

Dell PowerEdge FX2 – FN I/O Module - Fibre Channel Storage Direct Connect Deployment Guide

Configuring and Validating the New Fibre Channel F_Port Feature on a Pair of FN2210S I/O Modules (v1.2)

Dell Networking Solutions Engineering
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1 Introduction

Dell EMC provides customers with the most efficient use of current networking equipment at the lowest cost, while still providing today's great new technologies focused around the explosive data growth in the industry. Various application demands have driven the need for increased bandwidth, lower latency infrastructures in today's networks. Dell EMC's portfolio covers all these key areas to provide the best in service and customer experience.

Today's businesses find it difficult to keep pace with the changing networking and enterprise landscape. With limited resources, they must support a variety of devices that provide key business functions, deliver IT services that are reliable and flexible, and provide discernible cost savings.

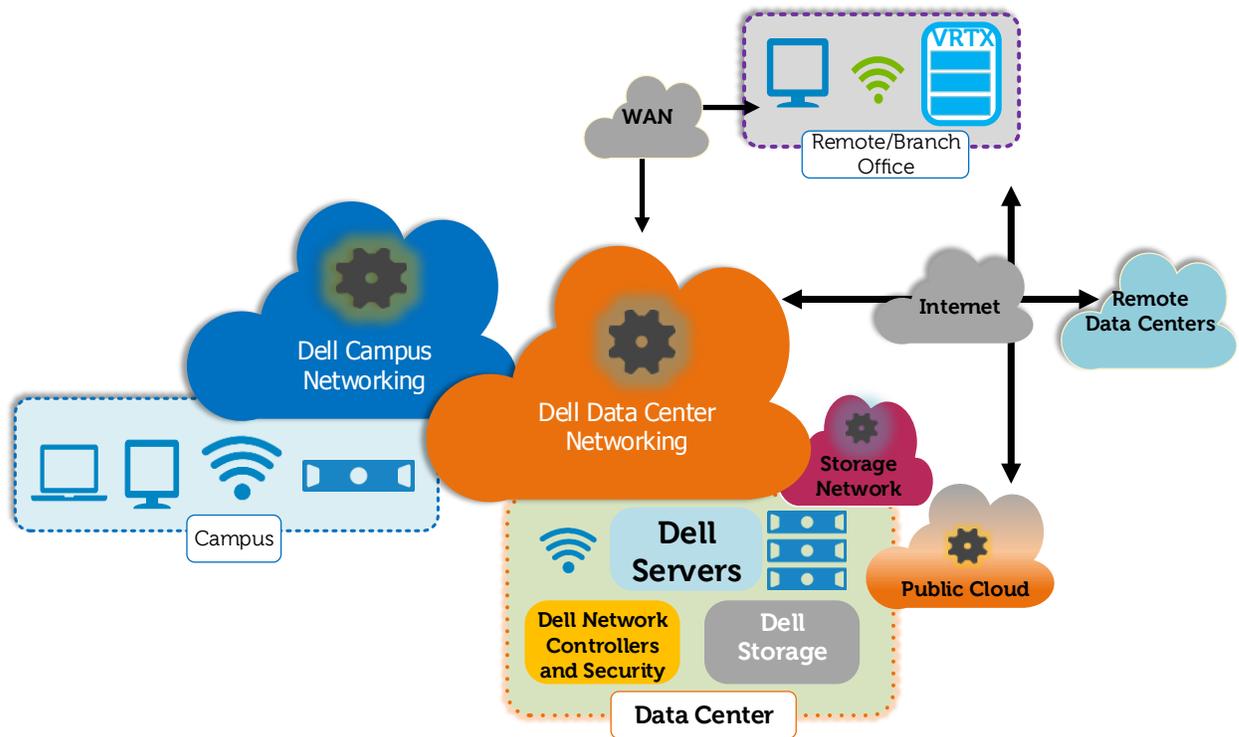


Figure 1 Networking architecture overview

The Dell PowerEdge FX architecture is a revolutionary approach to shared infrastructure for Enterprise Computing. It combines the density and innovative agility of hyperscale computing with the ease of use and efficiency of advanced management technologies. The FX2 chassis provides a straightforward, modular approach to infrastructure and introduces a more practical way to manage the complex IT needs of businesses.

This guide focuses on data center Ethernet and storage Fibre Channel (FC) networks (Figure 1). In particular, the ability of the FN2210S I/O Module to handle Ethernet and Fibre Channel traffic while also providing fabric services that enables direct connectivity to FC storage.

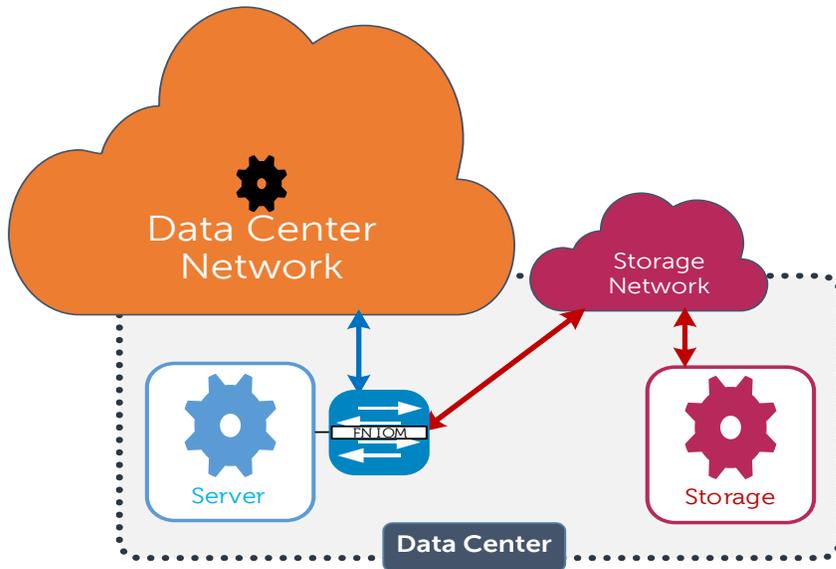


Figure 2 Traffic in a typical environment

In a typical environment (Figure 2), storage traffic goes from the FN IOM to an intermediate Fibre Channel Forwarder (FCF) switch in the storage network. The FCF provides fabric services and storage connectivity.

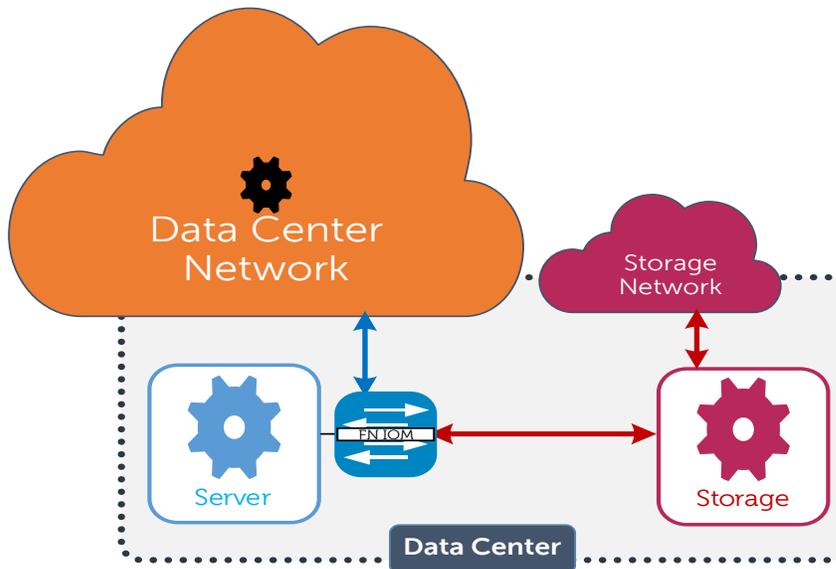


Figure 3 Traffic in the topology covered in this guide - direct storage connection

This guide presents the fabric services (or F_Port) feature provided in the Dell Networking Operating System (DNOS) 9.10. This feature enables the FN2210S to have direct connectivity to Fibre Channel storage devices (Figure 3).

1.1 Typographical conventions

Monospace Text	CLI examples
<u>Underlined Monospace Text</u>	CLI examples that word wrap. This text should be entered as a single command.
<i>Italic Monospace Text</i>	Variables in CLI examples
Bold Monospace Text	Commands entered at the CLI prompt

2 Hardware

In this section, the hardware used to validate the topology outlined in this deployment guide is briefly discussed.

Note: Refer to [Appendix A](#) for specific firmware and driver versions used.

2.1 The Dell PowerEdge FX2 and supported modules

Introducing the Dell FX Architecture, a great way to bring optimized workloads, maximize efficiency, and simplify complexity in today's data center.



Figure 4 Dell PowerEdge FX2

The Dell FX2 enclosure is unique in its modular capabilities that come in a compact 2U size. This innovative design combines the density and efficiency of blade servers with the simplicity and cost benefits of the smaller rack-based server systems.



Figure 5 FX2 chassis with FN IOM (FN410S shown)



Figure 6 FX2 compute and networking modules

PowerEdge FX2

A converged enclosure with shared power, cooling, management and PCI connectivity in just 3.5" of rack space

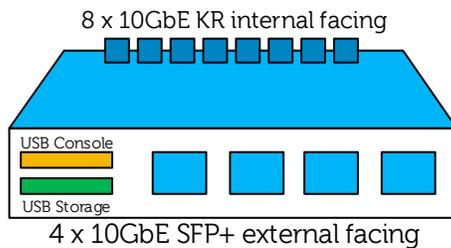
Flexible resources for every workload

<h4 style="text-align: center; margin: 0;">PowerEdge FC630</h4> <p style="font-size: small; margin-top: 5px;">A 2 socket, half width performance server node with the processing performance and memory scalability to handle virtually any workload.</p>	<h4 style="text-align: center; margin: 0;">PowerEdge FC430</h4> <p style="font-size: small; margin-top: 5px;">An ultra-dense 2 socket, quarter-width mainstream server, ideal for distributed environments requiring multi-node reliability & efficiency.</p>
<h4 style="text-align: center; margin: 0;">PowerEdge FM120x4</h4> <p style="font-size: small; margin-top: 5px;">A half width compute module providing four microservers per node, delivering a high density, low cost solution ideal for web serving and dedicated hosting.</p>	<h4 style="text-align: center; margin: 0;">PowerEdge FC830</h4> <p style="font-size: small; margin-top: 5px;">A full-width, 4-socket node with massive memory scalability, expandable storage, and powerful processing, great for core applications and cutting-edge virtualization.</p>
<h4 style="text-align: center; margin: 0;">PowerEdge FD332</h4> <p style="font-size: small; margin-top: 5px;">A half width direct attached storage node with up to 16 drives, it combines with compute to build highly flexible, scale-out or software defined storage solutions.</p>	<h4 style="text-align: center; margin: 0;">PowerEdge FN IOM</h4> <p style="font-size: small; margin-top: 5px;">Converged networking modules for simplified network deployment and improved "east/west" communication.</p>

Figure 7 FX2 module descriptions

2.2 FN I/O modules

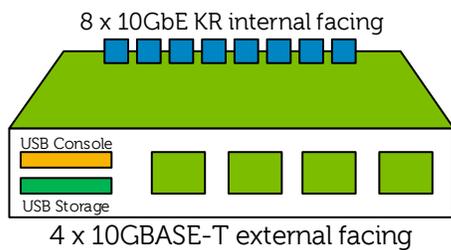
The PowerEdge FX2 is a chassis capable of housing compute, network, and storage modules. The network modules, referred to as one of three FN I/O Modules (FN IOMs), behave as traditional network switches that are housed in the rear of the FX2 chassis. All three FN IOM options (Figure 8), offer network services for both the Ethernet and storage fabrics in a data center. While the FN2210S is used in this deployment guide, Dell EMC offers three options of FN IOMs providing plug-and-play Ethernet as well as LAN/SAN convergence with iSCSI and Fibre Channel over Ethernet (FCoE).



FN410S

4-port SFP+ I/O module

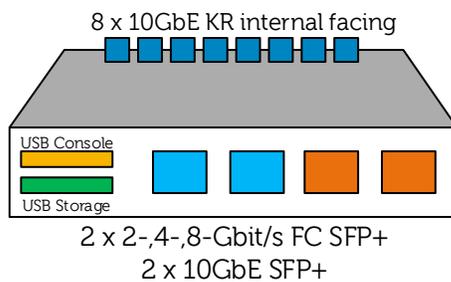
Provides 4 ports of SFP+ 10GbE connectivity. Supports optical and DAC cable media.



FN410T

4-port 10GBASE-T I/O module

Provides 4 ports of 10GBASE-T connectivity. Supports cost effective copper media up to 100 meters.



FN2210S

4-port Combo FC/Ethernet I/O module

Delivers up to 2 ports of 2, 4, or 8Gbit/s Fibre Channel. Ethernet is provided by 2 ports of SFP+ 10GbE connectivity. Supports optical and DAC cable media.

Figure 8 FN I/O modules

2.3 Dell Storage SC8000 Controller

The Dell Storage (formerly Compellent) SC8000 Controller (Figure 9) is a high-performance, efficient, and scalable data storage platform. It supports simultaneous iSCSI, Fibre Channel (FC) and Fibre Channel over Ethernet (FCoE) front-end interconnects. In this guide, the SC8000 is used with dual controllers for high availability (HA). The SC8000 can support 960 drives (3PB raw capacity) per dual-controller system.



Figure 9 Dell Storage SC8000 Controller

2.4 Dell Networking S4810 Managed Switch

The Dell Networking S4810 10/40GbE switch (Figure 10) is a high-density Top-of-Rack (ToR) that features 48 x 10GbE and 4 x 40GbE ports. The 1U S4810 enables streamlined connectivity, low latency operation and includes support for Virtual Link Trunking (VLT). VLT eliminates spanning tree protocol (STP) blocked ports and provides fast convergence if a link or device fails.



Figure 10 Dell Networking S4810

3 Initial out-of-box connectivity check and default settings

The environment documented in this guide covers an Ethernet/Fibre Channel architecture. However, many times there is a need to simply bring up a single networking connection.

Out of the box, the FN IOM is configured in Standalone mode with the applicable default settings. All server facing network ports are shut down until an uplink port channel to the ToR (top of rack) switch is operational. This is due to a feature called Uplink Failure Detection, whereby, when upstream connectivity fails, the FN IOM disables the downstream (server-facing) links. This feature is essential for fail-over between two ports on the same network adapter.

If you wish to bring up the network connections to your servers before getting started with this guide, please follow the steps in [Appendix F](#).

For more information on Uplink Failure Detection, see the [Dell PowerEdge FN I/O Module Configuration Guide](#).

4 Configuration overview

4.1 Servers in FX2 chassis

This guide was developed using two FC630 servers installed in a single PowerEdge FX2 chassis. The table below summarizes the server configuration.

Table 1 Sever configurations

Server / FX2 Slot	Operating System	Converged Network Adapter (CNA)
FC630 / Slot 1	Windows Server 2012 R2	Emulex OCm14102-U4-D 10Gb bNDC
FC630 / Slot 2	VMWare ESXi 6.0 (WS2012 R2 guest OS)	QLogic BCM57810S 10Gb bNDC

For redundancy, MPIO (Multi-Path IO) is configured in the server Operating Systems.

4.2 FN2210S port numbering

Each FN IOM has eight internal ports numbered 1-8 for connections to servers installed in the FX2 chassis, and four external ports numbered 9-12 for connections to upstream devices.

On the FN2210S, these ports are as follows:

- Internal ports 1-8 are 10 Gb Ethernet (abbreviated to 0/1-8).
- External ports 9 and 10 are 2/4/8 Gb Fibre Channel (abbreviated fi 0/9 and fi 0/10).
- External ports 11 and 12 are 10 Gb Ethernet (abbreviated to 0/11 and te 0/12).

For more details on how the eight internal FN IOM ports are allocated based on installed servers and CNAs, see [Appendix C](#).

4.3 Ethernet LAN topology

The figures below represent the Ethernet LAN (**non-storage**) topology used in this guide. The dashed lines from the FC630 servers to the FN2210S represent the internal, connections that carry TCP/IP as well as FCoE traffic inside the FX2 Chassis.

In Figure 11, the Emulex CNA ports 1 and 2 of the FC630 server in **slot 1** of the FX2 chassis are connected to internal ports **te 0/1** on FN2210S-A1 and FN2210S-A2:

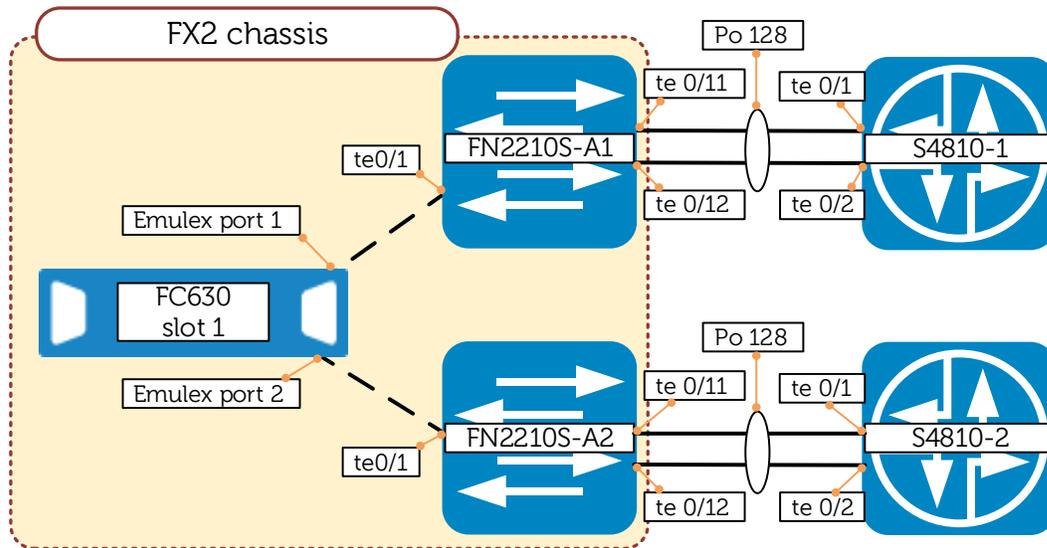


Figure 11 FC630 slot 1 Ethernet LAN topology

In Figure 12, QLogic ports 1 and 2 of the FC630 in **slot 2** of the same FX2 chassis are connected to internal ports **te 0/3** on the same two FN2210S switches:

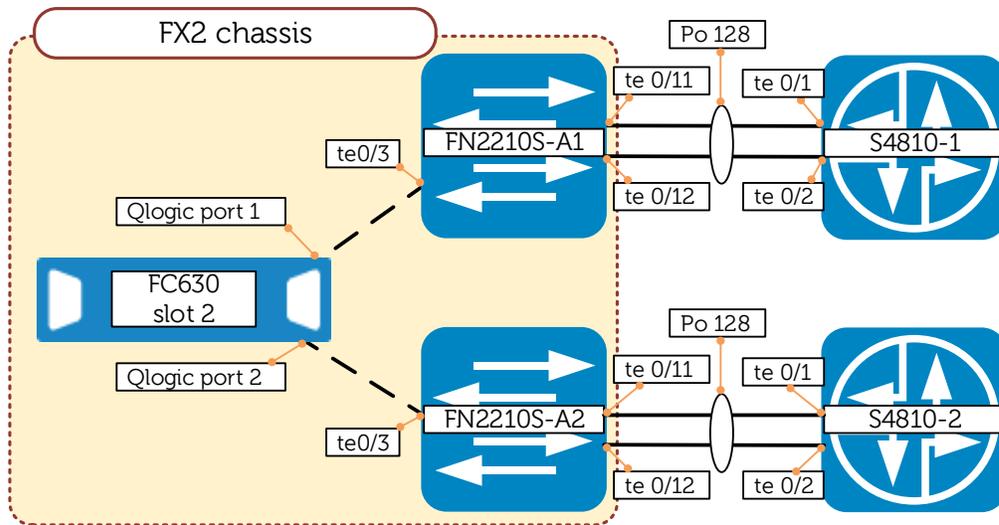


Figure 12 FC630 slot 2 Ethernet topology

On both of the FN2210S switches, external Ethernet ports te 0/11 and te 0/12 are combined in LACP (Link Aggregation Control Protocol) port channel 128 (Po 128) which is connected to a corresponding port channel on an S4810 ToR switch. The S4810 switches are in turn connected to the upstream network (not shown).

4.4 Storage topology

The next figure covers the FCoE/FC storage topology used in this guide. Both external Fibre Channel ports (Fi 0/9 and Fi 0/10) on each FN2210S are directly connected as shown to two different controllers in the SC8000. This provides multipathing and redundancy.

A FIP (FCoE Initialization Protocol) snooping session is established between the server's CNA and the FN2210S. FIP allows the CNA to discover the FCF (Fibre Channel Forwarder) and the FCoE VLAN to use to connect to it. The FN2210S with F_Port enabled becomes the FCF, providing fabric services and eliminating the need for an additional FCF switch.

The direct storage connections from the FN2210S to FC storage are only possible if the F_Port feature available in DNOS 9.10 is enabled. This is covered in the [FN2210S Configuration](#) section.

Note: For clarity, Figure 13 only shows a single FC630, its internal connections and the external storage connections. Not shown are the second FC630 and the four external connections to the S4810 ToR switches.

Note: The storage array Fibre Channel HBAs (host bus adapters) in this example are located in slot 5 of each SC8000 controller. Ports 1 and 2 are used on both. The actual slot/port numbers on the storage side varies depending on the array's numbering system and the actual slots/ports used.

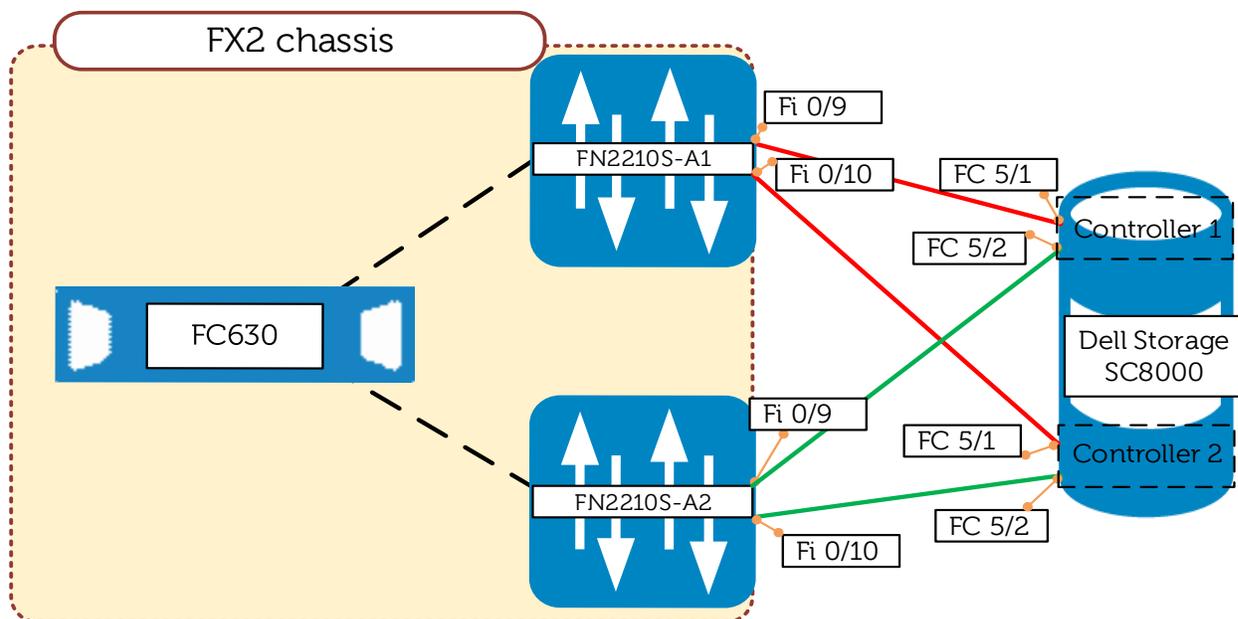


Figure 13 Storage topology

5 Converged Network Adapters

As covered earlier in the [Servers in FX2 Chassis](#) section, this guide uses an Emulex 5 CNA in a server running Windows 2012 R2, and a QLogic converged network adapter (CNA) in a server running ESXi 6.0.

5.1 CNA Configuration

For information on configuring the Emulex or QLogic CNAs as used in this guide, please see the relevant attachment.

Table 2 Converged network adapter configuration guides

CNA Type	Attachment Name
Emulex OCm14102	CNA_Emulex_OCm14102_FCoE_v1.1.pdf
QLogic BCM57810	QLogic_BCM578xx_FCoE_LC_v2.1.pdf

Note: For information on fine-tuning CNA settings specifically for use with SC-Series Storage arrays, see the *Dell Storage Center System Manager Administrator's Guide* available at customer.compellent.com (account required).

5.2 CNA FCoE port WWN determination

Properly configuring a storage LUN to be presented to a server requires the CNA FCoE port World Wide Name (WWN). One method is to obtain the FCoE port WWN through the Chassis Management Controller (CMC) of the PowerEdge FX2 chassis. Initial deployment of the FX2 must be completed before continuing with these steps.

1. Enter the IP address of the CMC into a browser and log in (username **root**, password **calvin**).
2. In the left pane of the GUI, select **Server Overview**. See Figure 14.
3. Once the Server Overview page is populated, select **WWN/MAC** in the top pane. The screen shows the WWNs and MAC addresses for all servers in the chassis.
4. Filter the results by selecting **Fibrechannel** under **Protocol**. For our configuration, we need the FCoE-WWN for the servers in slots 1 and 2.
5. Next to **SLOT-01**, note the first **FCoE-WWN** listed next to **Fabric A1** and the first **FCoE-WWN** listed next to **Fabric A2**. Repeat for **SLOT-02**. The required FCoE-WWNs for this example are circled in Figure 14. Repeat for additional servers if needed.

The screenshot shows the Dell Chassis Management Controller (CMC) GUI. The left sidebar contains a navigation tree with 'Server Overview' selected. The main content area shows the 'WWN/MAC' configuration page. The table below lists the WWN/MAC addresses for network adapters in slots 01 and 02, filtered by Protocol = Fibrechannel. The first FCoE-WWN for each fabric in each slot is circled in red.

Server Slot	Fabric	Protocol	WWN/MAC Addresses
SLOT-01 (WIN-IEBPQI7609G)	A1	FCoE-WWN	10:00:00:90:FA:87:1E:E7
		FCoE-WWN	10:00:00:90:FA:87:1E:E8
		FCoE-WWN	10:00:00:90:FA:87:1E:E9
	A2	FCoE-WWN	10:00:00:90:FA:87:1E:EF
		FCoE-WWN	10:00:00:90:FA:87:1E:F0
		FCoE-WWN	10:00:00:90:FA:87:1E:F1
SLOT-02 (localhost)	A1	FCoE-WWN	20:01:54:9F:35:17:1F:4D
		FCoE-WWN	20:01:54:9F:35:17:1F:51
		FCoE-WWN	20:01:54:9F:35:17:1F:55
	A2	FCoE-WWN	20:01:54:9F:35:17:1F:59
		FCoE-WWN	20:01:54:9F:35:17:1F:4F
		FCoE-WWN	20:01:54:9F:35:17:1F:53
		FCoE-WWN	20:01:54:9F:35:17:1F:57

Figure 14 FCoE-WWNs of network adapters

5.3 CNA port WWN summary

For this example, the four CNA FCoE port WWNs required are shown in Table 3.

Table 3 Network adapter port WWNs

Server / FX2 Slot	CNA / Port	Fabric	FCoE Port WWN
FC630 / Slot 1	Emulex port 1	A1	10:00:00:90:fa:87:1e:e7
	Emulex port 2	A2	10:00:00:90:fa:87:1e:ef
FC630 / Slot 2	QLogic port 1	A1	20:01:54:9f:35:17:1f:4d
	QLogic port 2	A2	20:01:54:9f:35:17:1f:4f

6 Dell Storage SC8000 initial configuration

This section highlights initial configuration of the Dell Storage SC8000 for the environment used in this guide. For more information, please refer to your Dell Storage SC Series documentation.

Note: Any Dell SC/SCvf series FC array can be used in this

6.1 Configure ports and fault domains

The Dell Storage SC8000 used in this configuration has two controllers for redundancy.

As shown in Figure 13 above, port FC 5/1 for each controller is connected to FN2210S-A1 and port FC 5/2 for each controller is connected to FN2210S-A2 (port numbering varies depending on actual storage hardware and configuration).

The SC8000 is in virtual port mode (this mode is selected in the Dell Storage Center Startup Wizard during installation).

Launch the **Storage Center** GUI and create the fault domains as follows.

1. Go to **Storage Management > System > Setup > Configure Local Ports**.

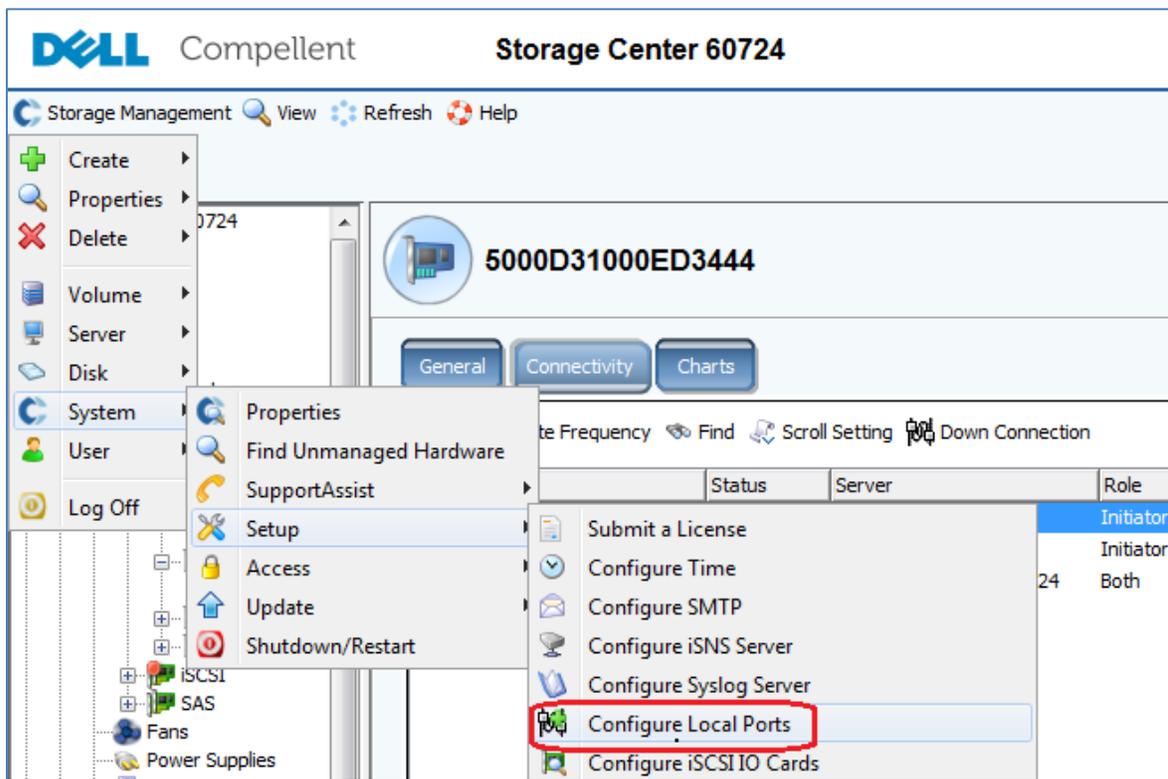


Figure 15 Configure local ports

2. In the **Configure Local Ports** window that opens, select the **FC** button to display the FC ports. Create two new fault domains – SAN_A1 and SAN_A2 as follows:
 - **Edit Fault Domains > Create Fault Domain > name the first one SAN_A1 > Continue > Create Now.**
 - Repeat to create a second fault domain named **SAN_A2**. Click **Return**.
3. In the **Purpose** column, make all four FC ports to be used **Front End** ports and assign the ports to the newly created fault domains as follows:
 - Assign the two storage ports connected to FN2210S-A1 to fault domain **SAN_A1** (port 5/1 on each controller in this example).
 - Assign the two storage ports connected to FN2210S-A2 to fault domain **SAN_A2** (port 5/2 on each controller in this example).

The **Configure Local Ports** table should now appear similar to Figure 16.

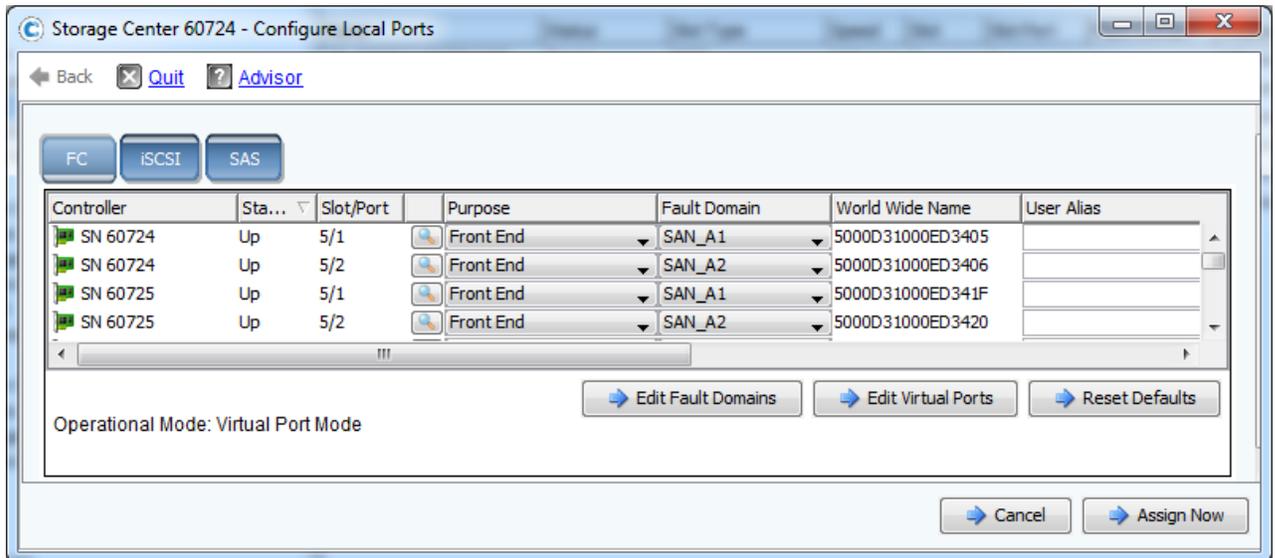


Figure 16 Storage Center port configuration and fault domain assignment

Note the World Wide Names (WWN) of the four ports. These are the *physical* port WWNs. When done, click **Assign Now > Yes (Assign Now)**.

- In the left pane of the Storage Center GUI, expand **Controllers**. Under each controller (SN 60724 and SN 60725 in this example), expand **IO Cards** then expand **FC**:

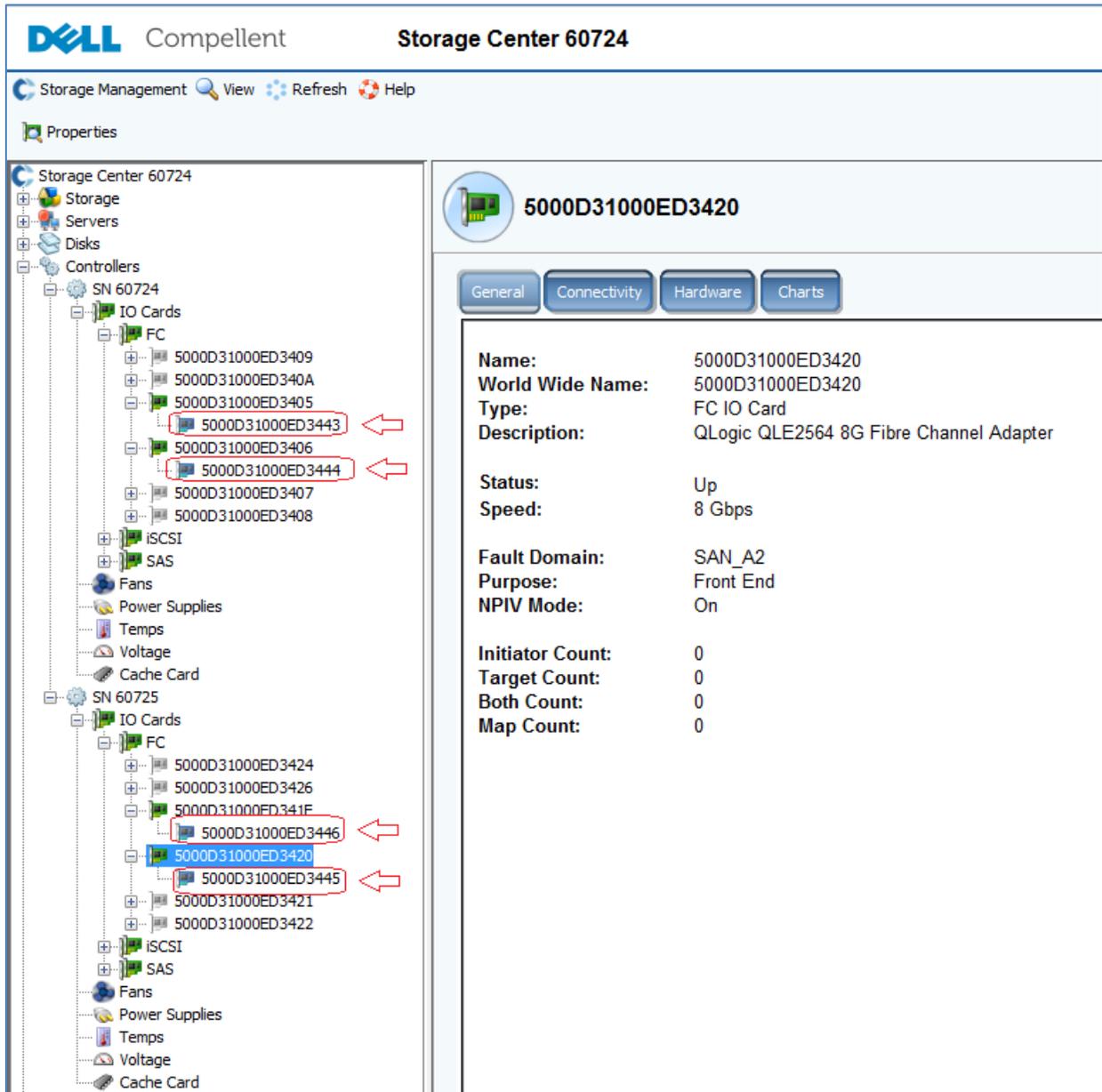


Figure 17 Virtual ports shown under physical ports

The tree shows the four physical port WWNs noted earlier. Expand each of the four physical port WWNs. The *virtual* port WWN (circled in Figure 17 above) displays beneath each physical port.

The physical and virtual port WWNs are used to configure zoning on the FN2210S switch when **Full Switch mode** is used. If the default **Standalone mode** is used on the FN2210S, WWNs do not have to be entered on the FN2210S as it is preconfigured to allow all.

6.2 Storage port WWN summary

For this example, the four physical and four virtual port WWNs needed to configure zoning on the FN2210S IOMs in Full Switch mode are shown in the tables below.

Physical ports

Table 4 Physical port WWN

Controller	Slot/Port	Physical port WWN
60724 – “Controller 1”	FC 5/1	50:00:d3:10:00:ed:34:05
60724 – “Controller 1”	FC 5/2	50:00:d3:10:00:ed:34:06
60725 – “Controller 2”	FC 5/1	50:00:d3:10:00:ed:34:1f
60725 – “Controller 2”	FC 5/2	50:00:d3:10:00:ed:34:20

Virtual ports

Table 5 Virtual port WWN

Controller	Slot/Port	Virtual port WWN
60724 – “Controller 1”	FC 5/1	50:00:d3:10:00:ed:34:43
60724 – “Controller 1”	FC 5/2	50:00:d3:10:00:ed:34:44
60725 – “Controller 2”	FC 5/1	50:00:d3:10:00:ed:34:46
60725 – “Controller 2”	FC 5/2	50:00:d3:10:00:ed:34:45

7 FN2210S switch configuration

The following section contains the configuration steps required to directly attach FC storage to the FN2210S.

Note: It is recommended that each FN2210S be returned to its factory default settings before beginning configuration. This applies to both modes – Standalone and Full Switch.

Note: For more information on the different supported modes, see [Appendix B](#).

To restore factory defaults, issue the following command on each FN2210S:

```
#restore factory-defaults stack-unit 0 clear-all
```

Answer **yes** when prompted to proceed. The system reloads its factory default settings.

7.1 Standalone mode

The benefit of this mode is ease of configuration.

If the FN2210S switches have been restored to their factory default settings, they are in **Standalone mode**. Verify this with the following command:

```
#show system stack-unit 0 iom-mode
```

The command output should be as follows:

Unit	Boot-Mode	Next-Boot
0	standalone	standalone

Note: If the FN2210S is directly connected to a storage FC adapter at this time, the connected Fibre Channel port(s) may flap (repeatedly go up/down) until the F_Port feature has been enabled. This is expected behavior as the connected ports are not yet in a compatible state. If you are in a serial console and the log messages are causing interference, you may shut ports fi 0/9-10 at this time or work in a telnet or SSH session (username = root, password = calvin) if preferred.

7.1.1 Standalone mode configuration

After both FN2210S IOMs have been reset to factory defaults, configure both by entering the commands in the figure below.

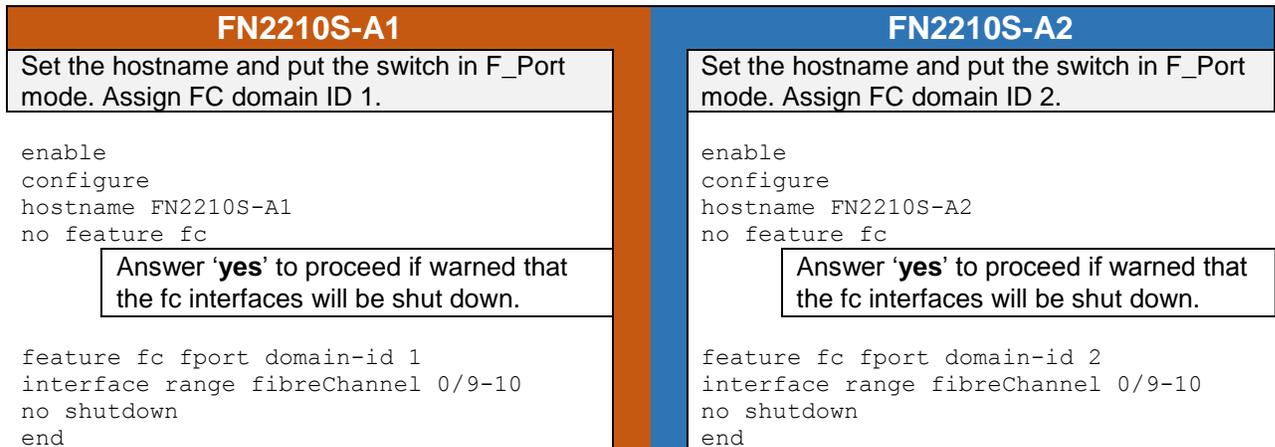


Figure 18 Configure FN2210S switches in Standalone mode

The above are the only commands necessary on the FN2210S in Standalone mode to use the solution in this guide. All other required items have either been preconfigured or are automatically configured. This includes:

- All fabric connections are allowed without zoning.
- The FCoE map and DCB map are auto-configured.
- External Ethernet ports te 0/11 and te 0/12 are configured in LACP port-channel 128.
- All internal ports and port channel 128 are in all VLANs except VLAN 1002 which is reserved for FCoE traffic. FCoE ports are automatically added to VLAN 1002.
- All internal ports and port channel 128 are in hybrid (trunk) mode and allow all VLANs.

7.2 Full switch mode

The benefit of Full Switch mode is the ability to customize your configuration (FCoE VLAN id, zoning, etc.) and the availability of extra features such as layer 3.

After the FN2210S IOMs are restored to their factory default settings as recommended above, they are in Standalone mode.

Note: If the FN2210S is directly connected to a storage FC adapter, the connected Fibre Channel ports may flap (repeatedly go up/down) until the F_Port feature has been enabled. This is expected behavior as the connected ports are not yet in a compatible state. If you are in a serial console and the messages are causing interference, you may shut down ports fi 0/9-10 at this time or work in a telnet or SSH session (username = root, password = calvin) if preferred.

Change both FN2210S switches from Standalone mode to Full Switch mode as follows:

```
#enable
#configure
(conf)#stack-unit 0 iom-mode full-switch
% You are about to configure the Full Switch Mode.
Please reload to effect the changes
(conf)#exit
#write
#reload
```

Answer **yes** to reload the first FN2210S. Repeat on the second FN2210S.

After the FN2210S switches have reloaded, verify **both** are in Full Switch mode with the command:

```
#show system stack-unit 0 iom-mode
```

The command output should be as follows:

Unit	Boot-Mode	Next-Boot
0	full-switch	full-switch

7.2.1 Zone preparation

The port WWNs for connected CNAs and storage adapters must be collected and combined into zones for communication.

Dell Storage Center guidelines for zoning are as follows:

- Include all Storage Center physical port WWNs in a single zone.
- Include all Storage Center virtual port WWNs in a single zone.
- Create server zones that contain a single initiator (CNA) and Storage Center virtual port WWNs, and which include the server CNA port WWN.

Zones in the example switch configurations follow the guidelines above.

Note: For more information on Storage Center zoning, see the *Dell Storage Center SC8000 Controller Deployment Guide* available at customer.compellent.com (account required).

Figure 19 shows the SC8000 *physical* port WWNs determined earlier. The FC aliases (optional) to be used in the example switch configuration are also shown, where “cont” and “pport” are abbreviations for controller and physical port, respectively.

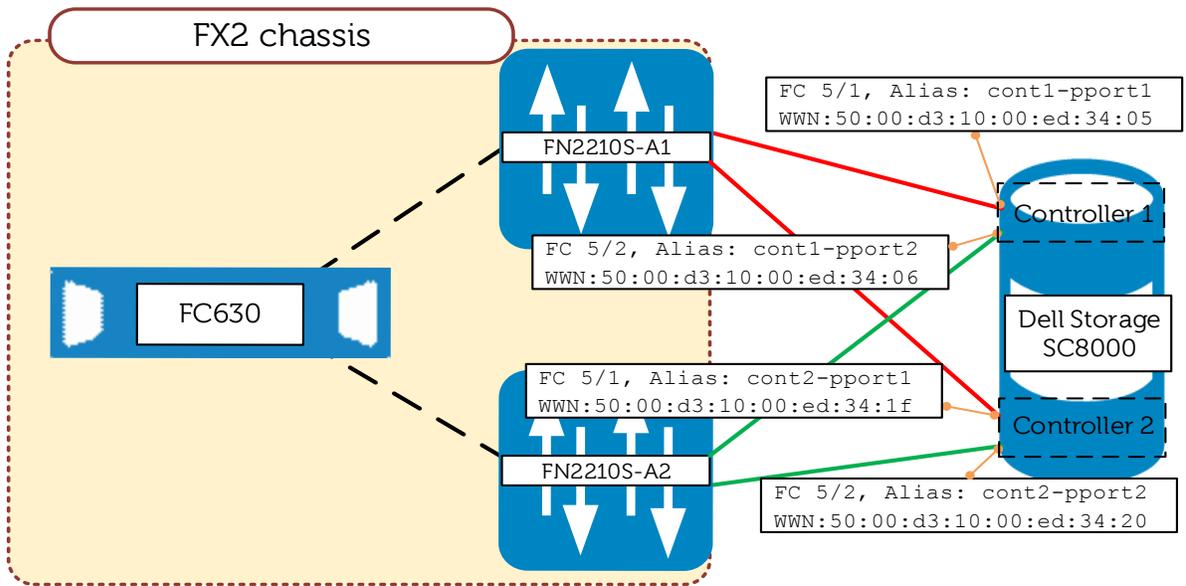


Figure 19 SC8000 physical port WWNs

Figure 20 and Figure 21 show the SC8000 *virtual* port WWNs and the CNA port WWNs determined earlier. The FC aliases (optional) to be used in the example switch configuration are also shown, where “vport” is an abbreviation for virtual port.

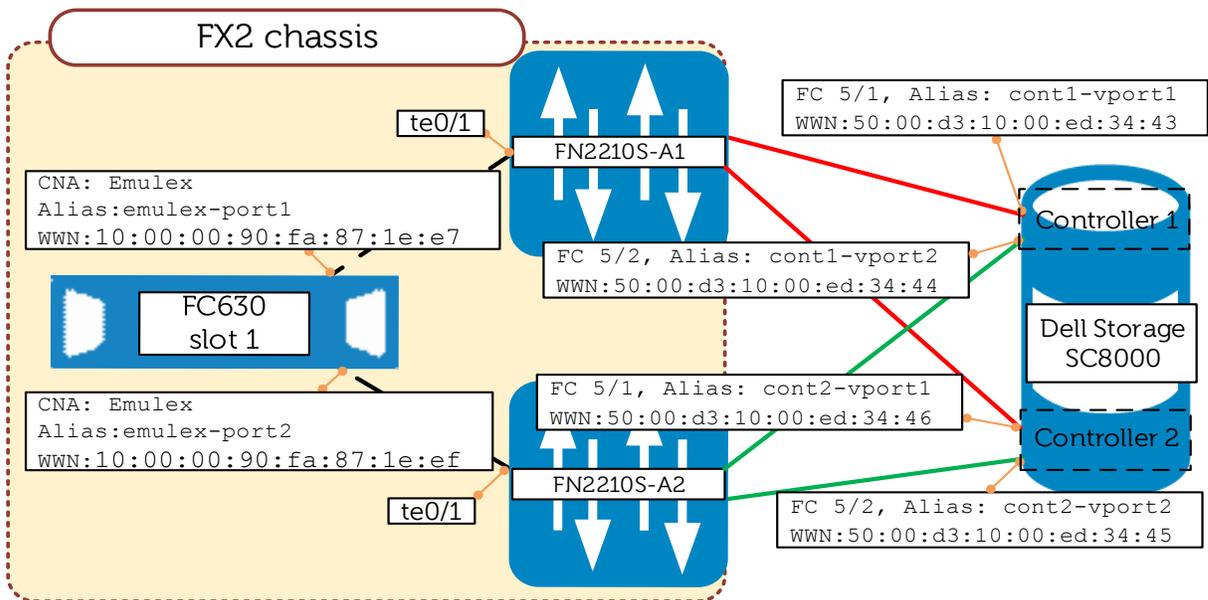


Figure 20 Emulex CNA port WWNs and SC8000 virtual port WWNs

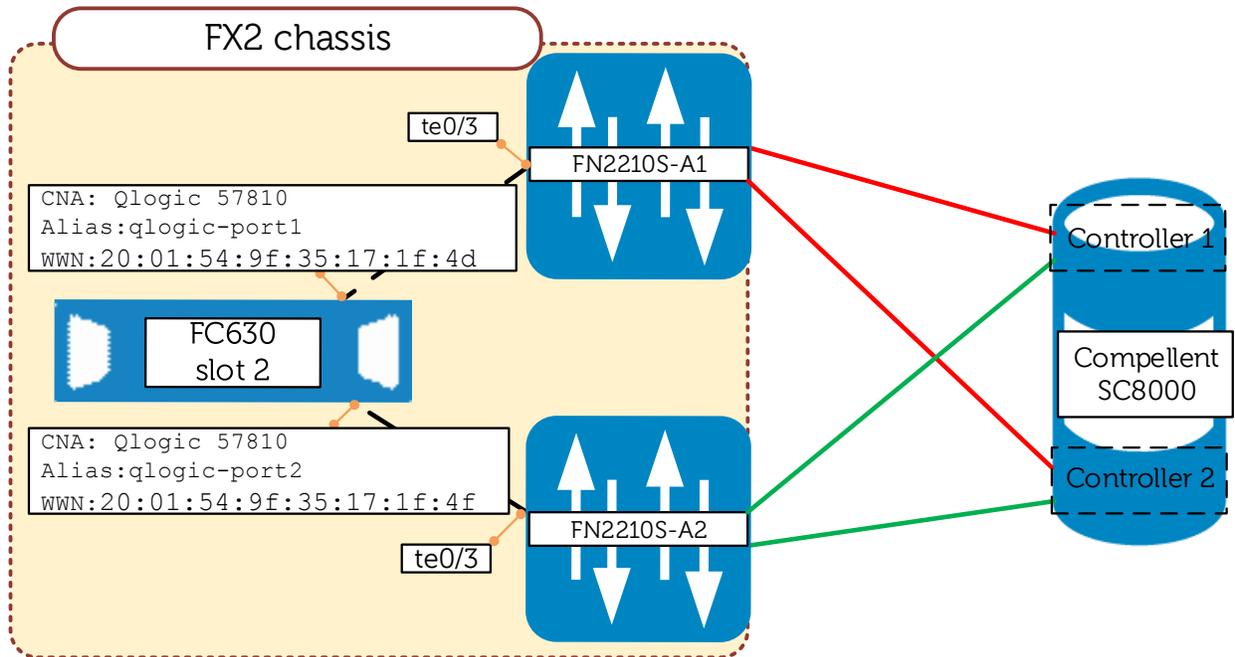


Figure 21 QLogic CNA port WWNs

7.2.2 Full Switch mode configuration

After both FN2210S IOMs have been reset to factory defaults and placed in Full Switch mode, configure each by entering the commands in the figure below.

FN2210S-A1

Set the host name and put the switch in F_Port mode. Assign FC domain ID.

```
enable
configure
hostname FN2210S-A1
no feature fc
```

Answer 'yes' if prompted to shut the Fibre Channel interfaces

```
feature fc fport domain-id 1
```

Create DCB map, FCoE VLAN, FC Aliases, and configure zoning.

```
dcb-map SAN_DCB_MAP_A1
priority-group 0 bandwidth 50 pfc off
priority-group 1 bandwidth 50 pfc on
priority-pgid 0 0 0 1 0 0 0 0
```

```
interface vlan 81
description FCoE vlan
no shutdown
```

```
fc alias cont1-pport1
member 50:00:d3:10:00:ed:34:05
fc alias cont2-pport1
member 50:00:d3:10:00:ed:34:1f
fc alias cont1-vport1
member 50:00:d3:10:00:ed:34:43
fc alias cont2-vport1
member 50:00:d3:10:00:ed:34:46
fc alias emulex-port1
member 10:00:00:90:fa:87:1e:e7
fc alias qlogic-port1
member 20:01:54:9f:35:17:1f:4d
```

```
fc zone physical_ports1
member cont1-pport1
member cont2-pport1
```

```
fc zone virtual_ports1
member cont1-vport1
member cont2-vport1
```

```
fc zone emulex1
member emulex-port1
member cont1-vport1
member cont2-vport1
```

```
fc zone qlogic1
member qlogic-port1
member cont1-vport1
member cont2-vport1
```

```
fc zoneset zoneset1
member physical_ports1
member virtual_ports1
member emulex1
member qlogic1
```

FN2210S-A2

Set the host name and put the switch in F_Port mode. Assign FC domain ID.

```
enable
configure
hostname FN2210S-A2
no feature fc
```

Answer 'yes' if prompted to shut the Fibre Channel interfaces

```
feature fc fport domain-id 2
```

Create DCB map, FCoE VLAN, FC Aliases, and configure zoning.

```
dcb-map SAN_DCB_MAP_A2
priority-group 0 bandwidth 50 pfc off
priority-group 1 bandwidth 50 pfc on
priority-pgid 0 0 0 1 0 0 0 0
```

```
interface vlan 82
description FCoE vlan
no shutdown
```

```
fc alias cont1-pport2
member 50:00:d3:10:00:ed:34:06
fc alias cont2-pport2
member 50:00:d3:10:00:ed:34:20
fc alias cont1-vport2
member 50:00:d3:10:00:ed:34:44
fc alias cont2-vport2
member 50:00:d3:10:00:ed:34:45
fc alias emulex-port2
member 10:00:00:90:fa:87:1e:ef
fc alias qlogic-port2
member 20:01:54:9f:35:17:1f:4f
```

```
fc zone physical_ports2
member cont1-pport2
member cont2-pport2
```

```
fc zone virtual_ports2
member cont1-vport2
member cont2-vport2
```

```
fc zone emulex2
member emulex-port2
member cont1-vport2
member cont2-vport2
```

```
fc zone qlogic2
member qlogic-port2
member cont1-vport2
member cont2-vport2
```

```
fc zoneset zoneset2
member physical_ports2
member virtual_ports2
member emulex2
member qlogic2
```

FN2210S-A1	FN2210S-A2
Configure the FCoE Map and activate the zone set.	Configure the FCoE Map and activate the zone set.
<pre>fcoe-map SAN_FABRIC_A1 fc-map 0efc01 fabric-id 81 vlan 81 ! fc-fabric active-zoneset zoneset1</pre>	<pre>fcoe-map SAN_FABRIC_A2 fc-map 0efc02 fabric-id 82 vlan 82 ! fc-fabric active-zoneset zoneset2</pre>
Configure internal interfaces and external Fibre Channel interfaces.	Configure internal interfaces and external Fibre Channel interfaces.
<pre>interface range fi 0/9-10 description To Storage fabric SAN_FABRIC_A1 no shutdown interface range te 0/1, te0/3 description To CNA no ip address mtu 12000 no switchport portmode hybrid switchport fcoe-map SAN_FABRIC_A1 dcb-map SAN_DCB_MAP_A1 no shutdown</pre>	<pre>interface range fi 0/9-10 description To Storage fabric SAN_FABRIC_A2 no shutdown interface range te 0/1, te0/3 description To CNA no ip address mtu 12000 no switchport portmode hybrid switchport fcoe-map SAN_FABRIC_A2 dcb-map SAN_DCB_MAP_A2 no shutdown</pre>
Configure external interfaces and port channel connected to the S4810 switch.	Configure external interfaces and port channel connected to the S4810 switch.
<pre>interface range te 0/11-12 description To ToR Switch no ip address ! port-channel-protocol LACP port-channel 128 mode active no shutdown interface Port-channel 128 description PO to ToR Switch no ip address portmode hybrid switchport no shutdown end</pre>	<pre>interface range te 0/11-12 description To ToR Switch no ip address ! port-channel-protocol LACP port-channel 128 mode active no shutdown interface Port-channel 128 description PO to ToR Switch no ip address portmode hybrid switchport no shutdown end</pre>

Figure 22 Full Switch mode configuration

7.2.3 Key points on configuration

- FC aliases for port WWNs are optional and alias names must begin with a letter. If preferred, member port WWNs can be entered directly in the FC zone.
- A zone set can contain multiple zones.
- Only one zone set can be active at any time.
- If any changes are made to aliases, zones, or zone sets, the zone set must be activated (or reactivated) for the changes to take effect. This is done with the following command sequence:

```
switch1(conf)#fcoe-map fcoe-map name  
switch1 (conf-fcoe-SAN_FABRIC)#fc-fabric  
switch1(conf-fmap-SAN_FABRIC-fcfabric)#active-zoneset zoneset name
```

Figure 23 Activate or reactivate a zone set

7.2.4 Optional configuration: F_port without zoning in Full Switch mode

In Full Switch mode, the FCoE map has the default zone mode set to deny (the status of this setting can be seen by running the command `show fcoe-map`). This setting denies all the fabric connections unless included in an active zone set. To change this setting, use the `default-zone-allow all` command. This change allows all fabric connections without zoning.

```
switch(conf)#fcoe-map fcoe-map name  
switch(conf-fcoe-SAN_FABRIC)#fc-fabric  
switch(conf-fmap-SAN_FABRIC-fcfabric)#default-zone-allow all
```

Figure 24 Optional configuration – F_Port without zoning

Note: On FN2210S in *Standalone* mode, this is the default behavior. All fabric connections are allowed without any additional zoning.

8 Dell Storage SC8000 final configuration

8.1 Create servers and map volumes

Note: For Storage Center to automatically detect the server HBAs (CNAs), in addition to the steps already covered in this guide, the operating systems on the servers need to be up and running. For servers running Microsoft Windows, Multipath I/O (MPIO) does not need to be configured on the server at this point. For servers running VMWare ESXi, guest operating systems do not have to be installed or running. For VMWare ESXi 6.0 installation, see the section titled [VMware ESXi 6.0 - Installation, Configuration, and Validation](#).

Log into the Storage Center GUI. In the left pane, select **Servers > Create Server**. If everything has been configured correctly, all connected server CNA ports are detected and appear in the list:

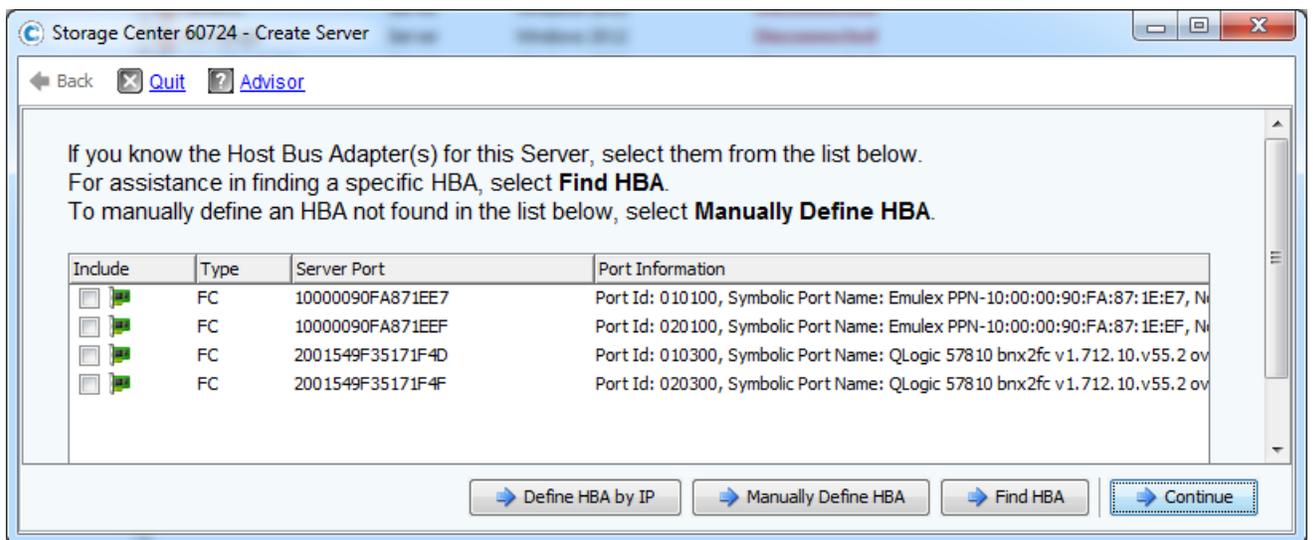


Figure 25 Server CNA ports detected in Storage Center

For the first server to be added, check the boxes for **both** of its CNA ports and click **Continue**. Give the server a **Name** and select its **Operating System** from the drop-down list.

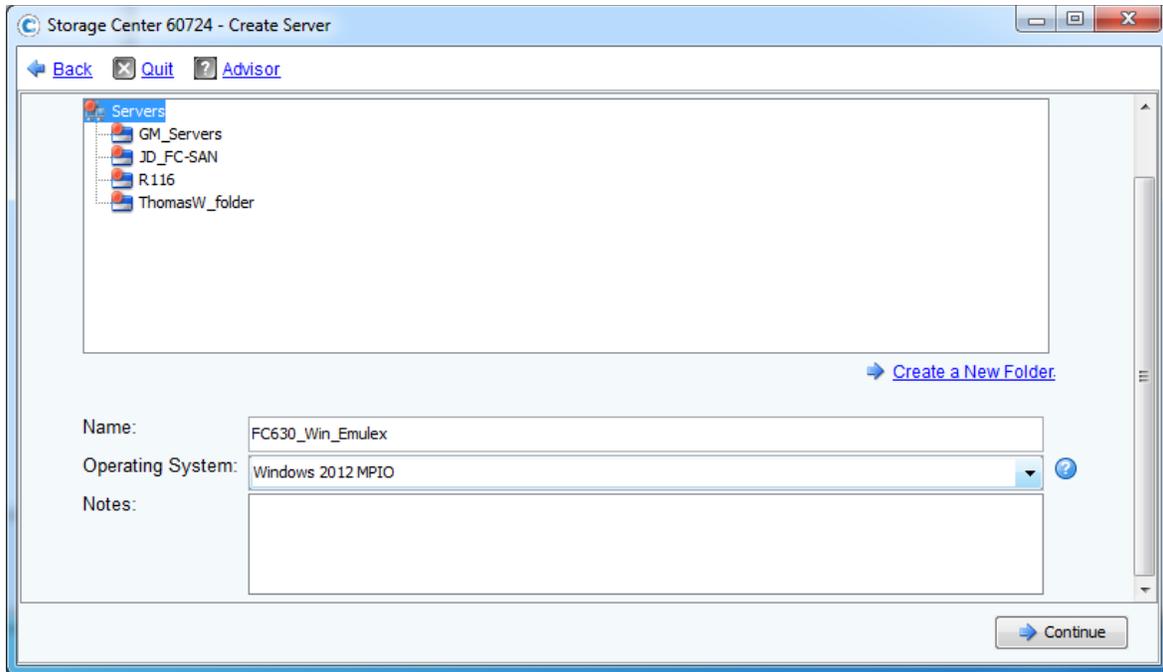


Figure 26 Windows 2012 with MPIO selected

Note: If using **ESXi**, select the appropriate **ESXi version** under **VMWare** in the drop-down list (do not select a Guest OS that may be running on ESXi). If using a **Windows Operating System** select the **MPIO** version of Windows.

Click **Continue > Create Now**.

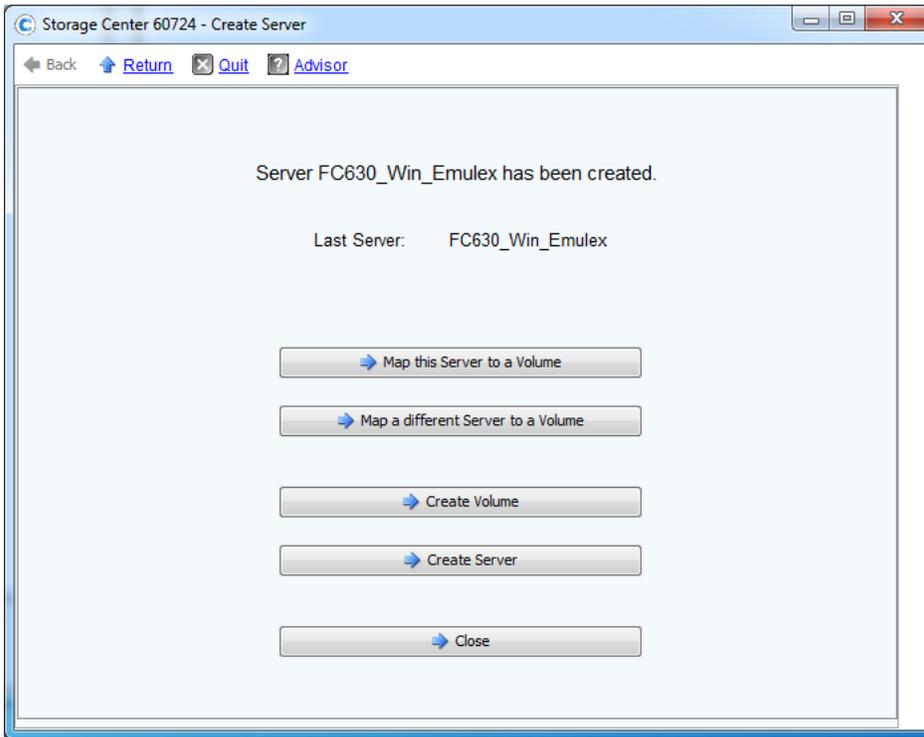


Figure 27 Options after server creation

At this point, you can use the options shown above to create the next server, or to create and map volumes now. You can also use the Storage Center GUI in Figure 28 to create and map volumes to servers as needed at any time.

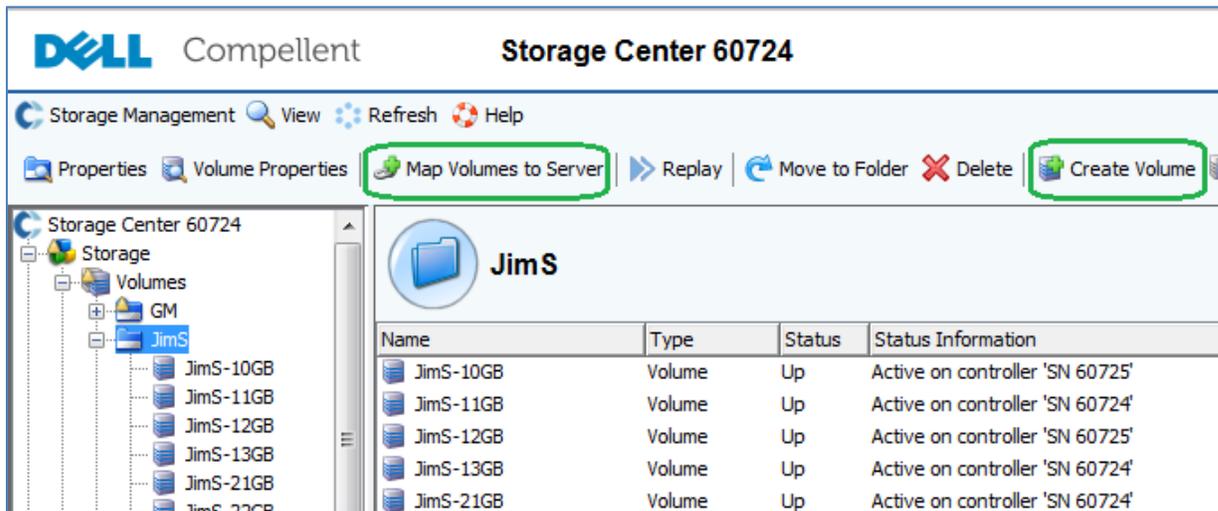


Figure 28 Additional method to create and map volumes

See your Storage Center documentation for more information.

9 ToR switch configuration

9.1 Overview

The S4810 is the ToR switch used in this guide for passing standard Ethernet traffic such as TCP/IP to the external network. The same two FN2210S IOMs connected to the Dell Storage SC8000 are also connected to the S4810 switches.

Note: For information on connecting FN IOMs (including the FN2210S) to other ToRs via LACP port channels, see [Appendix F](#). Sample commands for Cisco Nexus, Arista, and Brocade VDX ToR switches are provided.

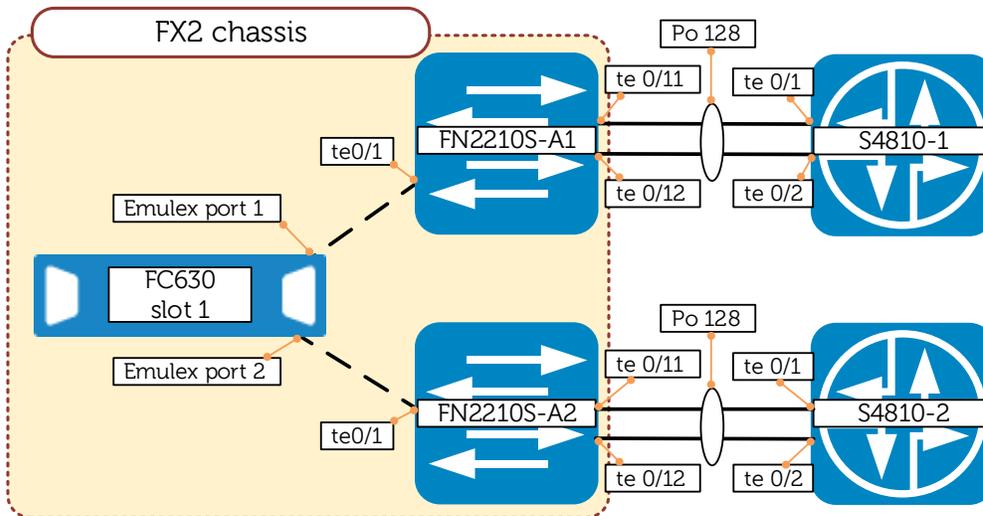


Figure 29 ToR switch configuration

9.2 S4810 switch configuration

Note: To work with this configuration, the FN2210S IOMs can use either the Standalone Mode or Full Switch mode configuration examples. The number 128 was assigned to the port channels on the S4810 switches. However, any number between 1 and 128 can be used and is not required to match the port channel number used on the FN2210S switches.

S4810-1	S4810-2
<pre>Configure the interfaces and port channel to connect to the FN2210S. interface range te 0/1-2 description Link to FN2210S-A1 no ip address ! port-channel-protocol LACP port-channel 128 mode active no shutdown interface Port-channel 128 description PO to FN2210S-A1 no ip address portmode hybrid switchport no shutdown</pre>	<pre>Configure the interfaces and port channel to connect to the FN2210S. interface range te 0/1-2 description Link to FN2210S-A2 no ip address ! port-channel-protocol LACP port-channel 128 mode active no shutdown interface Port-channel 128 description PO to FN2210S-A2 no ip address portmode hybrid switchport no shutdown</pre>

Figure 30 S4810 configuration

10 Server configuration

In this section, two different server configurations are presented. The first configuration covers installing, configuring, and validating VMware ESXi 6.0. The second covers configuring and verifying the functionality of Multipath I/O (MPIO) inside Windows Server 2012 R2.

10.1 VMware ESXi 6.0 - installation, configuration and validation

This section guides you through download, installation, and basic configuration of the Dell Custom ESXi 6.0 image, which can be download in .iso format from support.dell.com. For more information see [Dell Storage Center Best Practices with VMWare vSphere 6.x](#).

Installing Dell Custom VMware ESXi 6.0

This section provides an outline of the installation process for VMware ESXi 6.0. For further in-depth information on the installation of ESXi, please visit the VMware vSphere 6.0 Documentation Center at <https://pubs.vmware.com/vsphere-60/index.jsp>.

1. Insert the Dell Custom ESXi 6.0 installation media into the server.
This can either be a CD/DVD, a USB flash drive, or by mounting the installation ISO through the PowerEdge server's iDRAC interface.
2. Set the BIOS to boot from the media.
3. On the Welcome screen, press **Enter** to continue.
4. On the End User License Agreement (EULA) screen press **F11** to accept.
5. At this point, the installer scans for suitable installation targets. Choose the appropriate installation location.
6. Select the keyboard type for the host.
7. Enter a password for the host.
8. On the Confirm Installation window, press **Enter** to start the installation.
9. When the installation is complete, remove the installation CD, DVD, USB flash drive, or unmount the Virtual CD.
10. Press **Enter** to reboot the host.

Connecting to the ESXi host with the vSphere Client

Once installation has been completed, access the console for the host. From here, a management NIC can be activated and an IP address assigned. Follow the steps below to complete this.

Setting up the Management NIC.

1. Press **F2** to Customize System.
2. Select Configure Management Network and press Enter.
3. Select Network Adapters and press Enter.
4. Any NIC that is currently connected with show **Connected** under Status, use the spacebar to select the appropriate management NIC.
5. Press **Enter** to exit.
6. Press **Esc**.

7. Press **Y** for Yes to restart the management network.
8. Press **Esc** to exit System Customization.

Configuring a static IP address

1. Press **F2** to Customize System.
2. Select Configure Management Network and press Enter.
3. Select IP Configuration and press Enter.
4. Select Set static IP address and networking configuration and press the spacebar.
5. Type in an IP Address, Subnet Mask, and Default Gateway and press Enter.
6. Press **Esc**.
7. Press **Y** for Yes to restart the management network.
8. Press **Esc** to exit System Customization.

Connecting to the ESXi host using the vSphere Client

1. Use a web browser to go to http://<IP_address_of_ESXi_host>
2. Click on the link Download vSphere Client.
3. Launch the installer, agreeing to all the defaults for installation.
4. Launch the VMware vSphere Client.
5. Enter the **IP address of the ESXi host**, the **username** (root) and the **password** configured during the installation. Press **Enter**.

Verifying MPIO through the vSphere Client

Once connected to the ESXi host through the vSphere Client you can verify that a LUN is presented to the ESXi host. Additionally you see the number of paths for each LUN, which is useful in verifying that both paths are working (MPIO occurs automatically). Figure 31 shows the final step, which presents the number of targets, number of devices, and the number of paths.

1. Select your host from the left hand column
2. Click on the **Configuration** tab
3. Click **Storage Adapters** under Hardware
4. Locate your CNA in the list of storage adapters
Note: If the storage adapter is not listed, perform the following steps to install the software FCoE adapter.
 - a. Click **Add** in the Storage Adapters window
 - b. Select **Add Software FCoE Adapter**
 - c. Click **OK**
5. In the Details Window, under Storage Adapters (Figure 31) you should see the two LUNs presented to your host. Make note of **Targets**, **Devices**, and **Paths** as well.

NetXtreme II BCM57810 10 Gigabit Ethernet

- vmhba41 Fibre Channel o... 20:00:5c:f9:dd:17:5e:06 20:01:5c:f9:dd:17:5e:06
- vmhba42 Fibre Channel o... 20:00:5c:f9:dd:17:68:cd 20:01:5c:f9:dd:17:68:cd

MegaRAID SAS SKINNY Controller

- vmhba1 SCSI

Details

vmhba41
 Model: NetXtreme II BCM57810 10 Gigabit Ethernet
 WWN: 20:00:5c:f9:dd:17:5e:06 20:01:5c:f9:dd:17:5e:06
 Targets: 2 Devices: 1 Paths: 2

View:

Runtime Name	Target	LUN	Status
vmhba41:C0:T1:L0	50:0a:09:80:88:57:01:6c 50:0a:09:85:88:57:01:6c	0	◆ Active
vmhba41:C0:T0:L0	50:0a:09:80:88:57:01:6c 50:0a:09:85:98:57:01:6c	0	◆ Active (I/O)

Figure 31 QLogic NetXtreme BCM57810 software FCoE adapter

10.2 Microsoft Server Operating System MPIO installation and configuration

Microsoft Multipath I/O (MPIO) must be installed and configured for the Windows operating system to properly recognize multiple paths to a storage device.

Note: The following steps are specific to Windows Server 2012 R2. Microsoft MPIO is also supported on Windows Server 2012 (pre-R2), 2008 and 2008 R2. The configuration process is similar for all versions. For more information, see [Dell Storage Center: Microsoft Multipath I/O Best Practices](#).

1. In Windows Server 2012, select **Add Roles and features** in the Server Manager Dashboard.
2. On the Select installation type page, select **Role-based or feature-based installation** and click **Next**.
3. On the Select destination server page, choose **Select a server from the server pool**, make sure your server is highlighted, and click **Next**.
4. On the Select server roles page, click **Next** to skip.
5. On the Select features page, scroll down and check the box next to **Multipath I/O** (Figure 32).

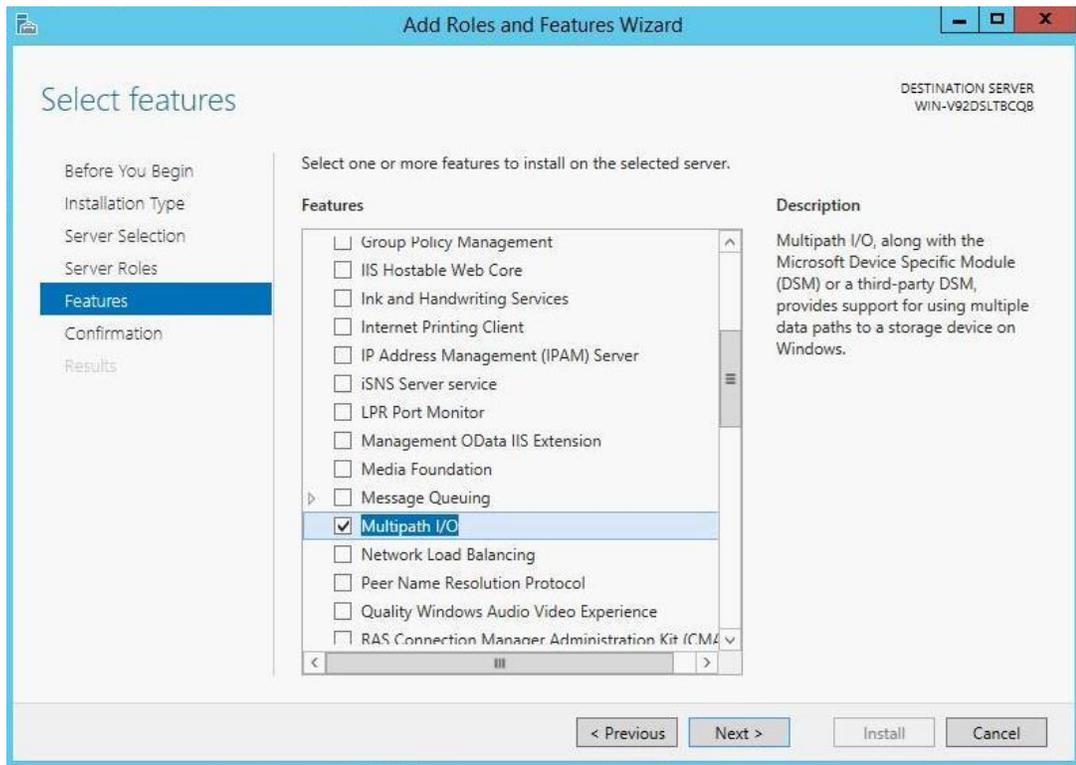


Figure 32 Windows 2012R2 – Add roles and features wizard

6. Click **Next**.
7. On the Confirm installation selections page, click **Install**.
8. On the Installation progress page, click **Close** when complete.

Configuring MPIO for your storage array

In Windows, launch **Control Panel** or **Administrative Tools**. An MPIO icon should appear. Launch MPIO and open the **Discover Multi-Paths** tab. If your storage array is SPC-3 compliant, it should appear in the **Device Hardware Id** box (Figure 33). If your storage array does not appear, you may need to install a Device-Specific Module (DSM) from your storage vendor. Check your storage documentation for more information on the MPIO configuration requirements for your device. Highlight the **Device Hardware ID** (**COMPELNTCompellent Vol**, in this case) and click **Add**. Reboot your system if prompted.

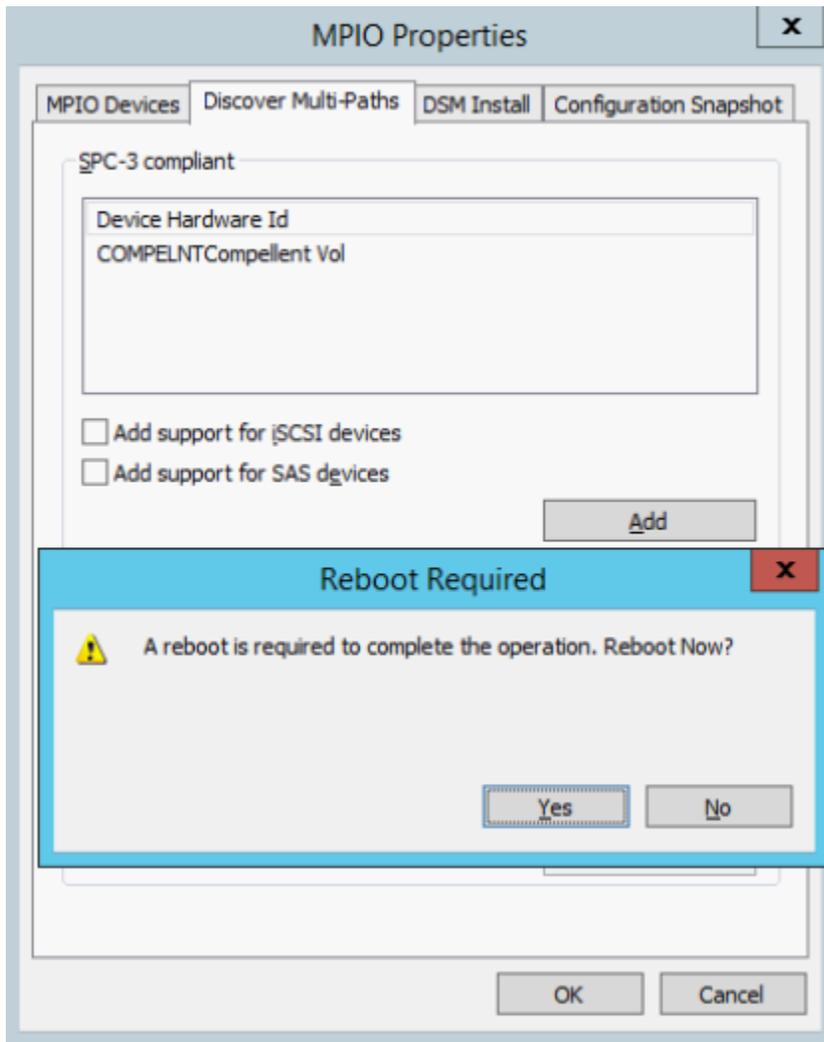


Figure 33 Adding storage array to MPIO

After rebooting, open MPIO. The device should now appear on the MPIO Devices tab (Figure 34).

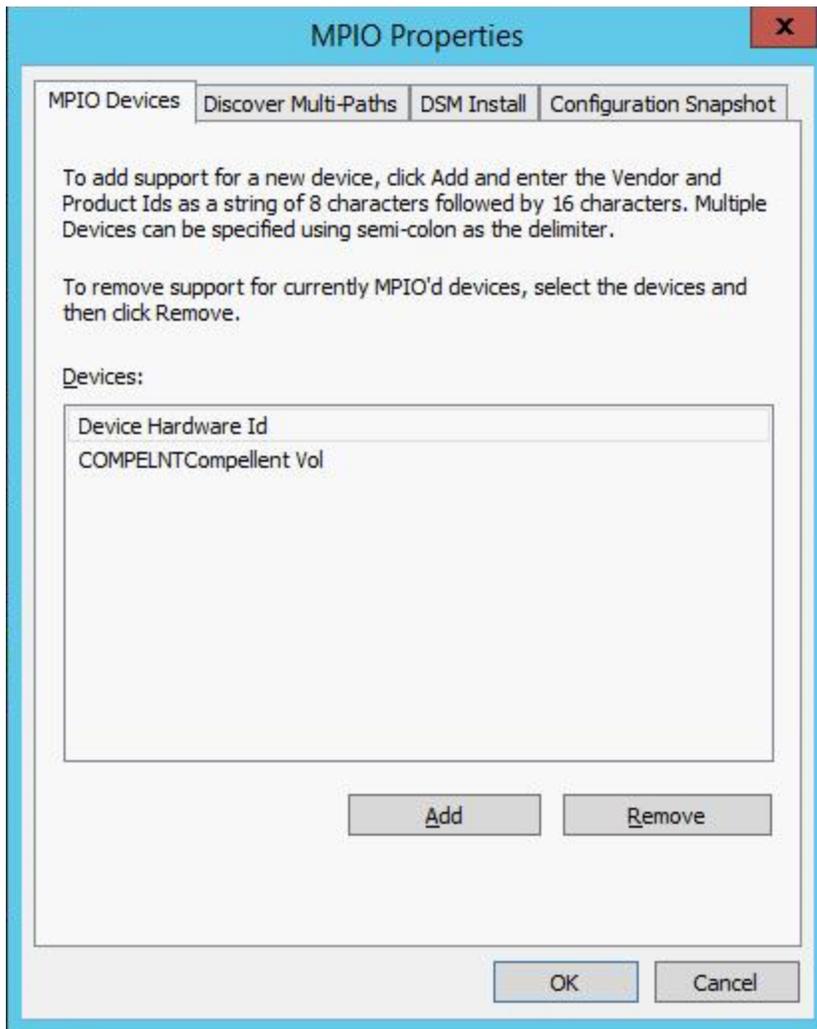


Figure 34 MPIO confirmation

Create disks and format

In Windows, go to **Server Manager > Tools > Computer Management > Storage > Disk Management**. Right-click on **Disk Management** and select **Rescan Disks**. If MPIO is configured properly, only one instance of each LUN configured on your storage array should appear. If there are two instances of each LUN, there is likely an issue with Microsoft MPIO configuration. Use the **Disk Management** utility to bring the disks online, assign drive letters and format as needed.

Configure MPIO

The Windows Disk Management utility can also be used to configure MPIO. Right-click on each remote disk (not the Volume) and select **Properties**.

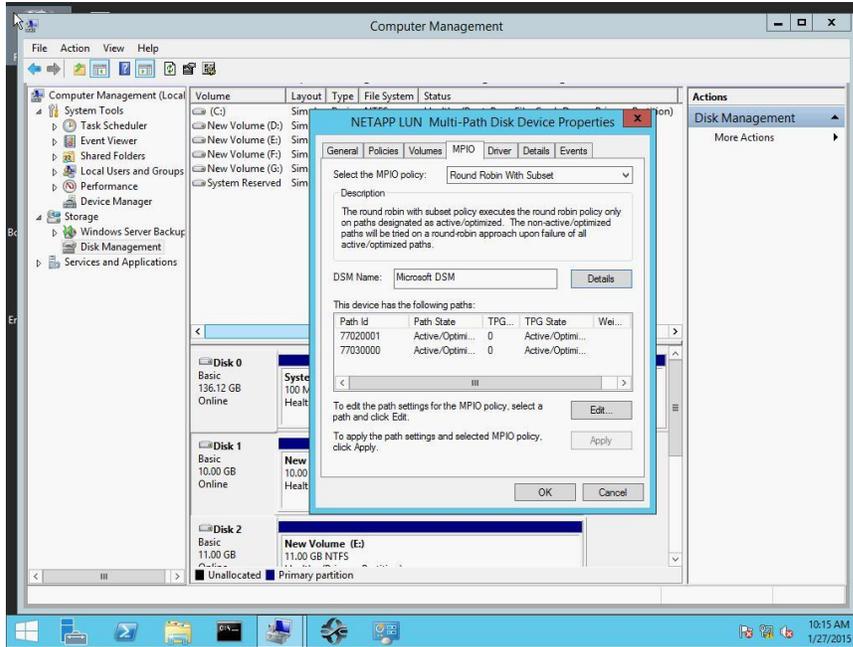


Figure 35 Windows MPIO disk properties

The **Multi-Path Disk Device Properties** window (Figure 35) is launched. Click on the **MPIO** tab. Note the option to configure the MPIO policy (**Failover Only**, **Round Robin with Subset**, etc.). The DSM Details button can be used to configure the redundant path verify period and other timer settings. Under **This device has the following paths:** the two available paths detected by MPIO are shown.

Verify redundant path functionality

Shut down a port on one of the paths between the server and storage, or reload an FN IOM. Verify the server can still connect to all disks. Repeat for the other path.

Note: By default, it may take Microsoft MPIO about 30 seconds to recognize a failed path. Microsoft has information about tuning MPIO parameters to reduce this time on their Technet web site, <http://technet.microsoft.com>.

11 Validation

The following section contains various *show* commands an administrator or network engineer can use on the FN2210S to verify that connections are functioning as expected.

The available commands include:

- `show fc switch`
- `show fc ns switch`
- `show fc alias` (Command applicable to Full Switch mode only)
- `show fc zoneset` (Command applicable to Full Switch mode only)
- `show fip-snooping sessions`
- `show fcoe-map`

Note: In all examples below, the output from FN2210S-A1 in Full Switch mode is shown.

show fc switch

This command (Figure 36) displays the FC switch mode and World Wide Name (WWN). This can be useful early in the configuration to ensure that the F_Port feature is successfully enabled on the switch.

```
FN2210S-A1
FN2210S-A1#sh fc switch
Switch Mode : FPORT
Switch WWN  : 10:00:f8:b1:56:5e:dc:92
```

Figure 36 Show fc switch command

show fc ns switch

A Fibre Channel fabric uses an addressing scheme to address the ports in the switched fabric. Each port in the switched fabric is assigned a 24-bit address by the FC switch. When the device logs into the switch fabric on a specific port with its WWN, the switch assigns the port address to that port; the switch also maintains the correlation between the port address and the WWN address of the device on that port. This function is implemented by the use of a name server database on the switch.

The `show fc ns switch` command (Figure 37) displays the objects in the name server database of currently attached devices.

In our example, there are six devices connected to each FN2210S switch. This includes two CNAs (one port on each server), two Dell Storage SC8000 physical ports, and two SC8000 virtual ports.

FN2210S-A1

```
FN2210S-A1#sh fc ns switch
```

```
Total number of devices = 6
```

```
Switch Name          10:00:f8:b1:56:5e:dc:92
Domain Id            1
Switch Port          Te 0/1
FC-Id                01:01:00
Port Name            10:00:00:90:fa:87:1e:e7
Node Name            20:00:00:90:fa:87:1e:e7
Class of Service     8
Symbolic Port Name   Emulex PPN-10:00:00:90:FA:87:1E:E7
Symbolic Node Name   Emulex OCm14102-U4-D FV10.6.133.18
DV10.6.114.0 HN:WIN-IEBPQI7609G OS:Windows 2012 R2
Port Type            N_Port

Switch Name          10:00:f8:b1:56:5e:dc:92
Domain Id            1
Switch Port          Te 0/3
FC-Id                01:03:00
Port Name            20:01:54:9f:35:17:1f:4d
Node Name            20:00:54:9f:35:17:1f:4d
Class of Service     8
Symbolic Port Name   QLogic 57810 bnx2fc v1.712.10.v55.2
over vmnic0
Symbolic Node Name   QLogic 57810 bnx2fc v1.712.10.v55.2
over vmnic0
Port Type            N_Port

Switch Name          10:00:f8:b1:56:5e:dc:92
Domain Id            1
Switch Port          Fc 0/9
FC-Id                01:09:00
Port Name            50:00:d3:10:00:ed:34:05
Node Name            50:00:d3:10:00:ed:34:00
Class of Service     8
Symbolic Port Name   Compellent Port QLGC FC 8Gbps; Slot=05
Port=01 in Controller: SN 60724 of Storage Center: Storage Center 60724
Symbolic Node Name   Compellent Storage Center: Storage
Center 60724
Port Type            N_Port
```

(output continued on next page)

FN2210S-A1

```
Switch Name          10:00:f8:b1:56:5e:dc:92
Domain Id            1
Switch Port          Fc 0/9
FC-Id                01:09:01
Port Name            50:00:d3:10:00:ed:34:43
Node Name            50:00:d3:10:00:ed:34:01
Class of Service     8
Symbolic Port Name   Compellent Port QLGC FC 8Gbps; Slot=05
Port=01 in Controller: SN 60724 of Storage Center: Storage Center 60724
Symbolic Node Name   Compellent Storage Center: Storage
Center 60724
Port Type            N_Port

Switch Name          10:00:f8:b1:56:5e:dc:92
Domain Id            1
Switch Port          Fc 0/10
FC-Id                01:0a:00
Port Name            50:00:d3:10:00:ed:34:1f
Node Name            50:00:d3:10:00:ed:34:00
Class of Service     8
Symbolic Port Name   Compellent Port QLGC FC 8Gbps; Slot=05
Port=01 in Controller: SN 60725 of Storage Center: Storage Center 60724
Symbolic Node Name   Compellent Storage Center: Storage
Center 60724
Port Type            N_Port

Switch Name          10:00:f8:b1:56:5e:dc:92
Domain Id            1
Switch Port          Fc 0/10
FC-Id                01:0a:01
Port Name            50:00:d3:10:00:ed:34:46
Node Name            50:00:d3:10:00:ed:34:02
Class of Service     8
Symbolic Port Name   Compellent Port QLGC FC 8Gbps; Slot=05
Port=01 in Controller: SN 60725 of Storage Center: Storage Center 60724
Symbolic Node Name   Compellent Storage Center: Storage
Center 60724
Port Type            N_Port
```

Figure 37 Show fc ns switch command

show fc alias

The complexity of configuring zone sets can be reduced by assigning aliases to the port WWN addresses. The `show fc alias` command can be used to identify the port WWN associated with each alias. The output for the example configuration is shown below (Figure 38).

```
FN2210S-A1
FN2210S-A1#show fc alias
ZoneAliasName          ZoneMember
=====
cont1-pport1          50:00:d3:10:00:ed:34:05
cont1-vport1          50:00:d3:10:00:ed:34:43
cont2-pport1          50:00:d3:10:00:ed:34:1f
cont2-vport1          50:00:d3:10:00:ed:34:46
emulex-port1          10:00:00:90:fa:87:1e:e7
qllogic-port1         20:01:54:9f:35:17:1f:4d
```

Figure 38 Show fc alias command

show fc zoneset

Zoning is a mechanism to ensure only the nodes that are part of a zone can communicate with each other. Zoning prevents unauthorized access of storage assets. Issue the command `show fc zoneset` to display the zone, the node members in the zone and the zone set itself (Figure 39). The output for the example configuration is shown below.

```
FN2210S-A1
FN2210S-A1#show fc zoneset
ZoneSetName          ZoneName             ZoneMember
=====
    zoneset1
                emulex1
                                cont1-vport1
                                cont2-vport1
                                emulex-port1
                physical_ports1
                                cont1-pport1
                                cont2-pport1
                qlogic1
                                cont1-vport1
                                cont2-vport1
                                qlogic-port1
                virtual_ports1
                                cont1-vport1
                                cont2-vport1

Active Zoneset: zoneset1

ZoneName             ZoneMember
=====
emulex1
                    *10:00:00:90:fa:87:1e:e7
                    *50:00:d3:10:00:ed:34:43
                    *50:00:d3:10:00:ed:34:46
physical_ports1
                    *50:00:d3:10:00:ed:34:05
                    *50:00:d3:10:00:ed:34:1f
qlogic1
                    *20:01:54:9f:35:17:1f:4d
                    *50:00:d3:10:00:ed:34:43
                    *50:00:d3:10:00:ed:34:46
virtual_ports1
                    *50:00:d3:10:00:ed:34:43
                    *50:00:d3:10:00:ed:34:46
```

Figure 39 Show fc zoneset command

show fip-snooping sessions

For further detail on FIP sessions the command `show fip-snooping sessions` can be issued (Figure 40). This command lists all interfaces, MAC addresses, and port WWN addresses used for any server participating in a fabric login.

Note: Due to width, the output has been split into two lines.

```
FN2210S-A1
FN2210S-A1#sh fip-snooping sessions
Enode MAC           Enode Intf         FCF MAC           FCF Intf         VLAN
-----
00:90:fa:87:1e:e7   Te 0/1            f8:b1:56:5e:dc:95 ~                81
54:9f:35:17:1f:4d   Te 0/3            f8:b1:56:5e:dc:95 ~                81

FCoE MAC           FC-ID             Port WWPN         Port WWNN
-----
0e:fc:00:01:01:00   01:01:00         10:00:00:90:fa:87:1e:e7 20:00:00:90:fa:87:1e:e7
0e:fc:00:01:03:00   01:03:00         20:01:54:9f:35:17:1f:4d 20:00:54:9f:35:17:1f:4d
```

Figure 40 Show fip-snooping sessions command

show fcoe-map

The `show fcoe-map` command is useful to identify the SAN fabric to which FCoE storage traffic is sent. As shown below (Figure 41) this command can be viewed as a summary command showing the fabric type, the fabric ID, fabric VLAN, the FC-MAP ID, the FC Domain ID and the active zone set. Additionally the participating interfaces are also shown at the bottom of the output.

```
FN2210S-A1
FN2210S-A1#show fcoe-map
Fabric Name          SAN_FABRIC_A1
Fabric Type          Fport
Fabric Id            81
Vlan Id              81
Vlan priority        3
FC-MAP               0efc01
FKA-ADV-Period       8
Fcf Priority          128
Config-State         ACTIVE
Oper-State           UP
=====
Switch Config Parameters
=====
DomainID             1
=====
Switch Zoning Parameters
=====
Default Zone Mode:   Deny
Active Zoneset:      zoneset1
=====
Members
Fc 0/9 Fc 0/10
Te 0/1 Te 0/3
=====
=====
```

Figure 41 Show fcoe-map command

12 Conclusion

The Dell Networking FN2210S I/O Module provides a reliable and evolutionary step in the right direction for lowering data center costs typically associated with storage. It eliminates the need for a separate physical FCF switch and can be very easy to use in its default-preconfigured mode.

A Products used in this guide

This section lists products and their respective versions used while validating the solution in this guide.

Table 6 Switches, chassis and storage

Component	Version
Dell FN2210S IO Modules	Dell Networking OS 9.10(0.1)
Dell S4810 Switches	Dell Networking OS 9.10(0.1)
Dell PowerEdge FX2	Chassis Management Controller Version 1.32
Dell Storage SC8000	Storage Center Controller Version 6.7.11
FC Adapters in SC8000	QLogic QLE2662 16Gb FC, Firmware 07.03.00

Table 7 Server in Dell PowerEdge FX2 chassis - slot 1

Component	Version
Server Platform	Dell PowerEdge FC630
Operating System	Windows Server 2012 R2
Server BIOS	2.1.5
CNA	Emulex OCm14102-U4-D 10Gb Dual Port bNDC
CNA Firmware / Driver	Firmware - 02.00.04 / Driver - 8.6.3

Table 8 Server in Dell PowerEdge FX2 chassis - slot 2

Component	Version
Server Platform	Dell PowerEdge FC630
Operating System	VMware ESXi 6.0 Build 2809209 – Dell Customized Image v. A01
Guest Operating System	Windows Server 2012 R2
Server BIOS	2.1.5
CNA	QLogic (Formerly Broadcom) BCM57810S 10Gb Dual Port bNDC
CNA Firmware / Driver	Firmware - 08.07.25 / Drivers provided in Dell VMWare Image

B PowerEdge FN I/O module operational modes

The FN IOM supports five operational modes: Standalone (SMUX), VLT, Stack, Programmable MUX (PMUX), and Full Switch. See Table 9 for detailed descriptions of each mode. To enable a new operational mode the command `stack-unit 0 iom-mode <mode>` is issued in configuration mode. After enabling a new operational mode, the switch must be reloaded.

Note: When switching modes it is important to factory restore the switch first: `restore factory-defaults stack-unit 0 clear-all` and then set the switch mode accordingly.

By default, in Standalone and VLT modes all external ports are configured in a single port channel (128) and all VLANs (1-4094) are tagged on this port channel. Additionally any Data Center Bridging Exchange (DCBx) protocol options are allowed as well as iSCSI or FCoE settings.

Table 9 FN IOM modes and descriptions

Mode	Description
Standalone mode (SMUX)	This is the default mode for FN IOM. It is a fully automated, low-touch mode, which allows VLAN memberships to be defined on the server-facing ports while all upstream ports are configured in port channel 128 (and cannot be modified).
VLT mode	This is a low-touch mode where all configurations except VLAN membership are automated. In this mode, port 9 is dedicated to VLT interconnect.
Programmable MUX mode (PMUX)	This mode provides flexibility of operation by allowing the administrator to create multiple LAGs, configure VLANs on uplinks and to configure Data Center Bridging (DCB) parameters on the server side.
Stack mode	This mode allows up to six FN IOMs to be stacked as a single logical switch. The stack units can be in the same or different chassis. This is a low-touch mode where all configurations except VLAN membership are automated. Note: Stack mode is not supported on FN2210S with Fibre Channel ports.
Full Switch mode	This mode is similar to PMUX mode but adds layer 3 functionality.

Note: Virtual Link Trunking (VLT) allows physical links between two chassis to appear as a single virtual link to the network core or other switches (Edge, Access, or ToR). VLT reduces the role of Spanning Tree protocols by allowing LAG terminations on two separate distribution or core switches, and by supporting a loop-free topology. VLT provides layer 2 multi-pathing, creating redundancy through increased bandwidth, enabling multiple parallel paths between nodes, and load-balancing traffic where alternative paths exist.

C FN IOM internal port mapping details

Quarter-width servers - dual port CNAs

For quarter-width servers configured with dual port CNAs, the CNA ports map to a single port on each of the two IOMs. The first row of the quarter-width servers are designated 1a through 1d, and the second row 3a through 3d. Figure 42 and Table 10 present the port mapping for quarter-width servers with dual port CNAs.

Note: Quad-port CNAs are not available for quarter-width servers.

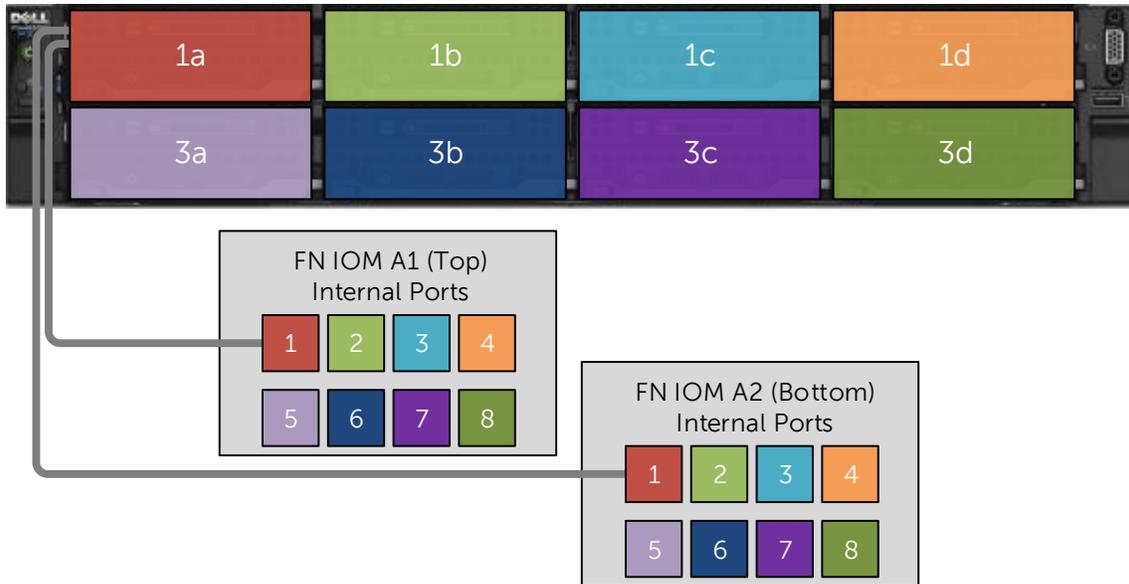


Figure 42 Quarter-width servers with dual port CNAs

Table 10 Quarter-width servers with dual port CNAs

Slot	FN IOM A1 (Top) Port Numbers	FN IOM A2 (Bottom) Port Numbers
1a	1	1
1b	2	2
1c	3	3
1d	4	4
3a	5	5
3b	6	6
3c	7	7
3d	8	8

Half-width servers – dual-port CNAs

In half-width servers with dual-port CNAs installed, the CNA ports map to a single port on each of the two IOMs. Figure 43 and Table 11 present the port mapping for half-width servers with dual-port CNAs.

Note: Ports 2, 4, 6 and 8 are not used when using half-width blades with dual-port adapters.

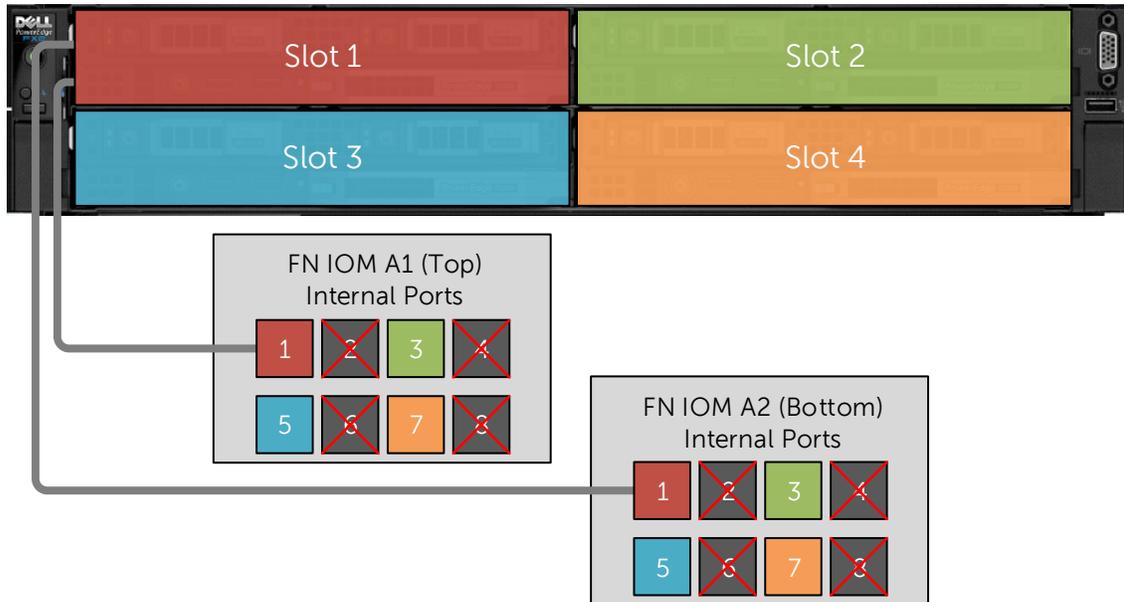


Figure 43 IOM Port Mapping half-width servers with dual-port CNAs

Table 11 Half-width servers with dual-port CNAs

Slot	FN IOM A1 (Top) Port Numbers	FN IOM A2 (Bottom) Port Numbers
1	1	1
2	3	3
3	5	5
4	7	7

Half-width servers – quad-port CNAs

In half-width servers with quad-port CNAs installed, the CNA ports map to two ports on each IOM. Figure 44 and Table 12 present the port mapping for half-width servers with quad-port CNAs.

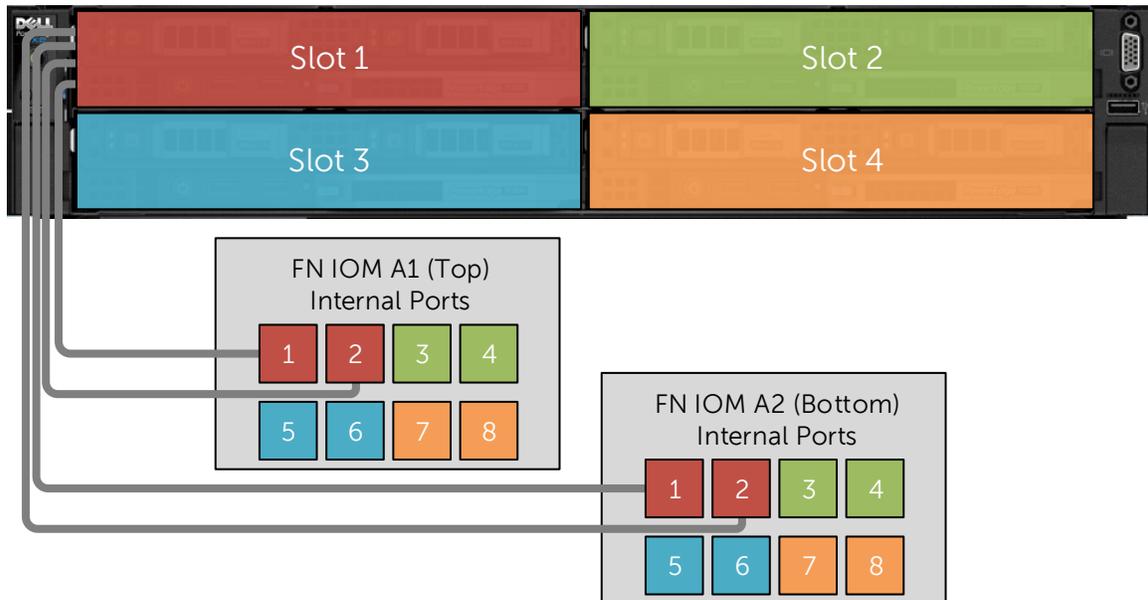


Figure 44 Half-width slots with quad-port CNAs

Table 12 Half-width slots with quad-port CNAs

Slot	FN IOM A1 (Top) Port Numbers	FN IOM A2 (Bottom) Port Numbers
1	1,2	1,2
2	3,4	3,4
3	5,6	5,6
4	7,8	7,8

D Fibre Channel over Ethernet and data center bridging

Fibre Channel over Ethernet (FCoE) is a networking protocol that encapsulates Fibre Channel frames over Ethernet networks. The FCoE protocol specification replaces the FC0 and FC1 layers of Fibre Channel stack with Ethernet. By retaining the native Fibre Channel constructs, FCoE can integrate with existing Fibre Channel fabrics and management solutions.

Note: FCoE (referenced as FC-BB_E in the FC-BB-5 specifications) achieved standard status in June 2009, and is documented in the T11 publication (<http://www.t11.org/ftp/t11/pub/fc/bb-5/09-056v5.pdf>).

FCoE operates directly above Ethernet in the network protocol stack, in contrast to iSCSI which runs on top of TCP and IP. As a consequence, FCoE cannot be routed across IP networks. Once de-encapsulation occurs, the FC packets can be routed accordingly with FC switches.

Since traditional Ethernet does not provide priority-based flow control, FCoE requires modifications to the Ethernet standard to support priority-based flow control mechanisms (this reduces frame loss from congestion). The IEEE standards body added priorities via Data Center Bridging (DCB). The three primary extensions are:

- Encapsulation of native Fibre Channel frames into Ethernet frames.
- Extensions to the Ethernet protocol itself to enable lossless Ethernet links.
- Mapping between Fibre Channel N_Port Ids (aka FCIDs) and Ethernet MAC address.

The primary purpose of the FCoE protocol is for traffic destined for FC/FCoE storage area networks (SANs). FCoE enables cable reduction due to converged networking possibilities. To achieve these goals three hardware components must be in place.

- Converged network adapters (CNAs)
- Lossless Ethernet links (via DCB extensions)
- An FCoE-capable switch, typically referred to as a Fibre Channel Forwarder (FCF)

A Fibre Channel Initialization Protocol (FIP) Snooping Bridge (FSB) is a fourth optional component which can be introduced and still allow full FCoE functionality. In traditional Fibre Channel networks, FC switches are considered trusted, while other FC devices must log directly into the switch before they can communicate with the rest of the fabric. This login process is accomplished through a protocol called FIP which operates at L2 for end point discovery and fabric association. With FCoE an Ethernet bridge typically exists between the End Node (ENode) and the FCF. This bridge prevents a FIP session from properly establishing. To allow ENodes the ability to login to the FCF, FSB is enabled on the Ethernet Bridge. By snooping on FIP packets during the discovery and login process, the intermediate bridge can implement data integrity using ACLs that permit valid FCoE traffic between the Enode and FCF.

Data Center Bridging (DCB) is a collection of mechanisms that have been added to the existing Ethernet protocol. These mechanisms allow Ethernet to become lossless which is a prerequisite for FCoE. The three additions are:

- Priority-based Flow Control (PFC) (IEEE 802.1Qbb)
- Enhanced Transmission Selection (ETS) (IEEE P802.1Qaz)
- Data Center Ethernet Bridging Capability Exchange Protocol (DCBX)

E FN IOM Dell Blade I/O Manager GUI

In previous versions of the Dell Networking Operation System (DNOS), the FN410S, FN410T, and FN2210S IOMs were only configurable via CLI. Now, with DNOS 9.10 these FN IOMs can be configured for most common deployments with an easy to use GUI application. The new Dell Blade I/O Manager GUI application allows IT administrators to configure features and perform tasks such as:

- Configuring modes, combo ports, account credentials, SNMP parameters, uplink failure detection and NTP through the Initial Setup Wizard
- Viewing logs and alerts and configuring settings for viewing logs and alerts
- Viewing port settings and configuring port settings, uplink ports, uplink failure detection, and combo port settings
- Assigning VLANs, Configuring LAGs, IGMP, Port Mirroring, Fibre Channel, iSCSI, and DCB
- Configuring TACACS+, RADIUS, AAA
- Configuring FN IOM users and passwords
- Configuring Broadcast Storm Control
- Configuring Auto LAG
- Configuring the default VLAN
- Configuring NTP servers
- Rebooting the FN IOM

The features listed above allow IT administrators to quickly deploy the FX2 FN IOMs in many data center environments. The Dell Blade I/O Manager can be launched from the FX2 CMC GUI or by typing the management IP address of the FN IOM into a browser with a port number of 8081.

To launch from the FX2 CMC GUI, go to the I/O Module Overview page and click the **Launch I/O Module GUI** button (Figure 45).

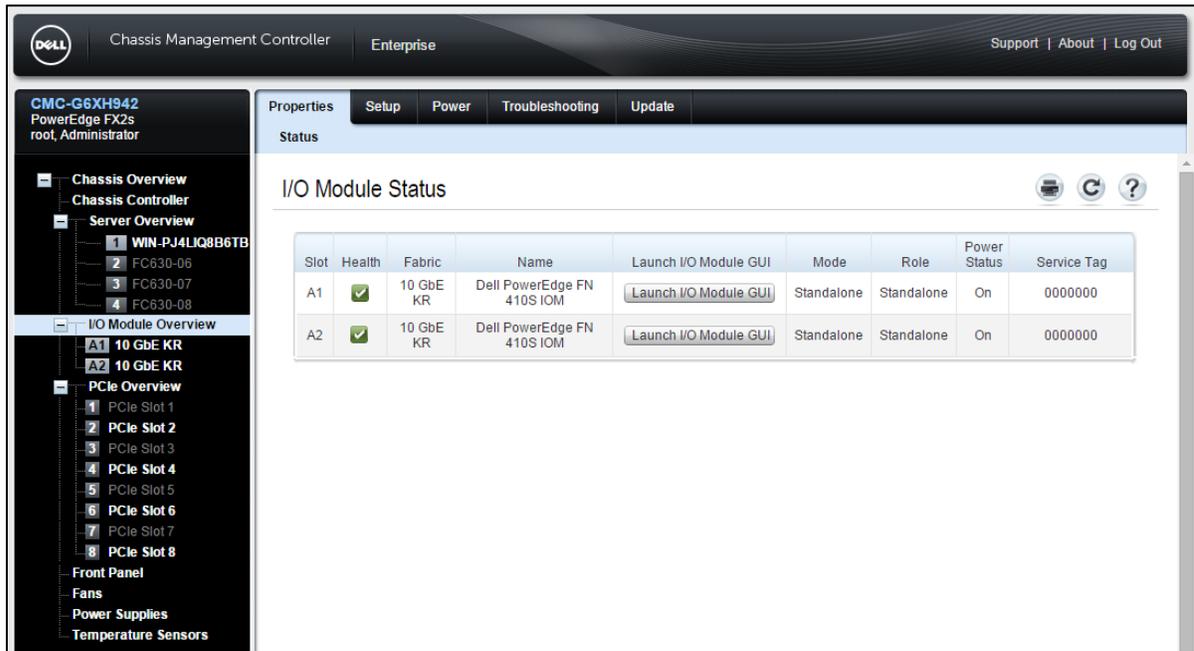


Figure 45 FX2 CMC I/O Module Overview

To launch from a browser, enter the management IP address of the FN IOM and specify port number 8081. For example: 172.25.210.235:8081.

Either method takes you to the login screen in Figure 46:

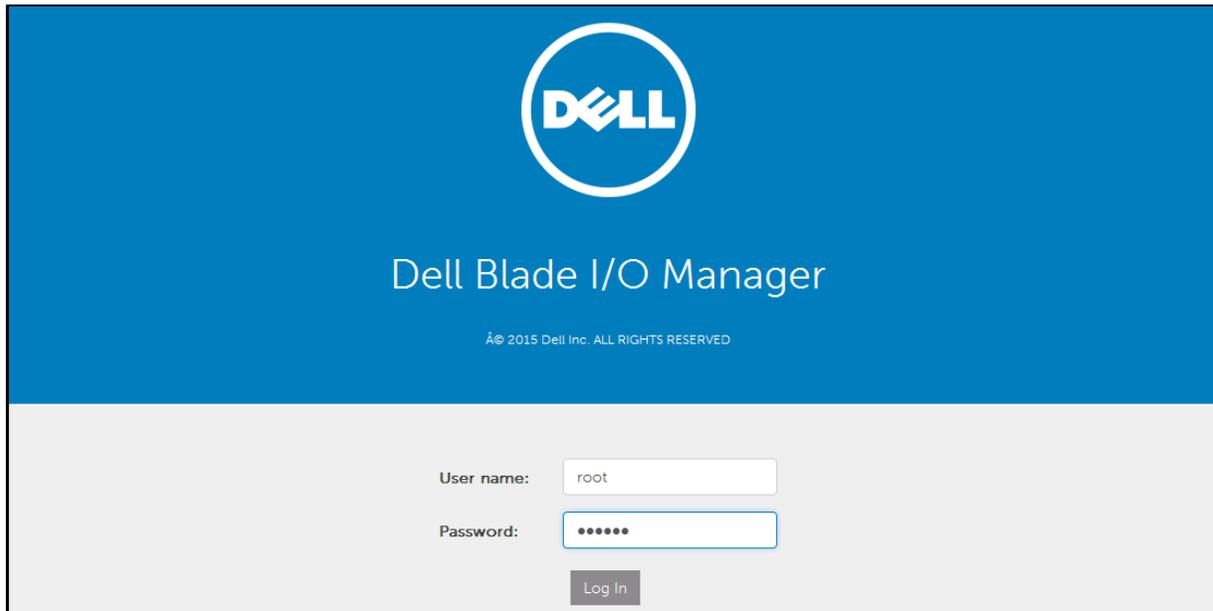


Figure 46 FX2 FN IOM Dell Blade IO Manager login screen

When the correct account credentials (defaults: user name **root**, password **calvin**) are entered into the Dell Blade I/O Manager Login page, the initial Dashboard view displays (Figure 47).

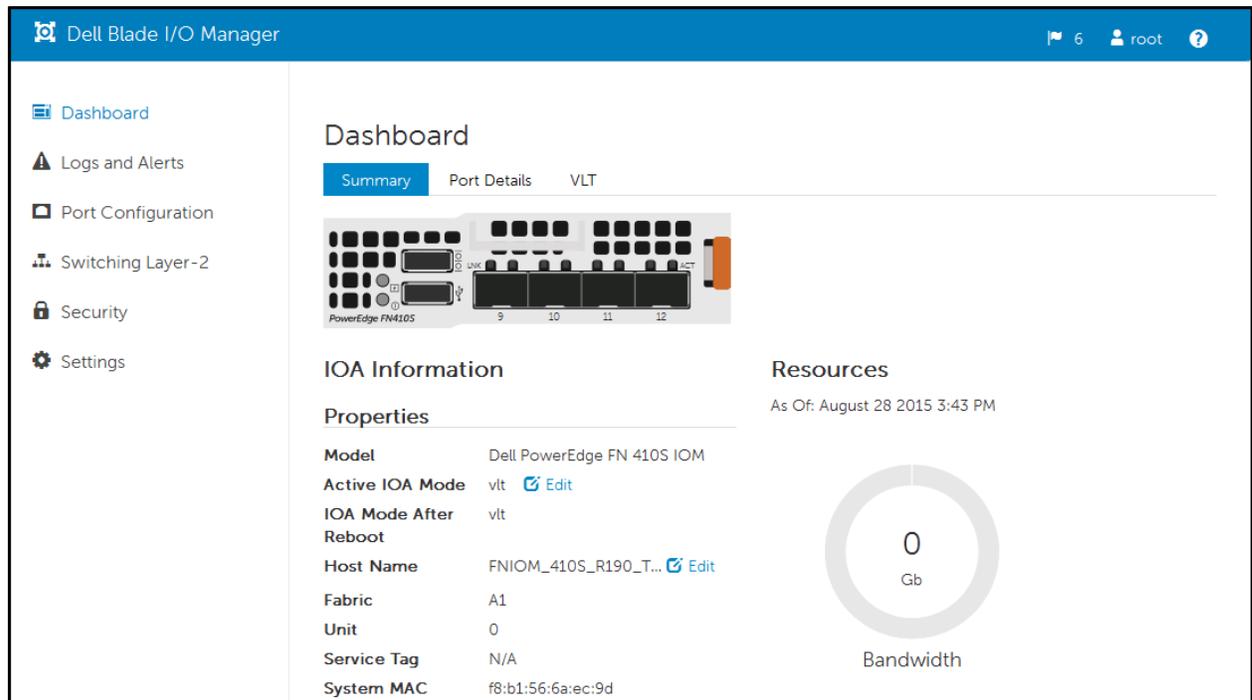


Figure 47 Dell Blade I/O Manager dashboard

The Dell Blade I/O Manager Dashboard page allows an overall configuration view of the FN IOM, which includes:

- FN IOM Mode
- Management IP address
- Recently logged activity
- Bandwidth utilization
- Detailed Port view
- Detailed mode view (Standalone, VLT, Stacked, Programmable Mux, Full Switch)

The menu choices on the left include Logs and Alerts, Port Configuration (both internal and external), Switching, Security, and Settings.

F FN IOM initial out-of-box configuration and default settings

This section applies to the Dell PowerEdge FN I/O Module (FN IOM) in Standalone mode. Modules covered by this section include FN410S, FN410T, and FN2210S (applicable to ports in Ethernet mode only). This section provides configuration examples for common upstream switches to establish a functional uplink and bring up network ports on PowerEdge FC-Series servers (FC830, FC630, FC430, FC620, and FC420) in three easy steps:

1. Ensure the FN IOM is in Standalone Mode
2. Create an LACP LAG on the upstream top-of-rack (ToR) switch
3. Verify the connection

By default, the FN IOM is shipped from the factory in Standalone Mode, which consists of the following default settings:

Table 13 Standalone mode default settings

Setting	Default Value
Chassis Management Controller Configuration	Yes
Stacking and VLT	Disabled
Data Center Bridging Exchange Protocol (DCBx)	Enabled
FIP Snooping Bridge (FSB)	Enabled on FN410S and FN410T Disabled on FN2210S
NPIV Proxy Gateway Mode (NPG)	Enabled in FN2210S Disabled on FN410S and FN410T
iSCSI Optimization	Enabled
Broadcast Storm Control	Enabled
Internet Group Management Protocol (IGMP) Flood Restrict	Enabled
Network Time Protocol (NTP)	Enabled
Enable and Disable ports	All ports enabled by default. Disable ports via Command Line Interface
Uplink Failure Detection (UFD)	Enabled
TACACS+/RADIUS (AAA Auth/Acct; Auth coming up)	Disabled
DHCP	Enabled in client only mode
Internet Group Management Protocol (IGMP) v2 and v3	Enabled
Auto LACP LAG	Enabled on all ports (Uplink created by default based on LACP PDU)
VLANS	All server and uplink ports are in all VLANS

By default, network ports on the PowerEdge FC-Series servers installed in the FX2 chassis are down until the uplink port channel is operational on the FN IOM. This is due to a feature called Uplink Failure Detection whereby, when upstream connectivity fails, the FN IOM disables the downstream links.

Note: For more information on Uplink Failure Detection and all other configuration settings, see the [Dell PowerEdge FN I/O Module Configuration Guide](#).

F.1 Interface and port channel configuration on the upstream switch

This step provides the commands used to configure port channels on common upstream switches that may be connected to the FN IOM (Figure 48).

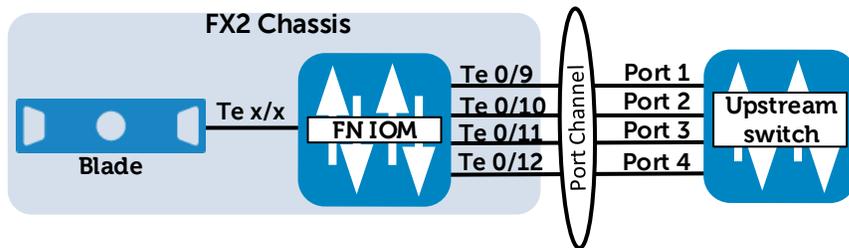


Figure 48 Interface and port channel view

Note: The diagram above (Figure 48) is applicable to the FN410S and FN410T. If you are using the FN2210S in its default configuration, you only use Ethernet ports Te 0/11 and Te 0/12 in the uplink port channel since ports Te 0/9 and Te 0/10 have been replaced by Fibre Channel ports. Ports 0/9 and 0/10 can be converted to Ethernet ports if desired by typing the command:

```
stack-unit 0 port-group 0 portmode ethernet
```

By default on the FN IOM, the external Ethernet ports are preconfigured in port channel 128 with LACP enabled. Port channel 128 is in hybrid (trunk) mode.

In order for the downstream (server) ports on the FN IOM to come up, port channel 128 must be up. Port channel 128 comes up when connected to a properly configured port channel on an upstream switch.

To accomplish this, start by connecting any combination of the FN IOM's external Ethernet ports (ports Te 0/9-12) to the upstream switch. The port channel may have a minimum of one and a maximum of four links. Configure a port channel on your upstream switch as shown in the following examples.

Upstream switch configuration examples

Note the following when configuring the upstream switch:

- No configuration is required on the FN IOM by default. All configuration is done on the upstream switch.
- In each example, four interfaces are configured in the port channel. You only need to configure as many interfaces as you have connected. Change the port numbers shown to match your switch.
- Any valid ID number can be used for the port channel number on the upstream switch. The examples below use port channel 128 except for the Cisco Nexus. On the Nexus, 128 is reserved so 10 has been assigned instead.

Dell Networking OS 9.X

```
S4810 (conf) #interface range tengigabitethernet 0/1-4
S4810 (conf-if-te-0/1) #no shut
S4810 (conf-if-te-0/1) #port-channel-protocol lacp
S4810 (conf-if-te-0/1-lacp) #port-channel 128 mode active

S4810 (conf) #interface port-channel 128
S4810 (conf-if-po-128) #portmode hybrid
S4810 (conf-if-po-128) #switchport
S4810 (conf-if-po-128) #no shut
```

Figure 49 Dell Networking S4810 port channel configuration

Arista 4.X

```
Arista (config) #interface Ethernet 21-24
Arista (config-if-Et21-24) #switchport mode trunk
Arista (config-if-Et21-24) #channel-group 128 mode active
Arista (config-if-Et21-24) #no shut

Arista (config) #int port-Channel 128
Arista (config-if-Po128) #switchport mode trunk
Arista (config-if-Po128) #no shut
```

Figure 50 Arista 7050Q-16 port channel configuration

Cisco NX-OS Release 7

```
Nx5548(config)# interface Ethernet 1/1-4
Nx5548(config-if-range)# switchport mode trunk
Nx5548(config-if-range)# channel-group 10 mode active
Nx5548(config-if-range)# no shut

Nx5548(config-if-range)# interface port-channel 10
Nx5548(config-if)# switchport mode trunk
Nx5548(config-if)# no shut
```

Figure 51 Cisco Nexus 5548 port channel configuration

Brocade Network OS 4.X

```
VDX(config)# interface TenGigabitEthernet 10/0/1-4
VDX(conf-if-te-10/0/1-4)# channel-group 128 mode active type standard
VDX(conf-if-te-10/0/1-4)# no shut

VDX(config)# interface Port-channel 128
VDX(config-Port-channel-128)# switchport
VDX(config-Port-channel-128)# switchport mode trunk
VDX(config-Port-channel-128)# no shut
```

Figure 52 Brocade VDX6730 port channel configuration

F.2 Configuration verification

When the port channel of the upstream switch has been properly configured, the port channel on the FN IOM comes up. A series of messages logged on the FN IOM indicate that port channel 128 is up and ports connected to the servers downstream have been brought up as well:

```
Changed interface state to up: Po 128

Downstream interface cleared from UFD error-disabled: Te 0/1
Downstream interface cleared from UFD error-disabled: Te 0/2
Downstream interface cleared from UFD error-disabled: Te 0/3
...etc.
```

Figure 53 Port channel 128 informational message

You may also run the following commands to verify the status:

```
Dell#show interfaces port-channel 128
Port-channel 128 is up, line protocol is up
```

Figure 54 Port channel 128 show command

```
Dell#shows uplink-state-group
Uplink State Group: 1 Status: Enabled, Up
```

Figure 55 Uplink state group show command

The **Blade I/O Manager** GUI has a View LAG Membership feature (Figure 56) that is equivalent to the CLI `show interfaces port-channel 128` command (Figure 54). This feature can be accessed by going to **Switching Layer-2 > View LAG Membership**. A healthy LAG can also be viewed from the main Switching Layer-2 page.

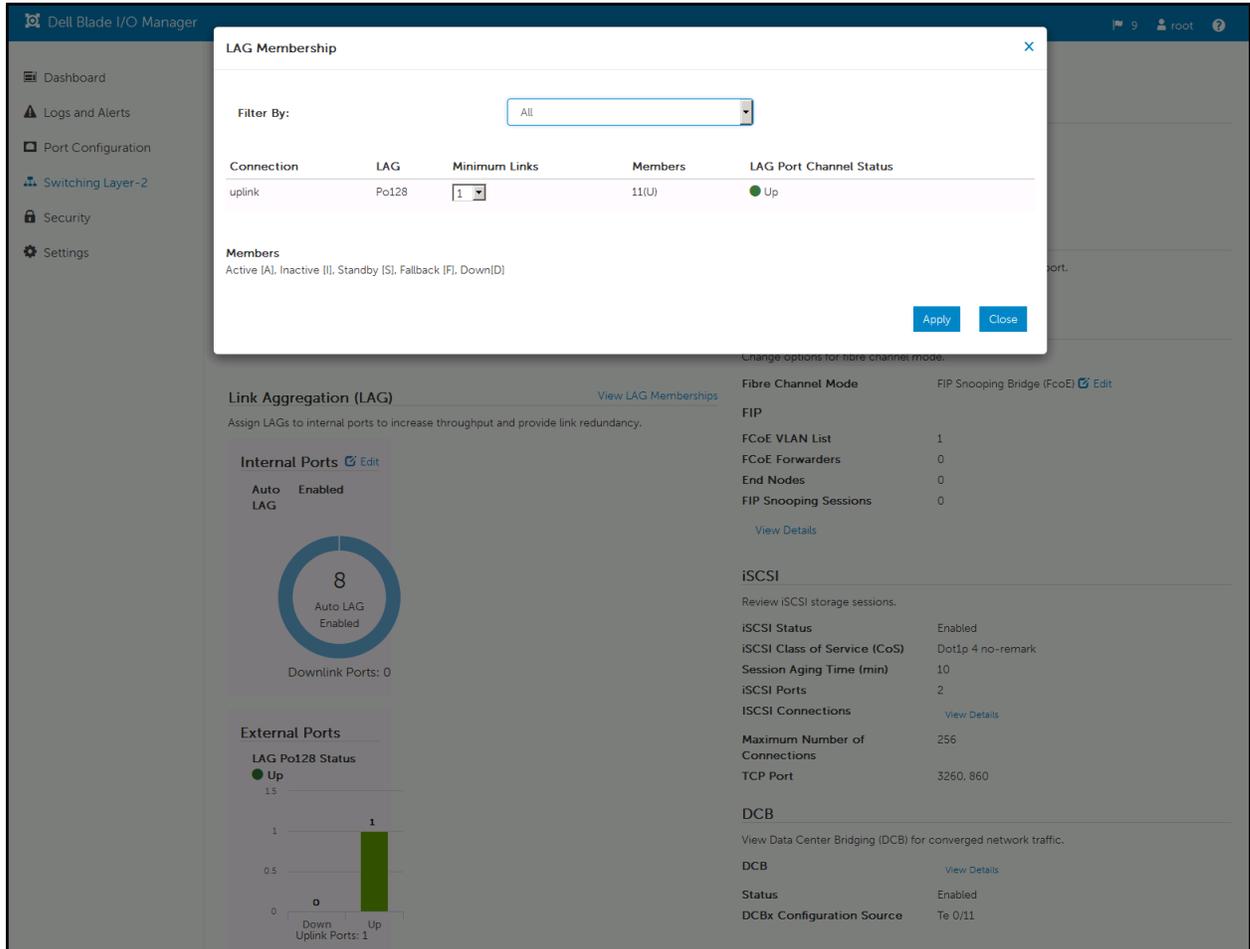


Figure 56 Dell Blade I/O Manager LAG membership

G Support and feedback

Contacting Technical Support

Support Contact Information

Web: <http://Support.Dell.com/>

Telephone: USA: 1-800-945-3355

Feedback for this document

We encourage readers of this publication to provide feedback on the quality and usefulness of this deployment guide by sending an email to Dell_Networking_Solutions@Dell.com

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