


Dell Fluid Cache for SAN Version 2.1.0

Deployment and Admin Guide for Linux
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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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 Linux based environments.

Topics:

- [Audience](#)
- [Related Documentation](#)
- [Dell Online Services](#)
- [Technical Support and Customer Service](#)
- [Contacting Dell](#)

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 and enter your Service Tag.

For cache device documentation, go to Dell.com/storagecontrollermanuals and click **Dell Power Edge Express Flash PCIeSSD**.

For Fluid Cache documentation, go to 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.
	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 Accessing Dell Compellent Documentation	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. To download Enterprise Manager and Storage Center documentation:

- 1 Go to 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.
- 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 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.

Topics:

- [Dell Fluid Cache for SAN Features](#)
- [Fluid Cache for SAN Environment](#)
- [Fluid Cache for SAN Deployment Requirements](#)
- [Fluid Cache for SAN in Enterprise Manager GUI](#)

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

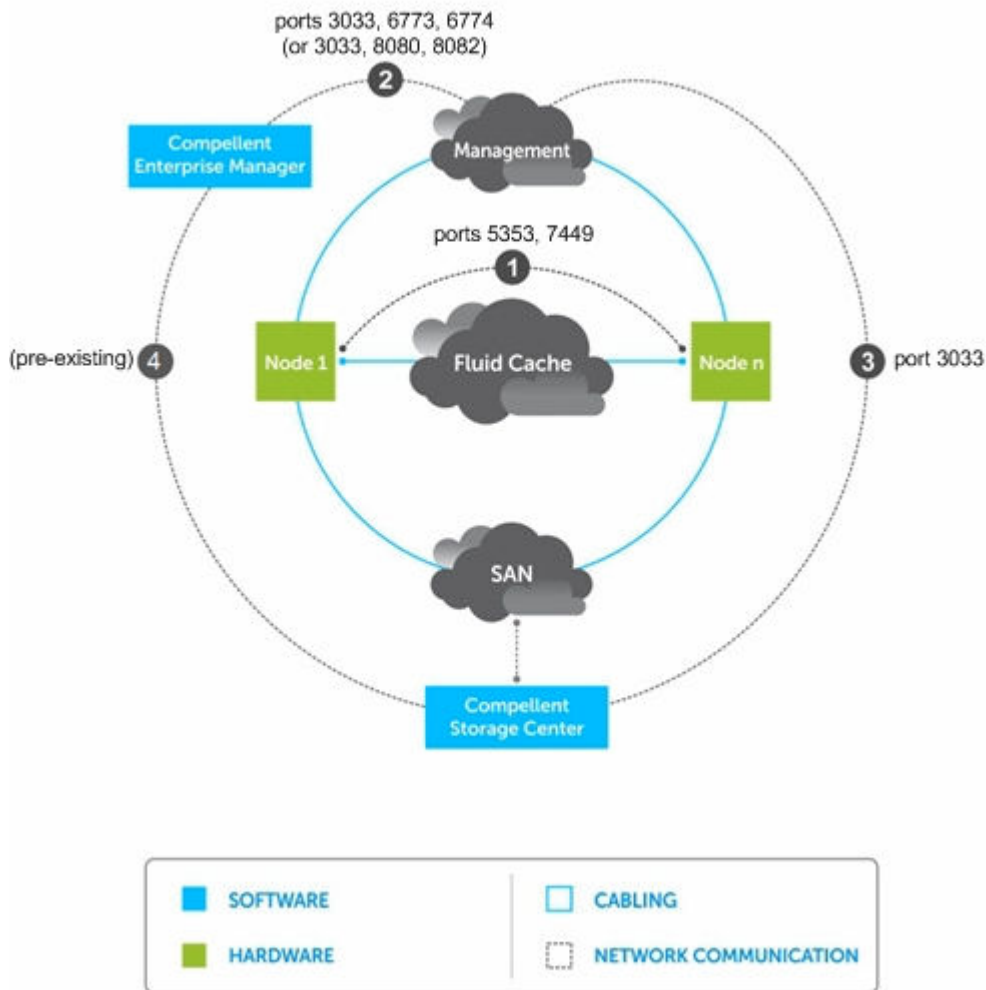
Fluid Cache operates on the following networks and interfaces:

Cache Network	A high speed, low latency private network that Fluid Cache uses to connect the servers in the Fluid Cache cluster.
Management Interface	The connection to Dell Compellent Enterprise Manager, which manages Fluid Cache and the SAN.

Storage Area Network

The network that Dell Compellent Storage Center uses to handle data connectivity within the SAN.

Figure 1. Fluid Cache Connectivity

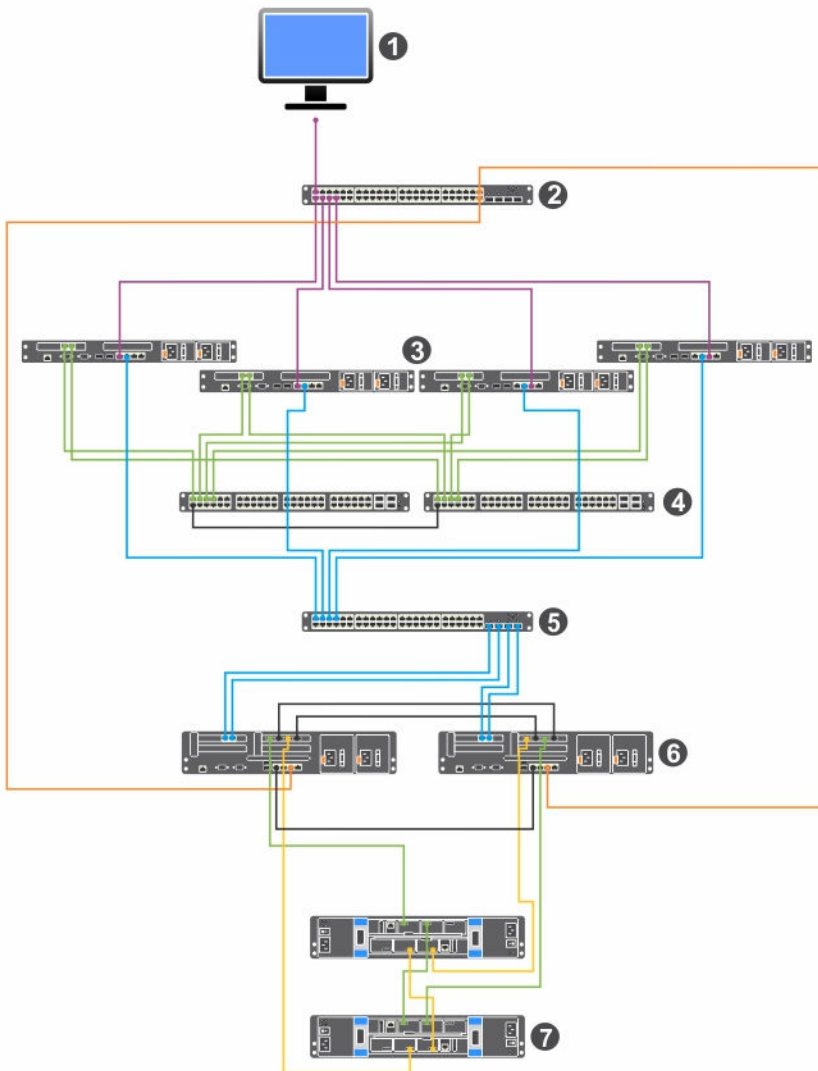


- 1 Fluid Cache nodes communicate with each other over a private network using RDMA.
- 2 Enterprise Manager creates, manages, and monitors the Fluid Cache clusters.
- 3 Fluid Cache nodes communicate with the Management IP (VIP) of the Storage Controllers.
- 4 Enterprise Manager manages the Dell Compellent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

The interfaces illustrated in the figure are associated with specific ports (see [Checking Network Connections](#)). For a schematic of an example Fluid Cache installation, see [Example 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.

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.

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.
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](#).


Topics:

- [Checking Security Settings](#)
- [Checking Network Connections](#)
- [Checking Application Settings](#)
- [Preparing the Servers](#)
- [Preparing the Cache Devices](#)
- [Preparing the Cache Network Adapters](#)
- [Preparing the Cache Network Switch](#)
- [Configuring a Dell Networking Switch](#)

Checking Security Settings

Before you start the installation, make sure that:

- If you are using servers that supports SSL v2, to prevent the servers from DROWN attack, upgrade the OpenSSL version to OpenSSL 1.0.1e.
- 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 below).
- SELinux, AppArmor, or other security frameworks do not limit applications or devices on the cache network.
- iptables exceptions have been entered where appropriate. (Note that some default RHEL installations may create an iptables entry that blocks Fluid Cache. See the troubleshooting topic [Cannot Configure Fluid Cache](#).)
- If your `avahi-daemon.conf` file does not use the default settings, make sure that **Disable Publishing** is set to `no`, **Deny Interfaces** does not list Fluid Cache interfaces, and **Allow Interfaces** is either commented out or lists all Fluid Cache interfaces.

 **NOTE:** If any of these 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

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

RDMA Functionality

To make sure that RDMA is working correctly between the cluster nodes, use the utility `ib_send_bw`:

- 1 On one node, run the command: `ib_send_bw`
- 2 On a second node, run the command: `ib_send_bw <IP_address_of_first_node>`

If the test is successful, the bandwidth for the node displays on each node.

Multipathing Support

Fluid Cache supports multipathing and uses existing multipath configurations. You must make two modifications to the **Devices** section of the `/etc/multipath.conf` file on each node in the cluster:

- 1 For the vendor "COMPELNT", specify `no_path_retry 6`
- 2 Add blacklist entries to exclude devices used by Fluid Cache, as shown:

```
blacklist {
    devnode "^f1dc[0-9]*"
    devnode "^nvme[a-z]*"
    devnode "^r[ssd][a-z]*"
}
```

Checking Application Settings

All applications that use volumes mapped to Fluid Cache must be configured to start after Fluid Cache and exit before Fluid Cache.

Preparing the Servers

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

- For updating Dell Lifecycle Controller and BIOS firmware on 13th 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
- For updating Dell iDRAC firmware on 13th 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
- 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 and set **System Profile Settings** to **Performance**.
- 2 Click **Back**, and then click **OK** to return to the main BIOS page.
- 3 Restart the server to activate the BIOS changes.
- 4 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.

NVMe Cache Devices

- **Firmware**— Refer to the *Dell PowerEdge Express Flash NVMe PCIe SSD User's Guide* for instructions about checking your current firmware version. Use the Dell Update Package to install the latest firmware.
- **Driver**— Refer to the *Dell PowerEdge Express Flash NVMe PCIe SSD User's Guide* for instructions about checking your current driver version and installing the updated driver.

Non-NVMe Cache Devices

- **Firmware**— Make sure the firmware is up to date by using this command: `dmesg | grep mtip32xx | grep Firmware`
For each cache device, you must get results similar to the following, showing firmware version B1490508 or later:

```
mtip32xx 0000:46:00.0: Firmware Ver.: B1490508
```
- ① **NOTE:** The firmware version must be B1490508 or later. Otherwise, even though they are visible in Enterprise Manager, the cache devices do not appear in the list of available devices when adding devices to a Fluid Cache cluster.
- **Driver**— Make sure the driver is up to date and running by using this command: `dmesg | grep -i micron`
For each cache device, you must get results similar to the following, showing driver version 2.4.2 or later:

```
Micron RealSSD PCIe Block Driver Version 2.4.2
```
- ⚠ **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.
- ① **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 the OFED package version, and then update, if necessary.
 - ① **NOTE:** It is recommended to use an MTU of 1500 for RDMA or Cache Network adapter connectivity.
 - ① **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 Create and configure an IP address on all RoCE network interfaces that are connected:
 - a Open the interface configuration file by running the commands:

```
cd /etc/sysconfig/network-scripts  
vi ifcfg-<interface_name>
```
 - b Edit the configuration parameters as given in the example here:

```
DEVICE="<interface_name>"  
BOOTPROTO="static"  
ONBOOT="yes"  
IPADDR="<ip address of the network adapter>"  
NETMASK="<netmask of the cache network>"  
NAME="<interface_name>"
```
 - c Make a note of the address and netmask for later reference when configuring the cache network.
 - d Save your changes to the configuration file.
 - e Open the interface by running the command: `ifup <interface name>`
- 4 If port bonding is used, refer to [Bonding Network Adapter Ports](#).

- 5 If a blade enclosure is used, disable FlexAddress in the blade enclosure.
- 6 Repeat this process for each network adapter in the cache network.

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.

Bonding Network Adapter Ports

Fluid Cache supports port bonding in active/passive mode (also called active/backup or master/slave). Before implementing bonding on your network adapters, make sure that your cache network switches and cabling are correctly configured for bonding. For an example of a system cabled for port bonding, see [Example Cabling Diagram](#).

NOTE: It is recommended that port bonding be used in configurations with redundant, uplinked cache network switches.

The following example describes configuring port bonding on an RHEL system using Dell Networking switches. For non-Dell Networking switches refer to the documentation specific to that networking switch.

- 1 Configure a virtual interface to be used as a bonded port (in this example, `bond0`) by running the following command:

```
vi /etc/modprobe.d/bond0.conf
```

- 2 In the configuration file, edit the parameters as follows:

```
alias netdev-bond0 bonding
```

- 3 Open the configuration file for the bonded port by running the following commands:

```
cd /etc/sysconfig/network-scripts
```

```
vi ifcfg-bond0
```

- 4 Edit the parameters in the configuration file as given in the example here:

```
DEVICE="bond0"  
BOOTPROTO="static"  
ONBOOT="yes"  
IPADDR="<ip address of the network adapter>"  
NETMASK="<netmask of the cache network>"  
NAME="bond0"  
BONDING_OPTS="mode=1 fail_over_mac=1 miimon=100 downdelay=300 updelay=300"
```

NOTE: In the `BONDING_OPTS` line, the values for `mode` and `fail_over_mac` must be set exactly as shown in the example.

- 5 Configure an interface for use on the bonded port by running the following command:

```
vi /etc/sysconfig/network-scripts/ifcfg-<interface name>
```

NOTE: For the names of the interfaces on your server used by Fluid Cache, run the command: `ip addr`. The names of the network interfaces used by Fluid Cache are often in the format `pXpY` (for example, `p6p2`), but may be in the format `ethX`, `emX`, or other formats, depending on your operating system.

- 6 In the configuration file, edit the parameters as follows:

```
DEVICE=<interface name>
BOOTPROTO="none"
ONBOOT="yes"
NM_CONTROLLED="no"
SLAVE="yes"
MASTER="bond0"
```

- 7 For the other interface in the bonded port, repeat the tasks in 5–6.
- 8 Start network connection to the bonded port by running the following command: `ifup bond0`
- 9 Check the status of your bonded port and its interfaces by running the following command: `ifconfig`
The output must contain entries similar to the following. Note the line that states that the port session is started as a master or slave, and note that the slave interfaces no longer have individual IP addresses:


```
bond0    Link encap:Ethernet  HWaddr 00:02:C9:E5:C5:C0
         inet addr:172.20.3.116  Bcast:172.20.7.255  Mask:255.255.248.0
         inet6 addr: fe80::202:c9ff:fee5:c5c0/64 Scope:Link
         UP BROADCAST RUNNING MASTER MULTICAST  MTU:1500  Metric:1
         .
         .
         .
p5p1    Link encap:Ethernet HWaddr 00:02:C9:E5:C5:C0
         UP BROADCAST RUNNING SLAVE MULTICAST MTU:1500 Metric:1
         .
         .
         .
p5p2    Link encap:Ethernet HWaddr 00:02:C9:E5:C5:C0
         UP BROADCAST RUNNING SLAVE MULTICAST MTU:1500 Metric:1
         .
         .
         .
```

- 10 Open the `avahi-daemon.config` file, and in the **Server** section, add this entry: **Allow Interfaces = bond0**.
- 11 Make sure that all servers in the cache network can ping every other server, and also the management interface.

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

Before completing the tasks in this section, install the required Linux dependencies.

Topics:

- Installing the Fluid Cache Software
- Setting up the Fluid Cache Servers

Installing the Fluid Cache Software

- 1 Copy to the server the Fluid Cache `tar.gz` package that you downloaded earlier.
- 2 Expand the `tar.gz` package.
A new Fluid Cache directory is created, which contains an RPM file.
- 3 Change to the new Fluid Cache directory and run the following command:
`rpm -i <RPM file name>`

There is a delay while the Fluid Cache software is installed on the server. During this process, RPM checks for the necessary Linux dependencies and asks you to install any that are not found. For a list of required dependencies, refer to the *Release Notes* available at the support site.

When processing is complete, the command prompt is displayed again.

NOTE: You can also install the software with a Yum repository using the following command: `yum install <RPM file name>`

- 4 Repeat tasks 1–3 for each server in the Fluid Cache cluster.

Setting up the Fluid Cache Servers

Before setting up the servers in your Fluid Cache cluster:

- Make sure that you have IP addresses configured for the network adapters on each server.
- Make sure that you can ping the Mellanox interfaces on every server in the Fluid Cache cluster.
- Record the following information for your servers (contact a network administrator, if necessary):
 - Management interface (used by Enterprise Manager to manage the SAN)
 - Network address: _____
 - Netmask: _____
 - Cache network
 - Network address: _____

- Netmask: _____

An example of the required information is a device with an IP address of 172.18.1.2, whose network address is 172.18.1.0, and netmask is 255.255.255.0.

- 1 Change to the following directory: `/opt/dell/fluidcache/bin/`
- 2 Start the Host Cache Node (HCN) Setup tool by running the following command:
`./hcn_setup.py`

HCN Setup sets up a server for use as a Fluid Cache cluster node, and starts an agent on the server that allows it to be discovered by Enterprise Manager.

- 3 Press <Enter> to begin the setup process.
A dialog box appears for a network address (for example, 172.18.1.0) and netmask (for example, 255.255.255.0) for the interface used by Enterprise Manager to manage the SAN—the “management interface.”
- 4 Enter the network address and press <Enter>.
- 5 Enter the netmask and press <Enter>.
- 6 When prompted to confirm your entries, press <Enter>.
- 7 If you are using more than one management network, enter the address and subnet mask for the auxiliary network. Otherwise, press <Enter>.
- 8 On the **Cache Network** page, enter the network address and press <Enter>.
- 9 Enter the netmask and press <Enter>.
- 10 When prompted to confirm your entries, press <Enter>.
A message is displayed indicating that configuration was successful and prompting you to start Fluid Cache.
- 11 Press <y> to start the Fluid Cache software.
A message is displayed indicating that the server is configured for Fluid Cache.
- 12 Repeat this process for the other servers in the Fluid Cache cluster.
You must set up Fluid Cache on at least three servers before creating a Fluid Cache cluster.

NOTE: If configuration is unsuccessful because of an incorrect value for a network address or netmask, restart HCN Setup and enter the correct values.

After setting up the Fluid Cache servers, create and configure Fluid Cache clusters in Enterprise Manager.

NOTE: HCN Setup also supports a CLI unattended installation. The commands used are:

```
hcn_setup.py -i <management interface IP address>:<subnet mask>
              -I <cache network IP address>:<subnet mask>
              -u [for unattended installations]
              -r [to run agent]
```

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](#)


Topics:

- [Creating a Fluid Cache Cluster](#)
- [Managing a Fluid Cache Cluster Environment](#)
- [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 server.
- b The **Port** box is autopopulated. Change only if necessary.
- c In the **User Name** box, type the username , which is `fldc`.
You can also use the root user name and password in these boxes, if available.
- d In the **User Password** box, type the password . 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.

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.

NOTE: If you have a shared data application, such as a clustered file system or clustered application, map volumes to a subcluster.

NOTE: Any applications that were using a volume before it was cached must be modified to use the new cached volume. When a cached volume is mapped to one or more servers, Fluid Cache creates its own Linux device file, `/dev/fldcX`. (The first device mapped is `/dev/fldc0`, the second is `/dev/fldc1`, and so on.) Any application that uses the cached volume must be configured to use the new Fluid Cache device rather than the `/dev/sdX` or `/dev/mptX` device. If the cached volume is shared by multiple servers, the `/dev/fldcX` device is available on each 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.

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.

- 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 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.
- 9 Click **Finish**.
At this stage, there is a delay while the system makes a number of configuration changes.

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 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.
- 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 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.)
- 2 In the **Storage** tab, expand **Servers**, and then the Fluid Cache clusters if necessary and select the subcluster whose mappings you want to remove.
- 3 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 a server can be removed from a Fluid Cache cluster.

Removing Volumes

To avoid the potential for performance issues and data loss, it is a recommended best practice to unmount, remove, and delete all volume information after the volume is no longer in use.


Note that this is a general guideline pertaining to all Dell Compellent installations, and is not specific to Fluid Cache.

For more information and the procedure for removing volume information, refer to the section about removing volumes in *Red Hat Enterprise Linux (RHEL) 6x Best Practices*.

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

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 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.
 - 2 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.
 - 3 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:** If you exit Fluid Cache on a server and then remove the server from a cluster, you must run HCN Setup on the server to add the server to any cluster, including the cluster from which it was removed.
- NOTE:** To completely remove the Fluid Cache software from the server, run this command: `rpm -e $(rpm -qa | grep FLDC)`. Although this command removes all configuration information, in some cases you may also want to remove all components of Fluid Cache from your installation by deleting the installation directory: `/opt/dell/fluidcache/`
- NOTE:** Do not disable the Fluid Cache agent service running the `chkconfig` command.

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 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 of cache per node then a minimum memory configuration of 128 GB is recommended for each server node.

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**.

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 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 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 one after the other.

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


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

Shutting Down and Restarting a Cluster

Shut down a cluster if, for example, you need to perform system maintenance but do not need to make any configuration changes to the cache network itself.

To shut down a cluster:

- 1 Exit any applications that access cached volumes.
- 2 In Enterprise Manager, click **Storage**.
- 3 In the **Storage** pane, expand **Fluid Cache Clusters** if necessary, and then select the Fluid Cache cluster.
- 4 Click **Shutdown**.
The **Shutdown** window is displayed.
- 5 Click **Yes**.
The system processes for some time while data is flushed. There may be a significant delay for large amounts of data.

 **NOTE:** While a cluster is shut down, all cached volumes and their data are inaccessible. If you need to maintain access to these volumes while the cluster is shut down, remap the volumes before shutting down the cluster.

To restart a cluster:

- 1 Make sure the SAN and Storage Center are fully operational, and the cache network is configured and running.
- 2 In Enterprise Manager, click the **Storage** view.
- 3 In the **Storage** pane, expand **Fluid Cache Clusters** if necessary and select the Fluid Cache cluster.
- 4 Click **Restart**.

Uninstalling the Fluid Cache Software

Uninstall the Fluid Cache software if a server will no longer be used for Fluid Cache.

Before uninstalling the software, you must remove all volume mappings and remove the server from its Fluid Cache cluster. See [Removing Volume Mappings](#) and [Removing a Server from a Fluid Cache Cluster](#).

To uninstall the Fluid Cache software, run the command:

```
rpm -e $(rpm -qa | grep FLDC)
```

Although this command removes all configuration information, in some cases you may want to remove all components of Fluid Cache from your installation by also deleting the installation directory: `/opt/dell/fluidcache/`

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.

Topics:

- [Accessing Fluid Cache Web Page](#)
- [Understanding Fluid Cache Web Page](#)

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 data (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.
- **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 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.

Topics:

- [Basic Troubleshooting Steps](#)
- [Cannot Set up Fluid Cache on a Server](#)
- [Unable to remove a cache device from Fluid Cache Cluster using Enterprise Manager](#)
- [Incorrect Network Address or Netmask](#)
- [Server Does Not Appear in List of Servers](#)
- [Cache Device Does Not Appear in List of Cache Devices](#)
- [Cache Device Cannot Be Added to a Cluster](#)
- [Cannot Select a Specific Cache Mode](#)
- [Fluid Cache Node Is Unavailable in Enterprise Manager](#)
- [Cached LUNs Are Unavailable](#)
- [Cannot Create a Fluid Cache Cluster](#)
- [Fluid Cache License Is Expired](#)
- [Fluid Cache License Is Invalid](#)
- [Cannot Configure the Cache Network](#)
- [Cannot Assign or Remove a Storage Center](#)
- [Cannot Determine Which Cache Device Failed](#)
- [Events for Fluid Cache Are Not Shown in Enterprise Manager](#)
- [Cluster or Application Has Performance Issues](#)
- [Unable to Recreate a Fluid Cache Cluster After a Hardware Failure](#)
- [Cache Node is Not Listed](#)
- [Unable to Select a Specific Caching Mode](#)
- [Fluid Cache License File is Invalid](#)
- [Option to Create Cluster Not Available](#)

- Unable to Add a Volume to a Fluid Cache Cluster
- Event Messages Are Not Being Delivered
- Storage Center is Not Available
- Fluid Cache Server is Not Available
- Information Displays Differently Between Storage Centers and Fluid Cache Clusters
- Verify That All Parts of the Fluid Cache Cluster are Communicating with Each Other
- Verify the Data Path is Working
- The Cluster in the Fluid Cache Clusters Display is Marked Red
- Problems Configuring Server Clusters Defined on a Storage Center with Dell Fluid Cache for SAN

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.
- The avahi-daemon is running.
- *(Optional—for systems with multipath enabled and running)* The Fluid Cache devices have been excluded in the `/etc/multipath.conf` file on each server in the cluster. See [Checking Network Connections](#).

Cannot Set up Fluid Cache on a Server

Possible Cause	HCN Setup could not set up Fluid Cache on a server because one of the Linux dependencies is not installed.
Solution	<p>Follow the instructions given by RPM, which should state the dependencies that are missing. Check for the dependencies listed in the <i>Release Notes</i> and compare them with the list of currently installed dependencies, which you can check by running this command: <code>rpm -qa</code></p> <p>Fluid Cache uses Avahi for autodiscovery between cluster nodes. To check that the Avahi daemon is running on a node, run the command: <code>ps -ef grep avahi-daemon</code>. To start the Avahi daemon, run the command: <code>/etc/init.d/avahi-daemon start</code>. To ensure that the Avahi daemon starts when the server is restarted, run the command: <code>chkconfig avahi-daemon on</code>. If your <code>avahi-daemon.conf</code> file does not use the default settings, make sure that Disable Publishing is set to <code>no</code>, that Deny Interfaces does not list Fluid Cache interfaces, and that Allow Interfaces is either commented out or lists all Fluid Cache interfaces.</p>

Possible Cause HCN Setup could not set up Fluid Cache on the server because the MPIO service was configured for multipathing, but devices required by Fluid Cache were not blacklisted in the `etc/multipath.conf` file.

Solution Add blacklist entries for the devices required by Fluid Cache. On each node in the cluster, modify the **Devices** section of the `/etc/multipath.conf` file as follows:

```
blacklist {
    devnode "^fldc[0-9]*"
    devnode "^nvme[a-z]*"
    devnode "^r SSD[a-z]*"
}
```

After creating the entries and saving the file, start Fluid Cache by running this command: `service fldc_agentd start`

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

Description In Enterprise Manager, when you perform operations such as removing a cache device from a Fluid Cluster node, the following error message is displayed:

Fluid Cache not Found

Possible Cause Enterprise Manager may not be in synchronization with the Fluid Cache cluster to retrieve the latest state.

Solution To resolve this issue, shutdown the EM client, and then restart the EM Data Collector.
If the issue persists, contact Dell Customer Support.

Incorrect Network Address or Netmask

Possible Cause While setting up a server, incorrect values were entered for the network address or netmask of either the management interface or the cache network.

Solution Restart HCN Setup and enter the correct values. See [Setting up the Fluid Cache Servers](#).

Server Does Not Appear in List of Servers

- Possible Cause** A configuration issue is preventing the server from appearing in the list.
- Solution** From the server, run the command `ip addr`. The cache network interface's state should display as `UP`. If not, recheck the server configuration. See [Preparing the Fluid Cache Servers](#) and [Setting up the Fluid Cache Servers](#).
- Possible Cause** Firewall or iptables settings are preventing network communication.
- Solution** Check your firewall and iptables settings. See [Checking Security Settings](#).
- Possible Cause** The network switch is not correctly cabled or configured.
- Solution** Review the settings for the network switch and consult your switch documentation. See [Cluster or Application Has Performance Issues](#).
- Possible Cause** The Fluid Cache agent is not running on the server.
- Solution** From the server, run the command: `service fldc_agentd start`
- Possible Cause** The Avahi daemon is not running on the server.
- Solution** From the server, run the command: `service avahi-daemon start`.

Cache Device Does Not Appear in List of Cache Devices

- Possible Cause** The cache device you are trying to add is not supported by Fluid Cache.
- Solution** Refer to the list of supported devices in [Requirements for Fluid Cache](#).
- Possible Cause** The driver or firmware for the cache device is not a supported version.
- Solution** Make sure that your cache device firmware and driver are up to date and that the driver is loaded.
- Firmware:** Run the command: `dmesg | grep mtip32xx | grep Firmware`
- In the output, the firmware version displayed must be B1490508 or later.
- Driver:** Run the command: `dmesg | grep -i micron`
- In the output, the driver version for the device named **Micron RealSSD PCIe** must be 2.4.2 or later.
- Possible Cause** The cache device 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. Replace the cache device if necessary, using instructions in the *Dell Compellent Enterprise Manager User's Guide*.

Cache Device Cannot Be Added to a Cluster

Possible Cause 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](#).

Fluid Cache Node Is Unavailable in Enterprise Manager

- Possible Cause** The node failed during restart. The node was unable to perform a graceful shutdown because the `chkconfig` command was used to shut down the Fluid Cache agent service.
- Solution** Do not use the `chkconfig` command to disable the Fluid Cache agent service. Perform normal node recovery procedures to return the node to normal operation.

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.

Cannot Create a Fluid Cache Cluster

- Possible Cause** 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.
- Solution** Add three or more nodes and configure the nodes before attempting to create a Fluid Cache cluster in Enterprise Manager.
- Possible Cause** Network connectivity issues are preventing the creation of a Fluid Cache cluster.
- Solution** Check that the security settings are correct and the required ports and network connections are open. See [Checking Network Connections](#) and [Checking Security Settings](#).

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 Configure the Cache Network

- Possible Cause** Firewall settings or IP table entries 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](#). To check which ports are currently in use, log in as a root user and run the command:
- ```
/bin/netstat -tulpn
```

Also, check for iptables entries that may be blocking Fluid Cache network traffic. Note that some default installations for RHEL create an iptables entry for `ib_send_bw` that prevents connections to another server and thus blocks Fluid Cache network traffic.

**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.

- Check which ports are in use by logging in as a root user and running this command:

```
/bin/netstat -tulpn
```

- To change the ports used by Fluid Cache, open the `/etc/services` file on each server and add the following information, modifying the port numbers as needed:

```
fldc-http 8080/tcp # Fluid Cache CFM Web Server
fldc-https 6773/tcp # Fluid Cache CFM Web Server
fldca-http 8082/tcp # Fluid Cache Agent Web Server
fldca-https 6774/tcp # Fluid Cache Agent Web Server
```

The existing entry for the mDNS service on UDP port 5353 may also need to be modified. It is used by the Avahi daemon, which is required by Fluid Cache.

- After changing the ports, restart the Fluid Cache agent service by running the following command:

```
service fldc_agentd restart
```

- ⓘ **NOTE:** Port 6774 is used to communicate with Enterprise Manager. If you change the port number for `fldca-https` in the `etc/services` file, you must also configure Enterprise Manager to use the new port number.
- ⓘ **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 is required by Fluid Cache. If another application is using this port, configure that application to use a different port.

**Possible Cause**

The network adapters are not configured for Ethernet functionality, and so the `ethtool` and `ifconfig` commands cannot be used to configure the network adapters.

**Solution**

On each node in the Fluid Cache cluster, run the command:

```
connectx_port_config
```

In the configuration file, if the entry for **ConnectX PCI Devices** references **auto** or **ib**, change the setting for **Select mode for port x** to 2.

# Cannot Assign or Remove a Storage Center

|                       |                                                                                                                                                     |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Possible Cause</b> | The Storage Center is already assigned to another Fluid Cache cluster.                                                                              |
| <b>Solution</b>       | In Enterprise Manager, see whether or not a Storage Center is listed for the Fluid Cache cluster.                                                   |
| <b>Possible Cause</b> | Network connectivity issues are preventing Enterprise Manager from communicating with Storage Center.                                               |
| <b>Solution</b>       | Make sure the network is functioning properly. Refer to <a href="#">Checking Network Connections</a> , <a href="#">Checking Security Settings</a> . |

# Cannot Determine Which Cache Device Failed

|                       |                                                                                                                                                                                                                                                               |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Possible Cause</b> | One of the cache devices has failed on a server with multiple cache devices installed, and it is not clear which of them failed.                                                                                                                              |
| <b>Solution</b>       | In Enterprise Manager, in the <b>Cache</b> 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

|                       |                                                                                                                                                                                                                                                                                                                                  |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Possible Cause</b> | When Enterprise Manager was installed, the Data Collector was not configured for the correct IP address.                                                                                                                                                                                                                         |
| <b>Solution</b>       | 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 <b>General Information</b> , and note the IP address within the URL in the <b>Web Site</b> field. Change the address if necessary and restart the Data Collector. |

# Cluster or Application Has Performance Issues

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Possible Cause</b> | One or more cache devices are uninstalled, have failed, or do not have the correct firmware or drivers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Solution</b>       | Use Enterprise Manager to check the functionality of the cache devices.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Possible Cause</b> | The Compellent storage array is overloaded.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Solution</b>       | In Enterprise Manager, check the storage latencies and throughput on the cached volumes. Add more capacity to the Compellent array if necessary.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Possible Cause</b> | The application is not making use of the cache.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Solution</b>       | 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 <a href="#">Mapping Volumes</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Possible Cause</b> | The active data set greatly exceeds the size of the cache pool.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Solution</b>       | Add more cache devices to increase the size of the cache pool.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Possible Cause</b> | Network traffic from outside Fluid Cache is interfering with performance.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Solution</b>       | 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Possible Cause</b> | The cache network switch is not configured correctly.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Solution</b>       | Make sure that the switch has the following settings: <ul style="list-style-type: none"><li>• The ports are in Layer 2 mode.</li><li>• The ports are in an untagged state.</li><li>• The switch firmware is up to date.</li><li>• Multicast is enabled.</li><li>• Verify that flow control is enabled and DCB is disabled. For Dell Networking switches, see <a href="#">Configuring the Cache Network Switch</a>. For all other switches, consult the manufacturer's documentation.</li></ul> <p>①   <b>NOTE:</b> Enabling flow control is a requirement for Fluid Cache.</p> <ul style="list-style-type: none"><li>• For blade enclosure, disable FlexAddress.</li></ul> <p>You can check network functionality by checking <code>rx_over_errors</code> using the <code>ethtool -S &lt;interface&gt;</code> command.</p> |
| <b>Possible Cause</b> | 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 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, then 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, then all Fluid Cache servers from the Storage Center server cluster must be in the Fluid Cache cluster.