N5600
LUNs per active/active configuration	1,024	1,024	2,048
FC queue depth available per port	1,966	1,966	1,966
LUNs per volume	1,024	1,024	2,048
FC port fan-in	64	64	64
Connected hosts per active/active configuration (FC)	256	256	256
iSCSI sessions per active/active configuration	128	256	512

Parameter	N5200	N5500	N5300 and N5600
igroups per active/active configuration	256	256	256
Initiators per igroup	256	256	256
LUN mappings per active/active configuration	4,096	4,096	4,096
LUN path name length	255	255	255
LUN size	16 TB (might require deduplication and thin provisioning)	16 TB (might require deduplication and thin provisioning)	16 TB (might require deduplication and thin provisioning)
FC target ports per active/active configuration	8	8	Data ONTAP 7.3.0: 16 7.3.1: 24

Related references

Configuration limit parameters and definitions on page 85

N3300, N3400, and N3600 single-controller limits

Each system model has configuration limits for reliable operation. Do not exceed the tested limits.

The following table lists the maximum supported value for each parameter based on testing. All values are for FC, FCoE, and iSCSI unless noted.

Note: The values listed are the maximum that can be supported. For best performance, do not configure your system at the maximum values.

The maximum number of LUNs and the number of HBAs that can connect to an FC port is limited by the available queue depth on the FC target ports.

Parameter	N3300	N3400	N3600
LUNs per controller	1,024	1,024	1,024
FC queue depth available per port	737	1,966	737
LUNs per volume	1,024	1,024	1,024
FC port fan-in	16	64	16

Parameter	N3300	N3400	N3600
Connected hosts per controller (FC)	24	128	32
iSCSI sessions per controller	24	128	32
igroups per controller	256	256	256
Initiators per igroup	256	256	256
LUN mappings per controller	4,096	4,096	4,096
LUN path name length	255	255	255
LUN size	16 TB (might require deduplication and thin provisioning)	16 TB (might require deduplication and thin provisioning)	16 TB (might require deduplication and thin provisioning)
FC target ports per controller	2	2	4

Related references

Configuration limit parameters and definitions on page 85

N3300, N3400, and N3600 active/active configuration limits

Each system model has configuration limits for reliable operation. Do not exceed the tested limits.

The following table lists the maximum supported value for each parameter based on testing. All values are for FC, FCoE, and iSCSI unless noted.

Limits for active/active configuration systems are *not* double the limits for single-controller systems. This is because one controller in the active/active configuration must be able to handle the entire system load during failover.

Note: The values listed are the maximum that can be supported. For best performance, do not configure your system at the maximum values.

The maximum number of LUNs and the number of HBAs that can connect to an FC port is limited by the available queue depth on the FC target ports.

Parameter	N3300	N3400	N3600
LUNs per active/active configuration	1,024	1,024	1,024

Parameter	N3300	N3400	N3600
FC queue depth available per port	737	1,966	737
LUNs per volume	1,024	1,024	1,024
FC port fan-in	16	64	16
Connected hosts per active/active configuration (FC)	24	128	32
iSCSI sessions per active/active configuration	24	128	32
igroups per active/ active configuration	256	256	256
Initiators per igroup	256	256	256
LUN mappings per active/active configuration	4,096	4,096	4,096
LUN path name length	255	255	255
LUN size	16 TB (might require deduplication and thin provisioning)	16 TB (might require deduplication and thin provisioning)	16 TB (might require deduplication and thin provisioning)
FC target ports per active/active configuration	4	4	8

Related references

Configuration limit parameters and definitions on page 85

N3700 single-controller limits

Each system model has configuration limits for reliable operation. Do not exceed the tested limits.

The following table lists the maximum supported value for each parameter based on testing. All values are for FC, FCoE, and iSCSI unless noted.

Note: The values listed are the maximum that can be supported. For best performance, do not configure your system at the maximum values.

The maximum number of LUNs and the number of HBAs that can connect to an FC port is limited by the available queue depth on the FC target ports.

Parameter	N3700
LUNS per controller	1,024
FC queue depth available per port	491
LUNs per volume	1,024
FC port fan-in	16
Connected hosts per controller (FC)	16
iSCSI sessions per controller	8
igroups per controller	256
Initiators per igroup	256
LUN mappings per controller	4,096
LUN path name length	255
LUN size	6 TB
FC target ports per controller	1

Related references

Configuration limit parameters and definitions on page 85

N3700 active/active configuration limits

Each system model has configuration limits for reliable operation. Do not exceed the tested limits.

The following table lists the maximum supported value for each parameter based on testing. All values are for FC, FCoE, and iSCSI unless noted.

Limits for active/active configuration systems are *not* double the limits for single-controller systems. This is because one controller in the active/active configuration must be able to handle the entire system load during failover.

Note: The values listed are the maximum that can be supported. For best performance, do not configure your system at the maximum values.

The maximum number of LUNs and the number of HBAs that can connect to an FC port is limited by the available queue depth on the FC target ports.

Parameter	N3700
LUNS per active/active configuration	1,024
FC queue depth available per port	491
LUNs per volume	1,024
FC port fan-in	16
Connected hosts per active/active configuration (FC)	16
iSCSI sessions per active/active configuration	32
igroups per active/active configuration	256
Initiators per igroup	256
LUN mappings per active/active configuration	4,096
LUN path name length	255
LUN size	6 TB
FC target ports per active/active configuration	2

Related references

Configuration limit parameters and definitions on page 85

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