

# Dell Fluid Cache for SAN Version 2.1.0

## Deployment and Admin Guide for VMware ESXi Systems



# Notes, cautions, and warnings

 **NOTE:** A NOTE indicates important information that helps you make better use of your computer.

 **CAUTION:** A CAUTION indicates either potential damage to hardware or loss of data and tells you how to avoid the problem.

 **WARNING:** A WARNING indicates a potential for property damage, personal injury, or death.

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# Contents

<b>1 Preface.....</b>	<b>7</b>
Audience.....	7
Related Documentation.....	7
Accessing Enterprise Manager and Storage Center Documentation.....	8
Dell Online Services.....	8
Technical Support and Customer Service.....	9
Contacting Dell.....	9
<b>2 Dell Fluid Cache for SAN Product Overview.....</b>	<b>10</b>
Dell Fluid Cache for SAN Features.....	10
Fluid Cache for SAN Environment.....	10
Example Cabling Diagram.....	12
Fluid Cache for SAN Deployment Requirements.....	13
Fluid Cache for SAN in Enterprise Manager GUI.....	13
<b>3 Preparing the Fluid Cache Components.....</b>	<b>14</b>
Checking Security Settings.....	14
Checking Network Connections.....	14
Checking Guest Virtual Machine Settings.....	15
Preparing the Servers.....	15
Preparing the Cache Devices.....	15
Non-NVMe Cache Devices.....	16
Preparing the Cache Network Adapters.....	16
Preparing the Cache Network Switch.....	16
Configuring a Dell Networking Switch.....	17
<b>4 Installing and Setting up Fluid Cache.....</b>	<b>18</b>
Enabling SSH on the ESXi Host.....	18
Marking Devices for Passthrough.....	18
Configuring the Network Adapters.....	19
Configuring Access to Compellent Storage.....	19
Configuring the iSCSI Network.....	20
Two vSwitches on Separate Subnets with a Single VMNIC.....	20
One vSwitch with Multiple VMNICS.....	20
Configuring Fibre Channel.....	21
Installing the Virtual Storage Appliance (VSA).....	21
Mapping Hardware.....	22
Configuring the VSA for Two iSCSI Subnets.....	23

Configuring the VSA.....	23
Fluid Cache Dependencies.....	25
Fluid Cache Dependencies for Creating a Fluid Cache Cluster.....	25
Fluid Cache Dependencies for Fluid Cache Configuration.....	25
Fluid Cache Dependencies for Starting Fluid Cache VSAs.....	25
Configuring ESXi Storage Adapter Settings.....	26
<b>5 Fluid Cache for SAN Cluster Creation and Management Operations.....</b>	<b>27</b>
Creating a Fluid Cache Cluster.....	27
Managing a Fluid Cache Cluster Environment.....	29
Configuring Fluid Cache Volumes.....	29
Mapping Volumes in Fluid Cache.....	29
Removing Volume Mappings.....	30
Deleting a Volume From a Fluid Cache Cluster.....	31
Adding Servers to a Fluid Cache Cluster.....	31
Removing a Server from a Fluid Cache Cluster.....	32
Adding Cache Devices to a Fluid Cache Cluster.....	33
Setting Storage Capacity for each Cache Server.....	33
Removing a Cache Device from a Fluid Cache Cluster.....	34
Reactivate a Cache Device Attached to a Fluid Cache Cluster.....	34
Reactivate a Volume on a Fluid Cache Cluster.....	34
Adding a Storage Center to a Fluid Cache Cluster.....	34
Remove a Storage Center from a Fluid Cache cluster.....	35
Reconnect a Fluid Cache Cluster to a Storage Center.....	35
Adding Hardware to a VSA.....	35
Change the License for a Fluid Cache cluster.....	36
Send Fluid Cache Cluster Information Using Dell SupportAssist.....	36
Shutting Down a Fluid Cache Cluster.....	36
Enable Server Load Equalizing for Storage Center Volumes.....	37
Maintaining Fluid Cache Environments.....	37
Rolling Upgrade of Fluid Cache.....	37
Upgrading Fluid Cache Cluster host components .....	41
<b>6 Fluid Cache Web Page Overview.....</b>	<b>45</b>
Accessing Fluid Cache Web Page.....	45
Understanding Fluid Cache Web Page.....	45
Status.....	45
CFM Info.....	45
Peer CFMs.....	45
Metadata Server Stats.....	46
Cache Server Stats.....	46
Cache Server Per-Path Stats.....	47

Block Device Stats.....	47
<b>A Troubleshooting Fluid Cache Installations.....</b>	<b>49</b>
Basic Troubleshooting Steps.....	49
Unable to remove a cache device from Fluid Cache Cluster using Enterprise Manager.....	49
Unable to connect the vCenter Server.....	50
Unable to recover the Fluid Cache Cluster after iSER fails.....	50
Creating a VSA cluster without SSDs causes iSER rescan issues.....	50
Delay in I/O on guest I/O virtual machine for a few minutes when the primary CFM VSA is turned off unexpectedly.....	50
VSA with unaligned I/Os has performance issues.....	50
The Mellanox Virtual Function is not available for Passthrough in ESXi 6.0.....	51
Server Does Not Appear in List of Servers.....	51
Cache Device Does Not Appear in List of Cache Devices.....	51
Cache Device Cannot Be Added to a Cluster.....	51
Cannot Select a Specific Cache Mode .....	52
Cached LUNs Are Unavailable.....	52
Enterprise Manager Freezes While Adding or Removing a Volume Mapping.....	52
Unable to Map Volumes to Fluid Cache using Enterprise Manager.....	53
Cannot Configure the Cache Network.....	53
Cannot Create a Fluid Cache Cluster.....	54
Cannot Map Volumes to a Fluid Cache Cluster.....	54
Cannot Connect to Cluster Nodes.....	55
Fluid Cache License Is Expired.....	55
Fluid Cache License Is Invalid.....	55
Cannot Assign or Remove a Storage Center.....	56
Cannot Determine Which Cache Device Failed.....	56
Events for Fluid Cache Are Not Shown in Enterprise Manager.....	56
Unable to PCI Passthrough a Samsung NVMe Flash Drive to Fluid Cache VSA through VMware vCenter Web Client.....	56
Fluid Cache VSA node not being added to Fluid Cache Cluster Server Object in Enterprise Manager.....	56
Cluster or Application Has Performance Issues.....	57
Unable to add a Fluid Cache ESXi 6.0 host to an existing server cluster.....	58
Unable to install Dell Fluid Cache VSA properly on the following Fluid Cache Cluster platforms.....	58
Unable to Recreate a Fluid Cache Cluster After a Hardware Failure.....	59
Cache Node is Not Listed.....	59
Unable to Select a Specific Caching Mode.....	59
Fluid Cache License File is Invalid.....	60
Option to Create Cluster Not Available.....	60
Unable to Add a Volume to a Fluid Cache Cluster.....	60
Event Messages Are Not Being Delivered.....	60

Storage Center is Not Available.....	60
Fluid Cache Server is Not Available.....	60
Information Displays Differently Between Storage Centers and Fluid Cache Clusters.....	61
Verify That All Parts of the Fluid Cache Cluster are Communicating with Each Other.....	61
Verify the Data Path is Working.....	61
The Cluster in the Fluid Cache Clusters Display is Marked Red.....	61
Problems Configuring Server Clusters Defined on a Storage Center with Dell Fluid Cache for SAN.....	62

## Preface

Dell Fluid Cache for SAN is a server-side caching accelerator software. Fluid Cache makes high-speed PCI Express (PCIe) SSDs a shared, distributed cache resource. Fluid Cache is deployed on clusters of Dell PowerEdge systems connected using RoCE-enabled Ethernet adapters and operates within a SAN environment employing a Dell Compellent backing store.

This guide provides information on how to install, configure and manage a Fluid Cache for SAN 2.1.0 for VMware ESXi based environments.

## Audience

This guide is intended for Dell Enterprise Deployment team (EDT), Customers, Channel Partners responsible for the deployment, configuration and administration of Fluid Cache for SAN 2.1.0 environments.

The assumption in this guide is that you have sufficient understanding on PowerEdge servers, networking configuration, management of Dell Storage or Compellent, and good understanding of tiered storage with Dell Storage.

## Related Documentation

For PowerEdge server documentation, go to [Dell.com/support/manuals](http://Dell.com/support/manuals) and enter your Service Tag.

For cache device documentation, go to [Dell.com/storagecontrollermanuals](http://Dell.com/storagecontrollermanuals) and click **Dell Power Edge Express Flash PCIeSSD**.

For Fluid Cache documentation, go to [ell.com/CacheSolutions](http://ell.com/CacheSolutions).

The following table lists documents you may want to refer to while installing and managing Fluid Cache.

Component	Document	Content
Fluid Cache	Release Notes	Describes new features, known issues, and upgrade steps for Enterprise Manager.
	Compatibility Matrix	Lists the compatibility matrix of different components included in the Dell Fluid Cache for SAN infrastructure.
Server	PowerEdge Owner's Manual	Describes how to install, remove, configure, and troubleshoot server components.
	Rack Placement	Describes how to rack the server.

Component	Document	Content
	Updating BIOS on Dell 12G PowerEdge Servers (iDRAC7 - 12G only)	Describes how to upgrade the BIOS on Dell 12G PowerEdge Servers using different Dell utilities.
	Updating BIOS on Dell 13G PowerEdge Servers (iDRAC8 - 13G only) (New for 13G)	Describes how to upgrade the BIOS on Dell 13G PowerEdge Servers using different Dell utilities.
	Lifecycle Controller Platform Update in Dell PowerEdge 12th Generation Servers	Describes how to upgrade the Lifecycle Controller using different Dell utilities.
	Updating DRAC Firmware	Describes how to upgrade iDRAC using different Dell utilities.
Cache Device	PowerEdge Express Flash PCIe SSD User's Guide	Describes how to install, remove, configure, and troubleshoot PCIeSSDs.
	Deploying the Dell PowerEdge Express Flash PCIe SSD	Describes the procedures for setting up, installing, and removing a PCIeSSD.
Network Switch	Dell Networking Owner's Manual/ Administrator's Guide/ Rack Placement	Describes how to set up the switch.
Network Adapter	ConnectX-3 VPI Adapter Card User Manual	Describes how to install, remove, and configure, the Ethernet adapter.
Dell Compellent Enterprise Manager	Release Notes	Describes new features, known issues, and upgrade steps for Enterprise Manager.
See <a href="#">Accessing Dell Compellent Documentation</a> .	Administrator's Guide	Describes how to monitor and run Dell Compellent Enterprise Manager.

## Accessing Enterprise Manager and Storage Center Documentation

Documentation for Dell Compellent products is not available at [dell.com/support/manuals](http://dell.com/support/manuals). To download Enterprise Manager and Storage Center documentation:

1. Go to [portal.compellent.com](http://portal.compellent.com).
2. Enter your user name and password and click **Login**.  
If you do not have a registration, send an email to [customer.portal@compellent.com](mailto:customer.portal@compellent.com).
3. In the portal page, click **Knowledge Center**.
4. Under **Product** in the left pane, select either **Enterprise Manager** or **Storage Center**, and download the documents.

## Dell Online Services

You can learn about Dell products and services using this procedure:


1. Visit [www.dell.com](http://www.dell.com) or the URL specified in any Dell product information.

2. Use the locale menu or click the link that specifies your country or region.

## Technical Support and Customer Service

Dell's support service is available to answer your questions about Fluid Cache for SAN 2.1.0.

### Contacting Dell

 **NOTE:** If you do not have an active Internet connection, you can find contact information on your purchase invoice, packing slip, bill, or Dell product catalog.

Dell provides several online and telephone-based support and service options. Availability varies by country and product, and some services may not be available in your area. To contact Dell for sales, technical support, or customer service issues:

1. Go to **dell.com/support**.
2. Select your support category.
3. Verify your country or region in the **Choose a Country/Region** drop-down list at the bottom of the page.
4. Select the appropriate service or support link based on your need.

# Dell Fluid Cache for SAN Product Overview

Dell Fluid Cache for SAN is a server-side caching accelerator software. Fluid Cache makes high-speed PCI Express (PCIe) SSDs a shared, distributed cache resource. Fluid Cache is deployed on clusters of Dell PowerEdge systems connected using RoCE-enabled Ethernet adapters and operates within a SAN environment employing a Dell Compellent backing store.

## Dell Fluid Cache for SAN Features

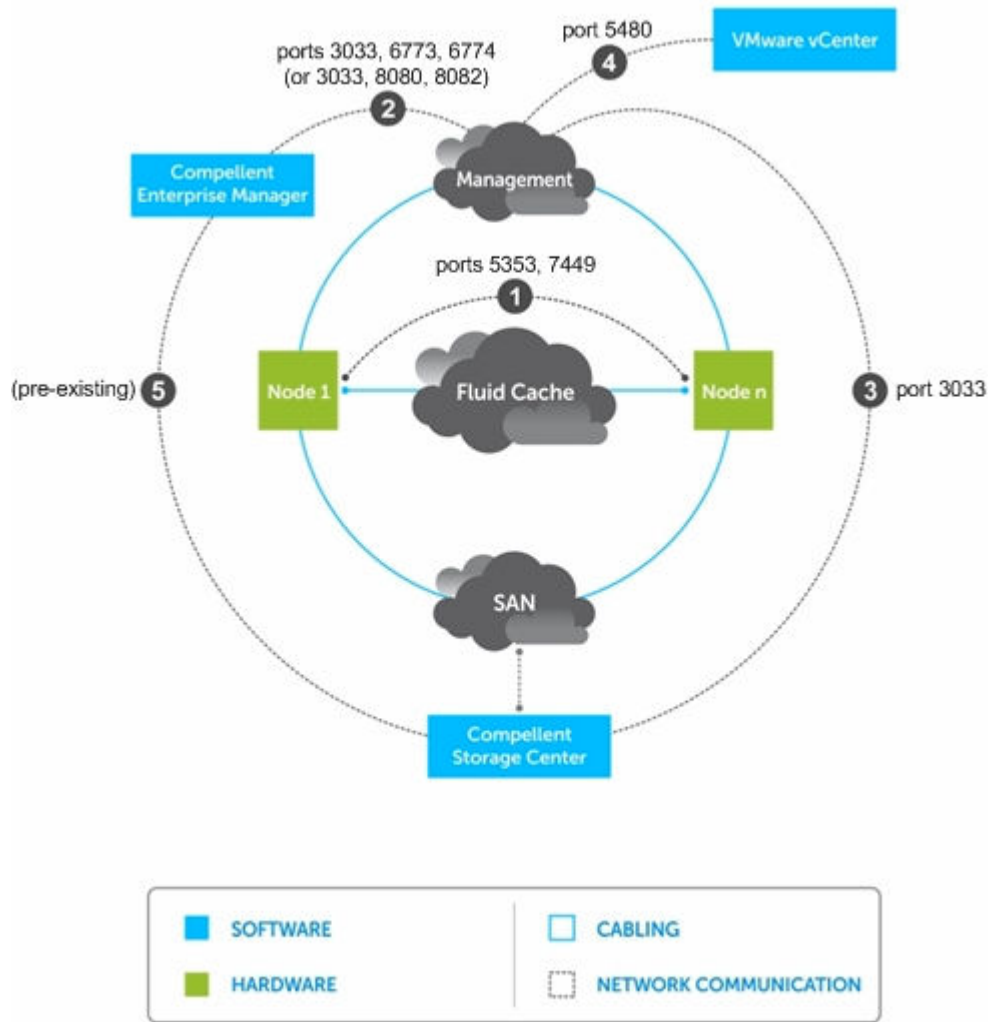
Fluid Cache supports the following key features:

- Write-back caching.
- Accelerates reads, writes, and read-after writes.
- Up to nine nodes in the cache cluster.
- Dynamic cache expansion.
- Centralized configuration, management, and reporting.

## Fluid Cache for SAN Environment

Fluid Cache operates on the following networks and interfaces:

<b>Cache Network</b>	A high speed, low latency private network that Fluid Cache uses to connect the servers in the Fluid Cache cluster.
<b>Management Interface</b>	The connection to Dell Compellent Enterprise Manager, which manages Fluid Cache and the SAN.
<b>Storage Area Network</b>	The network that Dell Compellent Storage Center uses to handle data connectivity within the SAN.

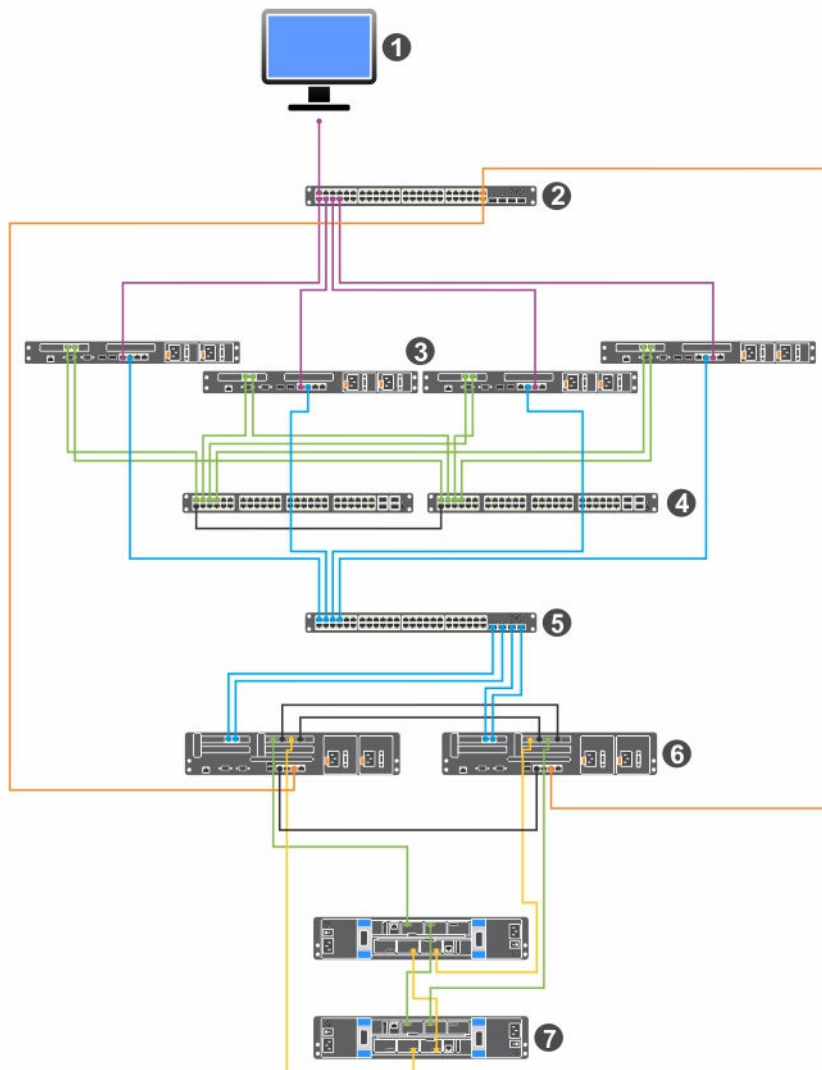


**Figure 1. Fluid Cache Connectivity**

1. Fluid Cache nodes communicate with each other over a private network using RDMA.
2. Enterprise Manager creates, manages, and monitors the Fluid Cache clusters.
3. Fluid Cache nodes communicate with the Management IP (VIP) of the Storage Controllers.
4. Fluid Cache communicates with vCenter to configure the VSA.
5. Enterprise Manager manages the Dell Compellent array.

The interfaces illustrated in the figure are associated with specific ports. See [Checking Network Connections](#). To understand how the architecture is set up, see [Example Racking and Cabling Diagram](#).

## Example Cabling Diagram




**Figure 2. Example Cabling Diagram**

- |  |                                   |
|--|-----------------------------------|
| 1. Enterprise Manager console              | 2. Management interface switch    |
| 3. Servers (4)                             | 4. Cache network switches (2)     |
| 5. SAN switch                              | 6. Storage Center controllers (2) |
| 7. Storage Center expansion enclosures (2) |                                   |

The example above has the following features:

- Fluid Cache is installed on four servers, which conforms to the minimum of three servers per each cache cluster and maximum of nine servers required.
- Each of the servers has a network adapter connected to a port on each of the two cache network switches. The switches are uplinked to each other.

- The servers access the Storage Center using SAN connectivity.
- Enterprise Manager is used to configure and monitor Fluid Cache.

 **NOTE:** For best practices on racking and cabling each hardware component, refer to the rack placement for the component at [dell.com/support/manuals](http://dell.com/support/manuals).

## Fluid Cache for SAN Deployment Requirements

The following are prerequisites for deploying Fluid Cache for SAN. Refer to the *Release Notes* for the most recent requirements.

The supported versions of firmware, drivers, and software are required to run Fluid Cache. These are listed in the *Release Notes* and are available at [dell.com/support](http://dell.com/support).

For the current list of validated hardware and software components, see the *Dell Fluid Cache for SAN Compatibility Matrix* available at <http://www.dell.com/CacheSolutions>.

**Table 1. System Requirements**

Servers	The cluster on which you deploy Fluid Cache must contain a minimum of three server per each cache cluster and a maximum of nine servers. All servers must support Single Root Input/Output Virtualization (SR-IOV).
Cache Devices	There must be a cache device installed on at least two servers in the cluster.
Network Adapters	A network adapter that supports Remote Direct Memory Access (RDMA) over Converged Ethernet (RoCE) must be installed on each server in the cluster.
Network Switch	A compatible switch must be available for the cache network. A redundant switch configuration is recommended.
SAN Management Software	Enterprise Manager must be started and configured to manage the Storage Center in use with Fluid Cache.
SAN Connectivity	All servers in the cluster must be connected to the SAN and be displayed on the Dell Compellent array.

## Fluid Cache for SAN in Enterprise Manager GUI

Use the Enterprise Manager Graphical User Interface (GUI) to centrally manage your Dell Fluid Cache for SAN clusters and monitor the status and performance of the Dell Fluid Cache for SAN cluster.


## Preparing the Fluid Cache Components

Before installing Fluid Cache, you must prepare the components of the Fluid Cache network: the servers, cache devices, network cards, and switches.

The instructions that follow assume that you have an existing SAN configured and managed. All nodes in the cache cluster must be connected to the SAN and visible on the Dell Compellent array. Instructions for racking and cabling a SAN solution are beyond the scope of this document. For more information about installing, upgrading, and configuring specific Dell components, see [Related Documentation](#).

### Checking Security Settings

Before you start the installation, make sure that firewall settings do not block traffic or devices on the cache network, or on networks used by Fluid Cache (refer to the table of port specifications here).


 **NOTE:** If firewall settings are incorrect, the Fluid Cache cluster cannot be configured.

### Checking Network Connections

For Fluid Cache to function correctly, each Fluid Cache server must be able to communicate with other network components. Make sure that the following ports are available:

**Table 2. Ports Specifications**

Interface	Port number	Port type
Fluid Cache cluster Configuration Manager	7449	TCP
Node Auto-Discovery functionality	5353	UDP
Web-based server status tool	6773 and 6774	TCP (https)
<i>(optional)</i> Web-based server status tool	8080 and 8082	TCP (http)
Fluid Cache to Enterprise Manager	3033	TCP
Fluid Cache to Storage Center	3033	TCP
Fluid Cache to vCenter	5480	TCP

 **NOTE:** Fluid Cache cannot be configured and does not function properly if any of these ports are unavailable. To diagnose network connection problems, see the troubleshooting topic [Cannot Configure Fluid Cache](#).

## Checking Guest Virtual Machine Settings


All guest VMs that use Fluid Cache volumes mapped to the ESXi hosts must be configured to start after the Fluid Cache VSA and stop before the Fluid Cache VSA. Make sure that any non-Fluid Cache VMs are not configured for a boot order priority of 1.

## Preparing the Servers

Make sure that each server in the ESXi cluster has the latest supported BIOS version, Lifecycle Controller firmware, and iDRAC firmware.

- For updating Dell Lifecycle Controller and BIOS firmware on 13<sup>th</sup> generation of PowerEdge servers, see the *Dell Lifecycle Controller Graphical User Interface Version 2.05.05.05 For 13th Generation Dell PowerEdge Servers User's Guide*, available at [http://topics-cdn.dell.com/pdf/idrac8-with-lc-v2.05.05.05\\_User's%20Guide2\\_en-us.pdf](http://topics-cdn.dell.com/pdf/idrac8-with-lc-v2.05.05.05_User's%20Guide2_en-us.pdf)
- For updating Dell iDRAC firmware on 13<sup>th</sup> generation of PowerEdge servers, see the *Integrated Dell Remote Access Controller 8 (iDRAC8) Version 2.05.05.05 User's Guide*, available at [http://topics-cdn.dell.com/pdf/idrac8-with-lc-v2.05.05.05\\_User's%20Guide\\_en-us.pdf](http://topics-cdn.dell.com/pdf/idrac8-with-lc-v2.05.05.05_User's%20Guide_en-us.pdf)
- For updating Dell Lifecycle Controller and BIOS firmware on 12<sup>th</sup> generation of PowerEdge servers, see the *Dell Lifecycle Controller 2 Release 1.4.0 User's Guide*, available at [http://downloads.dell.com/Manuals/all-products/esuprt\\_software/esuprt\\_remote\\_ent\\_sys\\_mgmt/esuprt\\_rmte\\_ent\\_sys\\_lifecycle\\_cntrlr/dell-lifecycle-cntrlr-2-rel-v1.4.0\\_User%27s%20Guide\\_en-us.pdf](http://downloads.dell.com/Manuals/all-products/esuprt_software/esuprt_remote_ent_sys_mgmt/esuprt_rmte_ent_sys_lifecycle_cntrlr/dell-lifecycle-cntrlr-2-rel-v1.4.0_User%27s%20Guide_en-us.pdf)
- For updating Dell iDRAC firmware on 12<sup>th</sup> generation of PowerEdge servers, see the *Integrated Dell Remote Access Controller 7 (iDRAC7) Version 1.50.50 User's Guide*, available at [http://topics-cdn.dell.com/pdf/integrated-dell-remote-access-cntrlr-7-v1.50.50\\_User's%20Guide\\_en-us.pdf](http://topics-cdn.dell.com/pdf/integrated-dell-remote-access-cntrlr-7-v1.50.50_User's%20Guide_en-us.pdf)
- For other latest information related to Dell iDRAC and Dell Lifecycle Controller documentation, go to <http://www.dell.com/support/home/us/en/19/product-support/product/idrac8-with-lc-v2.05.05.05/research>

Modify your BIOS settings as follows:


1. Enter the system BIOS setup mode and click **System BIOS** → **Integrated Devices**.
2. Select **SR-IOV Global Enable**.  
 **NOTE:** SR-IOV is required to create the virtual functions used by the Fluid Cache VSA.
3. Set **System Profile Settings** to **Performance**.
4. Click **Back**, and then click **OK** to return to the main BIOS page.
5. Restart the server to activate the BIOS changes.
6. Repeat this process for each server in the Fluid Cache cluster.

## Preparing the Cache Devices


- Make sure that all cache devices used in the Fluid Cache cluster have the minimum firmware and driver versions specified in [Requirements for Fluid Cache](#). To download updated firmware or drivers.
- Fluid Cache supports clusters containing cache devices of different sizes, but for the most predictable performance, it is recommended that the cache devices be of similar capacity.


## Non-NVMe Cache Devices

- **Firmware**— The firmware version for the Dell PCIe Express Flash SSDs must be B1490908 or later. Otherwise, even though they are visible in ESXi and in Enterprise Manager, the cache devices do not appear in the list of available devices.

 **NOTE:** The installed firmware version cannot be verified in ESXi. If the cache devices do not appear in the list of available devices and you are not sure that your firmware version is B1490908 or later, update your firmware. Also, see [Troubleshooting VMware Installations](#). You may also contact Dell Technical Support.


- **Driver**— The cache device driver used by Fluid Cache is native to the VSA and does not require updating.


 **CAUTION:** If the cache devices contain data, back up this data before adding the cache devices to the Fluid Cache cluster. All data on the cache devices are lost when they are added to the cluster.

 **NOTE:** If your server already has cache devices installed, make sure that the cache devices you intend to use in the Fluid Cache cluster are not used by any other application.


## Preparing the Cache Network Adapters

1. Install the network adapters in PCIe slots on the servers (x16 slots, if available).
2. Check the network adapter driver and firmware versions, and then update, if necessary.

 **NOTE:** It is recommended to use an MTU of 1500 for RDMA or Cache Network adapter connectivity.

 **NOTE:** Do not use a network adapter driver downloaded from the manufacturer's site. Fluid Cache uses a custom driver available only through Dell.


3. If a blade enclosure is used, disable FlexAddress in the blade enclosure.
4. Repeat this process for each network adapter in the cache network.
5. Make sure that all servers in the cache network can ping every other server, and also the management interface.

 **NOTE:** Make sure that all RoCE network adapters used by the Fluid Cache network are dedicated to the cache network and are not configured for any other network traffic.

## Preparing the Cache Network Switch

- For a schematic of an example Fluid Cache installation, see [Example Cabling Diagram](#).
- For configuration tasks for a supported Dell Networking switch, see [Configuring a Dell Networking Switch](#). For all other switches, see the manufacturer's documentation.
- For a list of supported switches, see [Requirements for Fluid Cache](#).


1. Connect the ports on the network adapter to properly configured ports on a network switch.

 **NOTE:** A redundant switch configuration is recommended.

If you have two switches for redundancy, on all of the cache network adapters, you must connect port 1 to one switch and port 2 to the other switch.

2. Make sure that all ports used in the cache network have the following settings:
  - The ports are in layer 2 mode.

- The ports are in an untagged state.
- The switch firmware is up to date.
- Flow control (transmit and receive) is enabled and Data Center Bridging (DCB) is disabled.

 **NOTE:** Enabling flow control is a requirement for Fluid Cache.

3. Save the running configuration.
4. To implement the changes, restart the switch.

## Configuring a Dell Networking Switch


The following procedure is for one of the supported Dell Networking switches listed in the table in [Requirements For Fluid Cache](#). For all other switches, see the manufacturer's documentation.

To configure a switch containing physical ports 0, 1, 2, and 3 for a cache network with four nodes connected to the switch's 10-gigabit Ethernet ports:


1. Telnet into the switch and enter the login name and password to enter Exec mode.  
While you are in Exec mode, the > prompt is displayed following the host name prompt, which is FTOS by default.

```
telnet 172.31.1.53
Trying 172.31.1.53...
Connected to 172.31.1.53.
Escape character is '^]'.
Login: username
Password: FTOS>
```

2. Enter Exec Privilege mode by running the command: `enable`
3. Enter Configuration mode by running the command: `configure`
4. Select either a single physical port or range of physical ports:
  - To configure a single port (in this example, port 0), run the command: `interface TenGigabitEthernet 0/0`
  - To configure a range of ports (in this example, ports 0-3), run the command: `interface range TenGigabitEthernet 0/0 - 3`
5. Define static IP addressing by running the command: `no ip address`
6. Enter Layer 2 mode by running the command: `switchport`
7. Enable the port by running the command: `no shutdown`
8. Enable flow control and disable DCB by running the command: `flowcontrol rx on tx on`

 **NOTE:** Enabling flow control is a requirement for Fluid Cache.

9. Close the configuration page by running the command: `exit`
10. Repeat tasks 4–9 for the remaining physical ports in the cache network.
11. Exit Exec Privilege mode by running the command: `exit`
12. Save all the changes by running the command: `write`

 **NOTE:** To create a VLAN (for example, to use available ports on an existing network switch to create the cache network), make sure that the cache network ports are in Layer 2 mode and in the untagged state.

# Installing and Setting up Fluid Cache

 **NOTE:** When installing and setting up Fluid Cache, you must restart the server multiple times.

## Enabling SSH on the ESXi Host


To enable SSH on the ESXi host, perform the following steps:

1. In the vSphere Windows client, select one of the servers in the Fluid Cache cluster.
2. In the **Configuration** tab, go to **Software** → **Security Profile**.
3. In the **Security Profile Services** box, select **Properties**.  
The **Services Properties** window is displayed.
4. In the **Services Properties** window, go to the **SSH** label, and under **Service Properties**, select **Options**.  
The **SSH (TSM-SSH) Options** window is displayed.
5. Make sure that the **Start** tab is grayed out. If not, click **Start**, and then click **OK**.
6. Repeat this process for all servers in the Fluid Cache cluster.

## Marking Devices for Passthrough

Fluid Cache requires a direct (“passthrough”) connection between the VSA and the cache devices, bypassing ESXi itself.

1. In the vSphere Windows client, select one of the hosts in the Fluid Cache cluster.
2. In the **Hardware** area of the **Configuration** tab, click **Advanced Settings**.  
The **DirectPath I/O Configuration** window is displayed.
3. In the **DirectPath I/O Configuration** window, select **Edit**.  
The **Mark Devices for Passthrough** window is displayed.
4. In the **Mark Devices for Passthrough** window, select the first cache device.  
Cache devices compatible with Fluid Cache contain either “Micron RealSSD” or “Samsung Electronics” in their name.
5. Read and acknowledge the warning message, and then click **Yes**.
6. Repeat steps 4 and 5 for each cache device in the cluster.
7. Click **OK**.
8. Restart the host.


 **NOTE:** You do not need to restart the host at this time if you are continuing with the following procedure, [Configuring the Network Adapters](#). The passthrough connection is enabled when the host is restarted at the conclusion of that procedure.

9. Repeat this procedure for all hosts in the Fluid Cache cluster.

# Configuring the Network Adapters

Before configuring network adapters, make sure that the network adapters are set up correctly. See [Preparing the Cache Network Adapters](#).

To configure the network adapters:

1. Download the network adapter driver for VMware.
2. In the vSphere Windows client, select one of the host servers in the Fluid Cache cluster.
3. In the **Hardware** area of the **Configuration** tab, click **Storage** and select a datastore.
4. Right-click the datastore and select **Browse Datastore**.  
The **Datastore Browser** dialog box is displayed.
5. In the **Datastore Browser** window, click the **Upload** symbol and select **Upload File**.  
The **Upload Items** dialog box is displayed.
6. In the **Upload Items** dialog box, navigate to the directory where you downloaded the driver .zip file, select the file, and then click **Open**.  
An upload/download operation message may be displayed.
7. Click **Yes** to acknowledge the upload/download operation warning message.  
The file is uploaded and displayed in the **Datastore Browser** window.
8. Log in to the host either from the console or using SSH.
9. From the Tech Support Mode console on the host, or from the CLI, change to the directory where you uploaded the driver file.  
For example, if the datastore name is `datastore1`, run the command: `cd /vmfs/volumes/datastore1`  
For more information about Tech Support Mode, see the Knowledge Base article **1017910** at [kb.vmware.com](http://kb.vmware.com).
10. Install the driver by running the command: `esxcli software vib install -d /vmfs/volumes/<datastore name>/<driver file name> --no-sig-check`  
For example, if the driver filename is `MLNX-OFED-ESX-1.9.10.2.zip`, run the command: `esxcli software vib install -d /vmfs/volumes/datastore1/MLNX-OFED-ESX-1.9.10.2.zip --no-sig-check`
11. Enable SR-IOV virtual functions on the network adapter by running this command: `esxcli system module parameters set --module mlx4_core --parameter-string "max_vfs=1"`  
 **NOTE:** If you upgrade the firmware for the network adapter, this setting reverts to the default and you must re-enable SR-IOV virtual functions by running this command again.
12. Restart the host.
13. Repeat this procedure for all hosts in the Fluid Cache cluster.

# Configuring Access to Compellent Storage

Fluid Cache requires access to a Compellent array on which you have storage that you want to cache. Fluid Cache can make use of an iSCSI or Fibre Channel connection to the Compellent array. If you want to access the Compellent storage using iSCSI, see [Configuring the iSCSI Network](#). If you want to access your Compellent storage using Fibre Channel, see [Configuring Fibre Channel](#).

# Configuring the iSCSI Network

**iSCSI networks with a single connection:** You must add a virtual port group to the iSCSI vSwitch before installing the VSA. For instructions on creating a port group, refer to the topic [Add a Virtual Machine Port Group](#) available at the VMware Support website.

**iSCSI networks with two subnets:** Follow the procedure below.

In a configuration with two subnets, typically one subnet is used on port 1 of each Compellent controller and the second subnet is used on port 2 of each controller.

In ESXi 5.5, there are two recommended methods of using multiple network adapters between the host and the iSCSI environment:

- Two vSwitches on separate subnets, each with one vmnic and one vmk port.
- One vSwitch with two vmnics and two vmk ports, with the default switch failover order configured so that the vmk port on subnet A uses only the vmnic connected to subnet A, and the vmk port on subnet B uses only the vmnic connected to subnet B.

These configurations are described in detail in the [vSphere Storage Guide](#), Chapter 11, available at the VMware Support website.

Fluid Cache needs to connect to the iSCSI network through a port group configured to match whichever method you are using. For instructions on creating a port group, refer to the topic [Add a Virtual Machine Port Group](#) available at the VMware Support website.

## Two vSwitches on Separate Subnets with a Single VMNIC

Add a virtual machine port group to each vSwitch, labeling them to identify which subnet they correspond to.

## One vSwitch with Multiple VMNICS

1. Add two virtual machine port groups to the same vSwitch, labeling them to identify which subnet they correspond to.
2. Edit each port group:
  - a. In the **Hardware** area of the **Configuration** tab, select **Networking**.
  - b. Locate the vSwitch and select **Properties**.
  - c. Select the first port group, and click **Edit**.
  - d. In the **NIC Teaming** tab, select **Override Switch Failover Order**.
  - e. Select one of the vmnics and use the **Move Up** and **Move Down** buttons to move it to the **Unused Adapters** area, leaving only the other vmnic active for the port group.
  - f. Click **OK**.
  - g. Select the second port group, click **Edit**, and repeat tasks d through f, making the vmnic that was made inactive previously the only active vmnic for this port group.

Whatever your configuration, make sure the network card configuration you are using on the vmk ports is replicated on the virtual machine port groups that the Fluid Cache VSAs use. For more information, refer to the VMware Document [Multipathing Configuration for Software iSCSI Using Port Binding](#) available at the VMware Support website.


After installing the VSAs, you must edit the network adapter settings for the VSA (see [Configuring the VSA](#)).

For more information on setting up and administering an iSCSI network with two subnets, refer to the following documents:

- [Dell Compellent Storage Center Best Practices with VMware vSphere 5.x](#)
- [Best Practices for Running VMware vSphere on iSCSI](#)

## Configuring Fibre Channel

If you plan to cache-enable volumes that are attached to the Fibre Channel network, one or more Fibre Channel HBAs must be enabled for the PCI pass-through feature, and then passed through to the VSA.

 **NOTE:** If there is more than one Fibre Channel HBA configured on the server, cached LUNs are accessed using the HBA that is passed through to the VSA, and uncached volumes are accessed through other HBAs. If there is only one Fibre Channel HBA configured on the server, then all volumes presented to the cluster must be enabled for caching.

To access the Compellent Storage using Fibre Channel:

1. Install the Fibre Channel HBAs on the ESXi hosts that host the Fluid Cache VSAs.
2. Configure the Fibre Channel zoning on the Compellent array that has the storage you want to cache.


## Installing the Virtual Storage Appliance (VSA)

The following are the prerequisites for installing the Fluid Cache VSA:

- You must have a licensed copy of ESXi 5.5 Update 2 and vCenter Server 5.5 Update 2.
- You must have the Open Virtual Appliance (OVA) file containing the Fluid Cache software.

To install the VSA:


1. In the vSphere Windows client, select one of the ESXi hosts in the Fluid Cache cluster.
2. Go to **File** → **Deploy OVF Template**.  
The **Deploy OVF Template** window is displayed.
3. In the **Deploy OVF Template** window, browse to the location of the OVA file and click **Next**.  
The **OVF Template Details** window is displayed.
4. In the **OVF Template Details** window, click **Next**.  
The **Name and Location** window is displayed.
5. In the **Name and Location** window, set a name for the VSA and click **Next**.

 **NOTE:** Each Fluid Cache VSA must have a unique name. Consider using a name that references the name of the ESXi host in order to facilitate configuration of the VSA.

If you have multiple datastores, the **Storage** window is displayed.

6. Select a datastore and click **Next**.  
The **Disk Format** window is displayed.
7. In the **Disk Format** window, select a provisioning method and click **Next**.  
The **Network Mapping** window is displayed.
8. In the **Network Mapping** window, the following source networks must be configured to an appropriate destination network.

- **Management Network** — Configure with a destination network that can communicate to all the VSAs that participate in the Fluid Cache cluster.
- **iSCSI Network 1, iSCSI Network 2** — Configure with a destination network that is connected to the iSCSI network. Using the network, the VSAs communicate to the Compellents that have the storage you want to cache.

 **NOTE:** If you have configured Fluid Cache to access the Compellent storage through Fibre Channel, then do not change the default settings for the iSCSI destination networks.

9. Click **Next**.


The **Ready to Complete** window is displayed.


10. In the **Ready to Complete** window, review your deployment settings, and click **Finish** to start the deployment.


 **NOTE:** Do not select the **Power on after deployment** option after adding the VSAs.

A dialog box displays the progress, which may take several minutes. When processing is complete, the VSA appears in the list of VSAs in vCenter.

11. Repeat this procedure for all servers in the Fluid Cache cluster.

 **NOTE:** Do not attempt to install more than one VSA on an ESXi host. There must be only one VSA configured for each ESXi host.

 **NOTE:** Make sure that the VSA is not migrated to another ESXi host using vMotion.

 **NOTE:** If you need to set a custom MAC address or choose a different network for the management connection other than the default selection, right-click the VM, choose **Edit Settings**, and then edit the **Network Adapter** settings.

## Mapping Hardware

1. In the vSphere Windows client, right-click a Fluid Cache VM and select **Edit Settings**.

The **Virtual Machine Properties** window is displayed.

2. In the **Hardware** tab, click **Add**.

The **Add Hardware** window is displayed.

3. In the **Add Hardware** window, select **PCI Device** from the list of device types, and then click **Next**.

4. Select the first cache device from the drop-down menu. Cache devices compatible with Fluid Cache contain either “Micron RealSSD” or “Samsung Electronics” in their name.

5. Select the Mellanox Virtual Function from the drop-down menu.

6. Click **Next**.


The **Ready to Complete** window is displayed.

7. In the **Ready to Complete** window, click **Finish**.

You may see a vCenter message indicating that data are no longer accessible to the host server. Accept the message, and then continue.

8. Repeat steps 3–6 for all remaining cache devices.

9. Repeat steps 3–6 for the network adapter virtual function. This is the item whose name contains “Virtual Function” in its description.

 **NOTE:** Do not add the same device twice.

10. If Fibre Channel is used to access your Compellent Arrays, repeat steps 3 to 6 for the Fibre Channel HBAs that are connected to the Compellent Arrays that have the storage you want to cache.

11. When you have finished adding hardware components, click **OK** in the **Virtual Machine Properties** window.
12. Repeat this process for each Fluid Cache VM.

## Configuring the VSA for Two iSCSI Subnets

If your iSCSI connection consists of two subnets (a single iSCSI connection is also supported), follow this procedure to change the settings on each VSA in the Fluid Cache cluster:

1. In the vSphere Windows client, right-click one of the VSAs in the Fluid Cache cluster and select **Edit Settings**.
2. Change **Network adapter 2** to use one of the iSCSI port groups.
3. Change **Network adapter 3** to use the other iSCSI port group.
4. Repeat this process for each VSA in the Fluid Cache cluster.



**NOTE:** Make sure the addresses you assign to the vmnics are on the same subnets as their respective network adapters in the VSA.

When you follow the procedure in [Configuring the VSA](#) below, the second network adapter is the `eth1` adapter in the **Configure/Manage iSCSI Interfaces** screen of the Fluid Cache configuration interface, and the third adapter is the `eth2` adapter.

## Configuring the VSA

Before configuring the Fluid Cache VSA, make sure you have met the following prerequisites:


- You have correctly cabled and configured all network adapters and network switches.
- The vCenter user configuring Fluid Cache has the following privileges:
  - In the vSphere web client, for the **Virtual machine** privilege, under **Configuration**, **Raw device** must be selected.
  - For the **Datastore** privilege, the following must be selected: **Allocate space**, **Browse datastore**, **Configure datastore**, **Low level file operations**, and **Remove datastore**.
  - In **Host Privileges**, under **Configuration**, the following must be selected: **Advanced settings**, **Change PciPassthru settings**, **Change settings**, **Connection**, **Maintenance**, **Memory configuration**, **Network configuration**, **Power**, **Storage partition configuration**, **System Management**, **System resources**, and **Virtual machine autostart configuration**.

1. In the vSphere Windows client, right-click the VSA and click **Power** → **Power on**.
2. Right-click the VSA and select **Open Console**.

After the VSA powers on, a login page is displayed. You are now in the text-based user interface (TUI) which configures the ESXi hosts and network interfaces of the Fluid Cache network. Use the arrow keys to navigate, press <Enter> to select, and press <Esc> to exit the current screen. Press <Ctrl> <Alt> to exit the TUI.
3. Enter the login for the VSA and press <Enter>.


The default login is `fldc`.
4. Enter the password for the VSA and press <Enter>.

The default password is `calvin`.


-  **NOTE:** If you change the default login or password on any VSA in the Fluid Cache cluster, you must change them on every VSA. The login and password must be the same on all VSAs in the Fluid Cache cluster.


After pressing <Enter>, the configuration home page is displayed.

5. Select **Change vCenter** and press <Enter> to register the ESXi host with vCenter:
  - a. Enter the hostname or IP address for your vCenter and press <Enter>.
  - b. Enter a vCenter username with the necessary privileges (See the and press <Enter>.

 **NOTE:** If this username or password changes, the cache cluster can no longer perform routine administrative functions. Follow this procedure again to enter the new username and password.
  - c. Enter the password and press <Enter>.

You are returned to the configuration home page. The fields in the upper area now show information for the ESXi host. The entry for **vCenter Connection** should read OK.
6. Select **View/Manage Appliance IP** and press <Enter>.
7. Select static IP addressing and press <Enter> to begin configuring a static IP address:
  - a. Enter the static IP address and press <Enter>.


 **NOTE:** Static addressing is preferred. If you choose DHCP, the allocation method used by the DHCP server must prevent any changes to the VSA's IP address. The VSA is disabled if the IP address changes.

 **NOTE:** If you need to change the IP addresses used for the management interface, these changes should be made from the vCenter console.
  - b. Enter the subnet mask and press <Enter>.
  - c. Enter the gateway IP and press <Enter>.
  - d. Enter the IP address of the primary DNS server and press <Enter>.
  - e. Enter the IP address of the secondary DNS server and press <Enter>.

You are returned to the configuration home page.
8. Select **Configure This Appliance** and press <Enter>.
9. Configure your Backend Storage connection.
10. If you are accessing your Compellent Storage using iSCSI, perform the following steps:
  - a. Select **Configure iSCSI** and press <Enter>.
  - b. Select **Configure/Manage iSCSI Interfaces** and press <Enter>.
    1. Enter the IP address or subnet mask for one or both of the iSCSI interfaces.
    2. Press <ESC> to get back up to the next level on the menu.
  - c. Select **Configure/Manage Compellents** and press <Enter>.
    1. Select **Add Compellent** and enter the IP address for the iSCSI interfaces on the Compellent.
    2. Press <ESC> three times to get back up to next level on the menu.
11. If you are accessing your Compellent Storage using Fibre Channel, perform the following steps:
  - a. Select **View Fibre Channel Configuration** and press <Enter>.

The **Fibre Channel HBAs** page displays the list of available Fibre Channel HBAs.
  - b. Select each of the listed Fibre Channel HBAs and verify that the link status is reported as online.
12. Select **Configure Cache Network** and press <Enter>.


The two iSER physical functions of the network adapter are displayed, and also the bonded interface. The bonded interface is within the VSA, while the two iSER interfaces are on the ESXi host.

 **NOTE:** The bonded and two iSER interfaces must be on the same subnet.

13. Select one of the iSER interfaces and press <Enter> to associate this interface with a virtual function:
  - a. Enter the IP address for the interface and press <Enter>.
  - b. Enter the subnet mask for the interface and press <Enter>.


14. Select the second iSER interface and press <Enter> to configure the interface, then enter an IP address for the second interface and press <Enter> again.

The subnet mask does not need to be re-entered. The second interface automatically uses the subnet mask entered for the first interface.

 **NOTE:** If you choose not to configure the second iSER interface, failover is not available for the system.

15. Select the bonded interface and press <Enter> to configure the interface, then enter an IP address for the bonded interface and press <Enter> again.

16. Select **Finalize Setup** and press <Enter>.

 **NOTE:** To check VSA connectivity, all of the cache network interfaces (iSER and bonded) should be pingable from each ESXi host.


## Fluid Cache Dependencies

### Fluid Cache Dependencies for Creating a Fluid Cache Cluster

- Fluid Cache for VMware is delivered as an OVA. Therefore, to install Fluid Cache on ESXi host, make sure to create a local data store and install the OVA on the local data store.
- After the Virtual Storage Appliances (VSAs) are installed and configured, use Dell Compellent Enterprise Manager to create and configure a Fluid Cache Cluster.
- It is not mandatory for you to configure DNS for the Fluid Cache to work. However, if you have DNS configured, make sure that the DNS server works correctly.
- Before creating a cluster, make sure a VMware vCenter server is properly functioning. Fluid Cache uses VMware vCenter to verify the ESXi server on which the Fluid Cache is running.

### Fluid Cache Dependencies for Fluid Cache Configuration

- Use Dell Compellent Enterprise Manager to do the following:
  - Configure the Fluid Cache cluster
  - Add or remove nodes
  - Add or remove cache devices
  - Map or unmap volumes
- Use the VMware vCenter server to enable adding or removing nodes to the cluster.

 **NOTE:** If Dell Compellent Enterprise Manager or VMware vCenter server runs on virtual machines, then make sure it does not reside on cache volumes.

### Fluid Cache Dependencies for Starting Fluid Cache VSAs

- Make sure the VMware vCenter server is functioning, because if VSA has stopped functioning or is manually turned off, the VMware vCenter server enables VSA to join the Fluid Cache cluster.

- If the VSAs are configured to use DNS, then make sure the name resolution is available for the VSA to start.

## Configuring ESXi Storage Adapter Settings

To ensure correct operation during certain failure scenarios, it is recommended to change the Noop Timeout and Noop Interval settings on the Mellanox iSCSI over RDMA (iSER) Adapter.

1. Log in to the vCenter Server as administrator using the vSphere Client.
2. Click the **Configuration** tab.
3. Click the **Storage Adapters** link in the **Hardware** section.
4. Select the vmhbaxx for the iSCSI software adapter and perform the following steps:
  - a. Click **Advanced** in the iSCSI Initiator Properties window.
  - b. Change the **NoopTimeout** setting to 30 seconds and **NoopInterval** setting to 60 seconds.
5. Repeat step 4 for the second vmhbaxx.

# Fluid Cache for SAN Cluster Creation and Management Operations

After you configure and validate the Fluid Cache for SAN components, use Enterprise Manager to create and manage the Fluid Cache Environment as described in the following sections.


- Creating a Fluid Cache Cluster. See [Creating a Fluid Cache Cluster](#)
- Managing a Fluid Cache Cluster Environment. See [Managing a Fluid Cache Cluster Environment](#)
- Maintaining a Fluid Cache Cluster Environment. See [Maintaining Fluid Cache Environments](#)

## Creating a Fluid Cache Cluster


- At least one cache server must be installed, cabled, and able to communicate with a Storage Center running version 6.5.1 or later.
    - To make the cluster fully redundant, use at least three servers.
    - To use write-back caching, at least two cache devices must be present in the cluster and installed in separate servers.
    - To use write-through caching, at least one cache device must be present in the cluster.
  - Your Enterprise Manager user account must have the Administrator or Volume Manager privilege. In addition, you must have admin (root) access to at least one of the cache servers.
  - The Fluid Cache license file must reside on the system running the Dell Storage Client and is used to create the cluster, or a share available to it.
  - At least one Storage Center must be added to Enterprise Manager.
1. Log in to Enterprise Manager as a user with Administrator or Volume Manager privileges.
  2. In Enterprise Manager's Storage view, expand **Storage Centers** if necessary, and then select a Storage Center.
  3. In the **Storage** pane, select **Dell Storage**.
  4. In the **Summary** tab, click **Configure Fluid Cache Cluster** to launch the configuration wizard. (Do not click **Add FluidFS Cluster**.)

The **Discover Fluid Cache Servers** page of the configuration wizard is displayed.
  5. Type or select appropriate data in the **Discover Fluid Cache Servers** window.
    - a. In the **Host or IP Address** box, type the host name or IP address associated with the management network of any available Fluid Cache VSA.

 **NOTE:** Do not reference a physical server here.

 **NOTE:** Except for the entries in this **Discover Fluid Cache Servers** window, all other references to *Fluid Cache servers* in this document and in Enterprise Manager refer to the ESXi host and not the VSA. There is no further use of the VSA name or IP address when managing Fluid Cache.

- b. The **Port** box is autopopulated. Change only if necessary.
- c. In the **User Name** box, type the username for the VSA, which is `fldc`.
- d. In the **User Password** box, type the password for the VSA. The default value is `calvin`.

 **NOTE:** If you change these default properties on any node in a Fluid Cache cluster, you must change them on all nodes. The login and password must be the same on all nodes in the Fluid Cache cluster.

- e. Click **Next**.

The **Select Servers** window is displayed.

6. By default, all available servers are selected. Clear the check box next to unwanted servers or select the **Unselect All** option, and then select three or more servers to be included. (Click **Select All** to use all available servers again.)

7. Click **Next**.

The **Cluster Settings** page of the configuration wizard is displayed.

8. Type or select appropriate data in the **Cluster Settings** window.

- a. In the **Name** box, enter a name for the cluster.
- b. Click **Browse** next to the **License File** box.

The **Select Fluid Cache License File** dialog box is displayed.

- c. Browse to the location of the license file, select the file, and then click **Save**.
- d. Verify that the license file and path displayed are correct and click **Next**.

The system processes for a few minutes while the cluster is created and the system automatically identifies compatible servers and devices on the network. After this process is completed, the **Select Devices** window is displayed.

9. By default, all available Fluid Cache devices are selected. Clear the check box next to unwanted devices or select the **Unselect All** option, and then select the required devices. (Select the **Select All** option to use all available devices again.)

 **CAUTION:** You will lose any existing data on the cache devices when they are added to the Fluid Cache cluster. Back up this data before proceeding.

10. Click **Next**.

The **Select Storage Centers** page of the configuration wizard is displayed.

11. In the **Select Storage Centers** page, select one or more Storage Centers to include in the Fluid Cache cluster, and then click **Finish**.

After a delay while the system processes, the Storage pane contains a new top-level folder named **Fluid Cache Clusters**. Inside this folder is the Fluid Cache cluster that was just created. Fluid Cache clusters are denoted by a blue circle with the letters **FC**.

Select the Fluid Cache cluster. In the **Summary** tab, different areas of the window show the cluster's status, servers, devices, and other information.

Note that the servers listed are not the physical servers you added earlier, in the **Select Servers** window, but the ESXi hosts in the SAN. Also, the IP addresses listed next to these hosts are not the IP addresses of the ESXi hosts, but the management network addresses of the VSAs.

After creating a Fluid Cache cluster, map volumes to the cluster. See [Mapping Volumes](#).

# Managing a Fluid Cache Cluster Environment

## Configuring Fluid Cache Volumes

A Fluid Cache volume extends a normal Storage Center volume to be contained across the cache devices in a Fluid Cache cluster as well as permanently stored in the Storage Center volume.

### Limitations for Fluid Cache Volumes

There are a number of considerations before utilizing a volume in a Fluid Cache cluster:

- Fluid Cache volumes cannot be expanded
- Fluid Cache volume Read and Write Cache options are not available
- Fluid Cache volumes cannot be the source or destination of Live Volumes
- Fluid Cache volumes cannot be the destination of a replication
- Fluid Cache volumes cannot be part of a synchronous replication or simulation

## Mapping Volumes in Fluid Cache

In Enterprise Manager, volume mappings created for a server in a Fluid Cache cluster behave similar to any other volume mappings. Volumes can be mapped either to an individual server, or to a server cluster (a "subcluster") within the Fluid Cache cluster.

If Fluid Cache is used with ESXi clusters, it is quicker to map to a subcluster than to each individual server.

### Mapping Volume to Servers

Before mapping a volume to a server node, create a Fluid Cache cluster (see [Creating a Fluid Cache Cluster](#)).

To map a volume to a server:

1. In the **Storage** view, expand **Storage Centers** if necessary, and then select the Storage Center that contains the appropriate volume.
2. In the **Storage** tab, expand **Volumes** if necessary, and then locate the volume you want to map.
3. Right-click the volume and select **Map Volume to Server**.
4. In the **Map Volume to Server** window, select the server.
5. Click **Next**.
6. Select **Enable Fluid Cache**.
7. From the **Host Cache Policy** drop-down menu, select a cache mode:
  - **Write-back** (default): In addition to caching reads, write-back mode allows the caching of written data without waiting for the Compellent Array to acknowledge the write operation. Write-back caching requires a cache device on two or more servers in the cluster.
  - **Write-through**: Write-through mode forces writes to both the cache and the Compellent Array simultaneously. Warm reads and read-after writes are accelerated but write operations are not. Write-through caching requires only one cache device on one server in the cluster.
8. (Optional) Select the **Keep cached data on the node that accessed the data** option. Selecting this option gives the best performance for warm reads from the cache for datasets that fit on the local



**NOTE:** The cache mode selected for a volume mapping cannot be changed. To select a different cache mode, you must remove the mapping and create a new mapping. When you create the new mapping, you can then select a different cache mode.

node's cache devices, because all data is local to the client. If this option is not selected, cached data is evenly distributed among all cache devices.

 **NOTE:** Use of this option with vMotioned guest VMs may result in reduced performance for that VM.

9. Click **Finish**.

At this stage, there is a delay while the system makes a number of configuration changes. When processing is complete, the volume is available for use in ESXi (as a datastore, RDM, and so on).

## Mapping Volumes to a Subcluster

Before mapping volumes to a subcluster, create a Fluid Cache cluster (see [Creating a Fluid Cache Cluster](#)) and a server cluster ("subcluster") within it.

To map a volume to a subcluster, follow the procedure for mapping a volume to a server (see previous section), but instead of selecting a server in the **Map Volume to Server** window ([step 4](#)), select a subcluster within a Fluid Cache cluster.

Although not specific to Fluid Cache, be aware of these aspects of volume mappings created at the subcluster level in Enterprise Manager:

- When servers are added to or removed from the subcluster, they automatically inherit or disinherit the subcluster's volume mappings.
- You can promote a volume mapping from a server to the subcluster, and demote it from the cluster to the subcluster.
- If a server has existing mappings, the server keeps those mappings when it becomes part of a subcluster.

## Removing Volume Mappings

To see a list of Fluid Cache mappings, select the appropriate Storage Center in the **Storage** view, and in the **Storage** tab, select the Fluid Cache cluster. The Fluid Cache mappings for the cluster are listed in the **Volumes** area at the bottom of the page.


### Removing Volume Mappings from a Server

1. Make sure the volume is no longer in use and unmounted in vCenter.
2. In Enterprise Manager's **Storage** view, expand **Storage Centers** if necessary and select the appropriate Storage Center. (Do not select **Fluid Cache Clusters** or its contents.)
3. In the **Storage** tab, expand **Servers** if necessary and locate the server whose Fluid Cache mappings you want to remove.
4. Right-click the server and select **Remove Mappings**.

The **Remove Mappings** window is displayed.


5. In the **Remove Mappings** window, select the volume and click **OK**.


There may be some delay while the mapping is removed and dirty data in the cache is flushed to main storage. When the mapping removal is complete, the volume's icon in the **Storage** tab turns from blue to gray color. You may need to manually refresh the display.

 **NOTE:** The Fluid Cache mappings for the server are listed in the **Volumes** area at the bottom of the page.

## Removing Volume Mappings from a Subcluster

1. Make sure the volume is no longer in use and unmounted in vCenter.
2. In Enterprise Manager's **Storage** view, expand **Storage Centers** if necessary and select the appropriate Storage Center. (Do not select **Fluid Cache Clusters** or its contents.)
3. In the **Storage** tab, expand **Servers**, and then the Fluid Cache clusters if necessary and select the subcluster whose mappings you want to remove.
4. In the right pane, below the list of servers, select the volume and click **Remove Mappings**.  
There may be some delay while the mapping is removed and dirty data in the cache is flushed to main storage. When the mapping removal is complete, the volume's icon in the **Storage** tab turns from blue to gray color. You may need to manually refresh the display.


 **NOTE:** The Fluid Cache mappings for the subcluster are listed in the **Volumes** area at the bottom of the page.

 **NOTE:** All Fluid Cache volume mappings must be removed before an ESXi host can be removed from a Fluid Cache cluster.

## Deleting a Volume From a Fluid Cache Cluster


Use Enterprise Manager to completely delete a volume from a Fluid Cache cluster while maintaining just the cluster.

1. Click the **Storage** view.
2. In the **Storage** pane, expand Fluid Cache Clusters if necessary and select the cluster with the mapped volume to delete.
3. In the **Cache** tab, expand Volumes, select the volume to be deleted and click **Delete**. The **Delete** dialog box appears.
4. (Optional) Select **Do you want to delete the Storage Center volume associated with the selected Fluid Cache volumes?** to also delete the volume on the Storage Center.

 **CAUTION:** If you select this option, it will delete the logical volume from the Storage Center and all the data contained in that volume will be permanently lost.

5. Click **OK**.

## Adding Servers to a Fluid Cache Cluster

 **NOTE:** You should not add 2.1.0 hosts to a Fluid Cache cluster that contains 2.0.10 hosts because the results will be indeterminate. This operation is not supported.

To add servers to a Fluid Cache cluster:

1. Log in to Enterprise Manager as a user with Administrator or Volume Manager privileges.
2. In the **Storage** view, expand **Fluid Cache Clusters** if necessary.
3. Right-click the Fluid Cache cluster (not **Fluid Cache Clusters** itself) and click **Tasks** → **Add Servers to Cluster**.

The **Add Servers to Cluster** dialog box is displayed. By default, all servers are selected that have Fluid Cache installed.

4. Clear the check boxes next to unwanted servers or select the **Unselect All** option, and then select the servers to be added. (To use all available servers again, select the **Select All** option.)
5. Click **OK**.

The system processes for some time, and then the server appears inside **Fluid Cache Clusters** in the **Storage** tab.

The **Add Devices to Cluster** dialog box is displayed. By default, all devices compatible with Fluid Cache are selected.

6. Clear the option next to unwanted cache devices or click the **Unselect All** option, and then select the cache devices to be added. (Select the **Select All** option to use all available cache devices again.)

 **CAUTION: Any existing data on a cache device is lost when the device is added to the Fluid Cache cluster. Back up this data before proceeding.**

7. Click **OK**.


The device now appears in the list in the **Devices** section.

If you have a shared data application such as a cluster file system or clustered application, you may want to add the server to a server cluster (a “subcluster”) inside the Fluid Cache cluster. See [Mapping Volumes](#). To create a subcluster, refer to the *Enterprise Manager Administrator’s Guide*.


## Removing a Server from a Fluid Cache Cluster

1. Make sure that no cached LUNs are in use by the ESXi server. Unmount VMFS datastores if present, remove any RDMs or VMDKs, and so on.
2. If the server belongs to a server cluster (a “subcluster”) within a Fluid Cache cluster, remove the server from the subcluster:
  - a. Prior to removing the server from a Fluid Cache cluster, you must shutdown the host or stop the Fluid Cache service.
  - b. In Enterprise Manager’s **Storage** view, select the appropriate Storage Center. (Do not select **Fluid Cache Clusters** or its contents.)
  - c. In the **Storage** tab, expand **Servers** if necessary and locate the server.
  - d. Right-click the server and select **Remove Server from Cluster**.
  - e. When asked to confirm the action, click **OK**.

In the **Storage** tab, the server now appears outside of the subcluster, but is still inside the Fluid Cache cluster.

 **NOTE:** Removing the server from the subcluster removes all mappings created for the subcluster.

3. Power off the VSA:
  - a. Log in to the Windows vCenter client and in the **Hosts and Clusters** view, navigate to the VSA’s ESXi host.
  - b. Right-click the VSA and select **Power** → **Power Off**. There is a delay while the system writes cached data to disk. For a large quantity of data, this could take a considerable amount of time. Periodically refresh the display until the VSA’s status shows that powering off is complete.
  - c. If you want to delete the VSA entirely, right-click the VSA again, select **Delete from Disk**, and when prompted to confirm the action, click **OK**.

 **NOTE:** There are important differences between powering off a VSA and deleting it entirely. Power off the VSA if it may rejoin the same cluster but you want to free up RAM (the VSA is configured to use 20 GB of RAM). Delete the VSA if you do not intend to use it in the same cluster again and you want to free up disk space (the VSA uses approximately 10GB), or if you intend to move the server to a different Fluid Cache cluster (changing clusters requires reinstallation of the VSA).

4. Remove all Fluid Cache mappings from all volumes mapped to that server (see [Removing Volume Mappings](#)). Note that you do not have to remove non-Fluid Cache mappings.
5. Remove the server from the Fluid Cache cluster:

- a. In the **Storage** view, select the Fluid Cache cluster. (Do not select **Storage Center** or its contents.)
- b. In the **Summary** tab, locate the server in the **Servers** section.
- c. Right-click the server and select **Remove Server from Cluster**.
- d. When asked to confirm the action, click **OK**.

After the system processes for some time, the server reappears outside of the cluster in the **Servers** area. You may need to manually refresh the display.



**NOTE:** After powering down the VSA on an ESXi host and then removing the ESXi host from a cluster, you must reinstall the VSA to add the server to any cluster, including the cluster from which it was removed.

## Adding Cache Devices to a Fluid Cache Cluster

1. Log in to Enterprise Manager as a user with Administrator or Volume Manager privileges.
2. In the **Storage** view, expand **Fluid Cache Clusters** if necessary, and then right-click the Fluid Cache cluster. (Do not right-click **Fluid Cache Clusters** itself.)
3. Click **Tasks** → **Add Devices to Cluster**.  
The **Add Devices to Cluster** window is displayed. By default, all available devices compatible with Fluid Cache are selected.
4. Clear the option next to unwanted cache devices or click the **Unselect All** option, and then select the cache devices to be added. (Click the **Select All** option to use all available cache devices again.)



**CAUTION:** Any existing data on a cache device is lost when the device is added to the Fluid Cache cluster. Back up this data before proceeding.

5. Click **OK**.  
The devices now appear in the list in the **Devices** section.

## Setting Storage Capacity for each Cache Server

The Fluid Cache VSA OVA is shipped with a default memory size of 24 GB, and it is sized for a maximum of 1.6 TB of cache per node for a 9-node cluster.

The maximum SSD storage capacity supported is 3.2 TB per node. However, the size of the cache devices on a fluid cache node affects the memory utilization of that server node. The number of nodes in the cluster also affect the memory utilization.

Therefore, if you want to use more than 1.6 TB or 3.2 TB of cache memory per node, it is recommended to increase the memory of the VSA to 34 GB, which will support maximum of 3.2 TB per server node.

If you want to use less than 1.6 TB, it is recommended to not to change the default VSA memory size.

The following procedure provides steps on how to increase the size of a Fluid Cache VSA using VMware vSphere client:

1. Right-click the Fluid Cache VSA and select **Power** → **Shut Down Guest**.
2. Right-click the Fluid Cache VSA and select **Edit Settings**.
3. Click the **Hardware** tab, and click **Memory**.
4. In the **Memory Configuration** section, in the **Memory Size** field, change the memory size from 24000 MB to 34000 MB.
5. Click the **Resources** tab, and click **Memory**.

6. In the **Resource Allocation** section, in the **Reservation** field, change the size from 24000 MB to 34000 MB
7. Click **OK** and power on the VSA.
8. Repeat the steps on other Fluid Cache VSA.

## Removing a Cache Device from a Fluid Cache Cluster

If you are removing the cache device from the server, perform a graceful removal by first ensuring that the cache device is not in active use. See [Removing a Server from a Fluid Cache Cluster](#) for the steps on gracefully removing a server from a cluster.

1. In Enterprise Manager's **Storage** view, expand **Fluid Cache Clusters** if necessary, and then select the Fluid Cache cluster. (Do not select **Storage Centers** or its contents.)
2. In the **Summary** tab, locate the cache device in the **Devices** section.
3. Right-click the device and select **Remove Device from Cluster**.
4. When asked to confirm the action, click **OK**.

As part of the deletion process, dirty data in the cache is flushed to main storage. This could take a considerable duration of time for a large quantity of data.

When processing is complete, the cache device no longer appears in the list of devices. You may need to manually refresh the data on the page.

## Reactivate a Cache Device Attached to a Fluid Cache Cluster

Use Enterprise Manager to reactivate a Fluid Cache cluster cache device.

1. Click the **Storage** view.
2. In the **Storage** pane, expand Fluid Cache Clusters if necessary and select the Fluid Cache cluster.
3. In the **Cache** or **Summary** tab, expand Servers if necessary, and expand the server housing the device if necessary. Select the device to be reactivated and click **Reactivate Device**. The **Reactivate Device** dialog box appears.
4. Click **OK**.

## Reactivate a Volume on a Fluid Cache Cluster

Use Enterprise Manager to reconnect to a volume in a failed state from a Fluid Cache cluster while maintaining the cluster and the volume.

1. Click the **Storage** view.
2. In the **Storage** pane, expand Fluid Cache Clusters if necessary and select the cluster with the questionable volume.
3. In the Volumes pane of the **Summary** tab, double-click the volume to be reactivated and click **Reactivate Volume**. The **Reactivate Volume** dialog box appears.
4. Click **OK**.

## Adding a Storage Center to a Fluid Cache Cluster

1. Log in to Enterprise Manager as a user with Administrator or Volume Manager privileges.
2. Click the **Storage** view.
3. In the **Storage** pane, expand **Fluid Cache Clusters** if necessary, and then select the Fluid Cache cluster.
4. In the **Cache** tab, select **Tasks** and click **Assign Storage Centers**.


The **Assign Storage Centers** window is displayed.

5. In the **Assign Storage Centers** window, select one or more Storage Centers to be added.
6. Click **OK**.

## Remove a Storage Center from a Fluid Cache cluster

Use Enterprise Manager to remove a Storage Center from a Fluid Cache cluster while keeping the cluster.

1. Click the **Storage** view.
2. In the **Storage** pane, expand Fluid Cache Clusters if necessary and select the Fluid Cache cluster.
3. In the **Cache** or **Summary** tab, expand Storage Centers if necessary, select the Storage Center to be removed and click **Remove Storage Center from Cluster**. The **Remove Storage Center from Cluster** dialog box appears.
4. Click **OK**.

 **NOTE:** The Storage Center cannot be removed if the cluster has volumes mapped to it.

## Reconnect a Fluid Cache Cluster to a Storage Center

Use Enterprise Manager to reconnect a Storage Center to a Fluid Cache.


1. Click the **Storage** view.
2. In the **Storage** pane, expand Fluid Cache Clusters if necessary and select the Fluid Cache cluster.
3. In the **Cache** tab, select Storage Centers and click **Reconnect Host Cache Cluster to Storage Center**.

## Adding Hardware to a VSA

Before adding cache devices or network adapters to a Fluid Cache cluster, do the following:

1. Log in to the vSphere Windows client.
2. Right-click a VSA under the ESXi host, and click **Power** → **Power Off**.
3. Confirm that you are turning off the VSA by clicking **OK** in the **Confirm Shutdown** dialog box.
4. Select the ESXi host.
5. In the **Hardware** area of the **Configuration** tab, click **Advanced Settings** → **Edit**.  
The **Mark Devices for Passthrough** window is displayed.
6. Select the cache devices for passthrough and click **OK**.  
The **DirectPath I/O Configuration** window is displayed.
7. In the **DirectPath I/O Configuration** window, click **Refresh** to display the SSDs you just entered.
8. Restart the ESXi host to make the SSDs available.
9. In the **Virtual Machines** tab, right-click the VM, and then select **Edit Settings**.  
The **Virtual Machine Properties** window is displayed.
10. In the **Hardware** tab, click **Add**.  
The **Add Hardware** window is displayed.
11. In the **Add Hardware** window, select **PCI Device** from the list of device types, and then click **Next**.
12. Select the first cache device from the drop-down menu. Cache devices compatible with Fluid Cache contain either "Micron RealSSD" or "Samsung Electronics" in their name.
13. Click **Next**.  
The **Ready to Complete** window is displayed.
14. In the **Ready to Complete** window, click **Finish**.

15. Repeat tasks 12–15 for all remaining cache devices.
16. Repeat tasks 12–15 for the network adapter virtual function (the adapters whose description contains the words “Virtual Function”).

 **NOTE:** Do not add the same device twice.

17. When you have finished adding components, click **OK** in the **Virtual Machine Properties** window.

Complete the tasks in [Adding Cache Devices to a Fluid Cache Cluster](#).

## Change the License for a Fluid Cache cluster

Use Enterprise Manager to change the license for a Fluid Cache cluster.

1. Click the **Storage** view.
2. In the **Storage** pane, expand Fluid Cache Clusters if necessary and select the Fluid Cache cluster.
3. Click **Edit Settings**. The **Edit Settings** dialog box appears.
4. Click **Submit License**. The **Submit License** dialog box appears.
5. Click **Browse**. Navigate to the location of the new license file, select it, and click **Save**.
6. Click **OK**.

## Send Fluid Cache Cluster Information Using Dell SupportAssist


Use Enterprise Manager to send Fluid Cache cluster information to technical support using Dell SupportAssist.

1. Click the **Storage** view.
2. In the **Storage** pane, expand Fluid Cache Clusters if necessary and select the Fluid Cache cluster.
3. Click **Edit Settings**. The **Edit Settings** dialog box appears.
4. Click **Dell SupportAssist**, and then click **Send Dell SupportAssist Data Now**. The **Send Dell SupportAssist Now** dialog box appears.
5. Click **OK**.


## Shutting Down a Fluid Cache Cluster

Use Enterprise Manager to shut down a Fluid Cache cluster.

1. Click the Storage view.
2. In the Storage pane, expand Fluid Cache Clusters if necessary and select the Fluid Cache cluster.
3. Click Shutdown. The Shutdown dialog box appears.
4. Click Yes.


 **CAUTION:** All cached volumes and their data become inaccessible when the Fluid Cache cluster is shut down, unless they're remapped to another cluster first.

If you do not remap the volumes before shutting down, call Dell Technical Support Services for help remapping a shut down cluster.

 **NOTE:** Volumes mapped to a Fluid Cache cluster that's been shut down can't be remapped anywhere other than a Fluid Cache cluster.

## Enable Server Load Equalizing for Storage Center Volumes


Server load equalizing dynamically adjusts queue depth for volumes experiencing high IOPS to minimize the performance impact on other volumes. Enable load equalizing on a Storage Center that hosts Fluid Cache volumes to prevent cache flushing operations from adversely affecting performance for other volumes.

 **NOTE:** Enable load equalizing only for environments using Fluid Cache clusters, or if directed by Dell Technical Support Services.

1. Click the **Storage** view.
2. In the **Storage** pane, select the Storage Center.
3. In the **Summary** tab, click **Edit Settings**. The **Edit Settings** dialog box appears.
4. Click the **Storage** tab.
5. Select the **Server Load Equalizer Enabled** check box.
6. Click **OK**.

## Maintaining Fluid Cache Environments

This chapter describes tasks that must occasionally be performed after initial Fluid Cache deployment.


 **WARNING:** When performing any operation to a server platform that hosts Fluid Cache software, you must perform either one of the following methods:

- Shut down a single Fluid Cache Cluster node (VSA) at a time and perform the host-based server updates.

After the updates to host server are complete, reboot the host and bring the Fluid Cache Cluster node (VSA) online. Before shutting down and updating the next Fluid Cache cluster node, verify that the Fluid Cache Cluster node is added to Fluid Cache Cluster appropriately.

- Place the entire Fluid Cache Cluster into maintenance mode, and then shut down the entire Fluid Cache Cluster by shutting down the Fluid Cache Cluster nodes (VSAs) one after the other.

After the updates to the host servers are complete, reboot the server and bring the Fluid Cache Cluster nodes (VSAs) online.

 **WARNING:** To avoid potential performance issues and data loss, you must NOT shutdown multiple Fluid Cache Cluster (VSA) nodes at the same time to perform Fluid Cache host server based updates.

## Rolling Upgrade of Fluid Cache

Fluid Cache Cluster rolling upgrade enables you to upgrade the Fluid Cache VSA version 2.0.10 to 2.1.0, without taking the entire cluster down.

Dell provides a standalone Windows utility to easily perform an online rolling upgrade of the Fluid Cache cluster. This utility enables you to export a particular VSA configuration from a running v2.0.10 VSA, and then import that configuration to a newly deployed v2.1 VSA.

If you do not want to perform a rolling upgrade, then you need delete the v2.0.10 cluster and then deploy a new v2.1 cluster.

## Rolling Upgrade Requirements

Before you begin the Fluid Cache VSA Rolling Upgrade process, download the following to an appropriate directory

- **fldc\_vsa.exe** — Application that enables you to import and export Fluid Cache VSA configuration during the rolling upgrade process.
- **Fluid-Cache-Dell-2.1.0.<build number>.OVA** — The OVA file for Fluid Cache for SAN, version 2.1.0.

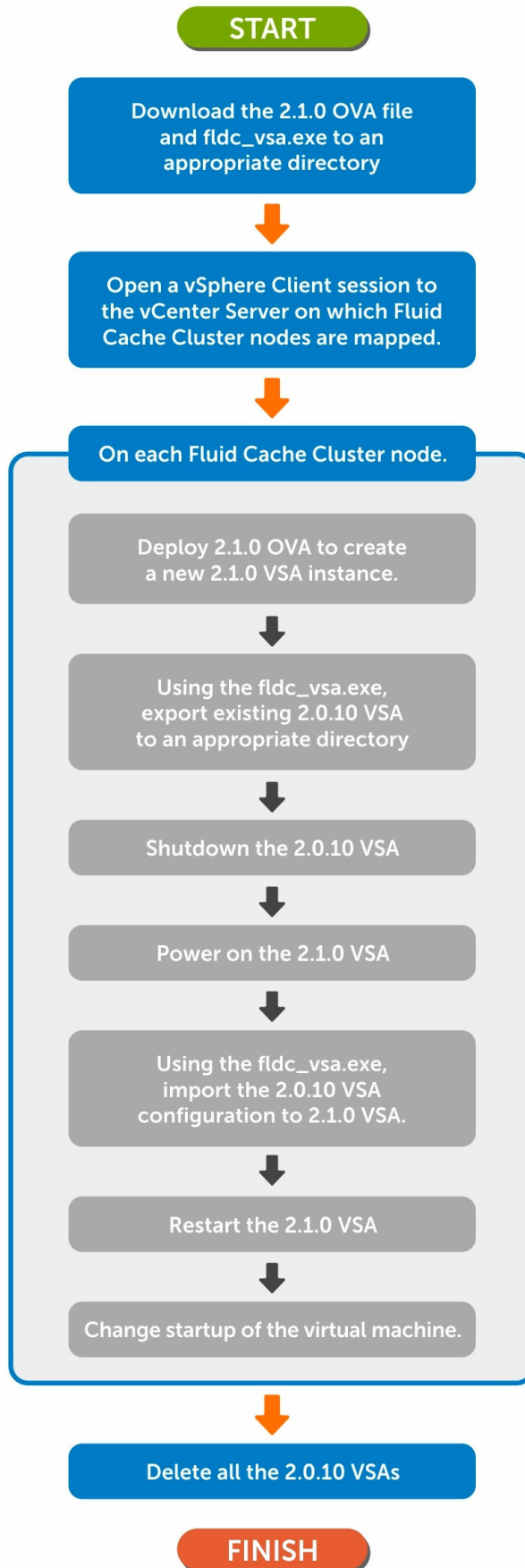
## Rolling Upgrade Prerequisites

Ensure the following before you start performing the rolling upgrade on Fluid Cache clusters:

- Fluid Cache clusters must have at least two nodes up at all times in order to function. Three nodes is the smallest cluster size that can be created and it is essential that two or more Fluid Cache VSA's remain up at all times for I/O to flow. On a cluster with four or more nodes it is possible to shut down more than one Fluid Cache guest, but it is recommended to wait for one Fluid Cache appliance guest to shut down completely before moving on to shutting down the next one, and of course, never go below two completely booted and online Fluid Cache nodes.
- During the rolling upgrade process, no configuration changes should be made to the Fluid Cache cluster until all the VSA's are upgraded to v2.1.
- It is not recommended for the cluster to run mixed versions of the VSA other than during the rolling upgrade process.
- The Primary CFM should be upgraded last. This will prevent situations where slow shutdowns can occur when there are still Secondary CFMs running the 2.0.10 version. Check the Fluid Cache Web page to identify the Primary CFM node.

## Rolling Upgrade Workflow

The following section describes the workflow for performing Cluster OS Rolling Upgrade.



**Note:** You can perform rolling upgrade on multiple cluster nodes. However, Dell recommends the following based on the number of nodes in the cluster:

Number of nodes in a cluster	Recommended
Three node cluster	One node
Four node cluster	Two nodes
More than four	Three nodes

**Note:** Dell recommends to upgrade the Primary CFM at last in this sequence. There is a known issue whereby if the Primary CFM is v2.1.0 and you try to shut down a Secondary CFM that is v2.0.10, there will be a long delay, more than one hour, for the secondary CFM to shut down.

## Rolling Upgrade Process

Upgrading a Fluid Cache cluster can be performed by using the rolling upgrade procedure where an existing VSA configuration is replaced with a new version 2.1.0 VSA on the ESXi host. The VSA configuration is exported from an original v2.0.10 VSA to a new v2.1.0 VSA and then the cycle is repeated for all nodes in the cluster.

Fluid Cache cluster Rolling upgrade includes the following steps:

1. Open a vSphere Client session to the vCenter Server on which Fluid Cache Cluster ESXi hosts are mapped.
2. On each ESXi hosts in the cluster, deploy the 2.1.0 VSA appliance. To deploy the 2.1.0 VSA, perform the following steps:
  - a. Go to **File** → **Deploy OVF Template**  
The **Deploy OVF Template** window is displayed
  - b. In the **Deploy OVF Template** window, browse to the location of the VSA 2.1.0 OVA file and click **Next**.  
The **OVF Template Details** window is displayed
  - c. In the **OVF Template Details** window, click **Next**.  
The **Name and Location** window is displayed.
  - d. In the **Name and Location** window, set a name for the VSA, and click **Next**.  
The **Storage** window is displayed
  - e. Select a datastore and click **Next**.  
The **Disk Format** window is displayed.
  - f. In the **Disk Format** window, select a provisioning method, and then click **Next**.  
The **Network Mapping** window is displayed.
  - g. In the **Network Mapping** window, the following source networks must be configured to an appropriate destination network.
  - h. Click **Next**.  
The **Ready to Complete** window is displayed.
  - i. In the **Ready to Complete** window, review deployment settings, and then click **Finish** to start the deployment.
3. Configure virtual functions for the newly deployed VSA 2.1.0. Perform the following steps to add the virtual functions.
  - a. In the **Add Hardware** window, select **PCI Device** from the list of device types, and then click **Next**.
  - b. Select the same cache device configured for 2.0.10 from the drop-down list.
  - c. Click **Next**.
  - d. Repeat steps **a** to **c** for the Mellanox Virtual Function
  - e. In the **Ready to Complete** window, click **Finish**.
4. Export the 2.0.10 VSA configuration. Perform the following steps:
  - a. Open PowerShell, and run the following command:

```
.\fldc_vsa.exe export -l <export location> -esx <ESXi host name> -esxu <ESXi host user name> -vmg <VSA 2.0.10 IP Address>
```
  - b. Enter the ESXi host password.
  - c. If you see the following message, enter **y**.  
There was a problem establishing a secure connection with the ESX host  
This could happen if you are using an SSL certificate on the host that

```
cannot be validated
Do you want to connect to this host anyway (y/N):
```

5. Shutdown the 2.0.10 VSA after the export operation is complete.
6. Power on the VSA 2.1.0, and in the console, enter the following:
  - a. Enter the default user name and password.
  - b. Enter the same Appliance IP address, Subnet Mask, Primary DNS IP, and the Secondary DNS IP used for 2.0.10 VSA.
7. Restart the VSA 2.1.0.
8. Import the configuration file that you have exported to the newly deployed VSA 2.1.0. To import the file, run the following command.

```
.\fldc_vsa.exe import -1 <location of the configuration file> -esxu <user name>
```



**NOTE:** Before you run the import command, ensure that you have entered the correct directory path (represented by IP address name of the 2.0.10 guest appliance) that contains the appropriate configuration file.

9. Restart the virtual machine.
10. Ensure the newly added VSA 2.1.0 rejoins the cluster by checking the Fluid Cache status web page.
11. Change the startup order to automatically power on the VSA 2.1.0 virtual machine. To change the order, perform the following steps:
  - a. Click the **Configuration** tab.
  - b. Select **Virtual Machine Startup / Shutdown** under **Software**.
  - c. Click **Properties** in the upper-right corner of the window.
  - d. In the **Startup Order** categories, under **Automatic**, move the newly added 2.1.0 VSA to power on first, and then move the 2.0.10 VSA to power on manually.
  - e. Ensure the Startup and Shutdown Delays are set to 0 seconds for the newly added 2.1.0 VSA.
12. Ensure the VSA 2.1.0 storage paths are active. To verify, perform the following steps:
  - a. Log in to the vSphere Client and select a server from the inventory panel.
  - b. Click the **Configuration** tab, and then click **Storage** in the **Hardware** panel.
  - c. Click **Devices** under **View**.
  - d. Select the required storage devices and view the paths.
13. Repeat steps 2 to 12 these steps for all the other hosts.
14. After all of the VSAs have been upgraded and the cluster is healthy you can delete the original v2.0.10 VSAs.

## Upgrading Fluid Cache Cluster host components

### Prerequisites for Upgrading Fluid Cache Host

Before upgrading the ESXi host, verify the following:

1. Ensure that only one Fluid Cache appliance is running on the ESXi host.
2. Ensure that the Fluid Cache cluster is in healthy state. To verify the state, go to the **Overview** page of the Fluid Cache web page and verify the following:

For more information on the Fluid Cache web page, see [Understanding Fluid Cache Web Page](#)


- a. In the **Status** section, ensure that the **Cluster State** is **Active**.
- b. In the **Peer CFMs** section, ensure that the **peer CFMS status** are **online**.
- c. In the **Metadata Server Stats**, ensure that all the **Metadata Servers** are **online**.

- d. In the **Cache Server Stats** page, in the **Connection** column, ensure that the connection is **RDMA/RC**, and in the **Devices** column ensure that the state of the cache devices are **Active**.
- e. In the **Block Device Stats** page, ensure that the status of all Fluid Cache device nodes are **online**.

## Preparing ESXi host

Prepare one ESXi host at a time for upgrading the ESXi host version or to patch the ESXi host.

1. If you want to use a new vCenter 6.0 server to manage Fluid Cache cluster, disconnect the hosts from the existing vCenter 5.5 server, and then connect the hosts to vCenter cluster on the vCenter 6.0 server.  
If the Fluid Cache hosts are already on a vCenter 6.0 system, continue with step 2.
2. Select a single ESXi host that you want to upgrade and migrate all the active guests, other than Fluid Cache appliance guest.
3. Shutdown of the Fluid Cache appliance guest by using one of the following methods:
  - In case of thick client, right-click the guest, from the **Power** menu, click **Shut Down Guest**.
  - In case of thin client, right-click the guest, and click **Shut Down Guest OS**.

 **NOTE:** To shut down the host, do not select the **Power Off** option, which immediately turns off the appliance without proper shutdown process.

You can monitor the status of the shutdown process in the **Cache Overview** page. Monitor the shutdown state of the guest appliance that is being shut down from the web page of the other Fluid Cache appliance web page.

4. On the **Cache Overview** page, monitor and verify the following:
  - a. The state of the cache devices changes to `CACHEDEV_STATE_SHUTTING_DOWN` (one device at a time), and the **In Use (GB)** number will gradually reduce to zero.
  - b. After the cache device shuts down completely, the status changes to `CACHEDEV_STATE_INACTIVE`.
  - c. When shutdown is complete, verify the following on Fluid Cache web page:
    - On the **Cache Server Stats** page, the **Devices** state changes to **no connection**.
    - On the **Block Device Stats** page, the status of all the cache devices in the host changes to **offline** or **disconnected**.
  - d. After all the components of appliance shuts down, confirm that Fluid Cache guest appliance is turned off.
5. Repeat the steps for other ESXi hosts.
  - To upgrade the ESXi host version from 5.5 to 6.0, see [Upgrading ESXi Hosts Version](#)
  - To patch the ESXi host version, see [Patching the ESXi host version](#)

## Upgrading ESXi Hosts Version

Prepare the servers as described in the section [Preparing ESXi host](#)

1. Place the ESXi host in maintenance mode.
2. Boot the server (host) from ESXi 6 installer CD or virtual CD using iDRAC virtual media. See [using iDRAC virtual media](#)
3. On the **Select a Disk to Install or Upgrade** page, select the same disk as the 5.5 install.
4. Select **Upgrade** on the **ESXi Found** dialog box. If you do not see the **ESXi Found** dialog box, click **Back** and ensure that you select the partition or device containing the ESXi 5.5 install.
5. On the **Confirm Upgrade** page, press F11 to confirm and start the upgrade.

6. After the upgrade is complete, reboot the host.
7. Configure the Mellanox drivers. [Configuring Mellanox Drivers](#)
8. Reconnect the host to vCenter.
9. Exit maintenance mode on the host and start the Fluid Cache guest appliance.

If your Fluid Cache guest for the upgraded node starts without any issues and reconnects on the Cache Overview page, the upgrade is complete on this node. Make sure that the node that is upgraded shows up with no disconnected elements or errors on the Cache Overview page before proceeding to the next node. The reconnect process can take several minutes.

### Patching the ESXi Hosts Version

Perform the following steps:

1. Place the ESXi host in maintenance mode.
2. Scan, stage, and remediate the host as you normally would.
3. After the ESXi node is back up, exit maintenance mode and power on the Fluid Cache appliance guest. Monitor the Cache Overview page (again, not from the node that you are powering on which might not be up yet) and you should see the node start to connect in the Cache Server Stats area within 5 minutes.
4. You may see extra replica entries on other nodes after the patched node comes back online. These replica entries will resolve over time. Verify that the top of the Cache Overview page displays three active metadata servers and two peer CFM servers online before proceeding. It is safe to vMotion guests back to the recently rebooted node once the cache server state is normal on the recently patched node.

If your Fluid Cache guest for the upgraded node starts without error and reconnects on the Cache Overview page, the upgrade is complete on this node. Make sure that the node that is upgraded shows up with no disconnected elements or errors on the Cache Overview page before proceeding to the next node. The reconnect process can take several minutes.

### Configuring Mellanox Drivers

ESXi 6.x shipped with Mellanox drivers that are not compatible with Fluid Cache 2.1.0.

### Verifying the Mellanox Drivers

To verify if the host is running the correct drivers, perform the following steps:

1. Log in to the host using SSH shell and run the following command:

```
esxcli network nic list
```

In the Driver column, the following driver must be listed for Mellanox vmnics.

```
mlx4_en us
```

2. If the following not compatible drivers are listed, perform the steps provided in the section [Installing the Supported Drivers](#) to install the appropriate driver.

```
nmlx4_core  
nmlx4-en  
nmlx4-rdma
```

## Installing the Supported Drivers

Perform the following steps to install the supported drivers:

1. SSH into the ESXi host. Run the following commands to disable the ESXi 6.x inbox driver:

```
esxcli system module set -e false -m nmlx4_en
esxcli system module set -e false -m nmlx4_core
esxcli system module set -e false -m nmlx4_rdma
```
2. In the SSH shell prompt, run the following command substituting the actual path you placed the file on and the filename for the current version of the driver at the time of your install:

```
esxcli software vib install -d /vmfs/volumes/ATL13\ NFS5\ export/MLNX-OFED-
ESX-1.9.10.6-10EM-600.0.0.2494585.zip
```
3. Re-enable Mellanox Virtual function. From the SSH shell for your ESXi host, run the following command:

```
esxcli system module parameters set --module mlx4_core --parameter-string
"max_vfs=1"
```
4. Reboot the host.
5. After the host reboots, right-click the host and select **Connect** to get the host re-connected to the vCenter.  
If you install the driver version, which is already being used in ESXi 5.5, then the current driver installation will not make any changes to your system.

# Fluid Cache Web Page Overview

The Fluid Cache web page collects all possible information about the Fluid Cache clusters and provides detailed status and activity report about the hosts and cache devices within the clusters.

## Accessing Fluid Cache Web Page

In the address bar, enter the URL of one of the hosts that is part of Fluid Cache cluster on port 8082. Use the following format:

```
http://<Fluid Cache Appliance Guest Host Name>:8082
```

The browser will display the Fluid Cache web page.

## Understanding Fluid Cache Web Page

This section describes the **Overview** page of the Fluid Cache Web page.

### Status

The status section of the **Overview** page displays the following information.

- **Version** – Displays the version and build number of Fluid Cache cluster.
- **Start Time** – Displays the time that the cluster was started.
- **Last Update** – Displays the time that the cluster was last modified.
- **Cluster State** – Displays the state of the cluster.

### CFM Info

The CFM Info section displays the following information about the primary (active) CFM in the cluster.

- **Peering state** – Displays the role of the CFM, The possible options are Primary or Secondary. You can have only one primary and two secondary CFMs up at any time.
- **Hostname** – Displays the hostname of this node.
- **Address** – Displays the management IP address of this node.
- **Listen Interfaces** – Displays the cache network IP address of this node.

### Peer CFMs

The Peer CFMs section displays the following information about other Fluid Cache hosts that serves as CFMs.

- **Hostname** – Displays the hostname of the Secondary CFMs in this cluster.

- **Address** — Displays the cache network IP addresses of the Secondary CFMs.
- **Port** — Displays the TCP ports that are used to communicate between the CFMs.
- **Online** — Displays the connection state of the Secondary CFMs. The possible options are Yes or No.

## Metadata Server Stats

The Metadata Server Stats section displays the following information about the Fluid Cache cluster hosts serving as Metadata Servers.

- **Hostname** — Displays the hostname of the three Metadata servers in the cluster.
- **Status** — Displays the status of the Metadata servers. The possible options are online or offline.
- **Connection** — Displays the connection protocol used for the Metadata servers. The connection protocols should be RDMA/RC.
- **Active** — Displays whether the Metadata server is Active. The possible options are Yes or No
- **Requests** — Displays the number of Metadata requests to each Metadata Server.

## Cache Server Stats

The Cache Server Stats section displays the following information about a single Fluid Cache Cluster host.

- **Hostname** — Displays the hostname of the host.
- **Connection** — Displays the connection method or protocol used by the host to communicate with other hosts in the cluster.
- **Devices** — Displays the details about the cache devices present in the host.
- **In Use (GB)** — Displays the cache memory space (in GB) that is being used on the host. This include data stored in replica blocks.
- **In Use (%)** — Displays the percent of cache memory space that is being used on the host.
- **Client Reading (GB)** — Displays the cumulative data (in GB) that is being read by a client.
- **Client Writing (GB)** — Displays the cumulative data (in GB) that is being written by a client.
- **Dirty (GB)** — Displays the number of unflushed blocks that exist on the cache server on this host.
- **Evicted (GB)** — Displays the cumulative data (in GB) that was evicted from this host.
- **Fill Read Ops** — Displays the cumulative number of cold read operations by the cache server on this host
- **Failed Fill Read Ops** — Displays the number of cold read operations that failed.
- **Slow Fill Read Ops** — Displays the number of cold read operations that took longer than two seconds.
- **Failed Flush Write Ops** - Displays the number of write operations on Compellent that failed.
- **Slow Flush Write Ops** — Displays the number of write operations on the Compellent that took longer than two seconds.
- **Fill read (GB)** - Displays the date (in GB) that have been read by the host from the Compellent.
- **Fill read rate (GB)** — Displays the rate (in GB) at which host data is being read from the Compellent.
- **Flush write (GB)** — Displays the rate ( in GB) at which data is being written on the Compellent from the host.
- **Flush write rate (MB/s)** — Displays the current rate at which the host is writing on the Compellent. This is usually limited by the Compellent.

- **Flush write dirty (GB)** – Displays the data (in GB), which is dirty, was written on the Compellent.
- **Flush write dirty rate (MB/s)** – Displays the current rate at which the host is writing dirty blocks on the Compellent. This is usually limited by the Compellent.
- **Write Same (GB)** – Not supported.
- **Write Same rate (MB/s)** – Not supported.

## Cache Server Per-Path Stats

The Cache Server Per-Path Stats displays the information about the activity of hosts based on each cached LUN.

The first row displays the LUN ID of the cached LUN and the total activity the hosts mapped to the LUN. The subsequent rows displays the storage paths mapped for the hosts in the LUN and about the activity of each node.

The following information is displayed in the Cache Server Per-Path Stats section and the row shows the value for each cache server relative to each volume

- **Storage Path** – Displays the storage path mapped from the Compellent to the Fluid Cache VSA.
- **Cache Server** – Displays the hostname of the cache server.
- **Availability** – Displays if the particular cache server is up and running. The possible options are Yes or No.
- **Cached (GB)** – Displays the amount of data that has been cached.
- **Replica (GB)**– Displays the number of replica bytes that exists.
- **Dirty (GB)** – Displays the amount of dirty data that exists.
- **Fill read (GB)** – Displays the total amount of data that has been read from the Compellent...
- **Fill read rate (MB/s)** – Displays the current rate at which data is being read from the Compellent in MB/s.
- **Flush write (GB)** – Displays the total amount of data that has been written to the Compellent.
- **Flush write dirty (GB)** – Display the total amount of dirty data that has been written to the Compellent, may be different from the Flush write because whole cache blocks can be written to the Compellent even if all of the sectors within the cache block are not dirty.
- **Reads/s**– Display the current rate of reads per second from the Compellent.
- **Writes/s** – Display the current rate of writes per second to the Compellent.
- **Flush write rate (MB/s)** – Display the current rate at which data is being written to the Compellent in MB/s.
- **Flush write dirty rate (MB/s)** – Display the current rate at which dirty data is being written to the Compellent in MB/s.
- **Write Same (GB)**– Not Used.
- **Write Same rate (MB/s)** – Not Used.

## Block Device Stats

The Block Device Stats section displays the activity of each Fluid Cache device. The first row displays the internal device name of the cached volume and the total activity of the hosts accessing the cache

volume. The rows displays the activity of individual nodes that are accessing the cache volume. A normal, healthy cluster displays a status of online for each node's access to the Fluid Cache device.

- **Device** — Displays the name of the Fluid Cache block device.
- **Hostname** — Displays the hostname of the nodes that have that block device mapped to them. For VMware the device will be mapped to all nodes in the cluster.
- **Connection** — Displays the connection protocol the block device uses to connect to the cache servers. The connection protocols should be RDMA/RC.
- **Size(GB)** — Displays the size of the Compellent Volume that is being cached in GB.
- **Persistent** — Displays the WWN of the Compellent backing store, note the 8 in the middle of all the zeros of the WWN.
- **Status** — Displays the current status of the vblock device on each node. If the device status is offline, the issue that took the device offline must be resolved, and then the device must be reactivated in EM.
- **Openers** — Displays the number of processes that have the device open.
- **Read (GB)** — Displays the number of GB that have been read from the block device.
- **Write (GB)** — Displays the number of GB that have been written to the block device.
- **Read rate (MB/s)** — Displays the Current rate at which data is being read from the block device in MB/s.
- **Write rate (MB/s)** — Displays the current rate at which data is being written to the block device in MB/s
- **Reads/s** — Displays the current number of reads per seconds that are being read from the block device.
- **Writes/s** — Displays the current number of writes per second that are being written to the block device.

# Troubleshooting Fluid Cache Installations

If you have unresolved issues running Fluid Cache after a successful completion of the installation procedure, contact your Compellent Copilot.

Troubleshooting the Compellent array and SAN architecture is beyond the scope of this document.

For additional troubleshooting information, refer to the *Enterprise Manager Administrator's Guide* and the documentation for other hardware and software components. See [Related Documentation](#).

After the initial list of **Basic Troubleshooting Steps**, the troubleshooting topics are presented in the order in which the issues are likely to appear as you deploy, configure, administer, and maintain a Fluid Cache installation.

## Basic Troubleshooting Steps

Make sure the following conditions are fulfilled:

- You have downloaded and installed the most recent firmware, drivers, and software required to support Fluid Cache for SAN (see [Requirements for Fluid Cache](#)).
- The hardware is racked and cabled according to your hardware documentation.
- The network security settings match those specified in [Checking Network Connections](#).
- The ports available to Fluid Cache match those specified in [Fluid Cache for SAN Environment](#).
- All servers are in the same management interface subnet and in the same cache network subnet.
- Each server in the Fluid Cache cluster appears in Enterprise Manager's list of servers.

## Unable to remove a cache device from Fluid Cache Cluster using Enterprise Manager

<b>Description</b>	In Enterprise Manager, when you perform operations such as removing a cache device from a Fluid Cluster node, the following error message is displayed:  <i>Fluid Cache not Found</i>
<b>Possible Cause</b>	Enterprise Manager may not be in synchronization with the Fluid Cache cluster to retrieve the latest state.
<b>Solution</b>	To resolve this issue, shutdown the EM client, and then restart the EM Data Collector.  If the issue persists, contact Dell Customer Support.

## Unable to connect the vCenter Server

**Description** If you change the vCenter server IP/network address or domain/admin password while rebooting the VSA, the connection between the VSA and Fluid Cache cluster will be lost.

**Solution** From the VSA console, log in to the vCenter server with correct IP address and credentials, and then reboot the VSA to reconnect the Fluid Cache cluster appropriately.

## Unable to recover the Fluid Cache Cluster after iSER fails

**Description** When a Fluid Cache cluster device in a VSA fails, the tgt target for that LUN is removed and iSER failover to another VSA.

**Solution** To add the Fluid Cache cluster device back to the node with tgt target, reboot the VSA with the failed device.

## Creating a VSA cluster without SSDs causes iSER rescan issues

**Solution** It is an expected behavior. Dell recommends not to create a VSA cluster without SSDs.

## Delay in I/O on guest I/O virtual machine for a few minutes when the primary CFM VSA is turned off unexpectedly.

**Solution** It is an expected behavior.

## VSA with unaligned I/Os has performance issues

**Solution** When using PCIe SSDs, ensure that partitions are aligned on 4KB boundaries for best performance.

## The Mellanox Virtual Function is not available for Passthrough in ESXi 6.0

<b>Possible Cause</b>	The ESXi 6.0 installation may include Mellanox drivers that do not support the virtual function.
<b>Solution</b>	Disable or uninstall the following inbox drivers and make sure to install and configure the correct versions of the Mellanox drivers. For more information about the supported Mellanox drivers, see the <i>Dell Fluid Cache for SAN Compatibility Matrix</i> available at <a href="http://www.dell.com/CacheSolutions">http://www.dell.com/CacheSolutions</a> . <ul style="list-style-type: none"><li>• nmlx4_core</li><li>• nmlx4-en</li><li>• nmlx4-rdma</li></ul>

## Server Does Not Appear in List of Servers

<b>Possible Cause</b>	A configuration issue is preventing the server from appearing in the list.
<b>Solution</b>	Make sure the procedure for configuring the server was completed successfully. See <a href="#">Configuring a Fluid Cache Server</a> .
<b>Possible Cause</b>	Firewall settings are preventing network communication.
<b>Solution</b>	Check your firewall settings. See <a href="#">Checking Security Settings</a> .
<b>Possible Cause</b>	The network switch is not correctly cabled or configured.
<b>Solution</b>	Review the settings for the network switch and consult your switch documentation. See <a href="#">Cluster or Application Has Performance Issues</a> .

## Cache Device Does Not Appear in List of Cache Devices

<b>Possible Cause</b>	The cache device you are trying to add is not supported by Fluid Cache.
<b>Solution</b>	Refer to the list of supported devices in <a href="#">Requirements for Fluid Cache</a> .
<b>Possible Cause</b>	The cache device is not functioning properly.
<b>Solution</b>	To check device function, select the device in Enterprise Manager and in the <b>Event</b> tab, look for a device failure message. Replace the cache device if necessary, using instructions in the <i>Dell Compellent Enterprise Manager User's Guide</i> .

## Cache Device Cannot Be Added to a Cluster

<b>Possible Cause</b>	The cache device is not functioning properly. Under some conditions, the process of adding a device completes normally even though the device being added is not functioning properly.
-----------------------	--

**Solution** To check device function, select the device in Enterprise Manager and in the **Event** tab, look for a device failure message.

If necessary, replace the cache device by following the instructions provided in the *Dell Compellent Enterprise Manager User's Guide*.

## Cannot Select a Specific Cache Mode

**Possible Cause** There is an existing cache mode configured for the volume mapping. The cache mode chosen for a volume mapping cannot be changed. The existing mapping must be deleted, and a new mapping created. A new cache mode can be selected while creating the new mapping.

**Solution** Remove the volume mapping and create a new mapping. When you create the new mapping, you can then select a different cache mode ("cache policy"). See [Removing Volume Mappings](#) and [Mapping Volumes](#).

**Possible Cause** The cluster is in maintenance mode.

**Solution** Take the Fluid Cache cluster out of maintenance mode by selecting the cluster in Enterprise Manager, clicking **Edit Settings** in the **Summary** tab, and clearing the **Maintenance Mode** option. Note that certain system failures or an invalid license may prevent the cluster from being taken out of maintenance mode. Refer to the Enterprise Manager **Status** and **Events** tabs, and see [Fluid Cache License Is Expired](#).

## Cached LUNs Are Unavailable

**Possible Cause** After restarting Fluid Cache or restarting a server, cached LUNs may not be immediately available.

**Solution** Wait for the cached LUNs to reappear. It may take a significant amount of time to write a large amount of data. The cached volumes reappear after the cache completes recovery.

**Possible Cause** A fault in the cluster is preventing the volume from being recognized by Enterprise Manager.

**Solution** Check the Enterprise Manager status page and event log for error messages.

## Enterprise Manager Freezes While Adding or Removing a Volume Mapping

**Possible Cause** You are using the VMFS filesystem and did not unmount the filesystem before removing volume mappings.

**Solution** Unmount the filesystem before removing the volume mappings (refer to the document [VMware Knowledge Base article 2004605](#)).

**Possible Cause** Under some conditions, when removing multiple volume mappings, the first volume may take an unusually long time (more than 20 minutes) to unmap.

**Solution** Wait for the volumes to unmap. Unmapping speed should increase as more volumes are unmapped.

## Unable to Map Volumes to Fluid Cache using Enterprise Manager

**Possible Cause** ESXi hosts were added to vCenter by using their IP Address and not their hostname when DNS is being used on your network.

**Solution** Turn off the Fluid Cache VSA virtual machines on the ESXi hosts. Remove the ESXi hosts from vCenter. Add the ESXi hosts back to vCenter by using their registered DNS name.

**Possible Cause** DNS assigned address for ESXi host and the VSA virtual machine that is used for Fluid Cache has changed from its initial setting during Fluid Cache cluster creation.

**Solution** Configure your DNS server to use static addresses for your ESXi hosts and Fluid Cache VSA VMs.


## Cannot Configure the Cache Network


**Possible Cause** Firewall settings are preventing access to one or more ports required by Fluid Cache.

**Solution** Change your firewall settings to allow access by Fluid Cache. For a list of required ports, see [Checking Network Connections](#).

**Possible Cause** One of the ports required by Fluid Cache is in use by another process.

**Solution** Refer to the required ports listed in [Checking Network Connections](#) and reassign ports as needed.

 **NOTE:** Port 3033 is used to communicate with Enterprise Manager and Storage Center. To configure those applications to use a different port, refer to the corresponding *Administrator's Guide*. After a new port is configured in Enterprise Manager or Storage Center, Fluid Cache automatically uses the new port.

 **NOTE:** Port 7449 and 5480 are required by Fluid Cache. If other applications are using these ports, configure those applications to use different ports.

**Possible Cause** If an incorrect IP address is entered during configuration of the VSA (see [Configuring the VSA](#)), an error message indicates that Fluid Cache cannot log in due to an incorrect vCenter address.

**Solution** Select **Change vCenter** and re-enter the IP address, or check network connections and settings.

**Possible Cause** If one of the iSER interfaces required by the VSA cannot be created, the VSA configuration fails and an error message indicates that the network is not configured properly. Note that an existing iSER interface configured in vCenter can prevent creation of the iSER interface required by the VSA.

<b>Solution</b>	Check your network connections and verify functionality of the iSER interfaces using vCenter ( <b>Configuration</b> → <b>Networking</b> ). Do not use vCenter to delete or modify the iSER interfaces used by Fluid Cache, or to create new iSER interfaces. Remove any iSER interfaces that were created prior to configuration of the Fluid Cache VSA.
<b>Possible Cause</b>	The correct version of the Mellanox driver is not installed, which results in an error message when attempting to power on the VSA. The error message may specify "Cannot set MAC address or default VLAN for PCI Virtual Function" or error 0x195887107.
<b>Solution</b>	Make sure you have the correct Mellanox driver version installed.
<b>Possible Cause</b>	One or more paths to the Compellent are not operational. During configuration of the VSA, all paths to the Compellent must be operational or the configuration is not successful.
<b>Solution</b>	Make sure that all paths to the Compellent are operational.
<b>Possible Cause</b>	The TUI configuration tool could not obtain the iSCSI IQN from the ESXi host. When attempting to configure the iSCSI network, the following error message is displayed: "Cannot configure iSCSI. ESXi host <host_name> is missing configured iSCSI software adapter."
<b>Solution</b>	Manually configure the ESXi host by logging in to the ESXi host that the VSA is deployed on and configure the iSCSI software initiator.

## Cannot Create a Fluid Cache Cluster

<b>Possible Cause</b>	A minimum of three PowerEdge servers have not been configured for use with Fluid Cache. Until at least three servers have Fluid Cache installed and configured, the option to create a Fluid Cache cluster is unavailable.
<b>Solution</b>	Add three or more nodes and configure the nodes before attempting to create a Fluid Cache cluster in Enterprise Manager.
<b>Possible Cause</b>	Network connectivity issues are preventing the creation of a Fluid Cache cluster.
<b>Solution</b>	Check that the security settings are correct and the required ports and network connections are open. See <a href="#">Checking Network Connections</a> and <a href="#">Checking Security Settings</a> .

## Cannot Map Volumes to a Fluid Cache Cluster

<b>Possible Cause</b>	The iSCSI software adapter on the ESXi host is not logged in to the Storage Center that contains the LUN you are mapping.
<b>Solution</b>	Make sure the iSCSI adapter on the ESXi host is logged in to the appropriate Storage Center.
<b>Possible Cause</b>	The iSCSI VMkernel port on the ESXi host is not bound properly to the iSCSI initiator.

**Solution** Check the binding in vSphere by opening the **iSCSI Initiator Properties** window. If no VMkernels are shown, click **Add**, select the VMkernel that corresponds to your iSCSI (uncached) network, and click **OK**. Click **Close** on the **Properties** window and when prompted to rescan the adapter, click **Yes**.

## Cannot Connect to Cluster Nodes

**Possible Cause** Time synch issues are preventing Enterprise Manager from connecting to the cluster nodes. The cluster appears to be configured correctly, but in the **Overview** page, no Fluid Cache connections are active.

**Solution** Make sure that you have enabled Network Time Protocol and that in the vTools control panel, **Synchronize guest time with host** is not selected. (For more information, refer to the VMware document [Timekeeping in VMware Virtual Machines](#)).

## Fluid Cache License Is Expired

**Possible Cause** System settings such as changes to the system date cause the current Fluid Cache license to expire. You can still access data on cached volumes, but performance is degraded because the Fluid Cache cluster has been placed in maintenance mode and caching is no longer active.

**Solution** Check the status of the license file by selecting the Fluid Cache cluster in Enterprise Manager and referring to the status shown on the **Events** or **Cache** tabs. If the license is expired, make sure that your system settings for date and time are correct. If it is not correct, set the appropriate date and time. Take the Fluid Cache cluster out of maintenance mode by selecting the cluster in Enterprise Manager, clicking **Edit Settings** in the **Summary** tab, and then clearing the **Maintenance Mode** option.

**Possible Cause** Fluid Cache for SAN is running on an evaluation license (typically 90 days) and that time period has been exceeded. You can still access data on cached volumes, but performance is degraded because the Fluid Cache cluster has been placed in maintenance mode and caching is no longer active.

**Solution** Check the status of the license file by selecting the Fluid Cache cluster in Enterprise Manager and referring to the license type shown on the **Events** or **Cache** tabs. If the number of days remaining is zero, contact your Dell representative to purchase a Fluid Cache for SAN license. After activating the new license, take the Fluid Cache cluster out of maintenance mode by selecting the cluster in Enterprise Manager, clicking **Edit Settings** in the **Summary** tab, and deselecting **Maintenance Mode**.

## Fluid Cache License Is Invalid

**Possible Cause** The license file is invalid if it is in any way modified. This causes unsuccessful digital signature validation.

**Solution** Contact Dell Customer Support.

## Cannot Assign or Remove a Storage Center

**Possible Cause** The Storage Center is already assigned to another Fluid Cache cluster.

**Solution** In Enterprise Manager, see whether or not a Storage Center is listed for the Fluid Cache cluster.

**Possible Cause** Network connectivity issues are preventing Enterprise Manager from communicating with Storage Center.

**Solution** Make sure the network is functioning properly. Refer to [Checking Network Connections](#) and [Checking Security Settings](#).

## Cannot Determine Which Cache Device Failed

**Possible Cause** One of the cache devices has failed on a server with multiple cache devices installed, and it is not clear which of them failed.

**Solution** In Enterprise Manager, in the **Cache** tab, the failed cache device is identified by a red X through it. Note the last digits of the number for this cache device. This number matches the serial number printed on the label of the failed cache device.

## Events for Fluid Cache Are Not Shown in Enterprise Manager

**Possible Cause** When Enterprise Manager was installed, the Data Collector was not configured for the correct IP address.

**Solution** Make sure the IP address that the Data Collector uses is accessible by the Fluid Cache nodes. To view the IP address, start the Data Collector Manager, select **General Information**, and note the IP address within the URL in the **Web Site** field. Change the address if necessary and restart the Data Collector.

## Unable to PCI Passthrough a Samsung NVMe Flash Drive to Fluid Cache VSA through VMware vCenter Web Client

**Solution** Use the thick client of VMware to mark the Samsung NVMe flash drive for PCI Passthrough.

## Fluid Cache VSA node not being added to Fluid Cache Cluster Server Object in Enterprise Manager

**Possible Cause** Duplicate hardware iSCSI initiator WWN configured on an ESXi host.

**Solution** Verify that all hardware iSCSI initiator WWNs configured on your ESXi hosts are unique across all ESXi nodes in your Fluid Cache Cluster.

## Cluster or Application Has Performance Issues

**Possible Cause** One or more cache devices are uninstalled, have failed, or do not have the correct firmware or drivers.

**Solution** Use Enterprise Manager to check the functionality of the cache devices.

**Possible Cause** The Compellent storage array is overloaded.

**Solution** In Enterprise Manager, check the storage latencies and throughput on the cached volumes. Add more capacity to the Compellent array if necessary.

**Possible Cause** The application is not making use of the cache.

**Solution** Make sure the application has an I/O profile that can leverage Fluid Cache, which accelerates reads, writes, and read-after writes. If the application does, check the running cache mode for that volume in Enterprise Manager. If necessary, change cache modes by deleting the volume mapping and creating a new one with a different cache mode. See [Mapping Volumes](#).

**Possible Cause** The active data set greatly exceeds the size of the cache pool.

**Solution** Add more cache devices to increase the size of the cache pool.

**Possible Cause** Network traffic from outside Fluid Cache is interfering with performance.

**Solution** The cache network switch is not configured correctly. Configure the ports on the switch used by Fluid Cache so that they are used solely by Fluid Cache.

**Possible Cause** The cache network switch is not configured correctly.

**Solution** Make sure that the switch has the following settings:

- The ports are in Layer 2 mode.
- The ports are in an untagged state.
- The switch firmware is up to date.
- Multicast is enabled.
- Verify that flow control is enabled and DCB is disabled. For Dell Networking switches, see [Configuring the Cache Network Switch](#). For all other switches, consult the manufacturer's documentation.



**NOTE:** Enabling flow control is a requirement for Fluid Cache.

- For blade enclosure, disable FlexAddress.

You can check network functionality by checking `rx_over_errors` using the `ethtool -S <interface>` command.

**Possible Cause** Fluid Cache is running on an evaluation license (typically 90 days) and that time period has been exceeded. You can still access data on cached volumes, but performance is degraded because the Fluid Cache cluster has been placed in maintenance mode and caching is no longer active.

**Solution** Check the status of the license file by selecting the Fluid Cache cluster in Enterprise Manager and referring to the status shown on the **Events** or **Cache** tabs. Contact your Dell representative to purchase a Fluid Cache license. After activating the new license, take the Fluid Cache cluster out of maintenance mode by selecting the cluster in Enterprise Manager, clicking **Edit Settings** in the **Summary** tab, and then clearing the **Maintenance Mode** option.

## Unable to add a Fluid Cache ESXi 6.0 host to an existing server cluster

**Description** Using Enterprise Manager GUI, if you try to add an ESXi 6.0 Fluid Cache host to an existing server cluster within a Storage Center, the following error message is displayed:

*SC servers must all have the same operating system.*

**Solution** When adding a new Fluid Cache ESXi6.0 server host to an existing sub server cluster, in the **Edit Server Settings** dialog box, select **VMware ESXi 5.5** for the **Operating System** type instead of VMware ESXi 6.0. After adding the server to the sub server cluster, when Enterprise Manager prompts you to change the version, change the operating system type to **VMware ESXi 6.0**.

This method enables you to add an ESXi 6.0 host to an existing sub server cluster on the SC8000 without any issue.

## Unable to install Dell Fluid Cache VSA properly on the following Fluid Cache Cluster platforms

**Description** When configuring Fluid Cache VSA iSCSI interface on the Fluid Cache Cluster ESXi5.5U3 and ESXi6.0U1 platforms during VSA installation, the following error message is displayed.

*"Cannot configure iSCSI initiator already configured for a different ESX host".*

**Solution 1(Preferred)** Perform the following steps, and then configure the iSCSI section in the VSA setup:

1. In the Web Client, open the VSA console, and enable SSH.
2. Log in to VSA through SSH.
3. Run the following command to navigate to the **iscsi** directory:

```
#cd /etc/iscsi
```

4. Open the **initiatorname.iscsi** file and verify if the value for the InitiatorName is displayed in asterix (\*). For example:

```
root@localhost iscsi]# cat initiatorname.iscsi
InitiatorName=*****
```

5. Run the following command to edit the `initiatorname.iscsi` file.
 

```
#vi initiatorname.iscsi
```
6. Change the characters with asterisk (\*) with the proper ESXi Hosts vmhba## software IQN that the VSA is associated. For example:
 

```
root@localhost iscsi]# cat initiatorname.iscsi
InitiatorName=iqn.1998-01.com.vmware:FLDC-QAESXi55U1-
Srv1-48a43810
```
7. Run the following command to restart `iscsid` service.
 

```
#service iscsid restart
```


## Solution 2

Perform the steps provided in the section “Configuring the VSA” of the deployment guide in the following sequence:

1. Perform the steps 1 through 5 as described in the deployment guide.
2. Select Configure This Appliance and press <Enter>.
3. Configure your Backend Storage connection.
4. Perform the steps 6 and 7 and continue with step 10 as provided in the deployment guide.

## Unable to Recreate a Fluid Cache Cluster After a Hardware Failure

Use Enterprise Manager to completely delete a Fluid Cache cluster that has failed before trying to remake the cluster.

 **NOTE:** Clean up Enterprise Manager and the Storage Centers after a hardware failure before recreating a Fluid Cache cluster. The Delete option will not appear unless the Fluid Cache cluster has been fully removed from Enterprise Manager.

## Cache Node is Not Listed

The node was not selected in the Select Servers window when creating the Fluid Cache cluster or the network switch may not be configured correctly.

1. Make sure the node is selected.
2. If the node is still not listed, review the settings for the network switch and consult your switch documentation.

## Unable to Select a Specific Caching Mode

The required number of nodes or PCIe SSDs may not be available.

Keep in mind that while a cache device or cache server may have been previously configured, it may have since failed or is impacted by a network failure.

- For write-back caching, ensure that there is a minimum of two nodes with PCIe SSDs on different servers in the Fluid Cache cluster.
- For write-through caching, ensure that there is at least one node with a PCIe SSD.
- Ensure the cluster is not in maintenance mode.

## Fluid Cache License File is Invalid

Verify that the license didn't expire or that a system change caused the license to be invalidated.

- The Fluid Cache license status can be verified on either the Fluid Cache clusters' Events tab or Cache tab.
- An evaluation license is valid for only 90 days. Contact your Dell sales representative to purchase a Dell Fluid Cache for SAN license.

## Option to Create Cluster Not Available

All of the prerequisites for creating a Fluid Cache Cluster must be satisfied before the option to do so appears.

- Must be running Enterprise Manager 6.5.1 or later.
- Must have a Storage Center attached that can support Fluid Cache.
- Must have a minimum of one Fluid Cache server configured for use with Fluid Cache.
- Must be running Dell Fluid Cache for SAN 2.0 later.

## Unable to Add a Volume to a Fluid Cache Cluster

To verify the issue, check to see that both of the following items are true.

- Make sure all the Fluid Cache servers are on the same network as the Storage Center that is serving the volume.
- Make sure that the volume is not in use on another server or cluster.

## Event Messages Are Not Being Delivered

The Enterprise Manager Data Collector is responsible for receiving alert messages and transmitting them to configured users. When setting up Enterprise Manager on a multi-homed system, make sure to set messaging to use a NIC that is on the same network as the Fluid Cache server(s), or configure routing on the cache server to be able to get to the address on the NIC the Enterprise Manager Data Collector was configured to use.

## Storage Center is Not Available

If you receive an error that you don't have a Storage Center or you don't see any Storage Centers, make sure that the Storage Center(s) is running version 6.5.1 or later.

## Fluid Cache Server is Not Available

If you do not see a Fluid Cache server that you expect to be listed, click the Rescan button as the server may not have been discovered by the other servers in the cluster.

## Information Displays Differently Between Storage Centers and Fluid Cache Clusters

The Fluid Cache Clusters display shows information from the Fluid Cache server perspective while the Storage Centers display shows information from the Storage Center perspective. If there is a communication issue between the Fluid Cache servers and the Storage Center, they may each show that condition differently.

There is some latency in gathering information from the Fluid Cache servers by both Data Collector and the Storage Center as well as from the Dell Storage Client gathering information from Data Collector. It could take several minutes for all parts of the system to synchronize and show a consistent view.

## Verify That All Parts of the Fluid Cache Cluster are Communicating with Each Other

If the Dell Storage Client displays a "reconnect" message in the Fluid Cache display for a Fluid Cache cluster it means that EM is no longer able to communicate with the Fluid Cache cluster through the management network.

- Verify that the network is operational between the Data Collector server and the Fluid Cache servers using a network tool such as ping.
- If ping works but a reconnect to that address continues to fail, make sure that the Fluid Cache software is operational on the server.

If the EM client displays a red mark over the cluster in the Storage Centers view of the cluster, it means that the Storage Center is reporting that it cannot communicate with the cluster servers over the management network.

- Verify that the network is operational between the cluster servers and the Storage Center by using a network tool such as ping.
- Note that it may take several minutes for the Storage Center to report the cluster status (down or up).

## Verify the Data Path is Working

The Storage Centers server view is present if the Storage Center is able to see data connections to the cluster. The HBAs will be have a red mark if there are problems.

The Fluid Cache Clusters server view will show the HBAs from the Fluid Cache Servers perspective. Depending on the server and its operating system, conditions such as connectivity may not be visible from this view.

When checking for data connectivity, always check the Storage Centers view first.

## The Cluster in the Fluid Cache Clusters Display is Marked Red

Take the following into consideration when troubleshooting this problem.

- Make sure the cluster is not in Maintenance mode.
- Enterprise Manager will give the cluster a red mark if EM is having trouble communicating with the Fluid Cache servers or if the Fluid Cache servers report problems back to EM. The Cache tab for the cluster in the Fluid Cache Clusters display may have some text to indicate the issue being experienced. Also check the events for clues as to what is causing the issue.
- Expand the tabs for each of the servers, volumes, and storage centers for the cluster in the Fluid Cache Clusters display. Additional red marks on a server, cache device, volume, or Storage Center may help determine why the cluster has a red mark.

## **Problems Configuring Server Clusters Defined on a Storage Center with Dell Fluid Cache for SAN**

When a Storage Center is assigned to a Fluid Cache cluster, the Fluid Cache cluster has to follow the same requirements as normal server clusters defined on the Storage Center. Servers in the Fluid Cache cluster are automatically mapped to an existing Storage Center server through their HBAs or created anew if no previous Storage Center server exists.

Since server clusters defined on a Storage Center must have the same operating system, all servers in the Fluid Cache cluster must also have the same operating system. If a Storage Center server with matching HBAs was previously created on the Storage Center prior to the assignment and it was defined with a different operating system on the Storage Center, than the Fluid Cache cluster will not be able to assign the Storage Center to the Fluid Cache cluster.

When a Fluid Cache cluster has servers that are part of a Storage Center server cluster, the Storage Center server cluster becomes a sub-cluster under the Fluid Cache cluster when the Storage Center gets assigned to the Fluid Cache cluster. To maintain cluster rules, if a server in the Fluid Cache cluster is part of a Storage Center server cluster, than all Fluid Cache servers from the Storage Center server cluster must be in the Fluid Cache cluster.