FlexArray Virtualization

Implementation Guide for Third-Party Storage

Contents

How this guide fits into your implementation planning

When planning a deployment with Data ONTAP systems and storage arrays, it is important to review the general requirements for setting up all storage arrays to work with Data ONTAP and also the specific requirements for your vendor and storage array vendor, which are discussed in this guide.

Data ONTAP systems can be deployed with a variety of storage arrays. Data ONTAP requirements for working with individual storage arrays can vary by vendor and storage array. This guide provides information about the storage arrays that Data ONTAP supports at the time of publication. Not all models described in this guide are supported in all Data ONTAP releases. To determine which storage array models are supported in a particular Data ONTAP release, see the Interoperability Matrix at *mysupport.netapp.com*.

> **Note:** The *Interoperability Matrix* is the final authority on information such as storage arrays, firmware, switches, and features that Data ONTAP supports.

What to read before this guide

When planning for setting up your configuration to work with storage arrays, you should start by reading the *FlexArray Virtualization Installation Requirements and Reference Guide*, which provides the general requirements for setting up Data ONTAP to work with storage arrays. For example, it contains general guidelines about how to configure array LUNs to work with Data ONTAP and how to set up paths to array LUNs. After you understand the requirements that apply to all vendors, you should read this guide, which provides the additional information that is specific to your vendor.

How this guide is organized

The information in this guide is organized in separate chapters for each storage array vendor. Each chapter includes information about the following:

- The requirements for parameters that must be set for each supported storage array from your vendor to be able to work with Data ONTAP

- Additional configuration guidelines, such as restrictions specific to an aspect of your vendor's storage array configuration

- The configurations that are supported for the storage arrays from your vendor
  The supported configurations shown for a vendor might not apply to all storage array models from the vendor. Any exceptions for individual models from a vendor are shown in the Interoperability Matrix at *mysupport.netapp.com*.

Where to find out about planning for and setting up Data ONTAP features

The FlexArray Virtualization guides provide information about how to set up Data ONTAP to work with storage arrays and how to set up the storage arrays to work with Data ONTAP. You should also refer to the Data ONTAP document library, which provides information about Data ONTAP features. The Data ONTAP guides also contain some procedures for installing and configuring your system to work with array LUNs.

Where to find interoperability and limits information for configurations with storage arrays

When planning your configuration to use Data ONTAP systems with storage arrays, you need to check sources in addition to product documentation for interoperability details information.

Tools available on the NetApp Support Site provide, in a central location, specific information about which features, configurations, and storage array models are supported in particular releases.

Interoperability information about support for storage arrays

Not all Data ONTAP releases support the same features, configurations, system models, and storage array models. During your deployment planning, you must check Data ONTAP support information to ensure that your deployment conforms to Data ONTAP hardware and software requirements for all systems in the deployment.

Previously all support information used to set up deployments with storage arrays was included in the V-Series Support Matrix. The information is divided into different tools, as shown in the following table:

For information about...	You should look here...
Data ONTAP working with devices, including the following: • Supported storage arrays and storage array firmware • Supported switches and switch firmware • Whether your storage array supports nondisruptive (live) upgrade of the storage array firmware • Whether a MetroCluster configuration is supported with your storage array	Interoperability Matrix at *mysupport.netapp.com* **Note:** The *Interoperability Matrix* shows the Brocade and Cisco switches that are supported. You can find guides for configuring specific vendor switches on the NetApp Support Site at *mysupport.netapp.com*.
Data ONTAP limits for releases and platforms, including the following: • Minimum and maximum array LUN sizes, including the minimum array LUN size for the root volume and spare core array LUNs • Minimum aggregate size for aggregates with array LUNs • Supported block size • Minimum and maximum capacity • Neighborhood limits	*Hardware Universe* at *hwu.netapp.com*
What is supported for specific arrays, including supported configurations	*FlexArray Virtualization Implementation Guide for Third-Party Storage*

Limits information for configurations with storage arrays

The *Hardware Universe* at *hwu.netapp.com* contains information about limits that you need to consider when planning for a configuration with storage arrays.

The *Hardware Universe* includes the following limits that do not apply to native disks:

- Minimum and maximum array LUN size that Data ONTAP supports

- Minimum size for the array LUN for the root volume

- Spare core array LUN minimum size

- Limits for RAID groups with array LUNs

- Minimum aggregate size for an aggregate of array LUNs

- Maximum number of array LUNs and disks combined, per platform

The *Hardware Universe* also contains storage limits that are the same for native disks and array LUNs.

Note: Limits for V-Series systems were previously provided in the *V-Series Limits Reference for Third-Party Storage* and the V-Series Support Matrix.

Use of storage array advanced features

Data ONTAP does not support storage array advanced features unless otherwise specified in the Interoperability Matrix at *mysupport.netapp.com*.

Data ONTAP systems that can use array LUNs on storage arrays

V-Series ("V") systems and new FAS platforms released in Data ONTAP 8.2.1 and later can use array LUNs if the proper license is installed. In discussions in the Data ONTAP and FlexArray Virtualization documentation, these systems are collectively referred to as Data ONTAP systems when it is necessary to make it clear which information applies to them and what information applies to storage arrays.

> **Note:** Starting with Data ONTAP 8.2.1, the capability of using LUNs on a storage array, formerly identified as V-Series functionality, has a new name—*Data ONTAP FlexArray Virtualization Software*. The capability of using array LUNs continues to be available as a licensed feature in Data ONTAP.

Systems prior to Data ONTAP 8.2.1 that can use array LUNs

The only systems released prior to Data ONTAP 8.2.1 that can use array LUNs are V-Series systems —systems with a "V" or "GF" prefix. A V-Series system is an open storage controller that virtualizes storage from storage array vendors, native disks, or both into a single heterogeneous storage pool.

> **Note:** Almost all Data ONTAP platforms released prior to Data ONTAP 8.2.1 were released with FAS and V-Series equivalent models (for example, a FAS6280 and a V6280). (For a few systems, there were no "V" equivalent models.) Although both types of models could access native disks, only the V-Series systems (a "V" or "GF" prefix) could attach to storage arrays.

Systems in Data ONTAP 8.2.1 and later that can use array LUNs

Starting with Data ONTAP 8.2.1, the model for how platforms are released and the storage they can use changes. Attaching to storage arrays is no longer limited to V-Series systems.

Starting with Data ONTAP 8.2.1, all new platforms are released as a single hardware model. This single hardware model has a FAS prefix; there are no longer separate "V" and FAS models for new platforms. If the V_StorageAttach license package is installed on a new FAS model, it can attach to storage arrays. (This is the same license required on a V-Series system.)

> **Important:** FAS systems released prior to Data ONTAP 8.2.1 cannot use LUNs on storage arrays, even if they are upgraded to Data ONTAP 8.2.1 or later; only the "V" equivalent of a platform can use array LUNs.

General configuration guidelines for all storage arrays

This section includes general configuration guidelines for any of the storage arrays supported by Data ONTAP.

Requirement for 8-Gb array port initialization

In a typical Fibre Channel (FC) fabric, storage array ports initialize as N-Ports (node ports) and their corresponding switch ports initialize as F-Ports (fabric ports). In some cases, these F-ports might go offline and resume operation as L-Ports (loop ports), resulting in fabric errors.

This behavior is caused by topology auto-negotiation issues in the Brocade switch.

To ensure that switch ports always initialize as F-ports, you must run the `portcfggport <portnumber> 1` command on Brocade switch ports that are connected to storage arrays. You must run this command when you start configuring the system to avoid this problem, and you must fix the problem if it occurs.

To promote efficiency on the fabric as a whole, you can also use this workaround on any Brocade ports attached to Data ONTAP initiator ports.

Fill word settings for 8-Gb Brocade switch ports

If you are using 8-Gb Brocade switches running firmware version FOS v6.3.1 or higher in your storage environment, you must ensure that appropriate fill word settings are configured on the switch ports connected to Data ONTAP systems and the switch ports connected to storage arrays.

Providing incorrect fill words might lead to link initialization failures in the switch ports.

For Data ONTAP systems, you must set the fill word on the corresponding switch ports to *3*.

For the storage arrays, you must set the fill word according to the recommended values listed in the following table:

Storage array	Fill word value on the Brocade switch ports
Hitachi	2
HP XP	
All other storage arrays supported with Data ONTAP systems	3

Note: See the Interoperability Matrix for information about the storage arrays supported with Data ONTAP. For information about how to configure the fill word, refer to the Brocade switch documentation.

EMC CLARiiON and VNX storage arrays

You must meet specific requirements when configuring storage arrays to work with Data ONTAP systems that use array LUNs. These requirements include setting configuration parameters on your storage arrays and deploying only supported configurations.

Required parameters for EMC CLARiiON and VNX storage arrays with Data ONTAP systems

Certain parameter settings are required on the storage array for the storage array to work successfully with Data ONTAP systems.

Host configuration parameters that must be set on the storage array are listed in the following table.

Parameter	Setting
Initiator type	Clariion Open or Clariion VNX
Array Com Path	Enabled
Failover mode	1
Unit serial number	LUN
Host Name	User-supplied host name and port number.
IP address	Unique fake IP address. Be sure that you have not entered this IP address anywhere else in the storage array configuration, and that it is not an IP address that is present on the network.

General configuration guidelines

Information in this section includes cautions, restrictions, special requirements, and information about array characteristics that you might need to consider when configuring or using your storage array.

How EMC CLARiiON and VNX storage arrays control access to data

EMC CLARiiON and VNX arrays use Storage Groups to control access to data. A Storage Group is one or more LUNs within the storage array that can be accessed only by the host or hosts that you associate with the array LUNs. A host cannot access or modify data in any array LUNs that are not part of its Storage Group.

Data ONTAP supports multiple Storage Groups if these rules are followed:

- Switch zoning must define which target ports the FC initiator ports on the Data ONTAP system use to access each array LUN group.

- LUN masking must be used to restrict host access to array LUNs.

- Storage Groups must define which array LUN groups are presented to each FC initiator port.

- One FC initiator port pair on each Data ONTAP system is required for each array LUN group.

If array LUN neighborhoods are used, the V-Series systems in the same neighborhood must be in the same Storage Group.

Limitation on array LUN numbering with EMC CLARiiON and VNX arrays

EMC CLARiiON (CX) and VNX storage arrays only support array LUN numbering from 0 through 255. Array LUNs that are numbered beyond that range are not visible to Data ONTAP.

Guidelines for enabling ALUA on EMC CLARiiON and VNX storage arrays

Starting with clustered Data ONTAP 8.2, support has been added for ALUA (Asymmetric Logical Unit Access) with CLARiiON and VNX arrays.

By default, support for ALUA is enabled in clustered Data ONTAP. But to use it, ALUA must be enabled on the storage array.

You should enable ALUA only on new configurations. You should not enable ALUA in an existing configuration.

If you are setting up ALUA on the storage array, you need to ensure that all hosts in a Storage Group are in the same failover mode, that is failover mode 4 (ALUA).

ALUA behavior of VNX2 storage arrays

Although all EMC CLARiiON and VNX arrays use ALUA (asymmetric active-active) failover mode, VNX2 storage arrays might differ in their ALUA behavior.

Like all other EMC array LUNs, VNX2 array LUNs presented to the Data ONTAP system from dynamic disk pools use ALUA failover mode. However, VNX2 array LUNs presented to the Data ONTAP system from traditional RAID groups use active-active failover mode, with all the paths being reported as **AO** (active optimized). This behavior of the array LUNs changes during certain operations, such as Snapshot creation in the backend array.

Therefore, to maintain consistent behavior of VNX2 array LUNs, Data ONTAP treats these LUNs as ALUA, irrespective of whether these array LUNs are presented from traditional RAID groups or from dynamic disk pools.

In such a situation, the I/O requests for a given VNX2 LUN are distributed only over the paths reported to be in **INU** (in-use) state and not over all the paths reported as **AO** (active-optimized).

For example, if you have four paths to a VNX2 array LUN presented to the Data ONTAP system from a traditional RAID group, all of the paths are reported as **AO**; however, only two of the paths are in **INU** state, while the two other paths are not used but are in **RDY** (ready) state.

EMC CLARiiON storage array families

Data ONTAP does not support mixing some types of storage in aggregates. To help you determine the array LUNs that can be mixed in an aggregate, the storage arrays from each vendor are grouped into families. When you create aggregates, you cannot mix array LUNs from different vendors and from different storage array families in the same aggregate.

Storage arrays in the same family share the same performance and failover characteristics. For example, members of the same family all perform active-active failover, or they all perform active-passive failover. More than one factor might be used to determine storage array families. For example, storage arrays with different architectures would be in different families even though other characteristics might be the same.

> **Note:** CX storage arrays use the asymmetric active-active (ALUA) failover mode.

The following list shows CLARiiON storage arrays organized by family:

- Family 1

- CX4-120

- CX4-240

- CX4-480

- CX4-960

The Interoperability Matrix at *mysupport.netapp.com* is the final authority for which storage arrays are supported for each vendor.

EMC VNX storage array families

Data ONTAP does not support mixing some types of storage in aggregates. To help you determine the array LUNs that can be mixed in an aggregate, the storage arrays from each vendor are grouped into families. When you create aggregates, you cannot mix array LUNs from different vendors and from different storage array families in the same aggregate.

Storage arrays in the same family share the same performance and failover characteristics. For example, members of the same family all perform active-active failover, or they all perform active-passive failover. More than one factor might be used to determine storage array families. For example, storage arrays with different architectures would be in different families even though other characteristics might be the same.

   Note: VNX storage arrays use the asymmetric active-active (ALUA) failover mode.

The following list shows the supported storage arrays, which are all in the same family:

- Family 1

  - VNX5100

  - VNX5300

  - VNX5500

  - VNX5700

  - VNX7500

- Family 2

  - VNX5200

  - VNX5400

  - VNX5600

  - VNX5800

  - VNX7600

  - VNX8000

The Interoperability Matrix at *mysupport.netapp.com* is the final authority for which storage arrays are supported for each vendor.

EMC Symmetrix storage arrays

You must meet specific requirements when configuring storage arrays to work with Data ONTAP systems that use array LUNs. These requirements include setting configuration parameters on your storage arrays and deploying only supported configurations.

Required parameters for EMC Symmetrix storage arrays with Data ONTAP systems

Certain parameter settings are required on the storage array for the storage array to work successfully with Data ONTAP systems.

Required host channel director port configuration parameters

The host channel director port configuration parameters that must be set on the storage array are shown in the following table:

Parameter (names might differ between GUI and CLI)	Setting
`Common SN` (Common Serial Number or C-bit parameter)	Enable
`PP` (Point-to-Point parameter)	Enable
`SC3` (SCSI-3)	Enable
`SPC-2` (SCS2_Protocol_version, SCSI Primary Command 2 parameter, or "`Allow inquiry data to be compiled to the standard`")	Enable
`UWN` (Unique Worldwide Name)	Enable
`Volume Set Addressing`	Disable

The `Volume Set Addressing` parameter must be set the same way on all channel director ports to which the LUN is mapped. If the settings are different, Data ONTAP reports this as a LUN ID mismatch in `storage errors show` output and in an EMS message. See the *FlexArray Virtualization Installation Requirements and Reference Guide* for information about troubleshooting this error.

Required host configuration parameters

The settings for host configuration parameters are shown in the following table:

Parameter	Setting
`Host Type Format`	Server or Open systems
`SCSI3_persist_reserv` (Persistent Reservations)	On

General configuration guidelines

Information in this section includes cautions, restrictions, special requirements, and information about array characteristics that you might need to consider when configuring or using your storage array.

Requirements for implementing LUN security on EMC Symmetrix storage arrays

You use LUN security to eliminate the possibility of a host writing data to a LUN that is not owned by that host.

To eliminate the possibility of a non-Data ONTAP host overwriting EMC Symmetrix array LUNs owned by a Data ONTAP system or vice versa, you must present the Symmetrix logical devices through the host (channel) director ports in one of the following ways:

- Present only the Symmetrix logical devices for Data ONTAP on specific Symmetrix host (channel) director ports that are dedicated to Data ONTAP use.

  If ports cannot be dedicated to Data ONTAP, you should confirm that all other hosts using those ports are compatible with Data ONTAP requirements. This is because each host connected to the Symmetrix array has requirements for different port attribute settings. Sharing ports between multiple hosts that are connected to the Symmetrix storage array might result in an impossible-to-implement configuration.

- For VMAX storage arrays, create masking views for required mapping and masking by creating port groups, Storage Groups, and initiator groups.

  To achieve this, you must first enable the ACLX port attribute on the VMAX storage array ports.

  Attention: Do not present the VCMDB LUN to all hosts by default. Configure the global setting to restrict visibility to the VCMDB unless it has been specifically made visible to a particular host.

Caution about using the VCMDB LUN

For the VCMDB (Volume Configuration Management Database) to be enabled, the VCMDB LUN must exist. The VCMDB LUN is a `command` type LUN, not a storage LUN. The VCMDB is typically mapped to LUN 0, but can be mapped to an array LUN other than LUN 0.

If the VCMDB LUN is mapped to a Data ONTAP system, Data ONTAP periodically logs a message that the VCMDB LUN is less than the minimum size required, and it marks the VCMDB LUN as failed. The Data ONTAP system continues to function normally after logging this error message, but it cannot use the LUN.

A VCMDB LUN should be unmapped from a Data ONTAP system.

Caution about using the ACLX LUN

On VMAX arrays, the ACLX (Access Control Logix) LUN is created during initialization if the customer requests that ACLX be used. The ACLX LUN is not a storage LUN, so it should not be mapped to Data ONTAP.

If the ACLX LUN is mapped to a Data ONTAP system, Data ONTAP logs a message that the ACLX LUN is less than the minimum size required, and it marks the LUN as failed. The Data ONTAP system continues to function normally after logging this error message, but it cannot use the LUN.

The ACLX LUN should be unmapped from the front-end director ports on the Data ONTAP system.

Restriction on using gatekeeper LUNs

If a gatekeeper logical device (LUN) is presented, you must not map it to the Data ONTAP system. Data ONTAP systems cannot use gatekeeper LUNs. A gatekeeper LUN is a Symmetrix logical device through which SYMAPI or the ControlCenter agent communicates with the storage array.

EMC Symmetrix storage array families

Data ONTAP does not support mixing some types of storage in aggregates. To help you determine the array LUNs that can be mixed in an aggregate, the storage arrays from each vendor are grouped into families. When you create aggregates, you cannot mix array LUNs from different vendors and from different storage array families in the same aggregate.

Storage arrays in the same family share the same performance and failover characteristics. For example, members of the same family all perform active-active failover, or they all perform active-passive failover. More than one factor might be used to determine storage array families. For example, storage arrays with different architectures would be in different families even though other characteristics might be the same.

The following EMC Symmetrix storage arrays are supported with Data ONTAP systems:

- Family 1
  - VMAX SE
  - VMAX 40k
  - VMAX/VMAX 20k
  - VMAXe/VMAX 10k
- Family 2
  - VMAX 100K
  - VMAX 200K
  - VMAX 400K

The Interoperability Matrix at *mysupport.netapp.com* is the final authority for which storage arrays are supported for each vendor.

Hitachi storage arrays

You must meet certain requirements when configuring Hitachi storage arrays to work with Data ONTAP systems that use array LUNs. These requirements include setting configuration parameters on storage arrays and deploying only supported configurations.

Required parameters for Hitachi storage arrays with Data ONTAP systems

Certain parameter settings are required on the storage array for the storage array to work successfully with Data ONTAP systems.

Required system parameters for USP-V and USP-VM storage arrays

The required parameter settings are shown in the following table:

Parameter	Setting
LUN security	Enabled
Host mode	Standard or 00

Required system parameters for AMS and HUS storage arrays

The parameters that must be set are listed in the following table:

Parameter	Setting
Mapping mode	Enabled
Host group security	Enabled
Mode Setting > Common Setting	Standard Mode
Platform	Not specified
Middleware	Not specified

Required system parameters for VSP and HUS VM storage arrays

The parameters that must be set are listed in the following table:

Parameter	Setting
Host mode	Standard or 00
Port security	Enabled

> **Note:** A host group that is separate from the default host groups should be created for each initiator-target port pair.

The storage array parameters should be set and LUNs should be mapped to the host groups before the switch is zoned to connect the Data ONTAP system to the Hitachi storage array.

If Data ONTAP FC initiator ports are zoned with Hitachi array target ports before the storage array parameters are set and the LUNs are mapped to the host groups, you might not be able to see any LUNs presented to the Data ONTAP interface.

In this situation, Data ONTAP generates one of the following EMS messages:

```
[fci.device.login.reject:info] The PLOGI transmitted by port XX was
rejected by port_id 0xYYYY with reason code 0x9 'Invalid R_CTL Field',
explanation code 0x29 'Insufficient Resources to Support Login'
[fci.device.login.reject:info]: The PLOGI transmitted by port XX was
rejected by port_id 0xYYYY with reason code 0x3 'Nx_Port Not Available,
Temporary', explanation code 0x29 'Insufficient Resources to Support Login'
```

Workaround

If zoning was configured prior to setting the parameters and mapping the LUNs to the host groups, you can resolve the problem of LUNs not being visible by performing a path re-initialization to force a rediscovery of the array LUNs that are mapped from the Hitachi storage array. See *Workaround when LUNs are not visible with Hitachi storage arrays* on page 18 for the workaround to this problem.

Workaround when LUNs are not visible with Hitachi storage arrays

The storage array parameters specified in the *Required parameters for Hitachi storage arrays with systems running Data ONTAP* on page 17 topic should be set and LUNs should be mapped to the host groups before the switch is zoned to connect the Data ONTAP system that uses array LUNs to a Hitachi storage array.

If zoning was configured prior to setting the parameters and mapping the LUNs to the host groups, you can resolve the problem of LUNs not being visible by performing a path reinitialization. The path reinitialization forces a rediscovery of the array LUNs that are mapped from a Hitachi storage array.

The procedure you use depends on whether aggregates with Hitachi array LUNs have already been configured on the Data ONTAP system. (In the following procedures, assume that Node-1 and Node-2 are the names of the Data ONTAP nodes.)

If aggregates with Hitachi array LUNs are already created on a Data ONTAP system that uses array LUNs

1. Run the following command to ensure that HA configuration is enabled on your Data ONTAP systems:

   cluster ha show

   The following output is displayed:

   ```
   High Availability Configured: true
   ```

2. Run the following command to ensure that storage failover is configured on your Data ONTAP systems:

   storage failover show

   The following output is displayed:

   ```
             Takeover
   Node          Partner       Possible State Description
   -------------- -------------- --------
   -----------------------------------
   Node-1    Node-2    true     Connected to Node-2
   Node-2    Node-1    true     Connected to Node-1
   2 entries were displayed.
   ```

3. Run the following command to perform a takeover operation on Node-1:

```
storage failover takeover -ofnode Node-1
```

4. Run the following command again to verify that Node-2 is ready for a giveback operation:

```
storage failover show
```

The following output is displayed:

```
          Takeover
 Node           Partner        Possible State Description
-------------- -------------- --------
-------------------------------------
 Node-2    Node-1    false    In takeover, Auto giveback will be
                                      initiated in 348 seconds
 Node-1    Node-2    -        Waiting for giveback (HA mailboxes)
 2 entries were displayed.
```

5. Run the following command to perform a giveback operation on Node-1:

```
storage failover giveback -ofnode Node-1 -require-partner-waiting true
```

6. From other nodes in the cluster, repeat Step 3 through Step 5.

If aggregates with Hitachi array LUNs have not been created on a Data ONTAP system that uses array LUNs

1. Run the following command to list all the Data ONTAP FC initiator ports that are connected to the Hitachi storage array:

```
system node run -node <node name> -command "sysconfig -v"
```
For example:

```
system node run -node Node-1 -command "sysconfig -v"
```

2. Run the following command to take all the listed ports offline:

```
system node run -node <node name> -command "priv set advanced;fcadmin
offline <adapter>"
```
For example:

```
system node run -node Node-1 -command "priv set advanced;fcadmin offline
0a"
```

3. Run the following command to bring all the listed ports online:

```
system node run -node <node name> -command "priv set advanced;fcadmin
online <adapter>"
```
For example:

```
system node run -node Node-1 -command "priv set advanced;fcadmin online
0a"
```

General configuration guidelines

Information in this section includes cautions, restrictions, special requirements, and information about array characteristics that you might need to consider when configuring or using your storage array.

Requirements for creating LUNs in dynamic pools

When creating LUNs in the dynamic pools, do not over-provision the pool capacity.

Requirements for formatting array LUNs

You can perform different types of array LUN formatting. Each type has an impact on the availability of LUNs or the entire storage array.

If you must present a new LUN to the Data ONTAP system immediately, you should use quick formatting. If you plan to present LUNs to the Data ONTAP system in the future, quick formatting is recommended but Online formatting is acceptable.

Quick formatting is recommended because both Online and Offline formatting delay disk discovery until after the LUN formatting is complete, as described in the following list:

- Online formatting takes the array LUN that is being formatted completely offline, and the array LUN does not respond to any SCSI commands.
  Formatting is performed on one array LUN at a time until all array LUNs are formatted.

- Offline formatting takes the entire storage array offline and the storage array does not respond to any SCSI commands.
  The array LUNs are formatted six at a time per controller until the formatting is complete.
  The storage array does not respond until all formatting is complete.

- If you are creating array LUNs (for any host) after initial setup of the Data ONTAP system and you are using Offline formatting, the system panics.
  Any array LUNs that are mapped to the Data ONTAP system, including array LUNs in the root volume, become unavailable until formatting is complete.

- Online and quick formatting of LUNs for other hosts do not impact the Data ONTAP system.

Requirements for using disks external to the storage array

Data ONTAP supports using the same disks behind the storage arrays that the vendor supports (that is, disks external to the storage array). Data ONTAP assumes that the configuration between the storage array and the external disks behind it is correct.

The following list shows restrictions and best practice recommendations for deploying storage arrays that use external disks:

- Root volumes and spare core LUNs are not supported on external disks.

- Array LUNs from external and internal disks should not be in the same Data ONTAP aggregate.

- Array LUNs from SATA drives and array LUNs from FC drives should not be in the same aggregate.

- Rules for the number of paths to array LUNs on external disks are the same as for array LUNs on disks on the storage array.
  In the case of external disks, the paths go from the Data ONTAP system through the storage array to the external disks. See the *FlexArray Virtualization Installation Requirements and Reference Guide* for information about the number of paths supported for different Data ONTAP releases and modes.

- Only block checksum is supported for array LUNs on external disks.

Guidelines for configuring ports on Hitachi storage arrays

You should follow certain guidelines when configuring ports on Hitachi storage arrays.

The guidelines for configuring ports on Hitachi storage arrays are as follows:

- You should add only one host group per port.

- You should ensure that a host group includes all the FC initiator ports of the V-Series systems in an array LUN neighborhood.

Hitachi storage array families

Data ONTAP does not support mixing some types of storage in aggregates. To help you determine the array LUNs that can be mixed in an aggregate, the storage arrays from each vendor are grouped into families. When you create aggregates, you cannot mix array LUNs from different vendors and from different storage array families in the same aggregate.

Storage arrays in the same family share the same performance and failover characteristics. For example, members of the same family all perform active-active failover, or they all perform active-passive failover. More than one factor might be used to determine storage array families. For example, storage arrays with different architectures would be in different families even though other characteristics might be the same.

The following list shows the storage arrays organized by family:

- Family 1
  - USP-V
  - USP-VM
- Family 2
  - VSP
  - VSP G1000
- Family 3
  - AMS 2100
  - AMS 2300
  - AMS 2500
- Family 4
  - HUS 110
  - HUS 130
  - HUS 150
- Family 5
  - HUS VM

The Interoperability Matrix at *mysupport.netapp.com* is the final authority for which storage arrays are supported for each vendor.

HP EVA storage arrays

You must meet certain requirements when configuring storage arrays to work with Data ONTAP systems. These requirements include setting configuration parameters on storage arrays and deploying only supported configurations.

Required parameters for HP EVA arrays with Data ONTAP systems

Certain parameter settings are required on the storage array for the storage array to work successfully with Data ONTAP systems.

System parameter settings are provided in the following table:

Parameter	Setting
Redundancy	Any RAID level except VRAID0
Preferred path/mode	No preference (default)
Host type	SUN Solaris

General configuration guidelines

Information in this section includes cautions, restrictions, special requirements, and information about array characteristics that you might need to consider when configuring or using your storage array.

Requirements for configuring the HP EVA Storage Management Server

Sharing FC initiator ports present on a Data ONTAP system and initiator ports present on an HP EVA Storage Management Server with common EVA target ports causes compatibility issues.

The compatibility issues result from the different host settings for the FC initiator ports present on a Data ONTAP system and the EVA Storage Management Server initiator ports.

HP recommends that any HP EVA Storage Management Server that resides in a fabric be configured in a zone that is separate from all operating systems.

Preparing HP EVA storage arrays for NDU

HP EVA storage arrays have a tendency to bring target ports offline during a firmware upgrade. Starting in Data ONTAP 8.2, Data ONTAP provides commands that increase Data ONTAP resiliency so that the Data ONTAP system is not disrupted if target ports go offline during the firmware upgrade. These commands can be used only with storage systems running clustered Data ONTAP.

About this task

You must follow the guidelines provided by HP for performing the firmware upgrade, including guidelines about the load recommendation (HP EVA). You can upgrade only to firmware that HP supports. This procedure pertains to the HP EVA firmware upgrade type *online upgrade*.

Note: During the firmware upgrade, both HP EVA controllers are rebooted.

This procedure instructs you to use Data ONTAP commands that increase Data ONTAP resiliency throughout the firmware upgrade. After the firmware upgrade is complete, you use the Data ONTAP commands again to return the ports to their normal operating mode.

Steps

1. On the Data ONTAP system, set the privilege level of the command session to advanced:

   `set -privilege advanced`

2. Set the `is-upgrade-pending` parameter to **true** for the HP EVA storage array that is undergoing a firmware upgrade:

   `storage array modify -name array_name -is-upgrade-pending true`

3. On the storage array, start the firmware upgrade.

4. After the firmware upgrade is complete, set the privilege level to advanced again, if necessary, and then on the Data ONTAP system, set the `is-upgrade-pending` parameter to **false** to return the storage array ports to normal operation:

   `storage array modify -name array_name -is-upgrade-pending false`

   If you did not exit advanced mode in Step 2 you do not need to access it again.

   The `is-upgrade-pending` parameter contains the following features to ensure proper use of the command:

   - If you attempt to set `is-upgrade-pending` to **false** while the upgrade is in progress on the storage array, the command fails and an EMS message is returned.

   - If the `is-upgrade-pending` status is not returned to **false** within 60 minutes from the time it is set to **true**, EMS messages are logged hourly until `is-upgrade-pending` is returned to **false**.

ALUA support for HP EVA storage arrays

Starting with Data ONTAP 8.1, support has been added for asymmetric logical unit access (ALUA) with HP EVA arrays.

By default, support for ALUA is enabled in Data ONTAP as well as on all the HP EVA storage arrays.

HP EVA storage array families

Data ONTAP does not support mixing some types of storage in aggregates. To help you determine the array LUNs that can be mixed in an aggregate, the storage arrays from each vendor are grouped into families. When you create aggregates, you cannot mix array LUNs from different vendors and from different storage array families in the same aggregate.

Storage arrays in the same family share the same performance and failover characteristics. For example, members of the same family all perform active-active failover, or they all perform active-passive failover. More than one factor might be used to determine storage array families. For example, storage arrays with different architectures would be in different families even though other characteristics might be the same.

The following list shows the storage arrays organized by family:

- Family 1

  ○ P6300

  ○ P6350

- ◦ P6500

- ◦ P6550

- • Family 2: HP EVAx100

  - ◦ EVA 4100

  - ◦ EVA 6100

  - ◦ EVA 8100

- • Family 3

  - ◦ EVA 4400

  - ◦ EVA 6400

  - ◦ EVA 8400

The Interoperability Matrix at *mysupport.netapp.com* is the final authority for which storage arrays are supported for each vendor.

HP XP storage arrays

You must meet certain requirements when configuring storage arrays to work with Data ONTAP systems that use array LUNs. These requirements include setting configuration parameters on storage arrays and deploying only supported configurations.

Required parameters for HP XP storage arrays with Data ONTAP systems

Certain parameter settings are required on the storage array for the storage array to work successfully with Data ONTAP systems.

Required system parameters for HP XP storage arrays

The required parameter settings are shown in the following table:

Parameter	Setting
Host mode	Standard or 00
Port security	Enabled

Note: A host group that is separate from the default host groups should be created for each initiator-target port pair.

The storage array parameters should be set and LUNs should be mapped to the host groups before the switch is zoned to connect the Data ONTAP system to an HP XP storage array.

If Data ONTAP FC initiator ports are zoned with HP XP array target ports before the storage array parameters are set and the LUNs are mapped to the host groups, you might not be able to see any LUNs presented to the Data ONTAP interface.

In this situation, Data ONTAP generates one of the following EMS messages:
`[fci.device.login.reject:info]` The PLOGI transmitted by port XX was rejected by port_id 0xYYYY with reason code 0x9 'Invalid R_CTL Field', explanation code 0x29 'Insufficient Resources to Support Login'
`[fci.device.login.reject:info]`: The PLOGI transmitted by port XX was rejected by port_id 0xYYYY with reason code 0x3 'Nx_Port Not Available, Temporary', explanation code 0x29 'Insufficient Resources to Support Login'

Workaround

If zoning was configured prior to setting the parameters and mapping the LUNs to the host groups, you can resolve the problem of LUNs not being visible by performing a path re-initialization to force a rediscovery of the array LUNs that are mapped from the HP XP storage array. See *Workaround when LUNs are not visible with HP XP storage arrays* on page 25.

Workaround when LUNs are not visible with HP XP storage arrays

The storage array parameters specified in the *Required parameters for HP XP storage arrays with Data ONTAP systems* on page 25 topic should be set and LUNs should be mapped to the host groups

before the switch is zoned to connect the Data ONTAP system that uses array LUNs to an HP XP storage array.

If zoning was configured prior to setting the parameters and mapping the LUNs to the host groups, you can resolve the problem of LUNs not being visible by -performing a path reinitialization. The path reinitialization forces a rediscovery of the array LUNs that are mapped from a HP XP storage array.

The procedure you use depends on whether aggregates with HP XP array LUNs have already been configured on the Data ONTAP system. (In the following procedures, assume that Node-1 and Node-2 are the names of the Data ONTAP nodes.)

If aggregates with HP XP array LUNs are already created on a Data ONTAP system that uses array LUNs

1. Run the following command to ensure that HA configuration is enabled on your Data ONTAP systems:

   cluster ha show

   The following output is displayed:

   ```
   High Availability Configured: true
   ```

2. Run the following command to ensure that storage failover is configured on your Data ONTAP systems:

   storage failover show

   The following output is displayed:

   ```
             Takeover
   Node          Partner        Possible State Description
   -------------- -------------- --------
   -------------------------------------
   Node-1    Node-2    true     Connected to Node-2
   Node-2    Node-1    true     Connected to Node-1
   2 entries were displayed.
   ```

3. Perform a takeover operation on Node-1 by running the following command:

   storage failover takeover -ofnode Node-1

4. Run the following command again to verify that Node-2 is ready for a giveback operation:

   storage failover show

   The following output is displayed:

   ```
             Takeover
   Node          Partner        Possible State Description
   -------------- -------------- --------
   -------------------------------------
   Node-2    Node-1    false    In takeover, Auto giveback will be
                                         initiated in 348 seconds
   Node-1    Node-2    -        Waiting for giveback (HA mailboxes)
   2 entries were displayed.
   ```

5. Perform a giveback operation on Node-1 by running the following command:

   storage failover giveback -ofnode Node-1 -require-partner-waiting true

6. From other nodes in the cluster, repeat Step 3 through Step 5.

If aggregates with HP XP array LUNs have not been created on a Data ONTAP system that uses array LUNs

1. Run the following command to list all the Data ONTAP FC initiator ports that are connected to the HP XP storage array:

   ```
   system node run -node <node name> -command "sysconfig -v"
   ```
   For example:

   ```
   system node run -node Node-1 -command "sysconfig -v"
   ```

2. Run the following command to take all the listed ports offline:

   ```
   system node run -node <node name> -command "priv set advanced;fcadmin
   offline <adapter>"
   ```
   For example:

   ```
   system node run -node Node-1 -command "priv set advanced;fcadmin offline
   0a"
   ```

3. Run the following command to bring all the listed ports online:

   ```
   system node run -node <node name> -command "priv set advanced;fcadmin
   online <adapter>"
   ```
   For example:

   ```
   system node run -node Node-1 -command "priv set advanced;fcadmin online
   0a"
   ```

General configuration guidelines

Information in this section includes cautions, restrictions, special requirements, and information about array characteristics that you might need to consider when configuring or using your storage array.

Requirements for creating LUNs in dynamic pools

When creating LUNs in the dynamic pools, do not over-provision the pool capacity.

Requirements for formatting array LUNs

You can perform different types of array LUN formatting. Each type has an impact on the availability of LUNs or the entire storage array.

If you must present a new LUN to the Data ONTAP system immediately, you should use quick formatting. If you plan to present LUNs to the Data ONTAP system in the future, quick formatting is recommended but Online formatting is acceptable.

Quick formatting is recommended because both Online and Offline formatting delay disk discovery until after the LUN formatting is complete, as described in the following list:

- Online formatting takes the array LUN that is being formatted completely offline, and the array LUN does not respond to any SCSI commands.
  Formatting is performed on one array LUN at a time until all array LUNs are formatted.

- Offline formatting takes the entire storage array offline and the storage array does not respond to any SCSI commands.
  The array LUNs are formatted six at a time per controller until the formatting is complete.
  The storage array does not respond until all formatting is complete.

- If you are creating array LUNs (for any host) after initial setup of the Data ONTAP system and you are using Offline formatting, the system panics.

Any array LUNs that are mapped to the Data ONTAP system, including array LUNs in the root volume, become unavailable until formatting is complete.

- Online and quick formatting of LUNs for other hosts do not impact the Data ONTAP system.

Requirements for using disks external to the storage array

Data ONTAP supports using the same disks behind the storage arrays that the vendor supports (that is, disks external to the storage array). Data ONTAP assumes that the configuration between the storage array and the external disks behind it is correct.

The following list shows restrictions and best practice recommendations for deploying storage arrays that use external disks:

- Root volumes and spare core LUNs are not supported on external disks.

- Array LUNs from external and internal disks should not be in the same Data ONTAP aggregate.

- Array LUNs from SATA drives and array LUNs from FC drives should not be in the same aggregate.

- Rules for the number of paths to array LUNs on external disks are the same as for array LUNs on disks on the storage array.
  In the case of external disks, the paths go from the Data ONTAP system through the storage array to the external disks. See the *FlexArray Virtualization Installation Requirements and Reference Guide* for information about the number of paths supported for different Data ONTAP releases and modes.

- Only block checksum is supported for array LUNs on external disks.

Guidelines for configuring ports on HP XP storage arrays

You should follow certain guidelines when configuring ports on HP XP storage arrays.

The guidelines for configuring ports on HP XP storage arrays are as follows:

- You should add only one host group per port.

- You should ensure that a host group includes all the FC initiator ports of the V-Series systems in an array LUN neighborhood.

HP XP storage array families

Data ONTAP does not support mixing some types of storage in aggregates. To help you determine the array LUNs that can be mixed in an aggregate, the storage arrays from each vendor are grouped into families. When you create aggregates, you cannot mix array LUNs from different vendors and from different storage array families in the same aggregate.

Storage arrays in the same family share the same performance and failover characteristics. For example, members of the same family all perform active-active failover, or they all perform active-passive failover. More than one factor might be used to determine storage array families. For example, storage arrays with different architectures would be in different families even though other characteristics might be the same.

The following list shows the storage arrays organized by family:

- Family 1

  ◦ P9500

  ◦ XP7

- Family 2

- ◦ XP24000

- ◦ XP20000

The Interoperability Matrix at *mysupport.netapp.com* is the final authority for which storage arrays are supported for each vendor.

IBM DS storage arrays

You must meet certain requirements when configuring storage arrays to work with Data ONTAP systems that use array LUNs. These requirements include setting configuration parameters on storage arrays and deploying only supported configurations.

Required settings for IBM DS storage arrays with Data ONTAP systems

Certain parameter settings are required on the storage array for the storage array to work successfully with Data ONTAP systems.

Required host type for DS8xxx storage arrays

The required host type setting is shown in the following table:

Parameter	Setting
Host type	nseries

Requirements for configuring DS8300 9A2 LPAR models

When setting up the DS8300 9A2 LPAR (system logical partition) model to interact with Data ONTAP systems, you must set up access to each array LUN so that the redundant paths are both accessing the same LPAR.

General configuration guidelines

Information in this section includes cautions, restrictions, special requirements, and information about array characteristics that you might need to consider when configuring or using your storage array.

Requirements for volume groups on DS8xxx storage arrays

You must be aware of limitations on the number of volume groups that you can use with a LUN group when configuring DS8xxx arrays.

You must use a single volume group for each LUN group on a DS8xxx storage array to guarantee that the DS8xxx array LUNs are consistently presented to all the FC initiators (that are on the Data ONTAP system) that access them.

> **Attention:** If array LUNs are not presented consistently, there is a potential for data corruption.

IBM DS storage array families

Data ONTAP does not support mixing some types of storage in aggregates. To help you determine the array LUNs that can be mixed in an aggregate, the storage arrays from each vendor are grouped into families. When you create aggregates, you cannot mix array LUNs from different vendors and from different storage array families in the same aggregate.

Storage arrays in the same family share the same performance and failover characteristics. For example, members of the same family all perform active-active failover, or they all perform active-passive failover. More than one factor might be used to determine storage array families. For

example, storage arrays with different architectures would be in different families even though other characteristics might be the same.

The following list shows arrays organized by family:

- Family 1

  ◦ DS8300

  ◦ DS8100

- Family 2

  ◦ DS8800 model 951

  ◦ DS8700 models 941, 94E

  ◦ DS8870

The Interoperability Matrix at *mysupport.netapp.com* is the final authority for which storage arrays are supported for each vendor.

IBM XIV storage arrays

You must meet certain requirements when configuring storage arrays to work with Data ONTAP systems that use array LUNs. These requirements include setting configuration parameters on storage arrays and deploying only supported configurations.

Requirements for configuring IBM XIV arrays with Data ONTAP systems

Certain parameter settings are required on the storage array for the storage array to work successfully with Data ONTAP systems.

System parameter settings

The following table lists the system parameter settings for IBM XIV Gen3 arrays:

Parameter	Setting
Type	Default
Host	User-supplied host name
Cluster	User-supplied cluster name

IBM XIV storage array families

Data ONTAP does not support mixing some types of storage in aggregates. To help you determine the array LUNs that can be mixed in an aggregate, the storage arrays from each vendor are grouped into families. When you create aggregates, you cannot mix array LUNs from different vendors and from different storage array families in the same aggregate.

Storage arrays in the same family share the same performance and failover characteristics. For example, members of the same family all perform active-active failover, or they all perform active-passive failover. More than one factor might be used to determine storage array families. For example, storage arrays with different architectures would be in different families even though other characteristics might be the same.

The following list shows the IBM XIV storage arrays supported with Data ONTAP systems:

- IBM XIV Gen 3

  ◦ 2810-114

  ◦ 2812-114

The Interoperability Matrix at *mysupport.netapp.com* is the final authority for which storage arrays are supported for each vendor.

3PAR storage arrays

You must meet certain requirements when configuring storage arrays to work with Data ONTAP systems that use array LUNs. These requirements include setting configuration parameters on storage arrays and deploying only supported configurations.

Required parameters for 3PAR arrays with Data ONTAP systems

Certain parameter settings are required on the storage array for the storage array to work successfully with Data ONTAP systems.

Host persona settings

For 3PAR arrays with firmware 2.3.1 and later, the required host persona values must be set as shown in the following table:

Connection type	Host persona
Direct connect	10
Fabric attached	10

The host definition, with the required host persona, should be created on a 3PAR storage array before the switch is zoned to connect the Data ONTAP system to a 3PAR storage array. If zoning is configured before the host definition, Data ONTAP discovers a 3PAR LUN as LUN 254 and product type SES, which Data ONTAP cannot use. The result is that newly mapped 3PAR LUNs cannot be assigned to Data ONTAP system and some 3PAR LUNs that might have already been added to an aggregate cannot be used because Data ONTAP sees a LUN 254 instead of a 3PAR LUN. If this problem occurs, Data ONTAP generates the following EMS message:

```
mlm.array.unknown:warning - Array LUN XXXXXXXX.126L254 [S/N 'XXXXXXX'
vendor '3PARdata' product 'SES'] is unknown and is not supported in this
version of Data ONTAP.
```

If zoning was configured prior to the host definition, you can resolve the problem by doing path re-initialization to force a rediscovery of the array LUNs that are mapped from the 3PAR storage array. See *Workaround for the unknown device (L254/SES) problem with 3PAR storage arrays* on page 33 for the workaround for this problem.

Port persona settings

For 3PAR arrays with firmware 2.2.x, the required port persona values must be set as shown in the following table:

Connection type	Port persona
Direct connect	18
Fabric attached	19

Workaround for the unknown device (L254/SES) problem with 3PAR storage arrays

The host definition, with the host persona specified in the *Required parameters for 3PAR arrays with Data ONTAP systems* on page 33, should be created on a 3PAR storage array before the switch is

zoned to connect the Data ONTAP system to a 3PAR storage array. If zoning is configured before the host definition, Data ONTAP discovers a 3PAR array LUN as LUN 254 and product type SES, which Data ONTAP cannot use.

When Data ONTAP discovers 3PAR array LUNs as LUN 254 and product type SES, newly mapped 3PAR LUNs cannot be assigned to Data ONTAP systems and some 3PAR LUNs that might have already been added to an aggregate cannot be used because Data ONTAP sees a LUN 254. Data ONTAP generates EMS messages for the LUN it discovered as LUN 254 and product type SES, reporting some LUNs as unknown devices.

If zoning was configured before the host definition, you can resolve the LUN 254/SES unknown device problem by forcing a rediscovery of the array LUNs that are mapped from the 3PAR storage array. The procedure you use depends on whether aggregates with 3PAR array LUNs have already been configured on the Data ONTAP system. (In the following procedures, assume that Node-1 and Node-2 are the names of the Data ONTAP nodes.)

If aggregates with 3PAR array LUNs were already created on a clustered Data ONTAP system

1. Run the following command to ensure that an HA configuration is enabled on your Data ONTAP systems:

   cluster ha show
   The following output is displayed:

   ```
   High Availability Configured: true
   ```

2. Run the following command to ensure that storage failover is configured on your Data ONTAP systems:

   storage failover show
   The following output is displayed:

   ```
             Takeover
   Node          Partner        Possible State Description
   -------------- -------------- --------
   -------------------------------------
   Node-1    Node-2    true     Connected to Node-2
   Node-2    Node-1    true     Connected to Node-1
   2 entries were displayed.
   ```

3. Perform a takeover operation on Node-1 by running the following command:

   storage failover takeover -ofnode Node-1

4. Run the following command again to verify that Node-2 is ready for a giveback operation:

   storage failover show
   The following output is displayed:

   ```
             Takeover
   Node          Partner        Possible State Description
   -------------- -------------- --------
   -------------------------------------
   Node-2    Node-1    false    In takeover, Auto giveback will be
                                          initiated in 348 seconds
   Node-1    Node-2    -        Waiting for giveback (HA mailboxes)
   2 entries were displayed.
   ```

5. Perform a giveback operation on Node-1 by running the following command:

   storage failover giveback -ofnode Node-1 -require-partner-waiting true

6. From other nodes in the cluster, repeat Step 3 through Step 5.

If aggregates with 3PAR array LUNs have not been created on a clustered Data ONTAP system

1. Run the following command to list all of the Data ONTAP FC initiator ports that are connected to the 3PAR storage array:

```
system node run -node <node name> -command "sysconfig -v"
```

The following example shows the command with a specific node name included:

```
system node run -node Node-1 -command "sysconfig -v"
```

2. Run the following command to take all of the listed ports offline:

```
system node run -node <node name> -command "priv set advanced;fcadmin
offline <adapter>"
```

The following example shows the command with a specific node name and adapter included:

```
system node run -node Node-1 -command "priv set advanced;fcadmin offline
0a"
```

3. Run the following command to bring all of the listed ports online:

```
system node run -node <node name> -command "priv set advanced;fcadmin
online <adapter>"
```

The following example shows the command with a specific node name and adapter included:

```
system node run -node Node-1 -command "priv set advanced;fcadmin online
0a"
```

General configuration guidelines

Information in this section includes cautions, restrictions, special requirements, and information about array characteristics that you might need to consider when configuring or using your storage array.

3PAR storage array families

Data ONTAP does not support mixing some types of storage in aggregates. To help you determine the array LUNs that can be mixed in an aggregate, the storage arrays from each vendor are grouped into families. When you create aggregates, you cannot mix array LUNs from different vendors and from different storage array families in the same aggregate.

Storage arrays in the same family share the same performance and failover characteristics. For example, members of the same family all perform active-active failover, or they all perform active-passive failover. More than one factor might be used to determine storage array families. For example, storage arrays with different architectures would be in different families even though other characteristics might be the same.

The following list shows the storage arrays organized by family:

- Family 1

  ◦ T400

  ◦ T800

- Family 2

  ◦ F200

- ◦ F400

- Family 3

  - ◦ 3PAR StoreServ 7200

  - ◦ 3PAR StoreServ 7400

  - ◦ 3PAR StoreServ 10400

  - ◦ 3PAR StoreServ 10800

The Interoperability Matrix at *mysupport.netapp.com* is the final authority for which storage arrays are supported for each vendor.

Supported fabric-attached configurations

The fabric-attached configurations included in this section are supported for all the storage array vendors unless mentioned otherwise.

For additional information about configuration with specific storage arrays, see the Interoperability Matrix at *mysupport.netapp.com*.

Stand-alone basic configuration

The stand-alone basic configuration of a Data ONTAP system that uses array LUNs is a simple, fabric-attached configuration with a single FC initiator port pair accessing a single LUN group.

This configuration is supported for use with all storage arrays listed in the *Interoperability Matrix* as supported for the release and mode of Data ONTAP running on your system.

The following illustration shows this configuration:
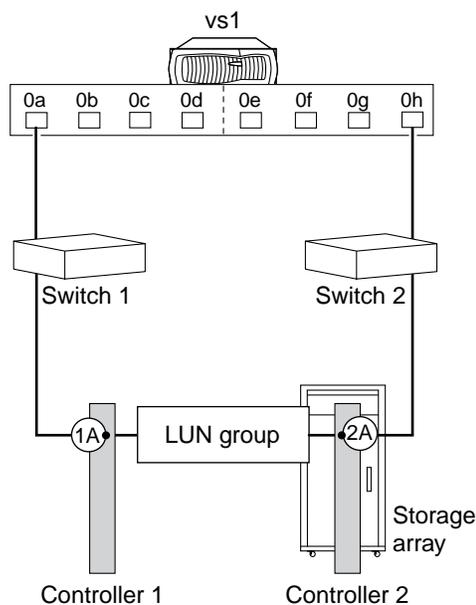
Stand-alone with two 2-port array LUN groups

In a stand-alone Data ONTAP system which is in a fabric-attached simple configuration, each FC initiator port pair present on the Data ONTAP system accesses a separate array LUN group.

This configuration is supported for use with all storage arrays listed in the *Interoperability Matrix* as supported for the release and mode of Data ONTAP running on your system.

The following illustration shows this configuration:
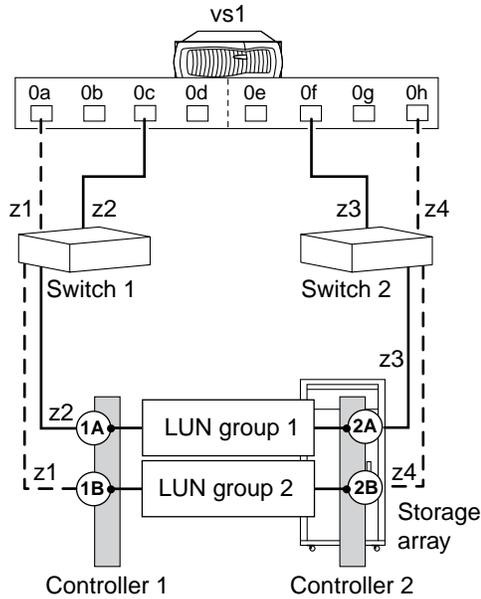
Single 4-port array LUN group

This configuration contains a single, 4-port LUN group with each target port accessed by a single Data ONTAP FC initiator port from the HA pair. Zoning ensures that there are only two paths to a specific array LUN from each Data ONTAP system.

This configuration is supported for use with all storage arrays listed in the *Interoperability Matrix* as supported for the release and mode of Data ONTAP running on your system.

The following illustration shows this configuration:
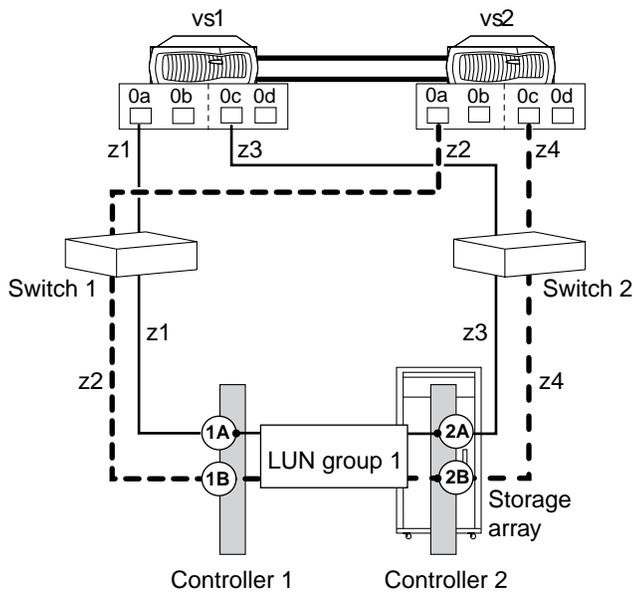
Two 4-port array LUN groups

In this configuration, each Data ONTAP FC initiator port pair accesses a separate array LUN group. The zoning is a single Data ONTAP FC initiator to a single array target port.

This configuration is supported for use with all storage arrays listed in the *Interoperability Matrix* as supported for the release and mode of Data ONTAP running on your system.

The following illustration shows a block diagram of this configuration:
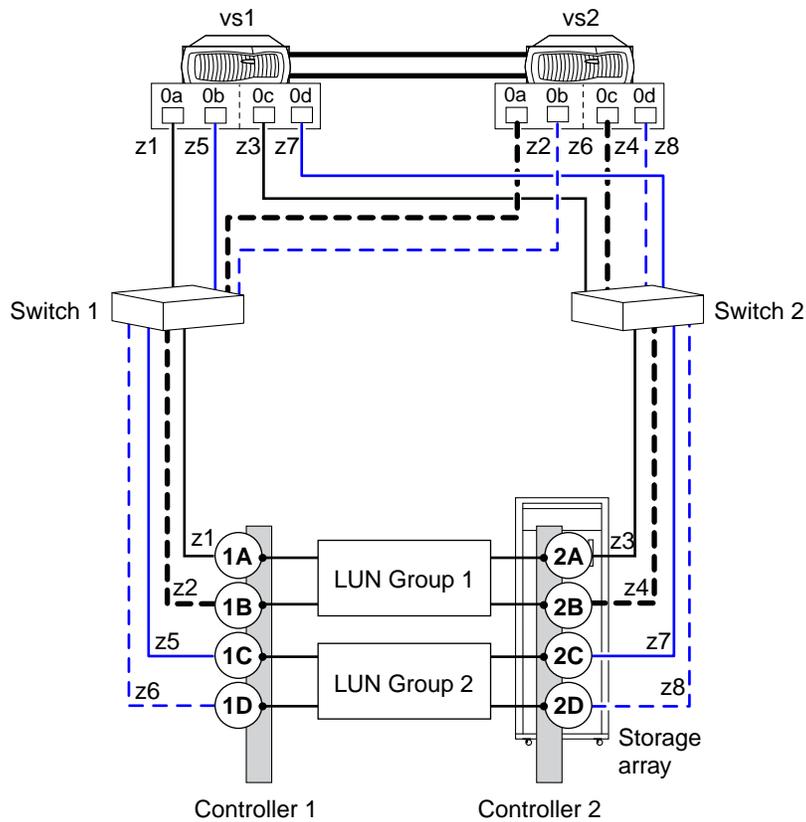
Eight-port array LUN group configuration

Starting in Data ONTAP 8.2, an eight-port LUN group configuration is supported on clustered V-Series systems and, starting in Data ONTAP 8.2.1, also on Data ONTAP systems that can use array LUNs.

This configuration is supported for use with all storage arrays listed in the *Interoperability Matrix* as supported for the release and mode of Data ONTAP running on your system.

There are two ways of deploying this configuration: crossed and uncrossed back-end connections.

Crossed back-end connections

In this configuration with the back-end connections crossed, the FC connections from the same storage array controller go to both fabric switches (redundant).

In this illustration of crossed back-end connections, note how the nodes are attached to the switches and to the storage array. Vs1 uses switch 1 when attaching to the storage array Controller 1 port 1A and Controller 2 port 2C, and uses switch 2 when attaching to storage array Controller 2 ports 2A and

Controller 1 port 1C. This optimizes the use of switch ports and array ports, which reduces the impact of a switch or storage array controller failure.
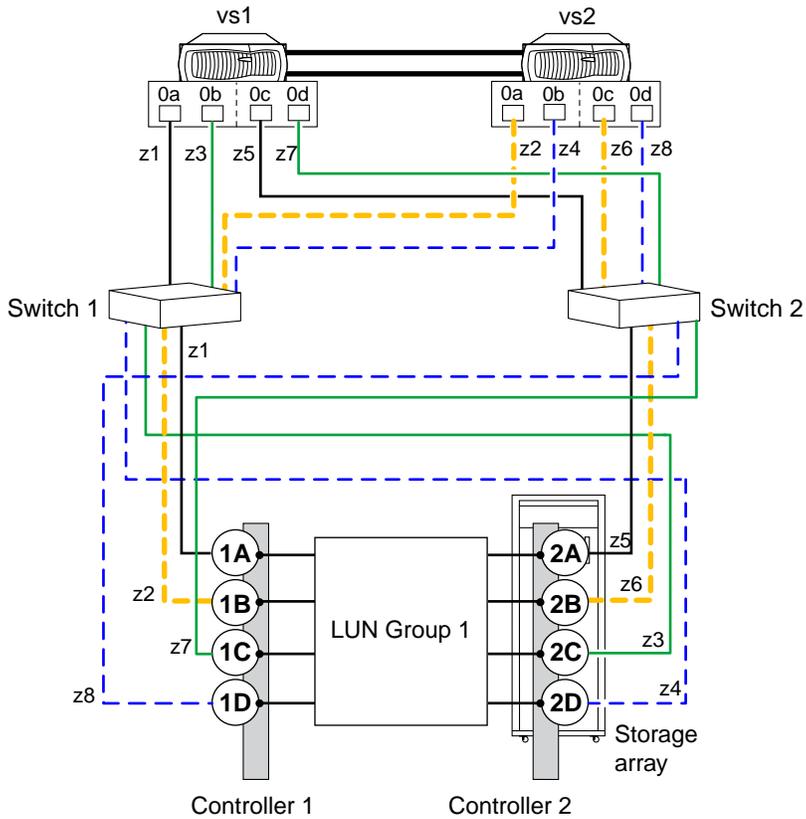
Note: The following problem can occur with Active-Passive storage arrays in crossed back-end connections: If one of the fabric switches is taken offline or goes down and a path failure from both Data ONTAP systems occurs, the Data ONTAP systems panic even though the alternate path from each system is still online. For example, if switch 2 is down and the "0b" paths on both vs1 and vs2 go down, vs1 and vs2 panic even though the "0a" paths are still online.

Back-end connections are not crossed

In this configuration in which the back-end connections are not crossed, the FC connections from the same storage array controller go to only one fabric switch.

The following illustration shows this configuration when the back-end connections are not crossed.
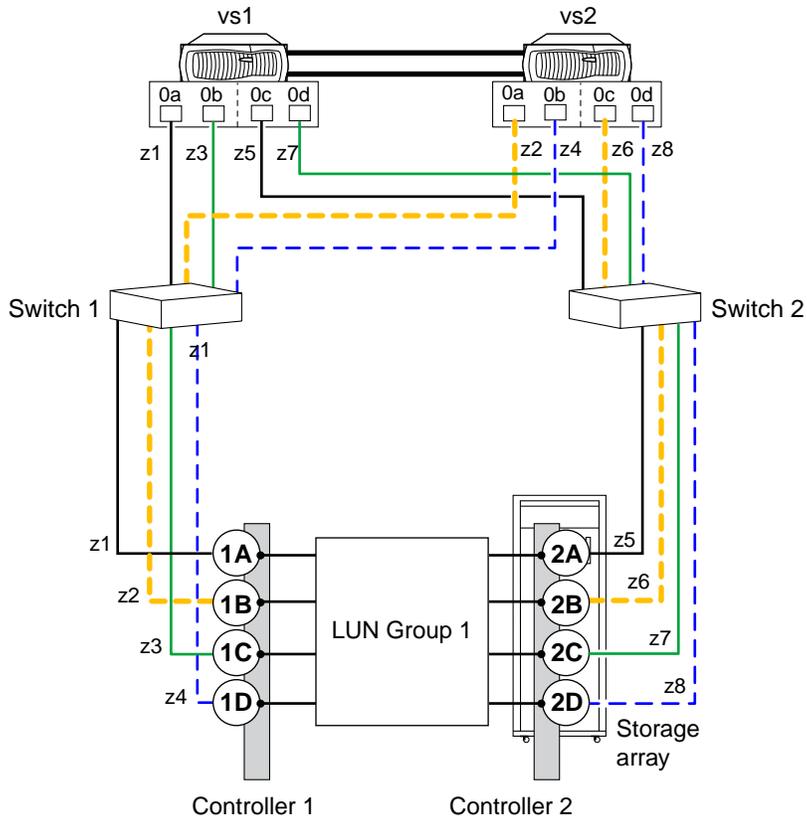
Data ONTAP FC initiator port attaching to multiple targets ports

Starting in Data ONTAP 8.2, a Data ONTAP FC initiator port can be attached to multiple target ports on separate storage arrays within the same family. The *FlexArray Virtualization Installation Requirements and Reference Guide* contains the rules for setting up this configuration. This configuration is not supported with MetroCluster configurations.

This configuration is supported for use with all storage arrays listed in the *Interoperability Matrix* as supported for the release and mode of Data ONTAP running on your system.

The following illustration shows a shared Data ONTAP FC initiator port configuration with an HA pair. However, sharing an FC initiator port with multiple target ports is supported with both stand-alone systems and HA pairs.

For details about sharing an FC initiator port with multiple target ports and zoning, see the information in the *FlexArray Virtualization Installation Requirements and Reference Guide*.

One Data ONTAP FC initiator port connecting to target ports on *separate* storage arrays

The following example shows an HA pair in which a single Data ONTAP FC initiator port connects to multiple target ports on different storage arrays:
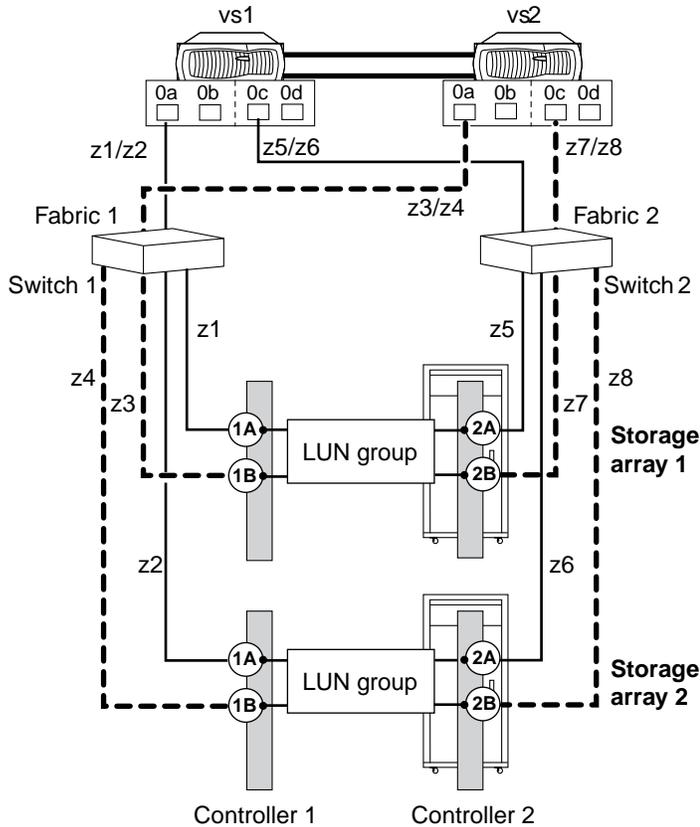
Target port attaching to multiple FC initiator ports

Starting with Data ONTAP 8.3, a maximum of two Data ONTAP FC initiator ports across nodes can be attached to a single target port on the storage array. This configuration is not supported with MetroCluster configurations.

This configuration is supported for use with all storage arrays listed in the *Interoperability Matrix* as supported for the release and mode of Data ONTAP running on your system.

The *FlexArray Virtualization Installation Requirements and Reference Guide* contains the rules for setting up this configuration.

The following illustration shows a shared target port configuration with an HA pair. Sharing a target port with multiple FC initiator ports is supported with both stand-alone systems and HA pairs.

For details about sharing a target port with multiple FC initiator ports and zoning, see the *FlexArray Virtualization Installation Requirements and Reference Guide*.

Shared target port attached to FC initiator ports

The following example shows an HA pair in which a single target port connects to multiple FC initiator ports:
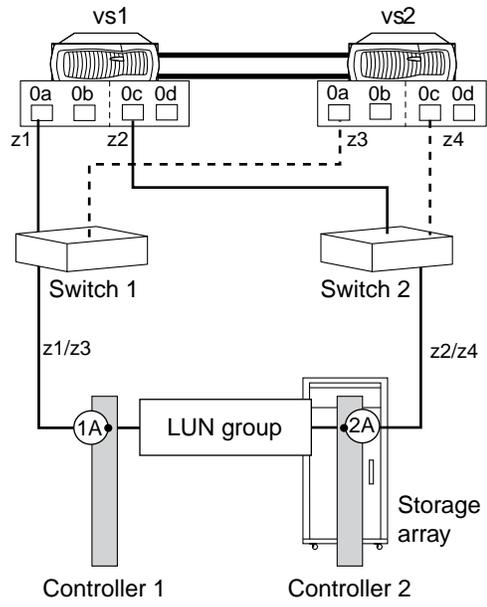
The initiator ports 0a of controllers vs1 and vs2 are connected to the storage array port 1A while ports 0c of the controllers are connected to the storage array port 2A.

Terminology comparison between storage array vendors

Different storage array vendors occasionally use different terms to describe similar concepts. Conversely, the meaning of the same term might differ between array vendors.

The following table provides a mapping between some common vendor terms:

Term	Vendor	Definition
host group	Hitachi	A configuration entity that enables you to specify host access to ports on the storage array. You identify the FC initiator port WWNs for the Data ONTAP system that you want to access the LUNs; the process differs according to vendor and sometimes differs for different storage array models of the same vendor.
	HP XP	
Storage Group	EMC CX, EMC VNX	
host definition	3PAR	
host	3PAR, HP EVA, HP XP, Hitachi	
parity group	Hitachi, HP XP	The arrangement of disks in the back-end that together form the defined RAID level.
RAID group	Data ONTAP, EMC CX, EMC VNX	
disk group	HP EVA	A set of physical disks that form storage pools from which you can create virtual disks.
parity set, RAID set	3PAR	A group of parity-protected *chunklets*. (A chunklet is a 256-MB block of contiguous space on a physical disk.)
cluster	Data ONTAP	In clustered Data ONTAP 8.x, a grouping of nodes that enables multiple nodes to pool their resources into a large virtual server and to distribute work across the cluster.
	Hitachi, HP XP	A hardware component on the storage arrays that contains the ports to which hosts attach.

Term	Vendor	Definition
controller	Data ONTAP	The component of a storage system that runs the Data ONTAP operating system and interacts with back-end storage arrays. Controllers are also sometimes called *heads* or *CPU modules.*
	Hitachi, HP EVA, HP XP	Hardware on the storage array on which the target ports are located.
node	3-PAR	A hardware component on the storage arrays that contains the ports to which hosts attach.
FEBE Board	EMC Symmetrix	
Storage processor (SP)	EMC CX, EMC VNX	
LUN	Many storage arrays	A grouping of one or more disks or disk partitions into one span of disk storage space. In the Data ONTAP documentation, this is referred to as *array LUN.*
LDEV	Hitachi, HP XP	
LUN	Data ONTAP	The Data ONTAP system can virtualize the storage attached to it and serve the storage up as LUNs to external applications and clients (for example, through iSCSI and FC). Clients are unaware of where a front-end LUN is stored.
LUN, virtual disk	HP EVA	A virtual disk (called a *Vdisk* in the user interface) is a simulated disk drive created in a disk group. You can assign a combination of characteristics to a virtual disk, such as a name, redundancy level, and size. Presenting a virtual disk offers its storage to a host.
array LUN	Data ONTAP documentation, Data ONTAP storage management tools	The Data ONTAP documentation uses the term *array LUN* to distinguish LUNs on the storage arrays from front-end LUNs (Data ONTAP LUNs).
vLUN	3PAR	(volume-LUN) A pairing between a virtual volume and a logical unit number (LUN). For a host to see a virtual volume, the volume must be exported as a LUN by creating vLUNs on the storage array.

Term	Vendor	Definition
volume	Data ONTAP	A logical entity that holds user data that is accessible through one or more of the access protocols supported by Data ONTAP, including Network File System (NFS), Common Internet File System (CIFS), HyperText Transfer Protocol (HTTP), Fibre Channel (FC), and Internet SCSI (iSCSI).
virtual volume	3PAR	A virtual storage unit created by mapping data from one or more logical disks.

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