Abstract
This document describes HPE 57xx/59xx and 129xxE/79xx FlexFabric switches and 6125XLG/6127XLG blade switches usage in converged Ethernet and fibre channel storage network configurations. It provides information about 59xx, 129xxE/79xx, and 6125XLG/6127XLG switch products, features, and supported block storage configurations.
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This chapter describes the FlexFabric 57xx/59xx and 129xxE/79xx Series switch products and features. This includes the HPE Networking campus/branch access switches, 57xx/59xx series, typically used as Top-Of-Rack (ToR) or End-Of-Row switches (EoR), and the data center chassis switches, 129xxE and 79xx, typically used as spine switches in leaf-spine network topologies.

The 59xx series products described include the FlexFabric 5900CP, 5900AF (48XG-4QSFP+ and 48XGT-4QSFP+), and 5920AF. The 5930 series products described include the FlexFabric 5930 32-port fixed port switch and FlexFabric 5930 2-slot and 4-slot modular switches. The 5940 series products described include the FlexFabric 5940 48 and 32-port fixed port switch models, and the FlexFabric 5940 2-slot and 4-slot modular switches. The FlexFabric 5700 series products described include the 42 port switches (40XG-2QSFP+ and 32XGT-8XG-2QSFP+ models).

The 129xxE and 79xx series products described include all model variants of each series. FlexFabric 129xxE and FlexFabric 79xx Switch Series are the next generation modular data center chassis switches designed to support virtualized data centers and evolution needs of private and public clouds deployments.

For more information about all FlexFabric series switches, see the HPE Networking Campus/Branch LAN Access switch portfolio and the Data Center chassis switch portfolio.

### FlexFabric 5900CP switch Overview

The FlexFabric 5900CP switch is a multipurpose converged L2/L3 switch with 48 converged ports and four 40 GbE QSFP+ ports. This switch provides seamless integration of lossless 10GbE networks into server-edge environments and chassis environments through iSCSI, FCoE, DCB, Fibre Channel, and many other Ethernet network protocols. It is a full featured switch and a software license is not required. When coupled with the HPE StoreFabric converged optical transceiver, it provides wire-once capability for 10GbE/FCoE/iSCSI and 8 Gb or 4 Gb or 2 Gb Fibre Channel.

![FlexFabric 5900CP switch](image)

**Figure 1: FlexFabric 5900CP front (port) and rear (power) view**

The 59xx switch family is supported for use as standard Ethernet switches in HPE Networking Ethernet networks and as DCB Ethernet switches for converged environments with Ethernet/FCoE and iSCSI connectivity. It provides native Fibre Channel and FCoE full-featured connectivity and can be used as a gateway to other HPE Fibre Channel switch series fabrics using NPV (N_Port virtualization).

The 59xx family series members can be common members of an IRF (Intelligent Resilient Framework) domain to simplify management by combining multiple physical switches into one virtual switch. An IRF fabric appears as one node or virtual switch and is accessible as a single IP address on the network. You can use this IP address to log in at any member device to manage all the members of the IRF domain.

### Features and benefits

The FlexFabric 5900CP switch provides the following features:
• FCoE support on 10GbE converged ports and 40GbE ports
• Fibre Channel 8Gb/4Gb/2Gb support on any of the 48 converged ports
• DCB/QCN
• Forty-eight converged ports that can use a single transceiver which supports 10GbE/FCoE or 8Gb/4Gb Fibre Channel
• FCoE/FC FCF and NPV gateway support
• Dual-hop support with Virtual Connect blade switches and the HPE 6125XLG/6127XLG blade switches
• Multi-hop support using FCoE VE_Port (7 hops) or Fibre Channel E_Port (3 hops) (inter-switch links ISLs, utilizing Fibre Channel Virtual Fabric Tagging (VFT) and san-aggregation trunking)
• 5900 Series IRF support (up to nine switches per domain with Ethernet, two switches per domain with storage)
• iSCSI support; optional lossless support
• Front-to-back or back-to-front airflow
• Comware OS version 7
• No additional feature licenses. The following five switch modes are available:
  - **Standard**—Configurable DCB switch
  - **FCF**—FC/FCoE initiator; target; FlexFabric SAN switch; F, VF, VE, and E port connectivity (4K zones); FSPF
  - **NPV**—Gateway for FC/FCoE multi-vendor connectivity
  - **Transit**—FIP-snooping DCB aggregation switch
  - **FCF-NPV**—per VSAN configurable FCF or NPV mode
• 1.28 Tb/s switching capacity
• 952.32 Million PPS throughput, integrated 9 MB packet buffer
• 10GbE cut-through latency < 1.5 µs (64Byte packets)
• CLI, OneView, and iMC/VAN/VFM (Intelligent Management Center) fabric management
• HPE IIIAS (Intelligent Infrastructure Analyzer Software) support
• L2/L3, IPv4/IPv6 dual stack, TRILL, VEPA
• Cloud and SDN ready (OpenFlow 1.3.1 support)

**Figure 2: FlexFabric 5900CP components and ports** on page 8 describes the major components and the ports of the FlexFabric 5900CP switch. The front view shows the 48 converged ports and the four 40GbE ports.

The switch supports two pluggable fan trays and two AC power supplies for redundancy. Two options are available for fan trays, front-to-back airflow or back-to-front airflow.
FlexFabric 5900CP network architectures

The FlexFabric 5900CP switch can be utilized in the following environments:

- A traditional Ethernet network switch for Ethernet data
- A converged network switch in environments that support Ethernet and FCoE for storage data
- A native Fibre Channel fabric switch for storage data
- iSCSI configuration support (flow-control, DCB/tagged VLANs)

In a converged environment, the FlexFabric 5900CP switch is typically configured as a ToR switch connecting to a LAN and a SAN.

LAN connectivity is made through any of the 48 converged ports configured as 10GbE ports or the 40GbE ports for a total of up to 64 10GbE ports.

SAN connectivity is made through any of the 48 converged ports configured as 10/40GbE/FCoE ports or configured as 8/4/2 Gb Fibre Channel ports. When configured as FCoE ports, the converged ports support device connectivity (VF_Port) or switch connectivity using ISLs (VE_Ports) to other FlexFabric switches, the 6125XLG/6127XLG, or via NPV (VNP_Ports) to other HPE FCoE switches that support NPIV. When configured as Fibre Channel ports, the converged ports support device connectivity (F_Port) or switch connectivity via ISLs (E_Ports) to other 5930/5940 modular and 5900CP switches, or via NPV (NP_Ports) to other Fibre Channel switches that support NPIV. Fibre channel NP_Port and E-Port ISLs can utilize VFT of multiple VSANs and san-aggregation trunking.

HPE 5900AF Switch Overview

The 5900AF switch is a low-latency 1/10GbE data center top-of-rack (ToR) switch. The switch is ideal for deployment at server access layer in large and medium sized enterprises.

These switches may also be used in campus core/distribution layers where higher performance 40GbE connectivity is required with 10GbE links. Virtualized applications and server-to-server traffic require ToR switches that meet the needs for higher-performance server connectivity, convergence, virtual environment support, and low-latency.

The 5900AF switches members can be common members of an Intelligent Resilient Framework (IRF) domain to simplify management by combining multiple physical switches into one virtual switch. An IRF fabric appears as one node or virtual switch and is accessible as a single IP address on the network. You can use this IP address to log in at any member device to manage all the members of the IRF domain.
Features and benefits

The 5900AF switch provides the following features:

- FCoE support on 10GbE and 40GbE ports
- DCB/QCN
- FCoE NPV gateway support
- Dual-hop support with Virtual Connect blade switches and the 6125XLG/6127XLG blade switches
- Multi-hop support using FCoE VE_Port (7 hops) (ISLs, utilizing Fibre channel Virtual Fabric Tagging (VFT) and san-aggregation trunking)
- 5900AF IRF support (up to nine switches per domain with Ethernet, two switches per domain with storage)
- iSCSI support; optional lossless support
- Front-to-back or back-to-front airflow
- Comware OS version 7.1
- No additional feature licenses. The following five switch modes are available:
  - **Standard**—Configurable DCB switch
  - **FCF**—FCoE initiator; target; FlexFabric SAN switch; VF and VE port connectivity (4K zones); FSPF
  - **NPV**—Gateway for FCoE multi-vendor connectivity
  - **Transit**—FIP-snooping DCB aggregation switch
  - **FCF-NPV-per vsan** configurable FCF or NPV mode

- 1.28 Tb/s switching capacity
- 952.32 Million PPS throughput, integrated 9 MB packet buffer
- 10GbE cut-through latency < 1.5 μs (64Byte packets)
- CLI, OneView, and Intelligent Management Center (iMC/VAN/VFM) fabric management
- HPE Intelligent Infrastructure Analyzer Software (IIIAS) support
- L2/L3, IPv4/IPv6 dual stack, TRILL, VEPA
- Cloud and SDN ready (OpenFlow 1.3.1 support)

HPE 5900AF network architectures

The 5900AF switch can be utilized in the following environments:
• A traditional Ethernet network switch for Ethernet data
• A converged network switch in environments that support Ethernet and FCoE for storage data
• iSCSI configuration support (flow-control, DCB/tagged VLANs)
• In a converged environment, the 5900AF switch is typically configured as a ToR switch connecting to a LAN and a SAN
• LAN connectivity is made through any of the 48 ports configured as 10GbE ports or the 40GbE ports for a total of up to 64 10GbE ports
• SAN connectivity is made through any of the 52 ports configured as FCoE ports. When configured as FCoE ports, the ports support device connectivity (VF_Port) or switch connectivity (VE_Port) using ISLs to other FlexFabric switches, the 6125XLG/6127XLG, or via NPV (VNP_Ports) to other FCoE switches that support NPIV

FlexFabric 5930 32QSFP+ Switch Overview

The HPE 5930 32QSFP+ switch has 32 QSFP+ ports, dual hot-pluggable power supplies and fan trays, and ultra-low-latency. It is ideally suited for deployment at the spine and server access layer in large enterprise data centers.

![Figure 4: FlexFabric 5930/5940 32 Port switch](image)

Features and benefits

The FlexFabric 5930 32QSFP+ switch is available in a 1RU 32-port 40GbE QSFP+ form factor. 40GbE ports 5 through 28 may be split into four 10GbE ports each for a total of 96 10GbE ports with eight 40GbE Uplinks per switch.

The FlexFabric 5930 32QSFP+ switch provides the following features:

• FCoE support on 10GbE and 40GbE ports
• DCB/QCN
• Delivers up to 2.56 Tbps switching capacity for the most demanding applications
• Supports up to 1492 MPPS throughput for data-intensive environments
• Low latency, under a 1.5µs 10GbE latency, gives your business agility
• iSCSI support; optional lossless support
• VXLAN support for network virtualization and overlay solutions
• Delivers IRF <50 msec convergence time enabling faster application response time
• The In Service Software Update (ISSU) enables high availability with updates accomplished without a reboot or power cycle, in the background
• Simplifies switch management by up to 88% with 9 unit Intelligent Resilient Framework (IRF) (Ethernet only)
• All switch ports are active and ready to use without need for activation licenses
• Automate tedious tasks with a Software-defined Network (SDN) and reclaim wasted resources

**FlexFabric 5930 fixed port switch network architectures**

The FlexFabric 5930 switch can be utilized in the following environments:

• A traditional Ethernet network switch for Ethernet data
• A converged network switch in environments that support Ethernet and FCoE for storage data
• iSCSI configuration support (flow-control, DCB/tagged VLANs)
• In a converged environment, the FlexFabric 5930 switch is typically configured as an EoR switch connecting to ToR switches and a LAN and SAN
• LAN connectivity is made through any of the 32 ports configured as 10GbE ports or the 40GbE ports for a total of up to 48 10GbE ports
• SAN connectivity is made through any of the converged ports configured as 10/40GbE/FCoE ports. When configured as FCoE ports, the converged ports support device connectivity (VF_Port) or switch connectivity (VE_Port) using ISLs to other FlexFabric switches, the 6125XLG/6127XLG, or via NPV (VNP_Ports) to other FCoE switches that support NPIV

**FlexFabric 5930 4-slot Modular Switch and FlexFabric 5930 2QSFP+ 2-slot Modular Switch Overview**

**FlexFabric 5930 4-slot Modular Switch**


![Figure 5: FlexFabric 5930/5940 Modular 4-slot switch](image)

**Switch Features**

Ports:

(4) module slots

Hot swappable Modules available:

• HPE 5930 24-port SFP+ and 2-port QSFP+ Module JH180A
• HPE 5930 24-port SFP+ and 2-port QSFP+ with MACsec Module JH181A
• HPE 5930 24-port 10GBASE-T and 2-port QSFP+ with MACsec Module JH182A
• HPE 5930 24-port Converged Port and 2-port QSFP+ Module JH184A
• HPE 5930 8-port QSFP+ Module JH183A
• 5940 2-port QSFP+ and 2-port QSFP28 Module JH409A
• 5930 24-port 10Gbe SFP/SFP+ and 2-port 40Gbe QSFP+ Module JH689A
• 5930 24-port 10GBASE-T and 2-port 40Gbe QSFP+ MACsec Module JH690A

NOTE:
10GbE FCoE VE-ports and 10GbE link members of bridge-aggregated FCoE VE-ports secured by the device-oriented mode of Media Access Control Security (MACsec) are supported with the JH181A, JH690A, and JH182A modules. Device-oriented mode secures data transmission between switches. When configuring MACsec, cut-through switching mode must NOT be enabled. For details on configuring device-oriented MACsec, refer to the HPE FlexFabric 5930 Switch Series Security Command Reference at the HPE Support Centre website.

Latency:

10 Gbps Latency: < 1 µs

Throughput:

Up to 1429 Mpps

Routing/switching capacity:

• 2560 Gbps
• Fibre Channel 8Gb/4Gb/2Gb support on any of the 24 converged ports of the JH184A module
• FCoE support on 10GbE and 40GbE ports

Stacking capabilities:

• IRF with 9 switches (Ethernet), 2 switches (storage)
• CLI, OneView, and Intelligent Management Center (iMC/VAN/VFM) fabric management

**FlexFabric 5930 2QSFP+ 2-slot Modular switch**

The FlexFabric 5930 2QSFP+ 2-slot switch has two module slots, 2 QSFP+ ports, dual hot-pluggable power supplies and fan trays, and ultra-low-latency. Ideally suited for deployment at spine and server access layers in large enterprise data centers. For additional information about FlexFabric 5930 Modular switches, see http://www.hpe.com/networking/5930.

![Figure 6: FlexFabric 5930/5940 Modular 2-slot switch](image-url)
Switch Features

Ports:

- (2) module slots
- (2) QSFP+ 40GbE ports
- (2) QSFP+ 40GbE ports on chassis; each QSFP+ port operable as 4x10GbE.

Modules available:

- 5930 24-port SFP+ and 2-port QSFP+ Module JH180A
- 5930 24-port SFP+ and 2-port QSFP+ with MACsec Module JH181A
- 5930 24-port 10GBASE-T and 2-port QSFP+ with MACsec Module JH182A
- 5930 24-port Converged Port and 2-port QSFP+ Module JH184A
- 5930 8-port QSFP+ Module JH183A
- 5940 2-port QSFP+ and 2-port QSFP28 Module JH409A
- 5930 24-port 10GbE SFP/SFP+ and 2-port 40GbE QSFP+ Module JH689A
- 5930 24-port 10GBASE-T and 2-port 40GbE QSFP+ MACsec Module JH690A

**NOTE:**

10GbE FCoE VE-ports and 10GbE link members of bridge-aggregated FCoE VE-ports secured by the device-oriented mode of Media Access Control Security (MACsec) are supported with the JH181A, JH690A, and JH182A modules. Device-oriented mode secures data transmission between switches. For details on configuring device-oriented MACSEC, refer to the *HPE FlexFabric 5930 Switch Series Security Command Reference* at the [HPE Support Centre](https://www.hpe.com) Website.

Latency:

10 Gbps Latency: < 1 µs

Throughput:

Up to 1071 Mpps

Routing/switching capacity:

- 1440 Gbps
- Fibre Channel 8Gb/4Gb/2Gb support on any of the 24 converged ports of the JH184A module
- FCoE support on 10/40/100GbE ports

Stacking capabilities:

- IRF with 9 switches, 2 switches (storage)
- CLI, OneView, and Intelligent Management Center (iMC/VAN/VFM) fabric management
FlexFabric 5930 Modular 2-slot and 4-slot switch network architectures

The FlexFabric 5930 Modular 2-slot and 4-slot switches can be utilized in the following environments:

- A traditional Ethernet network switch for Ethernet data
- A converged network switch in environments that support Ethernet, DCB, and FCoE for storage data
- iSCSI configuration support (pause or PFC flow-control, DCB, and tagged VLANs)
- A native Fibre Channel fabric switch for storage data
- In a converged environment, the FlexFabric 5930 Modular switch is typically configured as a EoR switch connecting to ToR switches and a LAN and SAN
- LAN connectivity is made through any of the converged ports configured as 10GbE ports or Through the 40GbE ports
- SAN connectivity is made through any of the converged ports configured as FCoE ports or configured as 8/4/2 Gb Fibre Channel ports. When configured as FCoE ports, the converged ports support device connectivity (VF_Port) or switch connectivity (VE_Port) using ISLs to other FlexFabric switches, the 6125X1G/6127X1G, or via NPV (VNP_Ports) to other FCoE switches that support NPIV. When configured as Fibre Channel ports, the converged ports support device connectivity (F_Port) or switch connectivity via ISLs (E_Ports) to other 5930/5940 Modular switches, 5900CP switches, or via NPV (NP_Ports) to other Fibre Channel switches that support NPIV
- Fibre channel NP_Port and E-Port ISLs can utilize VFT of multiple VSANs and san-aggregation trunking

FlexFabric 5940 32-port and 48-port fixed port switches

Overview

The FlexFabric 5940 Switch Series is a family of high performance and low-latency 10/40/100GbE top-of-rack (ToR) data center switches. The switch series also includes 100G uplink technology and a 2-slot and 4-slot modular form factor providing ultimate flexibility for an ever-changing Data Center requirements. This entire series is part of the Hewlett Packard Enterprise FlexFabric data center solution, which is a cornerstone of the FlexNetwork architecture.

The 5 models included in the FlexFabric 5940 fixed port Switch Series are ideally suited for deployment at the aggregation or server access layer of large enterprise data centers, or at the core layer of medium-sized enterprises.

With the increase pace of deploying virtualized applications, adopting software-defined networking, and the server-to-server traffic, many data centers now require spine and ToR switch innovations that will meet their requirements. The FlexFabric 5940 is optimized to meet the increasing requirements for higher-performance server connectivity, convergence of Ethernet and storage traffic, the capability to handle virtual environments, and low-latency.

Features and benefits

Quality of Service (QoS)

- Flexible queue scheduling-including Strict Priority (SP), WRR, WDRR, WFQ, SP+WRR, SP+WDRR, SP +WFQ,
- Configurable Buffer, Time range, Queue Shaping, CAR with 8kbps granularity.
- Packet filtering and remarking-Packet filtering at L2 (Layer 2) through L4 (Layer 4); flow classification based on source MAC address, destination MAC address, source IP (IPv4/IPv6) address, destination IP
(IPv4/IPv6) address, port, protocol, and VLAN. provides nonblocking, lossless Clos architecture with VOQs and large buffers with the flexibility and scalability for future growth

Data center optimized

- Flexible high port density-

5940 switch enables customers to scale their server-edge 10/40/100 GbE ToR deployments to new heights with highdensity 48 x 10 GbE ports with 6 ports of 40GbE, 48 x 10 GbE ports with 6 ports of 100GbE and 32 x 40 GbE delivered in a 1RU design; the 5940 32 ports of 40GbE switch can also be configured as a 72 x 10 GbE port device by using a 40GbE-to-10GbE break-out cable that turns each 40 GbE port into four 10-GbE ports. The 48 ports models comes in SFP+ or XGT supporting 10GBASE-T, and support for QSFP+ or QSFP28

- High-performance switching-

Cut-through and non-blocking architecture delivers low latency (~1 microsecond for 10GbE) for very demanding enterprise applications; the switch delivers high-performance switching capacity and wire-speed packet forwarding

- Higher scalability-

Hewlett Packard Enterprise Intelligent Resilient Fabric (IRF) technology simplifies the architecture of server access networks; up to nine HPE 5940 switches can be combined to deliver unmatched scalability of virtualized access layer switches and flatter two-tier networks using IRF, which reduces cost and complexity

- Advanced modular operating system-

Comware v7 software's modular design and multiple processes bring native high stability, independent process monitoring, and restart; the OS also allows individual software modules to be upgraded for higher availability and supports enhanced serviceability functions like hitless software upgrades

- Reversible airflow-

Enhanced for data center hot-cold aisle deployment with reversible airflow-for either front-to-back or back-to-front airflow

- Redundant fans and power supplies-

Internal redundant and hot-pluggable power supplies and dual fan trays enhance reliability and availability

- Lower OPEX and greener data center-

Provides reversible airflow and advanced chassis power management

- Data Center Bridging (DCB) protocols-

Provides support for IEEE 802.1Qbb Priority Flow Control (PFC), Data Center Bridging Exchange (DCBX), IEEE 802.1Qaz Enhanced Transmission Selection (ETS), Explicit Congestion Notification (ECN) for converged FCoE, iSCSI and RoCE environments

- FCoE support-

Provides support for T11 standards-compliant FC-BB-5 Fibre Channel over Ethernet (FCoE), including FCoE initialization protocol (FIP), FCP, Fiber Channel enhanced port types VE, TE and VF, NPV, NPIV, fabric name server, RSCN, login services, and name-server zoning, per- VSAN fabric services, FSPF, standard zoning and fiber channel ping
• Jumbo frames-
  With frame sizes of up to 10,000 bytes on Gigabit Ethernet and 10-Gigabit ports, allows high-performance remote backup and disaster-recovery services to be enabled

• VXLAN hardware support-
  VXLAN Layer 2 and Layer 3 gateway support for up to 4k tunnels

• Dynamic VXLAN configuration-
  OVSDB & ML2 support for dynamic VXLAN configuration

• EVPN-
  Control plane protocol for VXLAN based on industry standards. It enables Layer-2 and Layer-3 control-plane learning of end-host reachability information, enabling organizations to scale their VXLAN infrastructure better. Integration with Openstack Neutron plugin for overlay automation/orchestration

FlexFabric 5940 fixed port switch network architectures

The FlexFabric 5940 fixed port switches can be utilized in the following environments:

• A traditional Ethernet network switch for Ethernet data
• A converged network switch in environments that support Ethernet and FCoE for storage data
• iSCSI configuration support (flow-control, DCB/tagged VLANs)
• In a converged environment, the FlexFabric 5940 switch is typically configured as an EoR switch connecting to ToR switches and a LAN and SAN
• LAN connectivity is made through any of the ports configured as 10/40/100GbE ports
• SAN connectivity is made through any of the converged ports configured as 10/40/100GbE/FCoE ports.

When configured as FCoE ports, the converged ports support device connectivity (VF_Port) or switch connectivity (VE_Port) using ISLs to other FlexFabric switches, the 6125XLG/6127XLG, or via NPV (VNP_Ports) to other FCoE switches that support NPIV.

FlexFabric 5940 4-slot Modular Switch and FlexFabric 5940 2-slot Modular Switch Overview

FlexFabric 5940 4-slot Modular Switch


Switch Features

Ports:
• (4) module slots
• (2) QSFP+ 40GbE ports on chassis; each QSFP+ port operable as 4x10GbE

Hot swappable Modules available:

• HPE 5930 24-port SFP+ and 2-port QSFP+ Module JH180A
• HPE 5930 24-port SFP+ and 2-port QSFP+ with MACsec Module JH181A
• HPE 5930 24-port 10GBASE-T and 2-port QSFP+ with MACsec Module JH182A
• HPE 5930 8-port QSFP+ Module JH183A
• HPE 5930 24-port Converged Port and 2-port QSFP+ Module JH184A
• HPE 5940 2-port QSFP+ and 2-port QSFP28 Module JH409A
• HPE 5930 24-port 10Gbe SFP/SFP+ and 2-port 40Gbe QSFP+ Module JH689A
• HPE 5930 24-port 10GBASE-T and 2-port 40Gbe QSFP+ MACsec Module JH690A

NOTE:
10GbE FCoE VE-ports and 10GbE link members of bridge-aggregated FCoE VE-ports secured by the device-oriented mode of Media Access Control Security (MACsec) are supported with the JH181A, JH690A, and JH182A modules. Device-oriented mode secures data transmission between switches.

When configuring MACsec, cut-through switching mode must NOT be enabled. For details on configuring device-oriented MACsec, see the HPE FlexFabric 5930 Switch Series Security Command Reference at the HPE Support Centre website.

Latency:
10 Gbps Latency: < 1 μs

Throughput:
Up to 1429 Mbps

Routing/switching capacity:

• 2560 Gbps
• Fibre Channel 8Gb/4Gb/2Gb support on any of the 24 converged ports of the JH184A module
• FCoE support on 10GbE, 40GbE, and 100GbE ports

Stacking capabilities: FlexFabric 5940 4-slot Modular Switch and FlexFabric 5940 2QSFP+ 2-slot Modular Switch

• IRF with 9 switches (Ethernet), 2 switches (storage)
• CLI, OneView, and Intelligent Management Center (iMC/VAN/VFM) fabric management

**FlexFabric 5940 2-slot Modular switch**

The FlexFabric 5940 2QSFP+ 2-slot switch has two module slots, 2 QSFP+ ports, dual hotpluggable power supplies and fan trays, and ultra-low-latency. Ideally suited for deployment at spine and server access layers

### Switch Features

**Ports:**

- (2) module slots
- (2) QSFP+ 40GbE ports on chassis; each QSFP+ port operable as 4x10GbE

**Hot swappable Modules available:**

- HPE 5930 24-port SFP+ and 2-port QSFP+ Module JH180A
- HPE 5930 24-port SFP+ and 2-port QSFP+ with MACsec Module JH181A
- HPE 5930 24-port 10GBASE-T and 2-port QSFP+ with MACsec Module JH182A
- HPE 5930 8-port QSFP+ Module JH183A
- HPE 5930 24-port Converged Port and 2-port QSFP+ Module JH184A
- HPE 5930 2-port QSFP+ and 2-port QSFP28 Module JH409A
- HPE 5930 24-port 10Gbe SFP/SFP+ and 2-port 40Gbe QSFP+ Module JH689A
- HPE 5930 24-port 10GBASE-T and 2-port 40Gbe QSFP+ MACsec Module JH690A

**NOTE:**


**Latency:**

10 Gbps Latency: < 1 μs

**Throughput:**

Up to 1071 Mbps

**Routing/switching capacity:**

- 1440 Gbps
- Fibre Channel 8Gb/4Gb/2Gb support on any of the 24 converged ports of the JH184A module
- FCoE support on 10GbE, 40GbE, and 100GbE ports

**Stacking capabilities:**
• IRF with 9 switches (Ethernet), 2 switches (storage)
• CLI, OneView, and Intelligent Management Center (iMC/VAN/VFM) fabric management

**FlexFabric 5940 Modular 4-slot and 2-slot switch network Architectures**

The FlexFabric 5940 Modular 4-slot and 2-slot switches can be utilized in the following environments:

- A traditional Ethernet network switch for Ethernet data
- A converged network switch in environments that support Ethernet, DCB, and FCoE for storage data
- iSCSI configuration support (pause or PFC flow-control, DCB, and tagged VLANs)
- A native Fibre Channel fabric switch for storage data
- In a converged environment, the FlexFabric 5940 Modular switch is typically configured as a EoR switch connecting to ToR switches and a LAN and SAN
- LAN connectivity is made through any of the converged ports configured as 10GbE ports or through the 40/100GbE ports
- SAN connectivity is made through any of the converged ports configured as 10/40/100GbE/FCoE ports or configured as 8/4/2 Gb Fibre Channel ports. When configured as FCoE ports, the converged ports support device connectivity (VF_Port) or switch connectivity (VE_Port) using ISLs to other FlexFabric switches, the 6125XLG/6127XLG, or via NPV (VNP_Ports) to other FCoE switches that support NPIV. When configured as Fibre Channel ports, the converged ports support device connectivity (F_Port) or switch connectivity via ISLs (E_Ports) to other 5940 or 5930 Modular switches, 5900CP switches, or via NPV (NP_Ports) to other Fibre Channel switches that support NPIV
- Fibre channel NP_Port and E-Port ISLs can utilize VFT of multiple VSANs and san-aggregation trunking

**FlexFabric 5700 Switch Overview**

The FlexFabric 5700 Switch Series is a family of cost-effective, high-density, ultra-low-latency, top-of-rack (ToR) switches. They are ideally suited for deployment at the server access layer of large enterprise data centers.

The FlexFabric 57xx switch series includes the following models:

**5700-40XG-2QSFP+ (JG896A) 42 Port Switch**—It comes with 40x fixed 1000 / 10000 Mb/s SFP+ ports, and 2x QSFP+ for 40-GbE ports, which can optionally be split to 4x10Gbe ports.

**5700-48G-4XG-2QSFP+ (JG894A) 54 Port Switch**—It comes with 48x 10/100/1000 Mb/s ports, 4x fixed 1000 / 10000 Mb/s SFP+ ports, and 2x QSFP+ for 40-GbE ports, which can optionally be split to 4x10Gbe ports.
NOTE:
FCoE is supported over 10GbE and 40GbE links, and iSCSI over 1GbE and 10GbE links is supported.

5700-32XGT-8XG-2QSFP+ (JG898A) 42 Port Switch—It comes with 32x RJ-45 10GBASE-T ports, 8x fixed 1000 / 10000 Mb/s SFP+ ports, and 2x QSFP+ for 40-GbE ports, which can optionally be split to 4x10GbE ports.

Figure 7: FlexFabric 5700-48G-4XG-2QSFP+ switch

Features and Benefits

The FlexFabric 57xx switch series products provides the following features:

- FCoE support on 10GbE and 40GbE ports
- Cut-through with ultra-low-latency and wire speed
- HPE Intelligent Resilient Framework (IRF) for virtualization and two-tier architecture
- High 1GbE/10GbE ToR port density with 10 GbE and 40 GbE uplinks
- Layer-2 and Light Layer-3 Features with Static Routing and RIP
- Convergence ready with DCB/QCN, FCoE, and TRILL
- iSCSI support; optional DCB lossless support
- CLI, OneView, and Intelligent Management Center (iMC/VAN/VFM) fabric management
- IPv6 Host / Management
- IPv6 Routing
- OpenFlow (SDN)
- Redundant Power
- Replaceable Fans
- Stacking
- Fibre Channel over Ethernet (FCoE)
- OpenFlow now - v1.3.1

FlexFabric 57xx Series Network Architectures

The FlexFabric 57xx Switch series products can be utilized in the following environments:

- A traditional Ethernet network switch for Ethernet data
- A converged network switch in environments that support Ethernet and FCoE for storage data
• iSCSI configuration support (flow-control, DCB/tagged VLANs)
• In a converged environment, the FlexFabric 57xx switch is typically configured as a ToR switch connecting to a LAN and a SAN
• LAN connectivity is made through any of the ports configured as 10GbE ports or the 40GbE ports
• SAN connectivity is made through any of the ports configured as FCoE ports. When configured as FCoE ports, the ports support device connectivity (VF_Port) or switch connectivity (VE_Port) using ISLs to other FlexFabric switches, or the 6125XLG/6127XLG.

FlexFabric 129xxE Switch Series Overview

The FlexFabric 129xxE Switch Series is a next-generation modular data center chassis switch designed to support virtualized data centers and the evolving needs of private and public cloud deployments. It delivers unprecedented levels of performance, buffering, scale, and availability with high density 10GbE, 40GbE and 100GbE connectivity.

The Switch Series includes 4-, 8-, 10- and 16-slot chassis. Ready for software-defined networking (SDN), FlexFabric 129xxE switches support full Layer 2 and 3 features and advanced data center features to build resilient scalable fabric and achieve convergence

![HPE 129xxE switch](image)

Figure 8: HPE 129xxE switch

Features and Benefits

Product architecture

• Modern scalable system architecture
• Distributed architecture with separation of data and control planes
• Advanced Comware modular operating system
• In-Service Software Upgrade (ISSU)
• Multitenant Device Context (MDC)

Performance
• High-performance fully distributed architecture delivers up to 184 Tbps switching capacity and 92.1 Bpps throughput with non-blocking wire speed performance

• High-density 1GbE/10GbE and 40GbE interface connectivity offers up to 16 interface module slots to scale up to 768 1GbE/10GbE, 768 40GbE ports and 576 100GbE ports

• Distributed scalable fabric architecture offers up to six fabric modules to deliver more than 2 Tb per slot bandwidth

Data center optimized

• Virtual Extensible LAN (VxLAN)
• Scalable Layer 2 fabrics
• HPE Ethernet Virtual Interconnect (EVI)
• Edge Virtual Bridging (EVB) with Virtual Ethernet Port Aggregator (VEPA)
• Data Center Bridging (DCB) protocols
• Fibre Channel over Ethernet (FCoE) features deliver support for FCoE, including expansion, fabric, trunk VF and N ports, and aggregation of E-port and N-port virtualization
• Front-to-back airflow design accommodates deployment in data centers utilizing hot-cold aisles

Intelligent Resilient Fabric (IRF)

• Redundant/load-sharing fabrics, management, fan assemblies, and power supplies
• Hot-swappable modules
• Graceful restart
• Virtual Router Redundancy Protocol (VRRP)
• Device Link Detection Protocol (DLDP)
• Hitless patch upgrades
• IEEE 802.3ad Link Aggregation Control Protocol (LACP)
• Passive design system

**FlexFabric 129xxE Series Network Architectures**

The FlexFabric 129xxE switches can be utilized in the following environments:

• A traditional Ethernet network switch for Ethernet data
• A converged network switch in environments that support Ethernet and FCoE for storage data
• iSCSI configuration support (flow-control, DCB/tagged VLANs)

  ◦ High-density 1/10GbE, 40GbE and 100GbE interface connectivity
  ◦ LAN connectivity is made through any of the Ethernet ports configured as 1GbE, 10GbE, 40GbE, or 100GbE
SAN connectivity is made through any of the ports configured as FCoE ports.

- When configured as FCoE ports, the 129xxE supports device connectivity (VF_Port) to storage or switch connectivity using ISLs (VE_Ports) to other FlexFabric switches.

**FlexFabric 79xx Switch Overview**

FlexFabric 79xx Modular Chassis Switch is a compact modular data center chassis switch supporting virtualized data centers and evolutionary needs of private and public clouds deployments. Delivering unprecedented levels of performance, buffering, scale, and availability with high density 10GbE, 40GbE and 100GbE interfaces, using only a fraction of the footprint used by traditional chassis.

The switch supports full Layer 2 and 3 features, including advanced features such as TRILL and Intelligent Resilient Fabric (IRF), which enable scale-out, two-tier leaf-spine architecture.

![Image of FlexFabric 7904 and 7910 switch models](image)

**Figure 9: HPE 7904 and 7910 switch models**

**Features and Benefits**

- Compact Modular Data Center chassis Switch
- The FlexFabric 79xx Modular chassis Switch supports virtualized data centers and public and private clouds deployments.
- Supports scale-out, two-tier leaf-spine architectures with greater reliability.
- Delivers unprecedented levels of performance at lower cost
- The FlexFabric 79xx Modular chassis Switch provides high density Ethernet interfaces in a smaller footprint than a traditional modular chassis.
- Combines the investment protection and flexibility of a chassis – but in a smaller footprint and at a lower entry price.
- Includes feature rich HPE Comware capabilities and simplified zero cost/complexity licensing.
- Enables a Simplified, Automated Software-Defined Networking (SDN) Fabric
- With the FlexFabric 79xx Modular chassis Switch you get large Layer 2 scaling with TRILL and HPE IRF.
- Federates FlexFabric infrastructure with VMware NSX virtual overlay.
- Supports VXLAN and OpenFlow 1.3.
- Supports open, standards based programmability – SDN App Store and SDK.

**FlexFabric 79xx Series Network Architectures**

The FlexFabric 79xx switch can be utilized in the following environments:
- A traditional Ethernet network switch for Ethernet data
- A converged network switch in environments that support Ethernet and FCoE for storage data
- iSCSI configuration support (flow-control, DCB/tagged VLANs)
  - High-density 1/10GbE, 40GbE and 100GbE interface connectivity
  - Supports a maximum of (120) 40GbE ports or (480) 10GbE ports or (240) 1/10GbE ports, or a combination
  - LAN connectivity is made through any of the Ethernet ports configured as 1GbE, 10GbE, 40GbE, or 100GbE
  - SAN connectivity is made through any of the ports configured as FCoE ports.
  - When configured as FCoE ports, the 79xx supports device connectivity (VF_Port) to storage or switch connectivity using ISLs (VE_Ports) to other FlexFabric switches.

**HPE 6127XLG blade switch Overview**

The HPE 6127XLG Switch is designed to support virtualized server environments with bandwidth of 20Gb to each and every server, while providing a mix of 40Gb and 10Gb links (with an aggregate of 240Gb) to the core network. Combined with hardware support for VXLAN encapsulation, this provides the ideal switch for Private/Public/Hybrid Cloud applications. The HPE 6127XLG also provides a converged fabric solution that supports Ethernet, iSCSI, Fibre Channel over Ethernet (FCoE), and Fibre Channel Forwarder (FCF) protocols that enables connectivity for multiple storage topologies. The HPE 6127XLG supports the HPE Software-defined Network (SDN) ecosystem that delivers simple, open, and Enterprise ready benefits to automate the data center network. With support for IETF industry standard TRILL (Transparent Interconnection of Lots of Links) and SPB (Shortest Path Bridging), the HPE 6127XLG delivers loop free large Layer 2 networks with multi-path support. Using Hewlett Packard Enterprise’s Intelligent Resilient Framework, (IRF) multiple switches can be virtualized and managed as a single entity with Hewlett Packard Enterprise’s Intelligent Management Center (IMC). A full complement of Layer 2/3 protocols and the latest in network security features are available in this blade switch.

**Features and Benefits**

The HPE 6127XLG Ethernet blade switch is a fully-featured enterprise-class switch, providing:

- Up to 20GbE of bandwidth available for each of sixteen server ports, increasing customer flexibility.
- Latest ASIC technology supports VXLAN, NGVRE encapsulation and the switching matrix is non-blocking.
- 40GbE and 10GbE uplinks for 240Gb of aggregate bandwidth to the network.
- Simplified management with HPE Intelligent Management Center (IMC) Software.
- Comware 7 and IRF II allows for a stackable domain of up to eight switches. An entire rack can be managed as part of a single domain.
- iSCSI configuration support on 10GbE and 40GbE ports (pause or PFC flow-control, DCB lossless, and tagged VLANs)
- FCoE support on 10GbE and 40GbE ports

For additional features and benefits, see the HPE 6127XLG quickspec, available under BladeSystem Interconnects at:
HPE 6127XLG blade switch Network Architectures

The HPE 6127XLG Ethernet blade switch:

- Supports Ethernet, iSCSI, Fibre Channel over Ethernet (FCoE), and Fibre Channel Forwarder (FCF) protocols—which is ideal for a Converged Infrastructure (CI) environment.
- Supports Software-defined Networking (SDN) deployment to provide an end-to-end solution to automate the network from edge to core. Compatible with HPE Networking’s Virtual Application Network (VAN) controller.
- Transparent Interconnection of Lots of Links (TRILL) and Shortest Path Bridging (SPB) provides Layer 2 multipath providing active-active links, enables faster convergence times, and increases network bandwidth.

HPE 6125XLG blade switch Overview

The HPE 6125XLG Ethernet blade switch from HPE Networking is built with the enterprise data center in mind. The HPE 6125XLG is based on HPE Comware v7 network operating system, which delivers enterprise grade resiliency. The 6125XLG is designed for data center convergence with full support for IEEE Data Center Bridging (DCB) for lossless Ethernet, and Fibre Channel over Ethernet (FCoE) protocols. The Fibre Channel Forwarder (FCF) feature allows 3PAR StoreServ arrays to be directly attached to the HPE 6125XLG switch through FCoE ports. The HPE 6125XLG supports HPE Software-defined Network (SDN) ecosystem that delivers simple, open, and Enterprise ready benefits to automate the data center network. With support for IETF industry standard TRILL (Transparent Interconnection of Lots of Links) and SPB (Shortest Path Bridging), the HPE 6125XLG delivers loop free large Layer 2 networks with multi-path support. With the HPE Intelligent Resilient Framework (IRF) multiple switches can be virtualized and managed as a single entity with the HPE Intelligent Management Center (IMC). The HPE 6125XLG is the industry’s first blade switch with VEPA (Virtual Ethernet Port Aggregation) support, enabling customers to unify the management of their physical and virtual networks. Combine these features with Virtual Application Network (VAN) and your data center provides the benefits of versatility of a true Virtualized Network. HPE 6125XLG Ethernet blade switch provides flexibility, versatility, and resiliency making it the optimal choice for any blade switching environment.

Features and Benefits

The HPE 6125XLG Ethernet blade switch is a fully-featured enterprise-class switch, providing:

- A converged fabric solution that simplifies management and helps reduce Capex and Opex for data center environments
- Intelligent Resilient Framework (IRF), improves the performance and resiliency of the network while simplifying network deployment and management
- High-performance 10/40 GbE switch capabilities for applications requiring 40 GbE connectivity to aggregation/core switch
- OpenFlow programmatic access to the data plane by forwarding abstraction and a wire protocol that is used to communicate with an SDN controller.
- In-Service Software Upgrade (ISSU) for fast software upgrades which eliminates downtime during the upgrade process of the IRF member switch.
- iSCSI configuration support on 10GbE and 40GbE ports (pause or PFC flow-control, DCB lossless, and tagged VLANs)
- FCoE support on 10GbE and 40GbE ports
HPE 6125XLG blade switch Network Architectures

• High-performance and Low-latency 10/40 Gb Ethernet blade switch
  ◦ HPE 6125XLG Ethernet blade switch is an advanced L2/L3 networking switch for applications and virtualized environments requiring 40 GbE connectivity to access/core switches.
  ◦ Intelligent Resilient Framework (IRF) improves the performance and resiliency of the network while simplifying network deployment and management.

• HPE 6125XLG Enables a Cost Effective and Converged Solution
  ◦ HPE 6125XLG Ethernet blade switch provides simplified management with HPE Intelligent Management Center (IMC) and seamless IRF with HPN switches to help reduce Capex and Opex for data center environments.
  ◦ With Ethernet, Fibre Channel over Ethernet (FCoE), and Fibre Channel Forwarder (FCF) support, delivers robust connectivity to FCoE storage platforms in converged fabric infrastructures.

• HPE 6125XLG supports advanced L2/L3 features
  ◦ HPE 6125XLG supports Software-defined Networking (SDN) to provide an end-to-end solution to automate the network from data center to campus and branch
  ◦ Transparent Interconnection of Lots of Links (TRILL) and Shortest Path Bridging (SPB) provides Layer 2 multipath providing active-active links, enables faster convergence times, and increases network bandwidth.
Port types and switch modes

To support LAN and SAN environments, the FlexFabric 57xx/59xx and 129xxE/79xx switches and the blade 6125XLG/6127XLG blade switches utilize standard or advanced system-working-mode. SAN environments utilizing FCoE and FC require use of the advanced system-working-mode. FCoE ports are configurable on all FlexFabric and 6125XLG/6127XLG switches operated in advanced system-working-mode. FC and FCoE ports are configurable on the 5900CP and the JH184 24 port CP plugin to the 5930/5940 modular 2-slot and 4-slot chassis. FCF, NPV, FCF-NPV, and transit switch FCoE-modes are configurable on all FlexFabric and 6125XLG/6127XLG blade switches.

Port types

FlexFabric and blade 6125XLG/6127XLG switches support multiple port types. Table 1 lists the port types supported.

### Table 1: FlexFabric and blade 6125XLG/6127XLG switch port types

<table>
<thead>
<tr>
<th>Ethernet Port Types</th>
<th>FCoE Port Types</th>
<th>FC Port Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>access, trunk, and hybrid bridge ports used for Ethernet data</td>
<td>• VF_Port: Virtual F_Port (FCoE switch to FCoE target/initiator)</td>
<td>• F_Port: Fabric port (switch to FC target/initiator)</td>
</tr>
<tr>
<td></td>
<td>• VE_Port: Virtual E_Port (FCoE switch to FCoE switch)</td>
<td>• E_Port: Expansion port (switch to switch ISL)</td>
</tr>
<tr>
<td></td>
<td>• VNP_Port: FCoE NPV switch port (FCoE switch to FCoE switch as a proxy)</td>
<td>• NP_Port: NPV switch port (FC switch to FC switch as a proxy)</td>
</tr>
</tbody>
</table>

Switch modes

FlexFabric and blade 6125XLG/6127XLG switches support five operating modes. Standard mode is the default mode, and is an Ethernet only mode. FCF, NPV, FCF-NPV, and Transit modes are advanced modes.

1. **Standard (Non-FCoE) Mode**—When a switch operates in this mode, it is a standard DCB/Ethernet switch and does not provide FCoE/FC capabilities

   **Ethernet connectivity**

   • Ethernet data port types: access, trunk, and hybrid)

2. **FCF (Fibre Channel Forwarder)**—When a switch operates in this mode, it is called as an FCF switch. In this mode FCoE and FC ports (on the 5900CP and JH184 plugin) may be configured.
Ethernet connectivity

- Ethernet data port types: access, trunk, and hybrid

Fibre Channel (Only supported on 5930 CP based I/O module and 5900CP switch)

- F_Port to an N_Port on a node
- An (NPIV) F_Port to an NP_Port on an NPV switch or module
- E_Port to an E_Port on another 5900CP or JH184 plugin to a 5930/5940 Modular FCF switch.

FCoE

- VF_Port to a VN_Port on a node
- A (NPIV) VF_Port to a VNP_Port on an NPV switch or module
- VE_Port to the VE_Port on another FlexFabric or blade 6125XLG/6127XLG FCF mode switch

If the primary mode of the FlexFabric 5900CP or FlexFabric 5930/5940 modular with CP plugin is set to FCF, the converged ports can be set to F_Port or E_Port, but cannot be set to NP_Port. FlexFabric and 6125XLG/6127XLG switch FCoE ports can be set to VF_Port or VE_PORT, but cannot be set to VNP_Port.

3. NPV/Gateway Mode—When a switch operates in this mode, it is called as an NPV (N_Port Virtualizer) switch. In this mode, the following converged port connections are available:

Ethernet connectivity

- 10GbE/40GbE ports for Ethernet data (access/tagged-trunk)

Fibre Channel

- F_Port to an N_Port on a node
- NP_Port to an F_Port on an FCF (NPIV) switch
- An (NPIV) F_Port to an NP_Port on an NPV switch or module

FCoE

- VF_Port to a VN_Port on a node
- VNP_Port to a VF_Port on an FCF (NPIV) switch
- A (NPIV) VF_Port to a VNP_Port on an NPV switch or module

If the primary mode of the FlexFabric 5900CP or FlexFabric 5930/5940 Modular switches is set to NPV, the converged ports can be set to F_Port or NP_Port, but cannot be set to E_Port. For FCoE, the 5700, 5900, and 5930/5940 modular ports can be set to VF_Port or VNP_Port, but cannot be set to VE_Port.

4. Transit Mode—When a switch operates in this mode, it is called as a Transit switch. A switch operating in this mode can restrict its Ethernet interface only to receiving traffic from an eNode or FCF switch. This is achieved by configuring the interface to operate in eNode mode or FCF mode. Fibre Channel is not supported in this mode. When a switch is configured in Transit mode, it always enables FIP snooping. VF_Port traffic is allowed, however, VE_Port traffic is blocked.
NOTE:

After changing to any one of the advanced modes and saving the configuration, you must reboot the
switch, configure the fcoe-mode, and then implement the port configurations.

<HP>system-working-mode {advance standard}
<HP>fcoe-mode {fcf-npv transit}
[confirmation]
[mode changed]
<HP>save
<HP>reboot

5. FCF-NPV Mode—When the switch operates in this mode, each VSAN can be configured to operate in
NPV or FCF mode. This mode enables a single switch to provide SAN connectivity to servers and storage
and also a gateway to another SAN.
Storage use-cases

The FlexFabric 57xx/59xx and 129xxE/79xx switches support several converged Ethernet/FCoE and the 5900CP and 5930/5940 Modular switches support several Fibre Channel storage configurations. To simplify understanding and implementation of these configurations, a set of use-case topology designs are defined. The use-cases describe recommended ways to deploy the switches, switch modes, and port types in different server-storage deployment scenarios. Some of the use-cases show multiple types of connectivity within the same configuration. This is meant to show the different connection options available. Your implementation may use one or more of these options, but not necessarily all as shown.

Hewlett Packard Enterprise recommends all storage configurations implement dual-redundant fabrics for high availability. All FlexFabric 57xx/59xx and 129xxE/79xx use-cases for storage described here implement dual-redundant fabrics for high availability.

NOTE:
The IRF feature of the FlexFabric 57xx/59xx and 129xxE/79xx switches can be implemented in dual-redundant fabric designs with storage, but has implications that must be considered. For more information about using IRF in a storage configuration, see IRF usage with storage on page 50.

FlexFabric and 6125/6127XLG major, single-tier use-case scenarios provides three major use-case scenarios, each describing a different implementation based on the hardware being utilized for servers and storage. All use-cases show a single layer or single tier of FlexFabric 57xx/59xx switches, also referred to as a storage East-West fabric topology, with variations for use-case 2 and use-case 3. Use-case 2 shows dual-hop on the server side and use-case 3 shows additional fabric connectivity on the storage side to other Fibre Channel/FCoE switch series fabrics via NPV gateway mode.

In converged-Ethernet network terminology, the single-layer switch topologies are referred as Top-Of-Rack (ToR) or leaf network topologies.

FlexFabric FCF Maximum FCoE Hop Count Use-Case 4A through FlexFabric FCF Maximum FC Hop Count Use-Case 5B describe FlexFabric 57xx/59xx multi-hop or cascaded switch use-cases. For all multi-hop configurations using the FlexFabric 57xx/59xx in FCF mode, Hewlett Packard Enterprise supports up to seven hops for FCoE, and for 5900CP and 5930/5940 modular CP up to three hops for Fibre Channel. For NPV mode, Hewlett Packard Enterprise supports a total of seven hops between any two devices in the 57xx/59xx fabric and the legacy Fibre Channel fabric connected via NPIV.

NOTE:
For all Ethernet/FCoE configurations shown, the FlexFabric 5900AF and 5700 10GbE switches can be utilized wherever 5900CP or 5930/5940 Modular switches in an FCoE configuration are shown. These switches do not support native Fibre Channel. Native Fibre Channel or NPV configurations shown require the use of 5900CP or 5930/5940 Modular with 24-port CP module switches.

FlexFabric Leaf-Spine Use-Case 6 describes a FlexFabric 129xx or 79xx leaf-spine switch network topology, and FlexFabric Edge-Core-Edge Use-Case 7 describes leaf-spine-leaf or edge-core-edge topology use cases.

For more information about current FlexFabric switches and storage support, see the HPE SPOCK website at http://www.hpe.com/storage/spock. You must sign up for an HP Passport to enable access.

In converged-Ethernet network terminology, the multi-hop switch topologies are referred as leaf-spine network topologies.
HPE FlexFabric and 6125XLG/6127XLG

3 Major Use Cases

<table>
<thead>
<tr>
<th>Major SAN Fabric Use-Case (Ethernet-Converged network terminology)</th>
<th>Variant</th>
<th>Server Connect</th>
<th>Storage Connect</th>
<th>5900CP/5930/5940 Modular Switch Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 Single-Tier Fabric, (ToR-Leaf) Rack Servers</td>
<td><strong>1A: FlexFabric FCF Use-Case</strong></td>
<td>Rack/CNA</td>
<td>Native FCoE</td>
<td>FCF</td>
</tr>
<tr>
<td></td>
<td><strong>1B: Rack Server, FCoE/FC, FC Storage</strong></td>
<td>Rack/CNA/H BA</td>
<td>Native FC</td>
<td></td>
</tr>
<tr>
<td>#2 Single-Tier Fabric, (ToR-Leaf) blade System</td>
<td><strong>2A: BladeSystem Dual-hop, FCoE Storage</strong></td>
<td>blade/VC</td>
<td>Native FCoE</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>2B: BladeSystem FC/FCoE, FC Storage</strong></td>
<td>blade/FC</td>
<td>Native FC</td>
<td></td>
</tr>
<tr>
<td>#3 Single-Tier Fabric, NPV (ToR-Leaf) Gateway</td>
<td><strong>3A: Rack Server, FC NPV Gateway, FC Storage</strong></td>
<td>Rack/CNA/H BA</td>
<td>FC via B/ C/H FC switch</td>
<td>NPV Gateway</td>
</tr>
<tr>
<td></td>
<td><strong>3B: BladeSystem, FC NPV Gateway, FC Storage</strong></td>
<td>blade/VC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table Continued

Figure 10: FlexFabric and 6125/6127XLG major, single-tier use-case scenarios

**FlexFabric 5900CP and 5930/5940 Modular switch use-cases** describes the FlexFabric 5900CP and 5930/5940 Modular switch use-cases. The items listed in the variant column are links to the figures which describe the variant connectivity options in detail.

Table 2: FlexFabric Modular switch use-cases
<table>
<thead>
<tr>
<th>Major SAN Fabric Use-Case (Ethernet-Converged network terminology)</th>
<th>Variant</th>
<th>Server Connect</th>
<th>Storage Connect</th>
<th>5900CP/5930/5940 Modular Switch Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3C: Rack/BladeSystem, FCoE NPV Gateway</strong></td>
<td></td>
<td>Rack/CNA/H BA blade/VC/FC</td>
<td>FC/FCoE via Cisco Nexus 55xx FCoE switch</td>
<td></td>
</tr>
<tr>
<td><strong>#4 Multi-hop Fabric, Rack (EoR-Spine) Servers</strong></td>
<td><strong>4A: Rack Server, FCoE Storage</strong></td>
<td>Rack/CNA</td>
<td>Native FCoE</td>
<td>FCF</td>
</tr>
<tr>
<td></td>
<td><strong>4B: Rack Server, FCoE FC, FC Storage</strong></td>
<td>Rack/CNA/H BA</td>
<td>Native FC</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>#5 Multi-hop Fabric, (EoR-Spine) blade Servers</strong></td>
<td><strong>5A: BladeSystem, FCoE Storage</strong></td>
<td>blade/VC</td>
<td>Native FCoE</td>
</tr>
<tr>
<td></td>
<td><strong>5B: BladeSystem FV/FCoE, FC Storage</strong></td>
<td>blade/FC</td>
<td>Native FC</td>
<td></td>
</tr>
<tr>
<td><strong>#6 Leaf-Spine Fabric</strong></td>
<td><strong>FlexFabric Leaf-Spine Use-Case 6</strong></td>
<td>Rack/CNA/H BA blade/VC/FC</td>
<td>Native FCoE/FC</td>
<td>FCF</td>
</tr>
<tr>
<td><strong>#7 Edge-Core-Edge Fabric</strong></td>
<td><strong>FlexFabric Edge-Core-Edge Use-Case 7</strong></td>
<td>Rack/CNA/H BA blade/VC/FC</td>
<td>Native FCoE/FC</td>
<td>FCF</td>
</tr>
<tr>
<td><strong>#8 Multi-hop Fabric, NPV (EoR-Spine) Gateway</strong></td>
<td><strong>8: For all FlexFabric 5900CP or 5930/5940 Modular NPV mode configurations, Hewlett Packard Enterprise supports a maximum of seven hops between any two devices in the 5900CP or 5930/5940 Modular fabric and the legacy Fibre Channel fabric connected via NPV/NPIV.</strong></td>
<td>Rack/CNA/H BA blade/VC/FC</td>
<td>FC via B/C/H FC switch</td>
<td>NPV Gateway</td>
</tr>
<tr>
<td><strong>#9 Dual-mode Configurations</strong></td>
<td><strong>9: Dual-mode configurations allow for the setting of a different switch mode for individual VSANs (FCF or NPV). This applies to the 5900CP and 5930/5940 modular switch models.</strong></td>
<td>Rack/CNA/H BA blade/VC/FC</td>
<td>Native FCoE, FC</td>
<td>FCF and NPV</td>
</tr>
<tr>
<td><strong>Storage Fabric IRF Configurations</strong></td>
<td>Applies to all Use-Cases above</td>
<td>Rack/CNA/H BA blade/VC/FC</td>
<td>Native FCoE, FC</td>
<td>FCF, NPV</td>
</tr>
</tbody>
</table>
NOTE:
For enhanced availability during incompatible Comware updates, multi-hop configurations should avoid configuring IRF on the last hop 5700, 5900 or 5930/5940 Modular switches when these switches are connected to storage devices.

Single-Tier Fabric, (ToR-Leaf) Rack Servers

Figure 11: FlexFabric FCF Use-Case 1A
Figure 12: FlexFabric FCF Use-Case 1B
Figure 13: FlexFabric FCF Use-Case 2A

Converged Ethernet/FCoE server connection options (Use-case 2A):

- Virtual Connect 20/40 F8 (8Gb FC, 10/40GbE FCoE/VC)
- Virtual Connect Flex - 10/10D, FCoE
- 6125XLG/6127XLG, FCoE (NPV)
- Virtual Connect FlexFabric 10Gb/24-Port (8Gb FC, 10GbE FCoE/Ethernet)
Figure 14: FlexFabric FCF Use-Case 2B

- Virtual Connect 20/40 F8 (8Gb FC, 10/40GbE FCoE/VC)
- Virtual Connect Flex - 10/10D, FCoE
- Virtual Connect FlexFabric 10Gb/24–Port (8Gb FC, -10GbE FCoE/VC)
- Virtual Connect 8Gb 24-Port Fibre Channel Module for c-Class BladeSystem (Brocade)
- Virtual Connect 8Gb 20-port Fibre Channel Module for c-Class BladeSystem
- blade Switch: 6125XLG/6127XLG, Ethernet/FCoE (6125XLG/6127XLG in NPV mode)
- blade Switch: Brocade 8Gb SAN Switch for BladeSystem c-Class (Access Gateway mode)
- blade Switch: Brocade 16Gb SAN Switch for BladeSystem c-Class (Access Gateway mode)
- blade Switch: Cisco MDS 8Gb Fabric Switch for BladeSystem c-Class (NPV/NPIV enabled)
Single-Tier Fabric, NPV (ToR-Leaf) Gateway

Figure 15: FlexFabric NPV Use-Case 3A
Figure 16: FlexFabric NPV Use-Case 3B

Converged or Native FC server connection options (Use-case 3B):

- Virtual Connect 20/40 F8 (8Gb FC, 10/40GbE FCoE/VC)
- Virtual Connect Flex - 10/10D, FCoE
- Virtual Connect FlexFabric 10Gb/24–Port (8Gb FC, -10GbE FCoE/VC)
- Virtual Connect 8Gb 24-Port Fibre Channel Module for c-Class BladeSystem (Brocade)
- Virtual Connect 8Gb 20-port Fibre Channel Module for c-Class BladeSystem
- blade Switch: 6125XLG/6127XLG, Ethernet/FCoE (6125XLG/6127XLG in NPV mode or FCF mode)
Figure 17: FlexFabric NPV Use-Case 3C

Converged Ethernet/FCoE server connection options (Use-case 3C):

- Virtual Connect Flex - 10/10D, FCoE
- Blade Switch: 6125XLG/6127XLG, Ethernet/FCoE (6125XLG/6127XLG in NPV mode or FCF mode)
- Virtual Connect FlexFabric 10Gb/24–Port (8Gb FC, 10GbE FCoE/Ethernet)

Configuring Automatic Load Balancing for FCoE/FC

When the system detects a new operational uplink interface, the system starts a delay timer. When the timer expires, the system automatically redistributes downlink interfaces across all uplink interfaces. If another uplink interface becomes operational before the timer expires, the system resets the timer. The delay timer helps reduce network flapping caused by up/down events of uplink interfaces. If the link layer state of uplink interfaces is stable, set the delay timer to a smaller value. Otherwise, set the delay timer to a greater value. This feature might trigger a load balancing process when a new uplink interface become operational, which causes traffic disruption. When this feature is disabled, downlink-to-uplink interface mappings are not affected. This feature combined with the npv traffic-map feature facilitates control of the downlink to uplink mappings.
NOTE:
For use case 3, the 57xx/59xx and 129xxE/79xx NPV mode switch supports configuring automatic load balancing of FC and FCoE downlinks across FC or FCoE NP-port uplinks. This feature automatically redistributes downlink interfaces across all uplink interfaces if the system detects new operational uplink interfaces and is especially useful when uplinks connect to B series switches and the downlinks support NPIV failover login such as with Virtual Connect blade modules.

# Enable automatic load balancing in VSAN 1; FC np port uplinks

```plaintext
<Sysname> system-view
<Sysname> vsan 1
<Sysname-vsan1] npv auto-load-balance enable
<Sysname-vsan1] npv auto-load-balance-interval 20
<Sysname-vsan1] npv traffic-map server-interface Fc1/2/19 external-interface Fc1/2/11
<Sysname-vsan1] npv traffic-map server-interface Fc1/2/20 external-interface Fc1/2/9
<Sysname-vsan1] npv traffic-map server-interface Fc1/2/21 external-interface Fc1/2/11
<Sysname-vsan1] npv traffic-map server-interface Fc1/2/22 external-interface Fc1/2/9
<Sysname-vsan1] npv traffic-map server-interface Vfc25 external-interface Fc1/2/10
```

# Enable automatic load balancing in VSAN 10; FCoE vnp port aggregation uplinks, configured with a vfc bind for each uplink member.

```plaintext
<Sysname> system-view
<Sysname> vsan 10
<Sysname-vsan10] npv auto-load-balance enable
<Sysname-vsan10] npv auto-load-balance-interval 20
<Sysname-vsan10] npv traffic-map server-interface Fc1/2/19 external-interface vfc11
<Sysname-vsan10] npv traffic-map server-interface Fc1/2/20 external-interface vfc9
<Sysname-vsan10] npv traffic-map server-interface Fc1/2/21 external-interface vfc11
<Sysname-vsan10] npv traffic-map server-interface Fc1/2/22 external-interface vfc9
<Sysname-vsan10] npv traffic-map server-interface Vfc25 external-interface vfc11
<Sysname-vsan10] npv traffic-map server-interface Vfc26 external-interface vfc9
```
Multi-hop Fabric, Rack (EoR-Spine) Servers

Figure 18: FlexFabric FCF Maximum FCoE Hop Count Use-Case 4A
Expand switches vertically as required, up to 4 switches (3 hops) total; each hop optionally an IRF pair.

5900CP or 5930/5940 Modular (w/ CP module)

FCF Native FC

IRF* between hop pairs of like-model switches (Optional, Ethernet connection only)

Rack Server/CNA

Rack Server/HBA

Figure 19: FlexFabric FCF Maximum FC Hop Count Use-Case 4B

Converged Ethernet/FCoE
Native FC
Native Ethernet
FCoE
IRF* between hop pairs of like-model switches (Optional, Ethernet connection only)
Multi-hop Fabric, (EoR-Spine) blade Servers

Converged Ethernet/FCoE server connection options (Use-case 5A):

- Virtual Connect 20/40 F8 (8Gb FC, 10/40GbE FCoE/VC)
- Virtual Connect Flex - 10/10D, FCoE
- blade Switch: 6125XLG/6127XLG, Ethernet/FCoE (6125XLG/6127XLG in NPV mode or FCF mode)

Figure 20: FlexFabric FCF Maximum FCoE Hop Count Use-Case 5A
**Figure 21: FlexFabric FCF Maximum FC Hop Count Use-Case 5B**

Converged or Native FC server connection options (Use-case 5B):

- Virtual Connect 20/40 F8 (8Gb FC, 10/40GbE FCoE/VC)
- Virtual Connect Flex - 10/10D, FCoE
- Virtual Connect FlexFabric 10Gb/24–Port (8Gb FC, -10GbE FCoE/VC)
- Virtual Connect 8Gb 24-Port Fibre Channel Module for c-Class BladeSystem (Brocade)
- Virtual Connect 8Gb 20-port Fibre Channel Module for c-Class BladeSystem
- blade Switch: 6125XLG/6127XLG, Ethernet/FCoE (6125XLG/6127XLG in NPV mode or FCF mode)
- blade Switch: Brocade 8Gb SAN Switch for HPE BladeSystem c-Class (Access Gateway mode)
- blade Switch: Brocade 16Gb SAN Switch for BladeSystem c-Class (Access Gateway mode)
- blade Switch: Cisco MDS 8Gb Fabric Switch for BladeSystem c-Class (NPV/NPIV enabled)
Figure 22: FlexFabric Leaf-Spine Use-Case 6
Figure 23: FlexFabric Edge-Core-Edge Use-Case 7

Converged or Native FC server connection options (Use-case 6 and 7):

- All 129xxE/79xx switch configurations require `burst-mode enable`
- For converged or native FC server connection options, see the applicable use cases (1 through 5) above based on the server type and leaf switch model being utilized

**Dual-mode Configurations**

Dual-mode switch configurations allow for the setting of a different switch mode for individual VSANs (FCF or NPV). This applies to the FlexFabric 59xx, and 6125XLG/6127XLG switch models. An example of FCOE-modes:

```
[FFswitch]fcoe-mode
  fcf    FCoE Forwarder (FCF) mode
  fcf-npv FCoE Forwarder (FCF) and N Port Virtualization (NPV) mode
  npv    N Port Virtualization (NPV) mode
  transit Transit mode
```

Converged, Native FC, FCF or NPV server connection options (Figures 24 through 27):
- Rack servers
- blade servers

Figure 24: FC Storage F_Port FC Storage F_Port F_Port N_Port NP_Port N_Port

Storage use-cases 47
Figure 25: Dual-mode connectivity to Fibre Channel storage via VNP_Ports to FCoE switches.
Figure 26: Dual-mode connectivity when using blade System 6127XLG or 6125XLG switches.
IRF usage with storage

The FlexFabric 5700, 5900CP, 5900AF, 5930/5940 Modular 129xxE/79xx switches support IRF for use with Ethernet and storage networks. For Ethernet networks, you can configure up to nine same-model switches in a single IRF domain. For storage networks, including FCoE, you can configure up to two same-model switches per fabric in an IRF domain. When using IRF, NIC teaming is supported and is utilized for LAN traffic.
NOTE:
SAN fabric services do not scale by adding switches to an IRF domain as they do when connecting switches with E-port and VE-port ISLs, hence there is a practical limit of two SAN enabled switches per IRF domain guideline. Switch models included in a SAN enabled IRF domain must match as follows:

FlexFabric switch pairing supported in an IRF domain:

- 5700-40XG-2QSFP+ - 5700-32XGT-8XG-2QSFP+
- 5700-40XG-2QSFP+ - 5700-40XG-2QSFP+
- 5700-32XGT-8XG-2QSFP+ - 5700-32XGT-8XG-2QSFP+
- 5900CP-48XG-4QSFP+ - 5900CP-48XG-4QSFP+
- 5900CP-48XG-4QSFP+ - 5900AF-48XGT-4QSFP+
- 5900CP-48XG-4QSFP+ - 5900AF-48XG-4QSFP+
- 5900AF-48XG-4QSFP+ - 5900AF-48XGT-4QSFP+
- 5900AF-48XG-4QSFP+ - 5900AF-48XG-4QSFP+
- 5900CP-48XG-4QSFP+ - 5900AF-48XGT-4QSFP+
- 5930 4-slot - 5930 4-slot
- 5930 2QSFP+ - 5930 2QSFP+
- 5930-32QSFP+ - 5930-32QSFP+
- 5930 4-slot - 5930-32QSFP+
- 5930 2QSFP+ - 5930 4-slot
- 5930-32QSFP+ - 5930-32QSFP+
- 5930 2-slot - 5930 2-slot
- 5940 4-slot - 5940 4-slot
- 5940 2-slot - 5940 2-slot
- 5940 48SFP+ 6QSFP28 - 5940 48SFP+ 6QSFP28
- 5940 48XGT 6QSFP28 - 5940 48XGT 6QSFP28
- 5940 48XGT 6QSFP+ 6QSFP+ 6QSFP+
- 5940 48SFP+ 6QSFP+ - 5940 48SFP+ 6QSFP+
- 5940 32QSFP+ - 5940 32QSFP+
- 6125XLG - 6125XLG; four 6125XLG switches per IRF domain is supported
- 6127XLG - 6127XLG; four 6127XLG switches per IRF domain is supported
- 129xx - 129xx
- 79xx - 79xx

NOTE:
The IRF capability must be enabled using the CLI command `chassis convert mode irf`, followed by a reboot. This IRF configuration command is not required on 57xx and 59xx switches.


For more information about IRF, see the FlexFabric 129xxE IRF Command Reference documentation available on the Networking website at [http://www.hpe.com/info/FF12900Switch-Manuals](http://www.hpe.com/info/FF12900Switch-Manuals).

For more information about IRF, see the FlexFabric 79xx IRF Command Reference documentation available on the Networking website at [http://www.hpe.com/info/FF7900Switch-Manuals](http://www.hpe.com/info/FF7900Switch-Manuals).

For Ethernet/FCoE/FC storage network environments, the following FlexFabric 5700, 5900, and 5930/5940 storage-IRF deployment scenarios are supported:

1. **Dual-redundant fabric SAN with no IRF**—Traditional Fibre Channel high availability no-single-point-of-failure (NSPOF) configuration. See Figure 27: Dual-redundant storage fabric configuration, no IRF on page 53.

   Provides *physically* separate redundant fabrics with failover capabilities for high availability with storage

   **Considerations**

   - Highly available, NSPOF configuration
   - Firmware updates require a fabric failover. See Software and Firmware update process on page 78
2. **Dual-redundant fabric SAN with 2-switch IRF for Ethernet**—Implemented with two FlexFabric 5700, 5900, 5930/5940 or 129xxE/79xx switches configured in an IRF domain across both the fabrics, with one switch from each fabric. See Figure 28: Dual-redundant storage fabric configuration, 2-Switch IRF for Ethernet-only on page 54.

- Provides *logically* separate redundant fabrics with failover capabilities for high availability with storage
- Requires two VSANs to prevent storage traffic across the IRF link
- Must be specific on device placement to allow desired access such as CNA to storage
- Allows Ethernet usage of the IRF links

**Considerations**

- Highly available, NSPOF configuration when using Comware version R2432P01 (or later)
- Firmware updates are considered disruptive to both VSANs, requiring scheduled downtime.
- Oversubscribed IRF ports should be avoided through provisioning adequate connections.
3. Dual-redundant fabric SAN with 4-switch IRF for Ethernet—Implemented with two FlexFabric 5700, 5900, 5930/5940 or 129xxE/79xx switches in each fabric configured in two IRF domains for high availability and NSPOF. See Figure 29: Dual-redundant storage fabric configuration, 4-Switch IRF for Ethernet-only on page 55.

- Provides physically separate redundant fabrics with failover capabilities for high availability with storage
- Requires four VSANs to prevent storage traffic across the IRF link
- Requires two CNAs per server or two HBAs per server
- Must be specific on device placement to allow desired access
- Allows Ethernet usage of the IRF links

Considerations

- Highly available, NSPOF configuration
- Firmware updates require a fabric failover. See Software and Firmware update process on page 78
- Oversubscribed IRF ports should be avoided through provisioning adequate connections.
4. Dual-redundant storage fabric configuration with two stacked switches in IRF domains—
   Implemented with two FlexFabric 5700, 5900, 5930/5940 or 129xxE/79xx switches in each fabric
   configured in two IRF domains for high availability and NSPOF. See Figure 30: Dual-redundant storage
   fabric configuration, two stacked switches in IRF domains on page 57.

   • Avoid irf-port congestion by using multiple 40G connections
   • Only one VSAN per IRF domain required
   • No specific device connectivity to maintain NSPOF
   • When storage is connected to switches utilizing IRF, add the following command to the configuration
     file:
     
     fspf graceful-restart
   • Firmware updates require a fabric failover. See Software and Firmware update process on page
     78
   • This configuration leverages IRF as a stacking interconnect with one VSAN per IRF domain and
     includes FCoE QOS configuration of stacked irf-ports. Enable FCoE priority 3 priority-flow-control on irf-
     ports

   Examples:
   
   #
   irf-port 1/1
   port group interface FortyGigE1/0/49
   port group interface FortyGigE1/0/50
   #
   irf-port 1/2
port group interface FortyGigE1/0/51
port group interface FortyGigE1/0/52
  #
  irf-port 2/1
port group interface FortyGigE2/0/51
port group interface FortyGigE2/0/52
  #
  irf-port 2/2
port group interface FortyGigE2/0/49
port group interface FortyGigE2/0/50
  #
  interface FortyGigE1/0/49
    priority-flow-control enable
    priority-flow-control no-drop dot1p 3
  #
  interface FortyGigE1/0/50
    priority-flow-control enable
    priority-flow-control no-drop dot1p 3
  #
  interface FortyGigE1/0/51
    priority-flow-control enable
    priority-flow-control no-drop dot1p 3
  #
  interface FortyGigE1/0/52
    priority-flow-control enable
    priority-flow-control no-drop dot1p 3
  #
  interface FortyGigE2/0/49
    priority-flow-control enable
    priority-flow-control no-drop dot1p 3
  #
  interface FortyGigE2/0/50
    priority-flow-control enable
    priority-flow-control no-drop dot1p 3
  #
  interface FortyGigE2/0/51
    priority-flow-control enable
    priority-flow-control no-drop dot1p 3
  #
  interface FortyGigE2/0/52
    priority-flow-control enable
    priority-flow-control no-drop dot1p 3
  #

Oversubscribed IRF ports should be avoided through provisioning adequate connections for storage data traffic. Combine initiator - target traffic planning to avoid IRF port congestion due to Storage data traffic.
Figure 30: Dual-redundant storage fabric configuration, two stacked switches in IRF domains
The FlexFabric 5700, 5900, and 5930/5940 switches support connectivity to multiple HPE server interconnect options including Virtual Connect modules/switches and BladeSystem switches. See Table 1.

For Virtual Connect modules, Flex-10/10D and FlexFabric 10 Gb/24-port, connectivity is through FIP Snooping to the FlexFabric 5700, 5900, and 5930/5940 switches which are operating in FCF mode.

For BladeSystem switches, connectivity is configured based on the BladeSystem switch used. For a 6125XLG/6127XLG dual-hop configuration, set 6125XLG/6127XLG mode to NPV and the FlexFabric 5700, 5900, and 5930/5940 switch mode to FCF or NPV. For multi-hop, set 6125XLG/6127XLG mode to FCF and 5700, 5900, and 5930/5940 switch to FCF mode.

For the HPE 8/24c SAN Switch (Brocade), set the switch in Access Gateway mode. For the MDS 8Gb 24-port Switch (Cisco), enable the switch for NPV/NPIV to connect to the FlexFabric 5900CP or 5930/5940 Modular CP plugin switch in FCF mode using NPIV.

Table 3 describes BladeSystem interconnect support for FlexFabric switches. For more information about current FlexFabric switches storage support, see the SPOCK website at [http://www.hpe.com/storage/spock](http://www.hpe.com/storage/spock). You must sign up for an HP Passport to enable access.

**Table 3: FlexFabric 5700, 5900CP, 5900/5920AF, 5930/5940 FP, 5930/5940 Modular BladeSystem Interconnect Support**

<table>
<thead>
<tr>
<th>Virtual Connect Modules/blade Switches</th>
<th>5900CP, 5930/5940 Modular Switch Mode</th>
<th>5700, 5900AF, 5930/5940 Fixed Port Switch Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPE Virtual Connect SE 40GB F8 Module for HPE Synergy</td>
<td>• FCF</td>
<td>• FCF</td>
</tr>
<tr>
<td>Virtual Connect 20/40 F8 (8Gb FC, 10GbE FCoE/VC)</td>
<td>• FCF</td>
<td>• FCF</td>
</tr>
<tr>
<td>Virtual Connect Flex-10/10D, FCoE (FIP Snooping)</td>
<td>• FCF</td>
<td>• FCF</td>
</tr>
<tr>
<td>Virtual Connect FlexFabric 10Gb/24-Port (8Gb FC, 10GbE FCoE/VC FIP Snooping)</td>
<td>• FCF</td>
<td>• FCF</td>
</tr>
<tr>
<td>Virtual Connect 8Gb 24-Port Fibre Channel Module for c-Class BladeSystem (Brocade)</td>
<td>• FCF¹</td>
<td>N/A</td>
</tr>
<tr>
<td>Virtual Connect 8Gb 20-port Fibre Channel Module for c-Class BladeSystem</td>
<td>• FCF¹</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Table Continued
<table>
<thead>
<tr>
<th>Virtual Connect Modules/blade Switches</th>
<th>5900CP, 5930/5940 Modular Switch Mode</th>
<th>5700, 5900AF, 5930/5940 Fixed Port Switch Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>blade Switch: 6125XLG/6127XLG, Ethernet/FCoE (6125XLG/6127XLG in NPV mode or Transit or FCF mode)</td>
<td>• FCF, NPV, or Transit</td>
<td>• FCF, NPV, or Transit</td>
</tr>
<tr>
<td>blade Switch: Brocade 8Gb SAN Switch for BladeSystem c-Class (Access Gateway mode)</td>
<td>• FCF¹</td>
<td>N/A</td>
</tr>
<tr>
<td>blade Switch: Brocade 16Gb SAN Switch for BladeSystem c-Class (Access Gateway mode)</td>
<td>• FCF¹</td>
<td>N/A</td>
</tr>
<tr>
<td>blade Switch: Cisco MDS 8Gb Fabric Switch for BladeSystem c-Class (NPV/NPIV enabled)</td>
<td>• FCF¹</td>
<td>N/A</td>
</tr>
</tbody>
</table>

For additional information about configuring BladeSystem interconnects with FlexFabric switches, see the HPE Virtual Connect FCoE Cookbook in the Virtual Connect Information Library at [http://www.hpe.com/info/vc/manuals](http://www.hpe.com/info/vc/manuals).
FlexFabric Switch Storage Network Support

For information about current FlexFabric switch storage support, see the Networking switch STREAM document on the SPOCK website at http://www.hpe.com/storage/spock. You must sign up for an HP Passport to enable access.
Remote-copy configurations are based on the relationship between a remote-copy pair of 3PAR storage systems. Within a remote-copy pair, the primary storage system is the system that holds the volumes that are copied to the backup storage system, through either or both an extended FC fabric and an Ethernet IP network. For high availability, a two fabric, two switches per site, configuration is recommended. This overview does not discuss use of FCIP gateways.

The 5900CP and 5930/5940 Modular switches support 3PAR RCFC through extended FC E_Port ISLs at up to 10km and FCoE VE Port ISLs at up to 40km and within the 3PAR specified maximum round trip time (RTT). The 5900CP/5930/5940 Modular configuration of a dedicated VSAN for remote-copy paired ports is recommended so that fabric changes do not interrupt the remote-copy E_Port or VE_Prot ISL. The 1GbE and 10GbE RCIP ports are supported directly and attached to the 5900CPs/5930/5940 Moduarls with the switch-to-switch Ethernet IP network operating at 1GbE, 10GbE, or 40GbE. The 10GbE and 40GbE switch-to-switch links may be operated utilizing lossless DCB configurations at up to 10km. The 10GbE switch-to-switch links may be operated utilizing lossless DCB configurations at up to 40km when configured for port connection-distance 40000.

**NOTE:**

The 10GbE port buffers are by default configured to operate lossless at 10km. The port lossless buffering is configurable to one of four working distances, 300m, 10km, 20km, or 40km using the port connection-distance CLI command as illustrated below. If configuring a bridge-aggregation as a VE-port ISL, ensure that all member links are configured with the same port connection-distance.

```
[fcf-Ten-GigabitEthernet3/0/33]port connection-distance ?
  300  Specify distance as 300m
  10000  Specify distance as 10000m
  20000  Specify distance as 20000m
  40000  Specify distance as 40000m
[fcf] interface Ten-GigabitEthernet 3/0/33
[fcf-Ten-GigabitEthernet3/0/33]di this
#
interface Ten-GigabitEthernet3/0/33
  port link-mode bridge
  port link-type trunk
undo port trunk permit vlan 1
  port trunk permit vlan 1004 to 1005 4004 to 4005
  port trunk pvid vlan 1005
  priority-flow-control auto
  priority-flow-control no-drop dot1p 3
  port connection-distance 40000
  lldp tlv-enable dot1-tlv dcbx
  qos trust dot1p
    qos wrr be group 1 byte-count 4
    qos wrr af2 group 1 byte-count 12
    qos wrr af3 group sp
    qos wrr af4 group sp
    qos wrr ef group sp
    qos wrr cs6 group sp
    qos wrr cs7 group sp
```
NOTE:
The FlexFabric 5700 also supports RCIP at up to 40km and also a FCoE VE_Port ISL at up to 40km. However 3PAR StoreServ requires Fibre Channel connectivity for RFC feature support.

The following table summarizes 5900CP/5930/5940 Modular switch to switch remote-copy ISL link configuration options:

### Table 4: 5900CP/5930/5940 Modular remote-copy connectivity options

<table>
<thead>
<tr>
<th>Switch to Switch connectivity</th>
<th>3PAR RC port mode</th>
<th>Switch to Switch Distance and Media</th>
<th>5900CP/5930/5940 Modular Transceiver</th>
</tr>
</thead>
<tbody>
<tr>
<td>1GbE</td>
<td>RCIP</td>
<td>40km SMF</td>
<td>JD061A HPE X125 1G SFP LC LH40 1310nm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40km SMF</td>
<td>JD062A HPE X120 1G SFP LC LH40 1550nm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>70km SMF</td>
<td>JD063B HPE X125 1G SFP LC LH70 1550nm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100m CAT5e</td>
<td>JD089B HPE X120 1G SFP RJ45 T</td>
</tr>
<tr>
<td></td>
<td></td>
<td>500m MMF</td>
<td>JD118B HPE X120 1G SFP LC 1000Base-SX</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5km SMF</td>
<td>JD119B HPE X125 1G SFP LC 1000Base-LX</td>
</tr>
<tr>
<td></td>
<td></td>
<td>500m MMF</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Up to 8x1GbE bridge-aggregation</td>
<td>See 1GbE list above</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40km or 20km SMF</td>
<td>See 1GbE list above.</td>
</tr>
<tr>
<td></td>
<td>RCIP</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>500m MMF</td>
<td>JD092B HPE X130 SFP+ LC SR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>220m MMF</td>
<td>JD093B HPE X130 SFP+ LC LRM</td>
</tr>
</tbody>
</table>

Table Continued
<table>
<thead>
<tr>
<th>Switch to Switch connectivity</th>
<th>3PAR RC port mode</th>
<th>Switch to Switch Distance and Media</th>
<th>5900CP/5930/5940 Modular Transceiver</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RCIP and RCFC (FCoE ISL)</td>
<td>10km SMF</td>
<td>JD094B HPE X130 SFP+ LC LR</td>
</tr>
<tr>
<td>up to 8x10GbE bridge-aggregation</td>
<td>RCIP and RCFC (FCoE ISL)</td>
<td>See 10GbE list above</td>
<td>See 10GbE list above</td>
</tr>
<tr>
<td>40GbE FCoE VE port isl supported</td>
<td>RCIP and RCFC (FCoE ISL)</td>
<td>10km SMF</td>
<td>JG661A HPE X140 40G QSFP+ LC LR4 SM</td>
</tr>
<tr>
<td></td>
<td>RCIP and RCFC (FCoE ISL)</td>
<td>100m MMF</td>
<td>JG325B HPE X140 40G QSFP+ MPO SR4</td>
</tr>
<tr>
<td></td>
<td>RCIP and RCFC (FCoE ISL)</td>
<td>300m MMF</td>
<td>JG709A HPE X140 40G QSFP+ CSR4 300m</td>
</tr>
<tr>
<td>up to 4x40GbE bridge-aggregation</td>
<td>RCIP and RCFC (FCoE ISL)</td>
<td>See 40GbE list above</td>
<td>See 40GbE list above</td>
</tr>
<tr>
<td>8/4/2 Gbps FC FC e-port ISL supported</td>
<td>RCFC (FC ISL)</td>
<td>10km SMF</td>
<td>AW584A HPE 8Gb LW FC SFP+</td>
</tr>
<tr>
<td></td>
<td>RCFC (FC ISL)</td>
<td>300m MMF</td>
<td>AJ718A 8Gb Short Wave FC SFP+</td>
</tr>
<tr>
<td>up to 8x8/4/2 Gbps FC san-aggregation trunk</td>
<td>RCFC (FC ISL)</td>
<td>See 8/4/2 Gbps FC above</td>
<td>See 8/4/2 Gbps FC above</td>
</tr>
</tbody>
</table>

HPE 3PAR remote-copy cannot replicate a primary volume group to a backup system and then replicate the volume group again from the backup system to a third storage system, that is, multi-hop replication.

Hewlett Packard Enterprise recommends to use synchronous mode replication whenever the additional write latency is induced by the network, plus the write latency induced by the target array, will not exceed the maximum write latency tolerable by the application whose data is being replicated.

**Table 5: 3PAR array-to-array remote-copy RTT specifications**

<table>
<thead>
<tr>
<th>Volume Group Mode</th>
<th>3PAR RC port mode</th>
<th>RTT - 3.1.2/3.2.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synchronous</td>
<td>RCFC</td>
<td>2.6 ms/5 ms</td>
</tr>
<tr>
<td></td>
<td>RCIP</td>
<td>2.6 ms/5 ms</td>
</tr>
<tr>
<td></td>
<td>FCIP</td>
<td>n/a/5 ms</td>
</tr>
</tbody>
</table>

Table Continued
<table>
<thead>
<tr>
<th>Volume Group Mode</th>
<th>3PAR RC port mode</th>
<th>RTT - 3.1.2/3.2.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodic asynchronous</td>
<td>RCFC</td>
<td>2.6 ms/5 ms</td>
</tr>
<tr>
<td></td>
<td>RCIP</td>
<td>150 ms</td>
</tr>
<tr>
<td></td>
<td>FCIP</td>
<td>120 ms</td>
</tr>
<tr>
<td>Quorum Witness Maximum RTT</td>
<td>Ethernet Management Ports</td>
<td>150 ms (with a connection timeout of 250 ms and a response timeout of 3 s)</td>
</tr>
<tr>
<td>Asynchronous streaming</td>
<td>RCIP</td>
<td>n/a/Not supported</td>
</tr>
<tr>
<td></td>
<td>RCFC</td>
<td>n/a/5 ms</td>
</tr>
<tr>
<td></td>
<td>FCIP</td>
<td>n/a/10 ms</td>
</tr>
</tbody>
</table>

For specific 3PAR synchronous and asynchronous RCIP and RCFC configuration requirements and steps, see 3PAR Remote Copy Software User's Guide.

Any two arrays in an M-to-N remote-copy configuration are configured the same as two arrays in a 1-to-1 configuration. The examples shown in Figure 31: Remote-copy FCoE ISL or IP Network links on page 65 and Figure 32: Remote-copy FC ISL links on page 67 focus on 1-to-1 configurations. Any single array in an M-to-N configuration can have relationships with no more than four other arrays. Storage systems in a remote-copy pair are connected through a dedicated network or through a link, as shown in Figure 31: Remote-copy FCoE ISL or IP Network links on page 65 and Figure 32: Remote-copy FC ISL links on page 67.

Bidirectional replication is supported. Volumes from array A can be replicated to target volumes on array B while different volumes from array B can be replicated simultaneously to target volumes on array A.

RCFC supports up to 32 links, 4 per node, between a pair of 8-node storage systems. RCIP supports up to 8 links, 1 per node, between a pair of 8-node storage systems.

The HPE 3PAR Quorum Witness becomes relevant only in a Peer Persistence Configuration, during an HPE 3PAR Peer Persistence failover.

Peer Persistence failover and switchover requires the following:

- The storage arrays must have at least two remote copy over FC links available or the storage arrays must have at least two remote copy over IP links available
- Primary and Secondary volumes must share a common WWN—the volumes must be created on the source and target arrays using the same WWN addresses and these volumes should be exported to the same host from both arrays using the extended fabric and an initiator—target active zone.
- Have the path_management group policy set
- For automatic transparent failover, HPE 3PAR Quorum Witness Host connected (port 8080) to both arrays through a minimum of two array controller nodes administration Ethernet TCP/IP ports. If the array has more than two controllers the best practice is to connect all controller nodes to the network.
- The source and target volumes are exported to the same host set from both arrays using different target port groups.

HPE 3PAR OS 3.1.3 and later should be installed for best granular use of available FC and RCFC ports. In a 1-to-1 remote-copy configuration with eight nodes on each of the primary and backup systems, 32 RCFC links can be configured. For FCIP, four physical links can be configured.
On the following storage systems, a 3PAR controller FC HBA may be shared, by separate ports, between host-connect and RCFC. Host ports and RCFC ports connected to a common 5900CP must be connected by separate ports.

- HPE 3PAR StoreServ 10000, 20000 Storage
- HPE 3PAR StoreServ 7450, 8450, 8440 Storage
- HPE 3PAR StoreServ 7400, 8400, 8200 Storage
- HPE 3PAR StoreServ 7000, 8000 Storage
- HPE 3PAR StoreServ 20450
- HPE 3PAR StoreServ 20800, 20840, 20850

![Diagram](image)

**Figure 31: Remote-copy FCoE ISL or IP Network links**

**IP Networks**

The remote-copy subnet can be shared with other I/O traffic, but a guaranteed amount of bandwidth must be dedicated to remote-copy on the shared subnet. Guaranteed bandwidth on the network is especially important when replicating synchronously over RCIP; the bandwidth must be large enough to ensure that no performance issues arise from replicating data synchronously. For asynchronous periodic replication, the bandwidth must be large enough to ensure that the recovery point objective (RPO) can be met.

Hosts that access the 3PAR systems for management purposes must not be on the same subnet as the RCIP ports. Verify that firewall settings allow the remote-copy systems access to TCP port 5785. With RCIP, a pair of IP ports on the node pairs in an array may have a remote-copy relationship with up to two other arrays. In other words, a pair of RCIP ports on an array may send data to up to two different remote-copy targets on two different arrays, and may be the remote-copy target for those same two arrays.

For RCIP:

- Each storage system in the remote-copy configuration must have at least two nodes
- The array management interface cannot be on the same subnet as the RCIP network
• Each RCIP GigE interface must use a unique IP address
• The 5900CP/5930 Modular jumbo frame enabled ports support a default 10,000 byte MTU on Ethernet ports, which is greater than the 3PAR maximum MTU of 9000 bytes
• Up to eight controller nodes can each have one RCIP GigE port contributing to an RCIP remote-copy pair
• The switch to switch lossless link could be a single 10GbE or 40GbE or a bridge-aggregation of lossless links and carry RCFC encapsulated as FCoE frames and RCIP traffic with logical separation based on VLANs and VSANs

Fibre Channel and Fibre Channel over Ethernet (FCoE) Networks

RCFC can be set up on 3PAR storage systems that communicate over FC SAN to the 5900CP/5930/5940 Modular switches. There is no RCFCoE or RCiSCSI support, however the VSAN to VSAN e-port can use either FCoE or FC between 5900CPs/5930/5940 Modular. The available 5900CP/5930 Modular FC port 15 BB-credits results in a 50% throughput reduction to 8Gbps FC at 10km. Line rate throughput is realized when FCoE transport is utilized over lossless 10GbE and 40GbE VE port based ISLs. However, an FC san-aggregation trunk may otherwise be utilized, but offers no converged solution for RCIP connectivity. With FCoE VE port ISLs, bandwidth for RCIP links is available and enhanced transmission selection (ETS) configuration ensures sharing and meeting throughput requirements. In addition, bandwidth for RCIP links is available and enhanced transmission selection (ETS) configuration ensures sharing and meeting throughput requirements.

RCFC ports of the remote-copy pair must be configured to be paired in the same fabric VSAN, zone, and active zoneset on each of 5900CP/5930 Modular switches. Only one RCFC port pair may exist for each distributed zone. RCFC port pairs cannot operate with other devices active in their zone.

For RCFC, each 3PAR storage system, there should be at least two RCFC controller ports, one per controller, for load sharing and fault tolerance. Host servers and 3PAR storage are connected and zoned in non-remote-copy VSANs, utilizing the 5900CPs/5930/5940 Modular VSAN partitions feature which supports up to 16 VSANs per switch. An FC SAN has at least two fabrics, the remote-copy pairs should be configured on two separate VSAN fabrics and follow the persistent ports partner guidelines. For these guidelines, see Technical white paper HPE 3PAR StoreServ Persistent Ports Rev. 3 or later.

The 5900CP with FC E_Port ISLs can utilize FC virtual-fabric tagging to trunk between FC attached remote-copy pair systems in a two fabric configuration. 3PAR controller HBAs in each storage system connect those systems through FC SAN, using FC cable connections as illustrated in Figure 32: Remote-copy FC ISL links on page 67.
Figure 32: Remote-copy FC ISL links

Configuring 5900CP for converged or FC remote-copy

This section assumes a user has selected the 3PAR controller FC and IP ports to use for remote copy and that the ports have been configured as RCFC and RCIP ports with assigned IP addresses.

A 3PAR RCFC port connects to a 5900CP/5930/5940 Modular which, in the example below, has VSAN 400 configured and dedicated to fabric A RCFC. The switch in fabric B has VSAN 500 configured and dedicated to remote copy. The fabrics are defaulted to operate dynamically, with the same VSAN priority, so that the principal election protocol treats the switches in each site equally. Optionally the fabric could be configured with static domain IDs and static priorities. The following RCFC and RCIP shared ISL configuration detail examples for Figure 31: Remote-copy FCoE ISL or IP Network links on page 65:

- Example 1: 40G ISL (80GbE between sites)
- Example 2: 10G ISL (20GbE between sites)
- Example 3: 10G aggregation (40GbE between sites) ISL, each site is one IRF domain

For the 40GbE FCoE ISL example, each ISL link is configured with an ETS of 50%/50%. Often there are only two fibers between sites, one for each fabric. The ISL trunk ports are capable of transporting additional VSANs, as are all of the FC/FCoE ISLs in these examples. Additional RCFC pair connections may be required or the server—storage fabrics extended between sites and these VSAN partitions can share the ISLs.

When IRF is configured between the two 5900CPs/5930 Modulars at each Site, a Bridge-Aggregation created from ports from each switch should maintain Fabric A and Fabric B VSAN separation. To maintain fabric separation in an IRF configuration, the 20GbE Bridge-Aggregation example below is comprised of two Ethernet ports, one port and associated VSAN from each of the physical switches, with each VSAN VFC bound to the 10GbE port member of the aggregation. The 10GbE ports are configured with ETS of 80% FCoE/20% RCIP to illustrate bandwidth sharing control.

The 1GbE RCIP port pairs are assigned to VLAN 1002 and VLAN 1003 and share the ISL link with the FCoE traffic.
FC ISL configurations are shown in Figure 32: Remote-copy FC ISL links on page 67, which carries only RCFC traffic. Two configuration examples are shown below:

- Example 4: 8G FC ISL (16G FC between sites)
- Example 5: 16G FC ISL trunk (32G FC between sites) using san-aggregation

To conform to a peer persistence cluster configuration, the server and storage VSAN on each switch could be added to the trunks and zoning the local and remote site 3PAR HOST ports with a server port enables visibility to the primary and secondary volumes with the same WWN from both sites. Example 6 in Table 6 shows configuration with servers – storage VSAN and distributed zones and an additional RCFC link per fabric and the ETS is adjusted to 60% FCoE and 40% Network.

Table 6: Switch-to-Switch site-to-site Configuration Examples

<table>
<thead>
<tr>
<th>500CP/5930/5940 Modular Site A switch A RCFC port 3PAR pwwn 20:11:00:02:ac:00:5f:74 FC 1/0/1</th>
<th>5900CP/5930/5940 Modular Site B switch A RCFC port 3PAR pwwn 20:11:00:02:ac:00:86:9a FC 1/0/1</th>
</tr>
</thead>
<tbody>
<tr>
<td>vlan 4004</td>
<td>vlan 4004</td>
</tr>
<tr>
<td>description ToRCFCa</td>
<td>description ToRCFCa</td>
</tr>
<tr>
<td>fcoe enable vsan 400</td>
<td>fcoe enable vsan 400</td>
</tr>
<tr>
<td>#</td>
<td>#</td>
</tr>
<tr>
<td>vlan 1002</td>
<td>vlan 1002</td>
</tr>
<tr>
<td>description To RCIP</td>
<td>description To RCIP</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>vlan 4094</td>
<td>vlan 4094</td>
</tr>
<tr>
<td>description enable VFT</td>
<td>description enable VFT</td>
</tr>
<tr>
<td>fcoe enable vsan 1</td>
<td>fcoe enable vsan 1</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>interface Fc1/0/1</td>
<td>interface Fc1/0/1</td>
</tr>
<tr>
<td>description 3PAR RCFC port</td>
<td>description 3PAR RCFC port</td>
</tr>
<tr>
<td>port access vsan 400</td>
<td>port access vsan 400</td>
</tr>
<tr>
<td>qos trust dot1p</td>
<td>qos trust dot1p</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>vsan 400</td>
<td>vsan 400</td>
</tr>
<tr>
<td>rscn aggregation enable</td>
<td>rscn aggregation enable</td>
</tr>
<tr>
<td>zone default-zone permit</td>
<td>zone default-zone permit</td>
</tr>
<tr>
<td>zone name a3par-fc011</td>
<td>zone name a3par-fc011</td>
</tr>
<tr>
<td>member pwwn 20:11:00:02:ac:00:5f:74</td>
<td>member pwwn 20:11:00:02:ac:00:5f:74</td>
</tr>
<tr>
<td>member pwwn 20:11:00:02:ac:00:86:9a</td>
<td>member pwwn 20:11:00:02:ac:00:86:9a</td>
</tr>
<tr>
<td>zoneset name rfc</td>
<td>zoneset name rfc</td>
</tr>
<tr>
<td>member a3par-fc011</td>
<td>member a3par-fc011</td>
</tr>
<tr>
<td>zoneset distribute full</td>
<td>zoneset distribute full</td>
</tr>
<tr>
<td>zoneset activate name rfc</td>
<td>zoneset activate name rfc</td>
</tr>
<tr>
<td>500CP/5930/5940 Modular Site A switch A RCFC</td>
<td>5900CP/5930/5940 Modular Site B switch A RCFC</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>port 3PAR pwnn 20:11:00:02:ac:00:5f:74 FC 1/0/1</td>
<td>port 3PAR pwnn 20:11:00:02:ac:00:86:9a FC 1/0/1</td>
</tr>
<tr>
<td>vsan 1</td>
<td>vsan 1</td>
</tr>
<tr>
<td>zone default-zone permit</td>
<td>zone default-zone permit</td>
</tr>
</tbody>
</table>

### 1GbE RCIP port - RJ45 JD089B

<table>
<thead>
<tr>
<th>500CP/5930/5940 Modular Site A switch A RCFC</th>
<th>5900CP/5930/5940 Modular Site B switch A RCFC</th>
</tr>
</thead>
<tbody>
<tr>
<td>description RCIP port</td>
<td>description RCIP port</td>
</tr>
<tr>
<td>port link-mode bridge</td>
<td>port link-mode bridge</td>
</tr>
<tr>
<td>port access vlan 1002</td>
<td>port access vlan 1002</td>
</tr>
<tr>
<td>flow-control</td>
<td>flow-control</td>
</tr>
<tr>
<td>stp edged-port</td>
<td>stp edged-port</td>
</tr>
</tbody>
</table>

### EXAMPLE 1: FCoE 40GbE ISL

<table>
<thead>
<tr>
<th>500CP/5930/5940 Modular Site A switch A RCFC</th>
<th>5900CP/5930/5940 Modular Site B switch A RCFC</th>
</tr>
</thead>
<tbody>
<tr>
<td>interface FortyGigE1/0/51</td>
<td>interface FortyGigE1/0/51</td>
</tr>
<tr>
<td>port link-mode bridge</td>
<td>port link-mode bridge</td>
</tr>
<tr>
<td>port link-type trunk</td>
<td>port link-type trunk</td>
</tr>
<tr>
<td>undo port trunk permit vlan 1</td>
<td>undo port trunk permit vlan 1</td>
</tr>
<tr>
<td>port trunk permit vlan 1002 4004</td>
<td>port trunk permit vlan 1002 4004</td>
</tr>
<tr>
<td>port trunk pvid vlan 1002</td>
<td>port trunk pvid vlan 1002</td>
</tr>
<tr>
<td>priority-flow-control auto</td>
<td>priority-flow-control auto</td>
</tr>
<tr>
<td>priority-flow-control no-drop dot1p 3</td>
<td>priority-flow-control no-drop dot1p 3</td>
</tr>
<tr>
<td>lldp tlv-enable dot1-tlv dcbx</td>
<td>lldp tlv-enable dot1-tlv dcbx</td>
</tr>
<tr>
<td>qos trust dot1p</td>
<td>qos trust dot1p</td>
</tr>
<tr>
<td>qos wrr be group 1 byte-count 15</td>
<td>qos wrr be group 1 byte-count 15</td>
</tr>
<tr>
<td>qos wrr af1 group 1 byte-count 15</td>
<td>qos wrr af1 group 1 byte-count 15</td>
</tr>
<tr>
<td>qos wrr af2 group sp</td>
<td>qos wrr af2 group sp</td>
</tr>
<tr>
<td>qos wrr af3 group sp</td>
<td>qos wrr af3 group sp</td>
</tr>
<tr>
<td>qos wrr af4 group sp</td>
<td>qos wrr af4 group sp</td>
</tr>
<tr>
<td>qos wrr ef group sp</td>
<td>qos wrr ef group sp</td>
</tr>
<tr>
<td>qos wrr cs6 group sp</td>
<td>qos wrr cs6 group sp</td>
</tr>
<tr>
<td>qos wrr cs7 group sp</td>
<td>qos wrr cs7 group sp</td>
</tr>
<tr>
<td>qos apply policy DCBX outbound</td>
<td>qos apply policy DCBX outbound</td>
</tr>
</tbody>
</table>

Table Continued
<table>
<thead>
<tr>
<th>500CP/5930/5940 Modular Site A switch A RCFC port 3PAR pwwn 20:11:00:02:ac:00:5f:74 FC 1/0/1</th>
<th>5900CP/5930/5940 Modular Site B switch A RCFC port 3PAR pwwn 20:11:00:02:ac:00:86:9a FC 1/0/1</th>
</tr>
</thead>
<tbody>
<tr>
<td>interface Vfc51</td>
<td>interface Vfc51</td>
</tr>
<tr>
<td>fc mode e</td>
<td>fc mode e</td>
</tr>
<tr>
<td>port trunk vsan 400</td>
<td>port trunk vsan 400</td>
</tr>
<tr>
<td>bind interface FortyGigE1/0/51</td>
<td>bind interface FortyGigE1/0/51</td>
</tr>
<tr>
<td><strong>Example 2: FCoE 10GbE ISL</strong></td>
<td><strong>Example 2: FCoE 10GbE ISL</strong></td>
</tr>
<tr>
<td>interface Ten-GigabitEthernet1/0/44</td>
<td>interface Ten-GigabitEthernet1/0/44</td>
</tr>
<tr>
<td>port link-mode bridge</td>
<td>port link-mode bridge</td>
</tr>
<tr>
<td>port link-type trunk</td>
<td>port link-type trunk</td>
</tr>
<tr>
<td>undo port trunk permit vlan 1</td>
<td>undo port trunk permit vlan 1</td>
</tr>
<tr>
<td>port trunk permit vlan 1002 4004</td>
<td>port trunk permit vlan 1002 4004</td>
</tr>
<tr>
<td>priority-flow-control auto</td>
<td>priority-flow-control auto</td>
</tr>
<tr>
<td>priority-flow-control no-drop dot1p 3</td>
<td>priority-flow-control no-drop dot1p 3</td>
</tr>
<tr>
<td>port connection-distance 40000</td>
<td>port connection-distance 40000</td>
</tr>
<tr>
<td>lldp tlv-enable dot1-tlv dcbx</td>
<td>lldp tlv-enable dot1-tlv dcbx</td>
</tr>
<tr>
<td>qos trust dot1p</td>
<td>qos trust dot1p</td>
</tr>
<tr>
<td>qos wrr be group 1 byte-count 2</td>
<td>qos wrr be group 1 byte-count 2</td>
</tr>
<tr>
<td>qos wrr af1 group 1 byte-count 8</td>
<td>qos wrr af1 group 1 byte-count 8</td>
</tr>
<tr>
<td>qos wrr af2 group sp</td>
<td>qos wrr af2 group sp</td>
</tr>
<tr>
<td>qos wrr af3 group sp</td>
<td>qos wrr af3 group sp</td>
</tr>
<tr>
<td>qos wrr af4 group sp</td>
<td>qos wrr af4 group sp</td>
</tr>
<tr>
<td>qos wrr ef group sp</td>
<td>qos wrr ef group sp</td>
</tr>
<tr>
<td>qos wrr cs6 group sp</td>
<td>qos wrr cs6 group sp</td>
</tr>
<tr>
<td>qos wrr cs7 group sp</td>
<td>qos wrr cs7 group sp</td>
</tr>
<tr>
<td>qos apply policy DCBX outbound</td>
<td>qos apply policy DCBX outbound</td>
</tr>
<tr>
<td>interface Vfc44</td>
<td>interface Vfc44</td>
</tr>
<tr>
<td>fc mode e</td>
<td>fc mode e</td>
</tr>
<tr>
<td>port trunk vsan 400</td>
<td>port trunk vsan 400</td>
</tr>
<tr>
<td>bind interface Ten-GigabitEthernet1/0/44</td>
<td>bind interface Ten-GigabitEthernet1/0/44</td>
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*Table Continued*
<table>
<thead>
<tr>
<th>500CP/5930/5940 Modular Site A switch A RCFC port 3PAR pwwn 20:11:00:02:ac:00:5f:74 FC 1/0/1</th>
<th>5900CP/5930/5940 Modular Site B switch A RCFC port 3PAR pwwn 20:11:00:02:ac:00:86:9a FC 1/0/1</th>
</tr>
</thead>
<tbody>
<tr>
<td>interface Ten-GigabitEthernet1/0/47</td>
<td>interface Ten-GigabitEthernet1/0/47</td>
</tr>
<tr>
<td>description RCIP port</td>
<td>description RCIP port</td>
</tr>
<tr>
<td>port link-mode bridge</td>
<td>port link-mode bridge</td>
</tr>
<tr>
<td>port access vlan 1002</td>
<td>port access vlan 1002</td>
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<tr>
<td>flow-control</td>
<td>flow-control</td>
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<td>stp edged-port</td>
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**Example 3: FC 8Gbps ISL**

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<thead>
<tr>
<th>interface Fc1/0/2</th>
<th>interface Fc1/0/2</th>
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</thead>
<tbody>
<tr>
<td>description FC ISL</td>
<td>description FC ISL</td>
</tr>
<tr>
<td>fc mode e</td>
<td>fc mode e</td>
</tr>
<tr>
<td>port access vsan 400</td>
<td>port access vsan 400</td>
</tr>
<tr>
<td>qos trust dot1p</td>
<td>qos trust dot1p</td>
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<table>
<thead>
<tr>
<th>Example 4: FC san-aggregation trunk 2x8Gbps ISL</th>
<th>Example 4: FC san-aggregation trunk 2x8Gbps ISL</th>
</tr>
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<tbody>
<tr>
<td>interface SAN-Aggregation 16</td>
<td>interface SAN-Aggregation 16</td>
</tr>
<tr>
<td>description FC trunk</td>
<td>description FC trunk</td>
</tr>
<tr>
<td>fc mode e</td>
<td>fc mode e</td>
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<tr>
<td>port trunk mode on</td>
<td>port trunk mode on</td>
</tr>
<tr>
<td>port trunk vsan 400</td>
<td>port trunk vsan 400</td>
</tr>
<tr>
<td>#</td>
<td>#</td>
</tr>
<tr>
<td>interface Fc1/0/15</td>
<td>interface Fc1/0/15</td>
</tr>
<tr>
<td>san-aggregation group 16</td>
<td>san-aggregation group 16</td>
</tr>
<tr>
<td>qos trust dot1p</td>
<td>qos trust dot1p</td>
</tr>
<tr>
<td>#</td>
<td>#</td>
</tr>
<tr>
<td>interface Fc1/0/16</td>
<td>interface Fc1/0/16</td>
</tr>
<tr>
<td>san-aggregation group 16</td>
<td>san-aggregation group 16</td>
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<tr>
<td>qos trust dot1p</td>
<td>qos trust dot1p</td>
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**Repeat fabric B using VSAN 500, VLANs 4005 and 1003 and 3PAR controller's partner RCFC port 21:11:00:02:ac:00:5f:74 and RCIP port**

**Example 5: FCoE Bridge-Aggregation 20G ISL IRF**

<table>
<thead>
<tr>
<th>Example 5: FCoE Bridge-Aggregation 20G ISL IRF</th>
<th>Example 5: FCoE Bridge-Aggregation 20G ISL IRF</th>
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<th><strong>5900CP/5930/5940 Modular Site B switch A</strong></th>
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<td>port 3PAR pwwn 20:11:00:02:ac:00:5f:74 FC 1/0/1</td>
<td>port 3PAR pwwn 20:11:00:02:ac:00:86:9a FC 1/0/1</td>
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<td>interface Bridge-Aggregation43</td>
<td>interface Bridge-Aggregation43</td>
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<tr>
<td>port link-type trunk</td>
<td>port link-type trunk</td>
</tr>
<tr>
<td>undo port trunk permit vlan 1</td>
<td>undo port trunk permit vlan 1</td>
</tr>
<tr>
<td>port trunk permit vlan 1002 1003 4004 4005</td>
<td>port trunk permit vlan 1002 1003 4004 4005</td>
</tr>
<tr>
<td>port trunk pvid vlan 1001</td>
<td>port trunk pvid vlan 1001</td>
</tr>
<tr>
<td>link-aggregation mode dynamic</td>
<td>link-aggregation mode dynamic</td>
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<tr>
<td>interface Ten-GigabitEthernet1/0/43</td>
<td>interface Ten-GigabitEthernet1/0/43</td>
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<tr>
<td>port link-mode bridge</td>
<td>port link-mode bridge</td>
</tr>
<tr>
<td>port link-type trunk</td>
<td>port link-type trunk</td>
</tr>
<tr>
<td>undo port trunk permit vlan 1</td>
<td>undo port trunk permit vlan 1</td>
</tr>
<tr>
<td>port trunk permit vlan 1002 1003 4004 4005</td>
<td>port trunk permit vlan 1002 1003 4004 4005</td>
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<td>priority-flow-control auto</td>
<td>priority-flow-control auto</td>
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<tr>
<td>priority-flow-control no-drop dot1p 3</td>
<td>priority-flow-control no-drop dot1p 3</td>
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<tr>
<td>port connection-distance 40000</td>
<td>port connection-distance 40000</td>
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<tr>
<td>lldp tlv-enable dot1-tlv dcbx</td>
<td>lldp tlv-enable dot1-tlv dcbx</td>
</tr>
<tr>
<td>qos trust dot1p</td>
<td>qos trust dot1p</td>
</tr>
<tr>
<td>qos wrr be group 1 byte-count 2</td>
<td>qos wrr be group 1 byte-count 2</td>
</tr>
<tr>
<td>qos wrr af1 group 1 byte-count 8</td>
<td>qos wrr af1 group 1 byte-count 8</td>
</tr>
<tr>
<td>qos wrr af2 group sp</td>
<td>qos wrr af2 group sp</td>
</tr>
<tr>
<td>qos wrr af3 group sp</td>
<td>qos wrr af3 group sp</td>
</tr>
<tr>
<td>qos wrr af4 group sp</td>
<td>qos wrr af4 group sp</td>
</tr>
<tr>
<td>qos wrr ef group sp</td>
<td>qos wrr ef group sp</td>
</tr>
<tr>
<td>qos wrr cs6 group sp</td>
<td>qos wrr cs6 group sp</td>
</tr>
<tr>
<td>qos wrr cs7 group sp</td>
<td>qos wrr cs7 group sp</td>
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<tr>
<td>qos apply policy DCBX outbound</td>
<td>qos apply policy DCBX outbound</td>
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<tr>
<td>port link-aggregation group 43</td>
<td>port link-aggregation group 43</td>
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<th>5900CP/5930/5940 Modular Site B switch A RCFC port 3PAR pwwn 20:11:00:02:ac:00:86:9a FC 1/0/1</th>
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<tr>
<td>interface Ten-GigabitEthernet2/0/43</td>
<td>interface Ten-GigabitEthernet2/0/43</td>
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<tr>
<td>port link-mode bridge</td>
<td>port link-mode bridge</td>
</tr>
<tr>
<td>port link-type trunk</td>
<td>port link-type trunk</td>
</tr>
<tr>
<td>undo port trunk permit vlan 1</td>
<td>undo port trunk permit vlan 1</td>
</tr>
<tr>
<td>port trunk permit vlan 1002 1003 4004 4005</td>
<td>port trunk permit vlan 1002 1003 4004 4005</td>
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<tr>
<td>priority-flow-control auto</td>
<td>priority-flow-control auto</td>
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<tr>
<td>priority-flow-control no-drop dot1p 3</td>
<td>priority-flow-control no-drop dot1p 3</td>
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<td>port connection-distance 40000</td>
<td>port connection-distance 40000</td>
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<td>lldp tlv-enable dot1-tlv dcbx</td>
<td>lldp tlv-enable dot1-tlv dcbx</td>
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<tr>
<td>qos trust dot1p</td>
<td>qos trust dot1p</td>
</tr>
<tr>
<td>qos wrq be group 1 byte-count 2</td>
<td>qos wrq be group 1 byte-count 2</td>
</tr>
<tr>
<td>qos wrq af1 group 1 byte-count 8</td>
<td>qos wrq af1 group 1 byte-count 8</td>
</tr>
<tr>
<td>qos wrq af2 group sp</td>
<td>qos wrq af2 group sp</td>
</tr>
<tr>
<td>qos wrq af3 group sp</td>
<td>qos wrq af3 group sp</td>
</tr>
<tr>
<td>qos wrq af4 group sp</td>
<td>qos wrq af4 group sp</td>
</tr>
<tr>
<td>qos wrq ef group sp</td>
<td>qos wrq ef group sp</td>
</tr>
<tr>
<td>qos wrq cs6 group sp</td>
<td>qos wrq cs6 group sp</td>
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<tr>
<td>qos wrq cs7 group sp</td>
<td>qos wrq cs7 group sp</td>
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<tr>
<td>qos apply policy DCBX outbound</td>
<td>qos apply policy DCBX outbound</td>
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<tr>
<td>port link-aggregation group 43</td>
<td>port link-aggregation group 43</td>
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<table>
<thead>
<tr>
<th>interface Vfc43</th>
<th>interface Vfc43</th>
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</thead>
<tbody>
<tr>
<td>fc mode e</td>
<td>fc mode e</td>
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<tr>
<td>port trunk vsan 400 500</td>
<td>port trunk vsan 400 500</td>
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<tr>
<td>bind interface Ten-GigabitEthernet1/0/43</td>
<td>bind interface Ten-GigabitEthernet1/0/43</td>
</tr>
<tr>
<td>interface Vfc242</td>
<td>interface Vfc242</td>
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<tr>
<td>fc mode e</td>
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<tr>
<td>port trunk vsan 400 500</td>
<td>port trunk vsan 400 500</td>
</tr>
<tr>
<td>bind interface Ten-GigabitEthernet2/0/42</td>
<td>bind interface Ten-GigabitEthernet2/0/42</td>
</tr>
</tbody>
</table>

Example 6: FCoE 40GbE shared 2xRCFC ISL with Server-Storage

Example 6: FCoE 40GbE shared 2xRCFC ISL with Server-Storage

*Table Continued*
<table>
<thead>
<tr>
<th>500CP/5930/5940 Modular Site A switch A RCFC port 3PAR pwnn 20:11:00:02:ac:00:5f:74 FC 1/0/1</th>
<th>5900CP/5930/5940 Modular Site B switch A RCFC port 3PAR pwnn 20:11:00:02:ac:00:86:9a FC 1/0/1</th>
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<tbody>
<tr>
<td>vlan 4004</td>
<td>vlan 4004</td>
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<td>description ToRCFCa</td>
<td>description ToRCFCa</td>
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<tr>
<td>fcoe enable vsan 400</td>
<td>fcoe enable vsan 400</td>
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<tr>
<td>#</td>
<td>#</td>
</tr>
<tr>
<td>vlan 4006</td>
<td>vlan 4006</td>
</tr>
<tr>
<td>description ToRCFCa</td>
<td>description ToRCFCa</td>
</tr>
<tr>
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<td>fcoe enable vsan 401</td>
</tr>
<tr>
<td>#</td>
<td>#</td>
</tr>
<tr>
<td>vlan 1002</td>
<td>vlan 1002</td>
</tr>
<tr>
<td>description To RCIP</td>
<td>description To RCIP</td>
</tr>
<tr>
<td>#</td>
<td>#</td>
</tr>
<tr>
<td>vlan 4001</td>
<td>vlan 4001</td>
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<tr>
<td>description ToServerSAN</td>
<td>description ToServerSAN</td>
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<td>fcoe enable vsan 100</td>
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<tr>
<td>#</td>
<td>#</td>
</tr>
<tr>
<td>vlan 1001</td>
<td>vlan 1001</td>
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<tr>
<td>description To Server</td>
<td>description To Server</td>
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<tr>
<th>500CP/5930/5940 Modular Site A switch A RCFC port 3PAR pwwn 20:11:00:02:ac:00:5f:74 FC 1/0/1</th>
<th>5900CP/5930/5940 Modular Site B switch A RCFC port 3PAR pwwn 20:11:00:02:ac:00:86:9a FC 1/0/1</th>
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<tbody>
<tr>
<td>interface FortyGigE1/0/52</td>
<td>interface FortyGigE1/0/52</td>
</tr>
<tr>
<td>port link-mode bridge</td>
<td>port link-mode bridge</td>
</tr>
<tr>
<td>port link-type trunk</td>
<td>port link-type trunk</td>
</tr>
<tr>
<td>undo port trunk permit vlan 1</td>
<td>undo port trunk permit vlan 1</td>
</tr>
<tr>
<td>port trunk permit vlan 1001 1002 4001 4004 4006</td>
<td>port trunk permit vlan 1001 1002 4001 4004 4006</td>
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<td>port trunk pvid vlan 1001</td>
<td>port trunk pvid vlan 1001</td>
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<td>priority-flow-control auto</td>
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<td>priority-flow-control no-drop dot1p 3</td>
<td>priority-flow-control no-drop dot1p 3</td>
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<td>lldp tlv-enable dot1-tlv dcbx</td>
<td>lldp tlv-enable dot1-tlv dcbx</td>
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<tr>
<td>qos trust dot1p</td>
<td>qos trust dot1p</td>
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<tr>
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<td>qos wrt be group 1 byte-count 8</td>
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<td>qos wrt af2 group sp</td>
<td>qos wrt af2 group sp</td>
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<tr>
<td>qos wrt af3 group sp</td>
<td>qos wrt af3 group sp</td>
</tr>
<tr>
<td>qos wrt af4 group sp</td>
<td>qos wrt af4 group sp</td>
</tr>
<tr>
<td>qos wrt ef group sp</td>
<td>qos wrt ef group sp</td>
</tr>
<tr>
<td>qos wrt cs6 group sp</td>
<td>qos wrt cs6 group sp</td>
</tr>
<tr>
<td>qos wrt cs7 group sp</td>
<td>qos wrt cs7 group sp</td>
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<tr>
<td>qos apply policy DCBX outbound</td>
<td>qos apply policy DCBX outbound</td>
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<td>interface Vfc52</td>
<td>interface Vfc52</td>
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<td>description trunk 2xRCFC and server VSANs</td>
<td>description trunk 2xRCFC and server VSANs</td>
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<td>port trunk vsan 100 400 401</td>
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<td>bind interface FortyGigE1/0/51</td>
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<td>interface Fc1/0/1</td>
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<td>description 3PAR RCFC port</td>
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<tr>
<td>qos trust dot1p</td>
<td>qos trust dot1p</td>
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<td>#</td>
<td>#</td>
</tr>
<tr>
<td>interface Fc1/0/3</td>
<td>interface Fc1/0/3</td>
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<td>member pwnn 20:11:00:02:ac:00:5f:74</td>
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<tr>
<td>member pwnn 20:11:00:02:ac:00:86:9a</td>
<td>member pwnn 20:11:00:02:ac:00:86:9a</td>
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<td>zoneset name rcfc</td>
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<td>member a3par-fc011</td>
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<td>zone default-zone permit</td>
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<tr>
<td>zone name aServer-3par-fcoe022</td>
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</tr>
<tr>
<td>member pwnn 20:00:2c:76:8a:5b:47:41</td>
<td>member pwnn 20:00:2c:76:8a:5b:47:41</td>
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<tr>
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</tr>
<tr>
<td>member pwnn 20:22:00:02:ac:00:86:9a</td>
<td>member pwnn 20:22:00:02:ac:00:86:9a</td>
</tr>
<tr>
<td>zone name bServer-3par-fcoe022</td>
<td>zone name bServer-3par-fcoe022</td>
</tr>
<tr>
<td>member pwnn 20:00:2c:76:8a:5b:45:51</td>
<td>member pwnn 20:00:2c:76:8a:5b:45:51</td>
</tr>
<tr>
<td>member pwnn 20:22:00:02:ac:00:5f:74</td>
<td>member pwnn 20:22:00:02:ac:00:5f:74</td>
</tr>
<tr>
<td>member pwnn 20:22:00:02:ac:00:86:9a</td>
<td>member pwnn 20:22:00:02:ac:00:86:9a</td>
</tr>
<tr>
<td>zoneset name local-remote-servers</td>
<td>zoneset name local-remote-servers</td>
</tr>
<tr>
<td>500CP/5930/5940 Modular Site A switch A RCFC port 3PAR pwnn 20:11:00:02:ac:00:5f:74 FC 1/0/1</td>
<td>5900CP/5930/5940 Modular Site B switch A RCFC port 3PAR pwnn 20:11:00:02:ac:00:86:9a FC 1/0/1</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>member bServer-3par-fc022</td>
<td>member bServer-3par-fc022</td>
</tr>
<tr>
<td>zoneset distribute full</td>
<td>zoneset distribute full</td>
</tr>
<tr>
<td>zoneset activate name local-remote-servers</td>
<td>zoneset activate name local-remote-servers</td>
</tr>
</tbody>
</table>

Repeat for fabric B using RCFC VSANs 500 501, Server VSAN 200, VLANs 4002, 4005, 4007, 1001, and 1003 and 3PAR controller's partner RCFC port 21:22:00:02:ac:00:5f:74, 21:22:00:02:ac:00:86:9a, servers pwwns 20:00:2c:76:8a:5b:47:41 20:00:2c:76:8a:5b:45:55 and RCIP port

Repeat fabric B using RCFC VSANs 500 501, Server VSAN 200, VLANs 4002, 4005, 4007, 1001, and 1003 and 3PAR controller's partner RCFC port 21:22:00:02:ac:00:5f:74, 21:22:00:02:ac:00:86:9a, servers pwwns 20:00:2c:76:8a:5b:47:41 20:00:2c:76:8a:5b:45:55 and RCIP port
Software and Firmware update process

Introduction

This section provides Hewlett Packard Enterprise recommendations for two update scenarios. Review this section before performing an update.

**New switch installation in a new fabric**

You are installing a new switch as a single switch fabric or installing multiple new switches as a multi-switch fabric:

- Hewlett Packard Enterprise recommends you upgrade the new switch or switches to the latest released software image. Go to Drivers and Software and search for FlexFabric 5900CP or FlexFabric 5930/5940 or FlexFabric 5700 Switch Series.

- Hewlett Packard Enterprise recommends all switches of the same model used in the same fabric utilize the same software image version.

**NOTE:**

- Different switch models may have different software files for a given software version release
- Different switch models may require different software versions
- Upgrades should always be executed on switches one fabric at a time

For switches in an IRF configuration:

- All IRF member switches must utilize the same software image version (except during the FW upgrade process)
- Verify the software auto-update function is enabled on all IRF member switches

For more information, see **IRF Considerations** on page 80.

**New switch installation in an existing fabric**

You are installing a new switch into an existing fabric:

- Hewlett Packard Enterprise recommends you upgrade the new switch to the latest released software image or to the version being used in currently installed switches. Go to Drivers & Software and search for FlexFabric 5900CP or FlexFabric 5930 or FlexFabric 5700 Switch Series.

- Hewlett Packard Enterprise recommends all switches of the same model used in the same fabric utilize the same software image version. Different switch models may have different software files for a given software version release.

- Determine if the software image installed in any existing switches is compatible with the latest released software image version. See the **Compatibility** section in the **Comware Release Notes**.

- Upgrades should always be executed on switches one at a time and done one fabric at a time.

For switches in an IRF configuration:
• All IRF member switches must utilize the same software image version (except during the FW upgrade process).

• Verify the software auto-update function is enabled on all IRF member switches.

For more information, see IRF Considerations on page 80.

Firmware Update Process – Non ISSU

The non-ISSU firmware update process is disruptive if you have implemented a single SAN fabric or a dual SAN fabric using logically separate fabrics. See IRF usage with storage on page 50. If you have implemented a dual-redundant NSPOF SAN, the firmware process requires a fabric failover. To update the firmware using non-ISSU procedure:

Procedure

1. Ensure the latest firmware is obtained via hpe.com

2. Use the dir command to verify that all IRF member devices have sufficient storage space for the upgrade images, and use the delete or delete/unreserved command to delete unused files. Use the reset recycle-bin command to permanently delete files from flash.

3. Use the ftp client on the switch to download and the boot-loader command to update flash for each slot.
   a. <HP> ftp <IP address> then login to the server.
   b. <HP> bin
   c. <HP> get <firmware filename.ipe>
   d. <HP> boot-loader file flash:/<firmware file name> slot 1 main

      The following message appears:
      This command will set the main startup software images. Continue? [Y/N]:.

      Enter: y and proceed.

      ___________________________
      NOTE:
      In an IRF configuration, step d must be executed for all slots.

   e. <HP> save
NOTE:
A save must be completed before a reboot to ensure that the current configuration is not lost unless the user wants to revert back to the saved configuration in the .cfg file.

The following message appears:
The current configuration will be written to the device. Are you sure? [Y/N]:
Enter: Y and proceed.
Please input the the filename (*.cfg) [flash:/config87.cfg] (To leave the existing filename unchanged, press the enter key): flash:/config87.cfg exists, overwrite?[Y/N]:
Enter: Y and proceed.
Validating file. Please wait... Saved the current configuration to mainboard device successfully.

f. `<HP> reboot`

NOTE:
The reboot command will reboot all switches in the IRF domain.

g. Verify the device is running the correct software.
   `<Sysname> display version`

IRF Considerations

IRF impacts on upgrading the software:

- If IRF is used for connecting switches between fabrics, configure VSANs such that a VSAN only exists in one IRF member switch. In general, connectivity should not allow FCoE data traffic across any IRF links. The exception is when you are implementing a dual-redundant storage fabric configuration with two stacked switches in two IRF domains. For more information, see IRF usage with storage on page 50.

- When IRF is employed and VSANs are configured, as a best practice, any software upgrade should be executed as a possibly disruptive upgrade due to potentials of interruption of connectivity for durations that are long for storage functionality.
Management Software

The primary management interface for the FlexFabric 57xx/59xx and 79xx/129xx switches is through the CLI. To access the CLI, see Using the CLI on page 81. All the management commands necessary for FlexFabric switches are available through the CLI. Management support for FlexFabric switches is also provided with an integrated GUI, HPE OneView and HPE Intelligent Management Center (IMC) software. For more information on OneView features supported by the FlexFabric switches, see HPE OneView Management Software on page 82. There are three levels of support with IMC – no license is required for level 1, a license is required for level 2 and for the FCoE plug-in module. For more information on IMC features, see IMC Management software on page 82.

Using the CLI

When accessing the switch for the first time, you must use a console cable to connect a console terminal, such as a PC, to the console port on the switch.

Using the console cable provided with the switch, first plug the DB-9 female connector of the console cable to the serial port of the PC, and then connect the RJ-45 connector to the console port of the switch.

To configure and manage the switch, you must run a terminal emulator program on the console terminal.

The required terminal settings are:

- Bits per second: 9,600
- Data bits: 8
- Parity: None
- Stop bits: 1
- Flow control: None
- Emulation: VT100

By default, login through the console port is enabled and the user role network-admin is assigned. A username and password is not required for login. After login, configure password or scheme authentication mode to improve device security.

To prevent illegal access to the CLI and control user behaviors, configure login authentication, assign user roles, configure command authorization and command accounting, and use ACLs to filter unauthorized login.

By default, you can log in to the CLI only through the console port. To facilitate device management, log in to the device through the console port and configure other login methods such as Telnet and SSH.

To log in through the Telnet:

1. Enable the Telnet server function.
2. Assign an IP address to a Layer 3 interface and make sure that the interface and the telnet client can establish a connection between them.
3. Configure an authentication mode for VTY login users.
4. By default, password authentication is used but no password is configured.
5. Assign a user role to VTY login users. The default role assigned is network-operator.

To log in through the SSH:
1. Enable the SSH server function and configure SSH attributes.
2. Assign an IP address to a Layer 3 interface and make sure the that interface and the SSH client can establish a connection between them.
3. Configure scheme authentication for VTY login users. The default authentication scheme is password authentication.
4. Assign a user role to VTY login users. The default role assigned is network-operator.

**HPE OneView Management Software**

OneView version 1.20 and later includes support for performing Fibre Channel SAN operations on the FlexFabric 5900CP switch. OneView version 3.1 includes support for FlexFabric 5700, 5900, 5930, and 5940 FC-FCoE switches. Interaction from OneView to the FlexFabric 5700, 5900, 5930, and 5940 switch uses the SNMP v3 interface which must be enabled and configured on the switch. Operations performed are:

- Discovery of configured FC and FCoE VSANs, and their properties.
- Discovery of VSAN zones, aliases and logged-in endpoints, used for server to storage connectivity validation.
- VSAN zoneset, zone and alias lifecycle management as server to storage data paths are configured/updated/monitored/unconfigured from server profiles.

For more information on OneView management software, see [http://www.hpe.com/info/oneview](http://www.hpe.com/info/oneview)

**IMC Management software**

IMC management software provides the following features:

- Level 1–Discovery: Basic standalone IMC support (event logs), no license required
- Level 2/3–Access device, read/update configurations: Virtual Application Network (VAN) Fabric Management (VFM), license required
- Optional plug-in module (FCoE add-on license)
- VAN Fabric topology–Physical topology of networks (LAN/SAN)
- DC management–Logical group of networks, servers, and storage devices
- SAN configuration–Fabric/FCoE management, zone configuration, zone sets, devices
- LAN configuration–Trill configuration, SPB network, device management, VLANs, AC lists, EVI config
- Statistics–VLAN, I-SID, ECT
- Interface–SNMP/MIBs
### FlexFabric 57xx/59xx and 129xxE/79xx system architecture considerations

<table>
<thead>
<tr>
<th>Parameter name/type</th>
<th>Parameter value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fabric logins per FCF</td>
<td>247</td>
<td>E-port utilizes one Login, reduce the number by one for each e-port connected switch. FSPF for hop by hop routing, static route support, up to 255 routes. The maximum number of static routes allowed in a VSAN is 256.</td>
</tr>
<tr>
<td>VSAN's per switch</td>
<td>16</td>
<td>Virtual SANs with overlapping address space up to 16. The maximum number of VSANs, including the default VSAN, allowed on a switch is 16.</td>
</tr>
<tr>
<td>VFC and FC interfaces per switch</td>
<td>512</td>
<td>Virtual FC interfaces up to 512 per switch.</td>
</tr>
<tr>
<td>Maximum number of logged in devices per fabric</td>
<td>964</td>
<td>Validated number of devices (initiators, targets, or NPIV devices) per fabric</td>
</tr>
<tr>
<td>Number of zones per switch</td>
<td>4000</td>
<td>Each soft zone can have as many members as necessary; recommend utilization of I-T zones. You can configure a maximum of 4000 zones for all VSANs on a switch.</td>
</tr>
<tr>
<td>Number of Hard Zones per 57xx/59xx switch</td>
<td>126</td>
<td>Limited by zone entry rules per port, assuming one I-T pairwise member per zone.</td>
</tr>
<tr>
<td>Number of Hard Zones per 129xxE/79xx switch</td>
<td>1024</td>
<td>Limited by zone entry rules per port, assuming one I-T pairwise member per zone.</td>
</tr>
<tr>
<td>Zone Alias names</td>
<td>4000</td>
<td>You can configure a maximum of 4000 zone aliases for all VSANs on a switch.</td>
</tr>
<tr>
<td>Zonesets per switch</td>
<td>128</td>
<td>You can configure a maximum of 128 zone sets for all VSANs on a switch.</td>
</tr>
</tbody>
</table>

**NOTE:** 32 VSANs are supported by 5930, 5940, 5950 beginning with CMW versions R26xx and R62xx.
<table>
<thead>
<tr>
<th>Parameter name/type</th>
<th>Parameter value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone member Alias names</td>
<td>4000</td>
<td>You can configure a maximum of 4000 zone member alias names.</td>
</tr>
<tr>
<td>Number of NPIV WWNs per NP port</td>
<td>127</td>
<td>NPIV support with up to 127 VN_Ports per VF_port.</td>
</tr>
<tr>
<td>Number of MAC addresses bound to VFCs per VF_port</td>
<td>127</td>
<td>NPIV support with up to 127 VN_Ports per VF_port.</td>
</tr>
<tr>
<td>Number of FC port Transmit BB credits</td>
<td>15</td>
<td>Default value set during link initialization.</td>
</tr>
<tr>
<td>Domain IDs or maximum number of switches per SAN</td>
<td>239</td>
<td>Similar to an FC switch, each FCF switch is assigned a domain ID. Each FC SAN supports a maximum number of 239 domain IDs, so an FC SAN cannot have more than 239 switches.</td>
</tr>
<tr>
<td>Switches per IRF Domain (Ethernet, no VSANs configured)</td>
<td>9</td>
<td>Ethernet-only configuration.</td>
</tr>
<tr>
<td>Switches per IRF domain (VSANs configured)</td>
<td>2</td>
<td>Storage configuration.</td>
</tr>
<tr>
<td>irf link-delay interval</td>
<td>INTEGER &lt;0-10000&gt;</td>
<td>The IRF fabric might run other protocols, for example, CFD, VRRP, FCoE, and OSPF, that have a shorter protocol packet lifetime than the delay interval. For stable protocol running, make sure the delay interval is shorter than the maximum lifetime of these protocol packets. You can adjust either the IRF link down report delay or the maximum lifetime of the protocol packets.</td>
</tr>
<tr>
<td>Non-overlapping VSANs per IRF domain member switch</td>
<td>8</td>
<td>Storage configuration recommends one VSAN per member switch and no common VSANs for member switches to avoid storage traffic flow over IRF links.</td>
</tr>
<tr>
<td>Set the maximum number of Selected ports for the aggregation group.</td>
<td>link-aggregation selected-port maximum number 32</td>
<td>By default, the maximum number of selected ports for an aggregation group is 32.</td>
</tr>
</tbody>
</table>

Table Continued
<table>
<thead>
<tr>
<th>Parameter name/type</th>
<th>Parameter value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set the minimum number of Selected ports for the aggregation group.</td>
<td>link-aggregation selected-port minimum number</td>
<td>By default, the minimum number of selected ports for the aggregation group is not specified.</td>
</tr>
<tr>
<td>10GbE LR SFP+ lossless (PFC) working distance; port-connection distance 10000</td>
<td>10 km - single-mode fiber</td>
<td>HPE X130 SFP+ LC LR Transceiver JD094B 10GbE lossless connectivity on single-mode fiber.</td>
</tr>
<tr>
<td>10GbE SR SFP+ lossless (PFC) working distance</td>
<td>300 m - OM3</td>
<td>HPE X130 SFP+ LC SR transceiver JD092B 10GbE lossless 300m connectivity on multi-mode fiber.</td>
</tr>
<tr>
<td>QSFP+ port 10GE 4xLC mode lossless (PFC) working distance</td>
<td>100 m - OM3 300 m - OM3</td>
<td>JG325B SR4 QSFP+ transceiver. JG709A CSR4 QSFP+ transceiver.</td>
</tr>
<tr>
<td>10GbE ER SFP+ lossless (PFC) working distance</td>
<td>40 km or 20 km - single-mode fiber</td>
<td>HPE X130 SFP+ LC ER transceiver JG234A 10GbE 40 km on single-mode fiber.</td>
</tr>
<tr>
<td>10GbE Limited SR SFP+ lossless (PFC) working distance</td>
<td>125 m - OM4</td>
<td>H6Z42A SFP+ 50um OM4 multi-mode fiber.</td>
</tr>
<tr>
<td>8 Gbps FC SFP+ BB credit working distance</td>
<td>150 m - OM3 190M - OM4</td>
<td>AJ718A SFP+ multi-mode fiber.</td>
</tr>
<tr>
<td>4 Gbps FC SFP+ BB credit working distance</td>
<td>380 m - OM3 400m - OM4</td>
<td>AJ718A SFP+ multi-mode fiber.</td>
</tr>
<tr>
<td>2 Gbps FC SFP+ BB credit working distance</td>
<td>500 m - OM3</td>
<td>AJ718A SFP+ multi-mode fiber.</td>
</tr>
<tr>
<td>8/4/2Gbps FC SFP+ working distance</td>
<td>10 km - single-mode fiber</td>
<td>AW584A SFP+ Link lengths up to 10 km at 8.5/4.25/2.125 GBd with single mode fiber (15 BB credits limited).</td>
</tr>
<tr>
<td>8Gbps FC SFP+ BB credit working distance</td>
<td>190 m - OM4</td>
<td>H6Z42A SFP+ 50um OM4.</td>
</tr>
<tr>
<td>4Gbps FC SFP+ BB credit working distance</td>
<td>400 m - OM4</td>
<td>H6Z42A SFP+ 50um OM4.</td>
</tr>
<tr>
<td>40GbE SR QSFP+ lossless (PFC) working distance</td>
<td>150 m - OM4 100 m - OM3</td>
<td>HPE X140 40G QSFP+ MPO SR4 transceiver JG325B.</td>
</tr>
</tbody>
</table>

Table Continued
<table>
<thead>
<tr>
<th>Parameter name/type</th>
<th>Parameter value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>40GbE LR4 QSFP+lossless (PFC) working distance</td>
<td>10 km - single-mode fiber</td>
<td>HPE X140 40G QSFP+ LC LR4 SM CWDM transceiver JG661A.</td>
</tr>
<tr>
<td>40GbE copper QSFP+ PFC working distance</td>
<td>5 m</td>
<td>HPE X240 40G QSFP+ 5m direct attach copper cable JG328A.</td>
</tr>
<tr>
<td>10GbE copper QSFP+ PFC working distance</td>
<td>7 m</td>
<td>HPE X240 10G SFP+ 7m direct attach copper cable JC784C.</td>
</tr>
<tr>
<td>FSPF graceful restart</td>
<td>120 s typical</td>
<td>The default setting is 120 seconds. FSPF GR (Graceful Restart) enables nonstop forwarding of traffic by backing up FSPF configuration information during a protocol restart, for example, the FSPF process restart triggered by the process command, or active/standby switchover.</td>
</tr>
<tr>
<td>Fabric Device Management Interface (FDMI) function, FDMI objects per port</td>
<td>8</td>
<td>An HBA object can have a maximum of eight port objects.</td>
</tr>
<tr>
<td>Upper limit of concurrent logins using the same user name</td>
<td>access-limit max-user-number 16 recommended</td>
<td>By default, the number of concurrent logins is not limited for the local user. This command takes effect only when local accounting is configured for the local user. It does not apply to FTP, SFTP, or SCP users who do not support accounting.</td>
</tr>
<tr>
<td>Configure password control attributes for the local user.</td>
<td>Depends on environment</td>
<td>Configure the maximum login attempts and the action to take if there is a login failure: password-control login-attempt login-times [ exceed { lock</td>
</tr>
<tr>
<td>Enable broadcast suppression and set the broadcast suppression threshold.</td>
<td>broadcast-suppression { ratio</td>
<td>pps max-pps</td>
</tr>
<tr>
<td>Enable multicast suppression and set the multicast suppression threshold.</td>
<td>multicast-suppression { ratio</td>
<td>pps max-pps</td>
</tr>
<tr>
<td>Enable unknown unicast suppression and set the unknown unicast suppression threshold.</td>
<td>unicast-suppression { ratio</td>
<td>pps max-pps</td>
</tr>
</tbody>
</table>

*Table Continued*
<table>
<thead>
<tr>
<th>Parameter name/type</th>
<th>Parameter value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set the maximum number of lines to be displayed on a screen.</td>
<td>screen-length screen-length</td>
<td>By default, a screen displays a maximum of 24 lines. A value of 0 disables pausing between screens of output.</td>
</tr>
<tr>
<td>Set the maximum number of concurrent Telnet users.</td>
<td>aaa session-limit telnet max-sessions default=32</td>
<td>Changing this setting does not affect online users. If the current number of online Telnet users is equal to or greater than the new setting, no additional Telnet users can log in until online users log out.</td>
</tr>
</tbody>
</table>
The FlexFabric 57xx/59xx and 79xx/129xx switches provide various display capabilities. You can use the displays to identify issues by viewing configurations, port status summaries, and more in-depth information about each port.

By default, the switch updates a logfile once a day. You can generate a g-zipped tar file using the display diagnostic CLI command and export this file for review. Two files are required for support:

- **Configuration file**—startup.cfg
- **Logfile**—logfile.log

These text files are stored in flash:/startup.cfg and flash:/logfile/logfile.log. The name of the configuration file can be different if you have changed it. You must have a backup copy of the configuration file. Ensure the current configuration is saved to a .cfg file before requesting support.

**NOTE:**

Generate a support file as follows (the following example is for 5900CP, 5930 Modular is similar):

```
[5900cp] display diag

Save or display diagnostic information
(Y=save, N=display)? [Y/N]: y

Input the file name
(*.tar.gz)[flash:/ diag.tar.gz]:

Displayed information included in the diag file, which can be separately logged:

display fc login {count}
display fcs data
display fc na database
display fc domain-list
display vsan port-member
display priority-flow-control interface
display stp brief
```

Following are some useful CLI commands:

- display current (HotKey <Ctrl-G>)
- display version
- display interface brief
- display interface
- display zone status
- display fc login
- display fcs database
- display vsan nnn port-member
• display npv login
• display counters inbound interface
• display counters outbound interface
• display link-aggregation verbose

These CLI commands help you to view the information and identify the issue quickly.

In the following examples, two configuration files are named after the switch number. The config87.cfg file is the primary file representing how the switch is presently configured.

```
<HP>dir
Directory of flash:
0 -rw- 8215552 Mar 10 2014 15:51:10 5900_5920-cmw710-boot-r2308p01.bin
1 -rw- 5290800 Mar 10 2014 15:53:08 5900_5920-cmw710-system-r2308p01.bin
2 -rw- 22736 Jul 23 2013 20:46:13 config87-npv.cfg
3 -rw- 32344 Mar 11 2014 23:19:59 config87.cfg
4 -rw- 223240 Mar 11 2014 23:19:59 config87.mdb
5 -rw- 169086 Mar 14 2014 15:27:27 diag.tar.gz
6 drw- - Mar 10 2011 00:00:35 diagfile
7 -rw- 567 Jul 16 2013 22:33:41 dsakey
8 - drw- - Feb 19 2014 18:02:53 fczone
9 -rw- 735 Oct 15 2013 09:26:30 config87.cfg
hostkey
10 -rw- 1795 Mar 11 2014 23:19:56 ifindex.dat
11 -rw- 0 Aug 13 2013 20:45:49 lauth.dat
12 drw- - Jan 01 2011 00:00:36 license
13 drw- - Feb 19 2014 18:02:53 logfile
14 -rw- 111321 Aug 08 2008 20:00:00 lsw152qf.vme
15 -rw- 916801 Aug 09 2013 14:04:55 lsws820x11152_v1.26 btw
16 -rw- 591 Oct 15 2013 09:26:20 serverkey
17- drw- - Aug 12 2013 17:43:59 versionInfo
524288 KB total (330800 KB free)
```
This appendix shows some sections from the 5700, 5900, or a 5930 switch configuration file. Use this as a guide for creating the configuration file for your specific implementation. Spanning Tree Protocol (STP) is implemented in networks to prevent loops. If STP is enabled, when a port becomes active a Topology Change Notification (TCN) packet is generated and STP will not set the port to the forwarding state immediately but usually a 15 second delay. To ensure that terminal based ports (server and storage connections) are not affected, use stp edged-port on all end node port configurations.

**LLDP must be and STP should be enabled for FCoE functionality**

```
# lldp global enable
#
# stp global enable

The switch must be in advance mode to operate FCoE/FC functionality, switch reboot is required after this mode is changed to/from advanced.

system-working-mode advance
#

Setup Switch Mode [fcf, npv, transit]

fcoe-mode fcf

# For balanced two fabric multi-hop configurations use FSPF graceful restart

fspf graceful-restart
#

Define the vsan - valid vsan numbers 1-3839 maximum 16 per switch

Can set the domain ID as a static ID or allow dynamic fabrics feature to assign domain IDs.

Zoning information for the vsan is kept here.

To use persistent FCIDs define using wwn <your WWN> area-port-id <4 digit hex of desired FCID>

vsan 100
rscn aggregation enable

wwn 21:00:2c:27:d7:53:f5:87 area-port-id 0001
zone-alias name Enc6S1P1
member pwnw 10:00:6c:3b:e5:a4:a2:71
zone-alias name P10K-FC-ports
member pwnw 20:52:00:02:ac:00:62:f6
member pwnw 21:52:00:02:ac:00:62:f6
zone name P10K-FC
member zone-alias Enc6S1P1
member zone-alias P10K-FC-ports
```
zoneset name 5900CP_vsan100
member P10K-FC
zoneset distribute full
zoneset activate name
5900CP_vsan100
#
vsan 1
#
vlan 1
#
vlan 1001
description ToLAN
#
There shall be an FCoE enabled VLAN associated with each vsan configured regardless of port-type FC and Ethernet/FCoE
vlan 4001
vlan 4094
vlan 4000
description ToSAN-A
description VFT ready
description iSCSI
fcoe enable vsan 100
fcoe enable vsan 1
#
#
Definition of the FCoE and other queues; alternative for iSCSI/FCoE
qos map-table dot1p-lp
import 0 export 0
import 1 export 0
import 2 export 0
import 3 export 1
import 4 export 0
import 5 export 0
import 6 export 0
import 7 export 0
#
#
NOTE:
For Comware versions R24xx and earlier versions.

acl 4000 for FCoE - acl 3000 for iSCSI use
acl number 4000 name DCBX
rule 0 permit type 8906 ffff
rule 5 permit type 8914 ffff
configure dcbx; alternative for iscsi/fcoe

traffic classifier dcbx operator or
if-match acl 4000
if-match acl 3000
#
#
traffic behavior dcbx
remark dot1p3
#
#
qos policy dcbx
classifier dcbx behavior dcbx mode dcbx
#
#
NOTE:

for comware versions R26xx and later versions.

acl 4000 for FCoE - acl 3000 for iSCSI use
#
acl advanced 3000
rule 0 permit tcp destination-port eq 3260
#
#
acl mac 4000
rule 0 permit type 8906 ffff
rule 5 permit type 8914 ffff
#
configure dcbx; alternative for iscsi/fcoe
#
traffic classifier dcbx operator or
if-match acl mac 4000
if-match acl 3000
#
traffic classifier iscsi operator or
if-match acl 3000
#

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acl advanced 3000
rule 0 permit tcp destination-port eq 3260

**Configure Console Connectivity**

line class aux
user-role network-admin
#
line class vty
user-role network-operator
#
line aux 0 1
user-role network-admin
idle-timeout 0 0
#
line vty 0 15
authentication-mode scheme
user-role network-admin
user-role network-operator

# execute set authentication password simple \<your_password> and it will put it in the config file similar to below.
set authentication password hash \$h\$6\$/YSmSK0b+i+RSYbX$OaP0ytCZcE8rWgKEx6nQw0rLML3Mf0+O0g7UZAeh95kEejMhv6RecR4nT06+9LTYESUUEzfhzMchHYC8h4ACcA==
idle-timeout 0 0
#
#
#
**LLDP management address - used for VC connectivity**

Each management interface must be in its own subnet

interface Vlan-interface1
ip address 10.10.10.1 255.255.255.0
#
domain system
#
domain default enable system
#
user-group system
#
local-user admin class manage

**execute password simple \<your_password> and it will put it in the config file similar to below.**
password hash
$h$6$im0rLRRYOJHlwCY$zjEOgLLx7RF5dm5GDg5h4Fc
6JGeVYkDomK9VKnq3NCW9QmsrGAIOPWZTy/Eu
tU0KLgW9HQismv1+PAOg==

Setup FTP/Telnet/SSH services

service-type ftp
service-type ssh telnet terminal
authorization-attribute user-role network-admin
authorization-attribute user-role network-operator
#
ftp server enable
#

This is the physical management port. Use YOUR IP address!

interface M-GigabitEthernet0/0/0
ip address 10.X.X.X 255.255.255.0
#

Settings for typical FCoE port

If setting up multiple ports simultaneously use the range command as illustrated:
#
interface range Ten-GigabitEthernet 1/0/1 to Ten-GigabitEthernet 1/0/9
#

Configure a HYBRID port when using multiple untagged VLANS

#Use the description to help with defining what the link is used for

interface Ten-GigabitEthernet1/0/1

description R113-S01
port link-mode bridge
port link-type hybrid
#vlan numbers have to be what you have defined
port hybrid vlan 4001 tagged         port hybrid vlan 4000 to 4001 tagged
port hybrid vlan 1 1001 untagged
port hybrid pvid vlan 1001
priority-flow-control auto

NOTE:
For iSCSI/FCoE port configuration

Table Continued
priority-flow-control no-drop dot1p 3
stp edged-port
lldp tlv-enable dot1-tlv dcbx
qos trust dot1p
qos wrr be group 1 byte-count 15
qos wrr af1 group 1 byte-count 15
qos wrr af2 group sp
qos wrr af3 group sp
qos wrr af4 group sp
qos wrr ef group sp
qos wrr cs6 group sp
qos wrr cs7 group sp
qos apply policy DCBX outbound
#

Configure a non-DCB iSCSI target or initiator port with PAUSE flow control
interface Ten-GigabitEthernet 1/0/12
port link-mode bridge
port access vlan 4000
flow-control
stp-edged-port
qos priority 4

Standard FC interface - to change the ethernet port to FC use the port-type fc command. Supported FC port modes [auto, e, f], auto is the default mode.

⚠️ IMPORTANT:
For all port-type FC interfaces qos trust dot1p shall be configured.
#
interface Fc1/0/11
port access vsan 100
qos trust dot1p

NOTE:
FC port speed default is AUTO and fill-word is idle-arbff. For 4Gbps and 2Gpbs, configure fill-word to idle-idle.
Configure a Vfc to enable FCoE device login. Supported FCoE port modes [f,e], f is the default mode, there is no auto mode. A ve port must be configured using fc mode e.

```conf
interface Vfc1
fc mode f
port trunk vsan 100
bind interface Ten-GigabitEthernet1/0/1
#
MAC binding when devices coming from a FIP snooping or standard DCB device
#
interface Vfc200
port trunk vsan 100
bind interface Bridge-Aggregation1 mac 6c3b-e5af-ad09
#
Setup a Vfc to uplink from NPV switch to FCF or NPV switch
#
interface vfc1000
fc mode np
port trunk vsan 100
bind interface FortyGigE 1/0/49
#
To create an aggregation group follow these steps:

Procedure

1. Create the link-aggregation interface.
   a. interface Bridge-Aggregation X (where X is a number)
   b. port link-type trunk
   c. port trunk permit vlan 1 102 1001
   d. link-aggregation mode dynamic

2. Associate each of the member ports.
   a. interface Ten-GigabitEthernet 1/0/1
   b. port link-aggregation group X
   c. interface Ten-GigabitEthernet 1/0/2
   d. port link-aggregation group X

3. Make final settings on the link-aggregation interface.
a. interface Bridge-Aggregation X
b. port link-type trunk
c. port trunk permit vlan 1 1001 4001 - use the vlans that were defined

interface Bridge-Aggregation1 description
port link-type trunk
port trunk permit vlan 1 4001
port trunk pvid vlan 1001
link-aggregation mode dynamic
#
interface Ten-GigabitEthernet 1/0/1
port link-mode bridge
port link-type trunk
port trunk permit vlan 1 1001 4001
port trunk pvid vlan 1001
priority-flow-control auto
priority-flow-control no-drop dot1p 3
lldp tlv-enable dot1-tlv dc bx
qos trust dot1p
qos wrr be group 1 byte-count 15
qos wrr af1 group 1 byte-count 15
qos wrr af2 group sp
qos wrr af3 group sp
qos wrr af4 group sp
qos wrr ef group sp
qos wrr cs6 group sp
qos wrr cs7 group sp
qos apply policy DCBX outbound
port link-aggregation group 1
#
interface Ten-GigabitEthernet 1/0/2
port link-mode bridge
port link-type trunk
port trunk permit vlan 1 1001 4001
port trunk pvid vlan 1001
priority-flow-control auto
priority-flow-control no-drop dot1p 3
lldp tlv-enable dot1-tlv dc bx
qos trust dot1p
qos wrr be group 1 byte-count 15
qos wrr af1 group 1 byte-count 15
qos wrr af2 group sp
qos wrr af3 group sp
qos wrr af4 group sp
qos wrr ef group sp
qos wrr cs6 group sp
qos wrr cs7 group sp
qos apply policy DCBX outbound
port link-aggregation group 1
#
The following is a proven working configuration for a 5900CP configured as an FC switch.
#
version 7.1.045, Release 2311P06
#
sysname HP
#
irf mac-address persistent { always | timer }

# always recommended - enables the IRF bridge MAC address to be permanent
irf auto-update enable
undo irf link-delay
irf member 1 priority 1
#
lldp global enable
#
spf graceful-restart
#
vsan 1
#
vsan 100
rscn aggregation enable
tuning vlan 1
member pwn 52:4a:93:7d:9b:7e:77:00
tuning vlan 1
member pwn 52:4a:93:7d:9e:77:00
zone-alias name PureSAN01-CT0-P1
member pwn 52:4a:93:7d:9b:7e:77:00
zone-alias name PureSAN01-CT1-P1
member pwn 52:4a:93:7d:9b:7e:77:00
zone-alias name VDI-ESX01-P1
member pwn 50:06:0b:00:00:c2:b2:00
zone-alias name VDI-ESX01-P2
member pwn 50:06:0b:00:00:c2:b2:02
zone name PureSAN01_VDI-ESX01
member zone-alias PureSAN01-CT0-P1
member zone-alias PureSAN01-CT1-P1
member zone-alias VDI-ESX01-P1
member zone-alias VDI-ESX01-P2
zoneset name FabricA_VSAN-100
member PureSAN01_VDI-ESX01
zoneset distribute full
zone default-zone permit
undo zone hard-zoning enable
zoneset activate name FabricA_VSAN-100
#
vlan 1
#
vlan 4001
fcoe enable vsan 100
description FC working VSAN
#
vlan 4094
fcoe enable vsan 1
description FC default VSAN
#
stp global enable
#
interface NULL0
#
interface FortyGigE1/0/49
port link-mode bridge
#
interface FortyGigE1/0/50
port link-mode bridge
#
interface FortyGigE1/0/51
port link-mode bridge
#
interface FortyGigE1/0/52
port link-mode bridge
#
interface M-GigabitEthernet0/0/0
ip address 10.6.8.88 255.255.240.0
ipv6 address 3001::88/64
ipv6 address auto link-local
#
interface Fc1/0/1

Important: For all port-type FC interfaces, qos trust dot1p shall be configured.

port access vsan 100
qos trust dot1p
#
interface Fc1/0/2
port access vsan 100
qos trust dot1p
#
interface Fc1/0/3 #continue same configuration through FC1/0/48
port access vsan 100
qos trust dot1p
# scheduler logfile size 16
# line class aux
user-role network-admin
#
line class vty
user-role network-operator
#
line aux 0
user-role network-admin
#
line vty 0 15
authentication-mode scheme
user-role network-admin
user-role network-operator
#
line vty 16 63
user-role network-operator
#
ssh server enable
#
radius scheme system
user-name-format without-domain
#
domain system
#
domain default enable system
#
role name level-0
description Predefined level-0 role
#
role name level-1
description Predefined level-1 role
#
role name level-2
description Predefined level-2 role
#
role name level-3
description Predefined level-3 role
#
role name level-4
description Predefined level-4 role
#
role name level-5
description Predefined level-5 role
#
role name level-6
description Predefined level-6 role
#
role name level-7
description Predefined level-7 role
#
role name level-8
description Predefined level-8 role
#
role name level-9
To improve the security for a VSAN, you can utilize hard zoning for a VSAN. When soft zoning is enough for meeting the access control requirements of a VSAN, you can disable hard zoning for a VSAN to save the hardware entry resources for use in another VSAN. When configuring a distributed VSAN with hard zones instead of soft zones across multiple switches, utilize enhanced zoning and pairwise zoning to reduce rules and improve the distribution update response time.

Two zoning modes and two zone types are available for each VSAN with FlexFabric SAN enabled switches: basic zoning and enhanced zoning modes and hard and soft zones. By default, the basic zoning mode is enabled and hard zones are enabled.

**Enhanced Zoning and HPE Smart SAN**

Enhanced zoning is required to be configured on VSANs supporting the HPE 3PAR Smart SAN functionality. Hewlett Packard Enterprise recommends that per VSAN enhanced zoning be enabled, using the `zone mode enhanced` CLI command prior to enabling Smart SAN. Only switches with initiator ports which will be used by Smart SAN and Smart SAN licensed 3PAR StoreServ target ports connected need Smart SAN enabled. Other switches in a distributed VSAN configuration only need enhanced zoning enabled. The global `smartsan enable` CLI command also enables enhanced zoning on all VSANs. The Smart SAN enable global policy to configure enhanced zoning on all VSANs of a switch could result in a segmented VSAN, if other switches in the fabric have VSANs which do not have enhanced zoning enabled. After executing the global `smartsan enable` CLI command, a user might want to undo `zone mode enhanced` on VSANs not participating in Smart SAN functionality.

You can enable the enhanced zoning mode only when all switches in the fabric support this mode. Hard zoning takes effect only when the hardware resources are sufficient for deploying zone rules. Soft zoning is always in effect. When the underlying resources are not sufficient for deploying the hardware zone rules of the current VSAN, the system clears all deployed hardware zone rules in order to keep the integrity of rules, and the system automatically disables hard zoning. In this case, only soft zoning is in effect.

Typically, servers do not need to access each other, and storage devices do not need to access each other. Without the Pairwise feature, an access entry is generated for each pair of members in a zone. The Pairwise feature allows a member to access only members with a different role in the same zone thereby conserving hardware entries.

There are two roles defined for zone members:
• Initiator — Typically a server
• Target — Typically a storage device

An example of enhanced mode hard zoning with pairwise zoning follows. In this example, the target members connected to switch 2 and a VE-port connects switch 2 to switch 1. The initiator members are connected to switch 1, thereby creating a distributed VSAN across the two switches.

```bash
system-view
[SwitchA-vsan1] vsan 1
[SwitchA-vsan1] rscn aggregation enable
[SwitchA-vsan1] zone mode enhanced
# Create a zone alias named Alias1.
[SwitchA-vsan1-zone-alias-Alias1] zone-alias name Alias1
[SwitchA-vsan1-zone-alias-Alias1] quit
# Create a zone named Zone1, and specify pWWN 22:33:44:55:66:77:00:95 and Alias1 as its members.
[SwitchA-vsan1-zone-Zone1] zone name Zone1
[SwitchA-vsan1-zone-Zone1] member zone-alias Alias1
[SwitchA-vsan1-zone-Zone1] quit
# Create a zone named Zone2, and enable the Pairwise feature for Zone2.
[SwitchA-vsan1-zone-Zone2] zone name Zone2
[SwitchA-vsan1-zone-Zone2] pairwise-zoning enable
# Add the zone alias Alias1 to Zone2 as a member.
[SwitchA-vsan1-zone-Zone2] member zone-alias Alias1
[SwitchA-vsan1-zone-Zone2] quit
# Create a zone named Zone3, and enable the Pairwise feature for Zone3.
[SwitchA-vsan1-zone-Zone3] zone name Zone3
[SwitchA-vsan1-zone-Zone3] pairwise-zoning enable
# Specify pWWN 20:33:44:55:66:77:00:74 as its initiator member.
# Add the zone alias Alias1 to Zone3 as a member.
[SwitchA-vsan1-zone-Zone3] member zone-alias Alias1
[SwitchA-vsan1-zone-Zone3] quit
# Create a zone set named Zoneset1, and add zones Zone1, Zone2, and Zone3 as its members.
[SwitchA-vsan1-zoneset-Zoneset1] zoneset name Zoneset1
[SwitchA-vsan1-zoneset-Zoneset1] member Zone1
[SwitchA-vsan1-zoneset-Zoneset1] member Zone2
[SwitchA-vsan1-zoneset-Zoneset1] member Zone3
[SwitchA-vsan1-zoneset-Zoneset1] quit
# Configure the zone distribution and merge type as complete.
[SwitchA-vsan1] zoneset distribute
# Activate a zone set and distribute it to the entire fabric.
[SwitchA-vsan1] zoneset activate name Zoneset1
```
This appendix illustrates a validated configuration of two 6125XLG/6127XLG FCF mode switches in an IRF domain. This configuration implements two VSANs, one non-overlapped VSAN per 6125XLG. In addition, a 4x40GbE bridge-aggregation 160GbE VE-port uplink is configured, presumably to an upstream IRF domain containing two FlexFabric switches. Please notice that there are 4 VFCs defined for this 160GbE uplink to avoid VSAN traffic crossing the IRF ports to utilize the trunked two VSAN bridge-aggregation.

# version 7.1.045, Release 2432P01
# sysname HP-612xXLG
# telnet server enable
# irf mac-address persistent { always | timer }
# always recommended – enables the IRF bridge MAC address to be permanent
# irf auto-update enable
undo irf link-delay
# irf member 1 priority 32
# irf member 2 priority 30
# lldp global enable
# system-working-mode advance
password-recovery enable
# fcoe-mode fcf
# fspf graceful-restart
# vsan 1
zone default-zone permit
# vsan 100
rscn aggregation enable
zone default-zone permit
undo zone hard-zoning enable
zoneset distribute full
# vsan 200
rscn aggregation enable
zone default-zone permit
undo zone hard-zoning enable
zoneset distribute full
# vlan 1
#
# vlan 1001
description ToLAN
# vlan 4001
description ToSAN
fcoe enable vsan 100
#
vlan 4002
description ToSAN
fcoe enable vsan 200
#
vlan 4094
fcoe enable vsan 1
#
irf-port 1/1
  port group interface Ten-GigabitEthernet1/0/17
  port group interface Ten-GigabitEthernet1/0/18
  port group interface Ten-GigabitEthernet1/0/19
  port group interface Ten-GigabitEthernet1/0/20
#
irf-port 2/2
  port group interface Ten-GigabitEthernet2/0/17
  port group interface Ten-GigabitEthernet2/0/18
  port group interface Ten-GigabitEthernet2/0/19
  port group interface Ten-GigabitEthernet2/0/20
#
qos map-table dot1p-lp
  import 0 export 0
  import 2 export 0
  import 3 export 1
  import 4 export 0
  import 5 export 0
  import 6 export 0
  import 7 export 0
#
traffic classifier DCBX operator or
  if-match acl 3000
#
traffic behavior DCBX
  remark dot1p 3
#
qos policy DCBX
  classifier DCBX behavior DCBX mode dcbx
#
stp global enable
#
interface Bridge-Aggregation160
  port link-type trunk
description 4x40G ISL to upstream 5900CPs IRF domain
  undo port trunk permit vlan 1
  port trunk permit vlan 1001 4001 to 4002
  port trunk pvid vlan 1001
  link-aggregation mode dynamic
#
interface NULL0
#
interface Vlan-interface1
  ip address 10.10.10.36 255.255.240.0
#
interface FortyGigE1/1/1
  port link-mode bridge
  port link-type trunk
undo port trunk permit vlan 1
port trunk permit vlan 1001 4001 to 4002
port trunk pvid vlan 1001
priority-flow-control auto
priority-flow-control no-drop dot1p 3
lldp tlv-enable dot1-tlv dcbx
qos trust dot1p
qos wrr be group 1 byte-count 15
qos wrr af1 group 1 byte-count 15
qos wrr af2 group sp
qos wrr af3 group sp
qos wrr af4 group sp
qos wrr ef group sp
qos wrr cs6 group sp
qos wrr cs7 group sp
qos apply policy DCBX outbound
port link-aggregation group 160
#
interface FortyGigE1/1/2
port link-mode bridge
port link-type trunk
undo port trunk permit vlan 1
port trunk permit vlan 1001 4001 to 4002
port trunk pvid vlan 1001
priority-flow-control auto
priority-flow-control no-drop dot1p 3
lldp tlv-enable dot1-tlv dcbx
qos trust dot1p
qos wrr be group 1 byte-count 15
qos wrr af1 group 1 byte-count 15
qos wrr af2 group sp
qos wrr af3 group sp
qos wrr af4 group sp
qos wrr ef group sp
qos wrr cs6 group sp
qos wrr cs7 group sp
qos apply policy DCBX outbound
port link-aggregation group 160
#
interface FortyGigE1/1/3
port link-mode bridge
#
interface FortyGigE1/1/4
port link-mode bridge
#
interface FortyGigE2/1/1
port link-mode bridge
port link-type trunk
undo port trunk permit vlan 1
port trunk permit vlan 1001 4001 to 4002
port trunk pvid vlan 1001
priority-flow-control auto
priority-flow-control no-drop dot1p 3
lldp tlv-enable dot1-tlv dcbx
qos trust dot1p
qos wrr be group 1 byte-count 15
qos wrr af1 group 1 byte-count 15
qos wrr af2 group sp
cos wrr af3 group sp
cos wrr af4 group sp
cos wrr ef group sp
cos wrr cs6 group sp
cos wrr cs7 group sp
cos apply policy DCBX outbound
port link-aggregation group 160
#
interface FortyGigE2/1/2
  port link-mode bridge
  port link-type trunk
  undo port trunk permit vlan 1
  port trunk permit vlan 1001 4001 to 4002
  port trunk pvid vlan 1001
  priority-flow-control auto
  priority-flow-control no-drop dot1p 3
  lldp tlv-enable dot1-tlv dcbx
  qos trust dot1p
  qos wrr be group 1 byte-count 15
cos wrr af1 group 1 byte-count 15
cos wrr af2 group sp
cos wrr af3 group sp
cos wrr af4 group sp
cos wrr ef group sp
cos wrr cs6 group sp
cos wrr cs7 group sp
cos apply policy DCBX outbound
  port link-aggregation group 160
#
interface FortyGigE2/1/3
  port link-mode bridge
#
interface FortyGigE2/1/4
  port link-mode bridge
  #for 6127XLG the configuration is: interface TwentyGigE1/0/1 to 1/0/16
  interface Ten-GigabitEthernet1/0/1 [same configuration for 1/0/1 to 1/0/16]
    port link-mode bridge
    port link-type hybrid
    undo port hybrid vlan 1
    port hybrid vlan 4001 tagged
    port hybrid vlan 1001 untagged
    port hybrid pvid vlan 1001
    priority-flow-control auto
    priority-flow-control no-drop dot1p 3
    lldp tlv-enable dot1-tlv dcbx
    qos wrr be group 1 byte-count 15
cos wrr af1 group 1 byte-count 15
cos wrr af2 group sp
cos wrr af3 group sp
cos wrr af4 group sp
cos wrr ef group sp
cos wrr cs6 group sp
cos wrr cs7 group sp
cos apply policy DCBX outbound
  #for 6127XLG the configuration is: interface TwentyGigE2/0/1 to 2/0/16
  interface Ten-GigabitEthernet2/0/1 [same configuration for 2/0/1 to 2/0/16]
port link-mode bridge
port link-type hybrid
undo port hybrid vlan 1
port hybrid vlan 4002 tagged
port hybrid vlan 1001 untagged
port hybrid pvid vlan 1001
priority-flow-control auto
priority-flow-control no-drop dot1p 3
lldp tlv-enable dot1-tlv dc bx
qos trust dot1p
qos wrr be group 1 byte-count 15
qos wrr af1 group 1 byte-count 15
qos wrr af2 group sp
qos wrr af3 group sp
qos wrr af4 group sp
qos wrr ef group sp
qos wrr cs6 group sp
qos wrr cs7 group sp
qos apply policy DCBX outbound
#
interface M-Ethernet0/0/0
  ip address 10.6.8.69 255.255.240.0
  ipv6 address 3001::69/64
  ipv6 address auto link-local
# for 6127XLG the configuration is:
interface Ten-GigabitEthernet1/1/5 to 1/1/12
interface Ten-GigabitEthernet1/1/5 [same configuration for 1/1/5 to 1/1/12]
  port link-mode bridge
  port link-type trunk
  port trunk permit vlan 1 1001 4001
  port trunk pvid vlan 1001
  priority-flow-control auto
  priority-flow-control no-drop dot1p 3
  lldp tlv-enable dot1-tlv dc bx
  qos trust dot1p
  qos wrr be group 1 byte-count 15
  qos wrr af1 group 1 byte-count 15
  qos wrr af2 group sp
  qos wrr af3 group sp
  qos wrr af4 group sp
  qos wrr ef group sp
  qos wrr cs6 group sp
  qos wrr cs7 group sp
  qos apply policy DCBX outbound
# for 6127XLG the configuration is:
interface Ten-GigabitEthernet2/1/5 to 2/1/11
interface Ten-GigabitEthernet2/1/5 [same configuration for 2/1/5 to 2/1/11]
  port link-mode bridge
  port link-type trunk
  port trunk permit vlan 1 1001 4002
  priority-flow-control auto
  priority-flow-control no-drop dot1p 3
  lldp tlv-enable dot1-tlv dc bx
  qos trust dot1p
  qos wrr be group 1 byte-count 15
  qos wrr af1 group 1 byte-count 15
  qos wrr af2 group sp
  qos wrr af3 group sp
  qos wrr af4 group sp
  qos apply policy DCBX outbound

qos wrr ef group sp
qos wrr cs6 group sp
qos wrr cs7 group sp
qos apply policy DCBX outbound
#
interface Ten-GigabitEthernet2/1/12  [Ethernet uplink to Management network]
port link-mode bridge
port access vlan 1001
flow-control
broadcast-suppression 1
multicast-suppression 1
unicast-suppression 1
# for 6127XLG the configuration is the same as 6125XLG internal IRF ports
interface Ten-GigabitEthernet1/0/17
priority-flow-control enable
priority-flow-control no-drop dot1p 3
#
interface Ten-GigabitEthernet1/0/18
priority-flow-control enable
priority-flow-control no-drop dot1p 3
#
interface Ten-GigabitEthernet1/0/19
priority-flow-control enable
priority-flow-control no-drop dot1p 3
#
interface Ten-GigabitEthernet1/0/20
priority-flow-control enable
priority-flow-control no-drop dot1p 3
#
interface Ten-GigabitEthernet2/0/17
priority-flow-control enable
priority-flow-control no-drop dot1p 3
#
interface Ten-GigabitEthernet2/0/18
priority-flow-control enable
priority-flow-control no-drop dot1p 3
#
interface Ten-GigabitEthernet2/0/19
priority-flow-control enable
priority-flow-control no-drop dot1p 3
#
interface Ten-GigabitEthernet2/0/20
priority-flow-control enable
priority-flow-control no-drop dot1p 3
# for 6127XLG the VFC bind configuration is: interface TwentyGigE1/0/1 to 1/0/16
interface Vfc1                       [same configuration for VF1 to VFC16]
port trunk vsan 100
bind interface Ten-GigabitEthernet1/0/1
# for 6127XLG the VFC bind configuration is: interface TwentyGigE2/0/1 to 2/0/16
interface Vfc21                      [same configuration for VF21 to VFC36]
port trunk vsan 200
bind interface Ten-GigabitEthernet2/0/1
#
interface Vfc260
fc mode e
port trunk vsan 200
bind interface FortyGigE2/1/1
#
interface Vfc261
  fc mode e
  port trunk vsan 200
  bind interface FortyGigE2/1/2
#
interface Vfc305
  port trunk vsan 100
  bind interface Ten-GigabitEthernet1/1/5
#
interface Vfc306
  port trunk vsan 100
  bind interface Ten-GigabitEthernet1/1/6
#
interface Vfc307
  port trunk vsan 100
  bind interface Ten-GigabitEthernet1/1/7
#
interface Vfc308
  port trunk vsan 100
  bind interface Ten-GigabitEthernet1/1/8
#
interface Vfc309
  port trunk vsan 100
  bind interface Ten-GigabitEthernet1/1/9
#
interface Vfc310
  port trunk vsan 100
  bind interface Ten-GigabitEthernet1/1/10
#
interface Vfc311
  port trunk vsan 100
  bind interface Ten-GigabitEthernet1/1/11
#
interface Vfc312
  port trunk vsan 100
  bind interface Ten-GigabitEthernet1/1/12
#
interface Vfc405
  port trunk vsan 200
  bind interface Ten-GigabitEthernet2/1/5
#
interface Vfc406
  port trunk vsan 200
  bind interface Ten-GigabitEthernet2/1/6
#
interface Vfc407
  port trunk vsan 200
  bind interface Ten-GigabitEthernet2/1/7
#
interface Vfc408
  port trunk vsan 200
  bind interface Ten-GigabitEthernet2/1/8
#
interface Vfc409
  port trunk vsan 200
bind interface Ten-GigabitEthernet2/1/9
    #
    interface Vfc410
    port trunk vsan 200
    bind interface Ten-GigabitEthernet2/1/10
    #
    interface Vfc411
    port trunk vsan 200
    bind interface Ten-GigabitEthernet2/1/11
    #
    scheduler logfile size 16
    #
    line class aux
    user-role network-admin
    user-role network-operator
    #
    line class console
    user-role network-admin
    #
    line class vty
    user-role network-operator
    #
    line aux 0
    user-role network-admin
    #
    line aux 1 3
    user-role network-operator
    #
    line con 0 3
    user-role network-admin
    #
    line vty 0 15
    authentication-mode password
    user-role network-admin
    user-role network-operator
    #
    set authentication password hash $h$6$Wp6zhS6NTsd9/YVv$78nnl+pnQdcl6MeM48/TLVU
        +ppEr8JmlXIPzA8DcHMyyJx+FJvhyhNOogXXgdVOa2VuPSE0cOVE1oOhMbVGTg==
    #
    line vty 16 63
    authentication-mode password
    user-role network-operator
    #
    snmp-agent
    snmp-agent local-engineid 800063A280D07E28F2087000000001
    snmp-agent community write private
    snmp-agent community read public
    snmp-agent sys-info contact Barry Maskas
    snmp-agent sys-info location TAY
    snmp-agent sys-info version all
    snmp-agent group v3 Demo_NoAuthNoPrivGroup write-view ViewDefault
    snmp-agent group v3 NOAUTHNOPRIV write-view ViewDefault
    snmp-agent target-host trap address udp-domain 10.6.0.158 params securityname
        public v2c
    snmp-agent usm-user v3 Demo_NoAuthNoPrivUser Demo_NoAuthNoPrivGroup
    snmp-agent usm-user v3 nanpUser NOAUTHNOPRIV
    #
    ntp-service enable

110  6125XLG/6127XLG Ethernet blade Switch configuration file
ntp-service unicast-server 10.6.5.2
#
rule 0 permit type 8906 ffff
rule 5 permit type 8914 ffff
#
radius scheme system
user-name-format without-domain
#
role name level-0
description Predefined level-0 role
#
role name level-1
description Predefined level-1 role
#
role name level-2
description Predefined level-2 role
#
role name level-3
description Predefined level-3 role
#
role name level-4
description Predefined level-4 role
#
role name level-5
description Predefined level-5 role
#
role name level-6
description Predefined level-6 role
#
role name level-7
description Predefined level-7 role
#
role name level-8
description Predefined level-8 role
#
role name level-9
description Predefined level-9 role
#
role name level-10
description Predefined level-10 role
#
role name level-11
description Predefined level-11 role
#
role name level-12
description Predefined level-12 role
#
role name level-13
description Predefined level-13 role
#
role name level-14
description Predefined level-14 role
user-group system
#
local-user admin class manage
password hash $h$6$gUOeinDwlwLHyca1$r0yxf+GY7tOgMoT5hXEySQncdI1S4GWhp3h/7c+4bVT1DQa1NIkHmQcJrJ+7gew10P19Ih7cf10quNIXlPrXQ==
service-type ftp
service-type ssh telnet terminal http https
authorization-attribute work-directory flash:
authorization-attribute user-role level-3
authorization-attribute user-role network-admin
authorization-attribute user-role network-operator
#
ip http enable
ip https enable
#
return
The interfaces in a VSAN can work as access ports or trunk ports.

- **Access port**—An access port can belong to only one VSAN.
- **Trunk port**—A trunk port can belong to multiple VSANs. FC port VFT and san-aggregation configuration support of NPV FC uplinks to F-ports and FCF FC ISLs – e-port to e-port requires VSAN 1 to be FCoE enabled, by an associated VLAN, for FC port VFT to function.

FC interfaces can work as access ports or trunk ports, depending on negotiation, and also in a san-aggregation configuration. VFC interfaces can only work as trunk ports and also in a bridge-aggregation configuration.

### Access VSAN

*Figure 33: Access VSAN* on page 113 shows a typical access VSAN:

- The ports of blue links on switches (including E_Ports and F_Ports) are configured as access ports and assigned to VSAN 10.
- The ports of purple links are configured as access ports and assigned to VSAN 20.

When servers read the disks, the N_Ports of different servers send FC frames to the F_Ports on FC Switch A. Switch A searches for the outgoing interfaces in the FIB table of the VSAN that each F_Port belongs to. These F_Ports use different E_Ports as outgoing interfaces. Packets are forwarded out of these E_Ports, and they might travel across multiple VSAN-capable switches to the E_Ports of FC Switch B.

Switch B searches for the outgoing interfaces in the FIB tables of the VSAN that each E_Port belongs to, and forwards them to the F_Ports. Then, the F_Ports send the frames to the N_Ports of different disk devices. The frames from the disk devices to the server are processed in the same way and finally reach the servers.
During the transmission procedure, frames are not changed. In order to support multiple VSANs, a switch must use different physical interfaces. The access VSAN technology does not reduce the number of physical connections. Though different VSANs are isolated from each other, they are physically rather than logically isolated. This mode cannot give full play to the advantages of the VSAN technology.

**Trunk VSAN in an FC network**

The trunk VSAN technology implements logical isolation among VSANs. The trunk VSAN adds a Virtual Fabric Tagging Header (VFT_Header, also known as VSAN tag) to the FC frames. The VFT_Header contains a VF_ID (also known as VSAN ID) field to indicate the VSAN of the FC frames. In this way, FC frames with different VF_IDs are contained in their respective VSANs, and different VSANs cannot communicate with each other. The trunk VSAN implements physical connectivity and logical isolation in the network.

*Figure 34: Trunk VSAN network* on page 114 shows a typical trunk VSAN:

- The F_Ports in blue on switches are configured as access ports and assigned to VSAN 10.
- The F_Ports in purple are configured as access ports and assigned to VSAN 20.
- The E_Ports are configured with trunk VSANs 10 and 20.

When servers read the disks, the N_Ports of different servers send FC frames without VFT_Headers to the F_Ports on FC switch Switch A. Switch A searches for the outgoing interfaces in the FIB table of the VSAN that each F_Port belongs to. These F_Ports use the same E_Port as the outgoing interface. When the frames are forwarded out of the E_Port, they are tagged with the VFT_Header of VSAN 10 and VSAN 20, respectively, and travel across multiple VSAN-capable switches to the E_Port of FC switch Switch B. According to the VFT_Headers, Switch B searches for the outgoing interfaces in the FIB tables of the VSANs, and forwards them to the F_Ports. Then, the F_Ports remove the VFT_Headers and send the frames to the N_Ports of different disk devices. The frames from the disk devices to the server are processed in the same way and finally reach the servers.

*Figure 34: Trunk VSAN network*

During the transmission process, VFT_Headers are added to and removed from the frames. A switch can use the same physical interface to support multiple VSANs. The trunk VSAN technology reduces the number of physical connections, actually implementing logical isolation in a physical network.
Trunk VSAN in an FCoE network

FCoE carries FC over Ethernet. In an FCoE network, VSANs in FC must be mapped to VLANs as configured by the user, and the FIB table for a VSAN is also stored on the relevant VLAN. FCoE frames use VLAN_Header in place of VFT_Header in FC frames and are forwarded based on the VLAN ID in VLAN_Header.

A VFC interface can only work as a trunk port. The bound Ethernet interface must also be configured as a trunk port, and its trunk VLAN list must include the VLANs mapped to each VSAN in the trunk VSAN list of the VFC interface. An FCoE frame transmitted from a VFC interface can use the VLAN ID in VLAN_Header to identify the VLAN to which it belongs.

Configuring the trunk mode

The trunk mode configuration is available only on FC interfaces. VFC interfaces can work only as trunk ports, so you do not need to configure the trunk mode for VFC interfaces.

To configure the trunk mode:

Table 7: Configuring the trunk mode

<table>
<thead>
<tr>
<th>Step</th>
<th>Command</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enter system view</td>
<td>system-view</td>
<td>N/A</td>
</tr>
<tr>
<td>Enter FC interface</td>
<td>interface fc interface-number</td>
<td>N/A</td>
</tr>
<tr>
<td>Configure the trunk mode of the interface.</td>
<td>port trunk mode { auto</td>
<td>off</td>
</tr>
</tbody>
</table>

Configuring a trunk VSAN

FC interfaces and VFC interfaces can be assigned to multiple VSANs as trunk ports.

If you assign an interface to VSANs as a trunk port multiple times, the final trunk VSAN list is the union of all the VSANs to which you have assigned the interface.

To assign an interface to the specified VSANs as trunk ports:

Table 8: Configuring a trunk VSAN

<table>
<thead>
<tr>
<th>Step</th>
<th>Command</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enter system view</td>
<td>system-view</td>
<td>N/A</td>
</tr>
<tr>
<td>Enter FC interface or VFC interface view.</td>
<td>interface { fc</td>
<td>vfc } interface-number</td>
</tr>
<tr>
<td>Assign the interface to the specified VSANs as a trunk port so that the interface allows the specified VSANs to pass through.</td>
<td>port trunk vsan vsan-id-list</td>
<td>By default, a port does not belong to any VSAN (including VSAN 1) as a trunk port. You can assign an interface to a non-existent VSAN as a trunk port.</td>
</tr>
</tbody>
</table>
Configuration procedure

This section describes only the VSAN configurations, see Figure 34: Trunk VSAN network on page 114. The same configuration is applied to Switch B.

# Configure the switch to operate in FCF mode.
<SwitchA> system-view
[SwitchA] fcoe-mode fcf

# Create VSAN 10 and VSAN 20.
[SwitchA] vsan 10
[SwitchA-vsan10] quit

[SwitchA] vsan 20
[SwitchA vsan20] quit

# Assign FC interface FC 1/0/1 to VSAN 10 as an access port.
[SwitchA-Fc1/0/1] port access vsan 10

# Assign FC interface FC 1/0/2 to VSAN 20 as an access port.
[SwitchA-Fc1/0/2] port access vsan 20
[SwitchA-Fc1/0/2] quit

# Configure the mode of interface FC 1/0/4 as E.
[SwitchA-Fc1/0/4] fc mode e

# Configure the trunk mode of interface FC 1/0/4 as ON, and assign interface FC 1/0/4 to VSANs 10 and 20 as a trunk port.
[SwitchA-Fc1/0/4] port trunk mode on
[SwitchA-Fc1/0/4] port trunk vsan 10 20
[SwitchA-Fc1/0/4] quit

# Enable FCoE for VLAN 10, and map VLAN 10 to VSAN 10.
[SwitchA] vlan 10
[SwitchA-vlan10] fcoe enable vsan 10
[SwitchA-vlan10] quit

# Enable FCoE for VLAN 20, and map VLAN 20 to VSAN 20.
[SwitchA] vlan 20
[SwitchA-vlan20] fcoe enable vsan 20
[SwitchA-vlan20] quit

# Enable FCoE for VLAN 4094, and map VLAN 4094 to VSAN 1.
[SwitchA] vlan 4094
[SwitchA-vlan4094] fcoe enable vsan 1
[SwitchA-vlan4094] quit

Configure Switch B in the same way as Switch A is configured.

FC link aggregation

FC link aggregation aggregates multiple physical FC interfaces into a logical FC aggregation group. FC links between two switches can be aggregated. The two switches can operate in FCF mode and NPV mode, respectively, or both operate in FCF mode or NPV mode.

FC link aggregation delivers the following benefits:

- Increased bandwidth—The bandwidth of the FC aggregate interface is the total bandwidth of all available member interfaces.
- Load sharing—Incoming/outgoing traffic is distributed across multiple member interfaces of the FC aggregation group.
- Improved connection reliability—When a member interface goes down, the traffic on it automatically switches over to other available member interfaces. This avoids service interruption and improves the connection reliability of the whole FC aggregate link.

FC link aggregation configuration example

To increase bandwidth and enhance connection reliability between FCF switches Switch A and Switch B see Figure 34: Trunk VSAN network on page 114. Add another FC link configured the same as FC 1/0/4 and create an FC aggregate link between Switch A and Switch B as shown in Figure 35: FC aggregate link – san-aggregation trunk VSAN 10 and VSAN 20 on page 117.
Figure 35: FC aggregate link – san-aggregation trunk VSAN 10 and VSAN 20

Member interface status
A member interface in an FC aggregation group can be in either of the following states:

- **Selected**—A Selected member interface can forward traffic.
- **Unselected**—An unselected member interface cannot forward traffic.

How FC link aggregation works

**FC aggregate interface operating mode**
The operating mode of an FC aggregate interface is determined as follows:

- When the configured mode of an FC aggregate interface is E, F, or NP, the operating mode of the FC aggregate interface is the configured mode.
- When the configured mode is auto, the operating mode of the FC aggregate interface is the same as the first member interface that goes up at the link layer. Possible operating modes are E or F.

To change the operating mode of an FC aggregate interface, perform the following tasks:

1. Execute the `shutdown` command to shut down the FC aggregate interface.
2. Configure a new operating mode for the FC aggregate interface.
3. Execute the `undo shutdown` command to bring up the FC aggregate interface
   All member interfaces will perform link negotiation again.

**Choosing Selected member interfaces**
Any of the following conditions might trigger a process of choosing Selected member interfaces from member interfaces:

- A new member interface joins the FC aggregation group
- A member interface leaves the FC aggregation group
- The state (up or down) of a member interface changes

The states of FC aggregation group member interfaces are determined as follows:

- When the configured mode of an FC aggregate interface is F, E, or NP, the configured mode of the member interfaces is the same as the FC aggregate interface. The member interfaces perform link
negotiation based on the configured mode. All member interfaces that pass the negotiation and have the highest speed become Selected.

- When the configured mode of an FC aggregate interface is auto, the configured mode of the member interfaces is also auto. The member interfaces perform link negotiation based on the auto mode. The operating mode negotiation result might be E or F mode. The operating mode of the FC aggregate interface is the operating mode of the first member interface that goes up at the link layer. All interfaces operating in the same mode as the FC aggregate interface and with the highest speed are Selected.

When an FC aggregation group has Selected member interfaces, the FC aggregate interface physically goes up and negotiates VSAN parameters. To modify VSAN settings of an FC aggregate interface, perform the following tasks:

1. Execute the `shutdown` command to shut down the FC aggregate interface.
2. Modify VSAN settings of the FC aggregate interface.
3. Execute the `undo shutdown` command to bring up the FC aggregate interface.

All member interfaces will perform link negotiation again.

**Speed of an FC aggregate interface**

The speed of an FC aggregate interface is the sum of the speed of each Selected member interface in the FC aggregation group.

**Load sharing mode**

An FC aggregate interface forwards traffic through its Selected member interfaces. When multiple Selected member interfaces exist in an FC aggregation group, the switch chooses some of the Selected member interfaces to forward traffic according to its load balancing mode. The following load balancing modes are available:

- Source FC_ID and destination FC_ID—Packets with the same source FC_ID and destination FC_ID are classified into one flow. Packets of the same flow are forwarded on the same Selected member interface.
- Exchange—Packets with the same exchange (an exchange is uniquely identified by the combination of source FC_ID, destination FC_ID, and initiator Exchange_ID) are classified into one flow. Packets of the same flow are forwarded on the same Selected member interface.

**Configuring an FC aggregate interface**

After you create an FC aggregate interface, the system automatically creates an FC aggregation group numbered the same.

To configure an FC aggregate interface:
### Table 9: Configuring an FC aggregate interface

<table>
<thead>
<tr>
<th>Step</th>
<th>Command</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enter system view.</td>
<td><code>system-view</code></td>
<td>N/A</td>
</tr>
<tr>
<td>Create an FC aggregate interface (if the specified interface does not</td>
<td><code>interface san-aggregate interface-number</code></td>
<td>N/A</td>
</tr>
<tr>
<td>exist) and enter its view.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Configure the mode of the FC aggregate interface.</td>
<td>`fc mode { auto</td>
<td>e</td>
</tr>
<tr>
<td>• When an FC switch is operating in FCF mode, the FC aggregate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>interfaces support E, F, and auto modes. The default is auto mode.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• When an FC switch is operating in NPV mode, the FC aggregate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>interfaces support F and NP modes. The default is F mode.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Optional) Configure a description for the FC aggregate interface.</td>
<td><code>description text</code></td>
<td></td>
</tr>
<tr>
<td>By default, the description of an FC aggregate interface is</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Interface name</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interface, for example, SAN-Aggregation3 Interface.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Optional) Configure the expected bandwidth for the FC aggregate</td>
<td><code>bandwidth bandwidth-value</code></td>
<td></td>
</tr>
<tr>
<td>interface.</td>
<td>The default setting is the interface baud rate divided by 1000.</td>
<td></td>
</tr>
<tr>
<td>The baud rate of an FC aggregate interface is the speed of the FC</td>
<td>The sum of the speed of each Selected FC interface.</td>
<td></td>
</tr>
<tr>
<td>aggregate interface, which is the sum of the speed of each Selected</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FC interface.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Optional) Restore the default settings for the FC aggregate</td>
<td><code>default</code></td>
<td>N/A</td>
</tr>
<tr>
<td>interface.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bring up the FC aggregate interface.</td>
<td><code>undo shutdown</code></td>
<td></td>
</tr>
<tr>
<td>By default, an FC aggregate interface is up.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Assigning an FC interface to an FC aggregation group

When you assign an FC interface to an FC aggregation group, follow these restrictions and guidelines:

- An FC interface can be assigned to only one FC aggregation group.
- Before you assign an FC interface to an FC aggregation group, use the `shutdown` command to shut down the FC interface. After assigning the FC interface to the FC aggregation group, assign the peer FC
interface to the peer FC aggregation group and use the undo shutdown command to bring up the local FC interface.

- Before you remove an FC interface from an FC aggregation group, use the shutdown command to shut down the FC interface. After removing the FC interface from the FC aggregation group, remove the peer FC interface from the peer FC aggregation group and use the undo shutdown command to bring up the local FC interface.

- After an FC interface is assigned to an FC aggregation group, the FC mode, trunk mode, trunk VSAN, and access VSAN configurations of the FC interface are removed. Also, you cannot configure these configurations for a member interface. After the FC interface is removed from the FC aggregation group, the default settings of these configurations are used.

- After an FC interface is assigned to an FC aggregation group, the FC interface uses the configuration of the FC aggregate interface to perform link negotiation.

An FC aggregation group can have a maximum of eight member interfaces. To assign an FC interface to an FC aggregation group:

**Table 10: Assigning an FC interface to an FC aggregation group**

<table>
<thead>
<tr>
<th>Step</th>
<th>Command</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enter system view</td>
<td>system-view</td>
<td>N/A</td>
</tr>
<tr>
<td>Enter FC interface view</td>
<td>interface fc interface-number</td>
<td>N/A</td>
</tr>
<tr>
<td>Shut down the FC interface</td>
<td>shutdown</td>
<td>By default, an FC interface is up.</td>
</tr>
<tr>
<td>Assign the FC interface to the specified FC aggregation group</td>
<td>san-aggregation group group-number</td>
<td>By default, an FC interface is not assigned to any FC aggregation group.</td>
</tr>
<tr>
<td>Bring up the FC interface</td>
<td>undo shutdown</td>
<td>By default, an FC interface is up. Perform this operation after assigning the peer FC interface to the peer FC aggregation group.</td>
</tr>
</tbody>
</table>

**Enabling local-first load sharing**

Local-first load sharing reduces the influence of traffic on the links between physical IRF ports. In an IRF fabric, if an IRF member device forwards traffic out of an FC aggregate interface with the member interfaces distributed on multiple IRF member devices, the system processes the traffic as follows based on the configurations on IRF member device:

- When local-first load sharing is enabled on the IRF member device:
If the IRF member device has Selected member interfaces, traffic is load-shared among the Selected interfaces of the IRF member device.

If the IRF member device does not have Selected member interface, traffic is load-shared among all Selected member interfaces on all IRF member devices.

When local-first load sharing is disabled on the IRF member device, the traffic is load-shared among all Selected member interfaces on all IRF member devices.

For more information about IRF, see Virtual Technologies Configuration Guide.

Local-first load sharing takes effect immediately after it is configured, and it might cause traffic loss. To enable local-first load sharing:

Table 11: Configuring local-first load sharing

<table>
<thead>
<tr>
<th>Step</th>
<th>Command</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enter system view</td>
<td>system-view</td>
<td>N/A</td>
</tr>
<tr>
<td>Enable local-first load sharing.</td>
<td>san-aggregation load-sharing mode local-first</td>
<td>By default, local-first load sharing is enabled.</td>
</tr>
</tbody>
</table>

# Create FC aggregate interface 1.
[SwitchA] interface san-aggregation 1
# Configure the mode of FC aggregate interface 1 as E.
[SwitchA-SAN-Aggregation1] fc mode e
[SwitchA-SAN-Aggregation1] quit
# Assign FC interfaces FC 1/0/4 and FC 1/0/5 to FC aggregation group 1.
[SwitchA] interface fc 1/0/4
[SwitchA-Fc1/0/4] shutdown
[SwitchA-Fc1/0/4] san-aggregation group 1
Current FC mode, trunk mode, trunk VSAN, and access VSAN configuration of the interface will be lost. Continue? [Y/N]:y
[SwitchA-Fc1/0/4] undo shutdown
[SwitchA-Fc1/0/4] quit
[SwitchA] interface fc 1/0/5
[SwitchA-Fc1/0/5] shutdown
[SwitchA-Fc1/0/5] san-aggregation group 1
Current FC mode, trunk mode, trunk VSAN, and access VSAN configuration of the interface will be lost. Continue? [Y/N]:y
[SwitchA-Fc1/0/5] undo shutdown
[SwitchA-Fc1/0/5] quit

Configure Switch B in the same way as Switch A is configured.
This glossary defines acronyms and terms used in this guide. It is not a comprehensive glossary of computer terms.

A

ACL

Access Control List. A list of permissions attached to an object. An ACL specifies which users or system processes are granted access to objects, as well as what operations are allowed on given objects. Each entry in a typical ACL specifies a subject and an operation.

B

BB_credit

Buffer-to-buffer credits. A method used to determine how many frames can be sent to a recipient when buffer to buffer flow control is in use. The credit is the maximum number of outstanding frames that can be transmitted by an N_Port, NL_Port, or an F_Port without causing a buffer overrun condition at the receiver.

C

C-Class BladeSystem

A brand name used by Hewlett Packard Enterprise for blade server chassis form factor for modular servers. Blade servers are a modern form of server technology that have a more efficient design than conventional servers, which cuts down on the excess components that are usually found in regular servers and makes room for the implementation of components that will help with the specified needs. This helps create more efficient use of physical space and energy. Blade servers are packaged as ultra-high density components that can be used for a variety of services. The common uses include servers, storage of data, and communication interfaces. Blades are racked inside blade enclosures, which supply them with power, cooling, and networking.

CLI

Command Line Interface

D

DCB

Data Center Bridging. A collection of standards designed to transform Ethernet into a lossless network with efficient Layer 2 multipath forwarding. DCB, formerly called converged enhanced Ethernet (CEE), depends on a handful of standards developed by three different standards bodies: the American National Standards Institute, the Institute of Electrical and Electronics Engineers, and the Internet Engineering Task Force (IETF). It is also known as Data Center Ethernet (DCE). To meet SAN requirements for guaranteed packet delivery, Ethernet controllers implement DCB, a set of IEEE industry standards that delivers end-to-end congestion notification and quality of service throughout the network which allows customers to configure traffic classes and priorities to deliver a lossless Ethernet fabric. DCB includes the following protocols: IEEE 802.1Qau (CN), IEEE 802.1Qaz (ETS and DCBX), and IEEE 802.1Qbb (PFC).

DCBX

Data Center Bridging Capability eXchange. A discovery and capability exchange protocol that is used for conveying capabilities and configuration of the DCB features between neighbors to ensure consistent
configuration across the network. This protocol leverages the functionality provided by IEEE 802.1AB (LLDP). It is included in the 802.1az standard.

**ENode**

FCoE Node. A Fibre Channel node with one or more lossless Ethernet MACs, each coupled with an FCoE controller.

**E_Port**

Extension port. Fibre Channel switch ports which provide direct switch-to-switch connections within the fabric. The Expansion port within a Fibre Channel switch or a bridge device through an inter-switch link. The data forwarding component of an FC entity that emulates an E-Port and is dynamically instantiated on successful completion of an ELP Exchange.

**ETS**

Enhanced Transmission Selection. A DCB feature that allows allocation of bandwidth on a NIC to applications based on their DCB priority. The DCB priority is a VLAN header with a 3 bit priority field. The priority field's value differentiates Ethernet packets in the network. DCB uses the priority value, also called the 802.1p priority, to associate traffic with other DCB properties such as PFC configuration and link bandwidth. You can configure DCB to set specific bandwidth to be allocated to packets depending on their priority values.

**Fabric Login**

A process by which a Fibre Channel node establishes a logical connection to a fabric switch.

**Fabric_Name**

A Name_Identifier associated with a fabric.

**FlexFabric**

A flexible, virtualization-optimized data center network architecture that requires far fewer devices, interconnections, layers, and discrete appliances.

**F_ID**

Fabric_Identifier. An entity consisting of one or more switches that interconnect various Nx_Ports attached to it, and capable of routing frames using only the D_ID information in an FC-2 frame header. An identifier assigned to each fabric in an inter-fabric routing environment.

**F_Port**

Fabric Port. FC switch ports that connect directly to N_Ports.

**FC**

Fibre Channel. A serial I/O interconnect capable of supporting multiple protocols, including access to open system storage (FCP), access to mainframe storage (FICON), and networking (TCIP/IP).

**FC-BB**

Fibre Channel Backbone. A standard that defines mappings for transporting Fibre Channel over different network technologies, including operation of Fibre Channel over Ethernet (FCoE).
FCF
FCoE forwarder. FCFs are the combination of FCoE termination functions and Fibre Channel stack on Ethernet switches (dual-stack switches) and are equivalent to Fibre Channel switches in native Fibre Channel networks.

FCoE
Fibre Channel over Ethernet. A technology that allows a convergence of Ethernet and Fibre Channel fabrics.

FCoE_LEP
FCoE Link Endpoint. The data forwarding component of an FCoE entity that handles FC frame encapsulation/decapsulation, and transmission/reception of encapsulated frames through a single Virtual Link.

FIP
FCoE Initialization Protocol. A protocol utilized to discover and initialize FCoE capable entities connected to an Ethernet cloud, such as the FCF. FIP uses a dedicated Ether type of 0x8914. 0FIP does the discovery by allowing ENodes to discover who to log in with, then enabling a single ENode to communicate with multiple different FC fabrics, and as a result, a one-to-many relationship is built in. FIP maintains links with Link Keep Alive and Clear Virtual Link functions to allow a loss of a physical link or logical connectivity to be detected and for both ends of the virtual link to be notified when this happens. This allows RSCN to function properly and for the distributed name server to remain in sync. FIP also reduces the security concerns when FIP snooping and dynamic ACLs are implemented.

FPMA
Fabric Provided MAC Address. A MAC address that is assigned by an FCF and is fabric-wide unique.

H
hard zone
A zone consisting of zone members that are permitted to communicate with one another through the fabric. Hard zones are enforced by fabric switches that prohibit communication among members not in the same zone on a frame by frame basis, based on the source and destination addressing. Well-known addresses are implicitly included in every zone.

HBA
Host bus adapter. A hardware device that connects the host server to the fabric.

I
IRF
Intelligent Resilient Framework. A software virtualization technology that connects multiple network devices through physical IRF ports and performs necessary configurations. These devices are then virtualized into a distributed device. This virtualization technology realizes the cooperation, unified management, and nonstop maintenance of multiple devices. An IRF virtual device appears as a node on the network. You can log in to it by connecting to any port of any member to manage all members of the IRF virtual device.

iSCSI
Internet Small Computer System Interface. A standard protocol that uses SCSI commands to transfer data over IP networks.
ISSU

In-Service Software Upgrade. A comprehensive transparent software upgrade capability for network switches. IRF assisted ISSU will reboot one unit in the IRF system, wait for it to come back online, then reboot another unit in the IRF system. When a unit is rebooting, it is really down, so any host which is single-wire connected to this unit will be offline. The ISSU process assumes hosts or peer devices are dual-connected to two different IRF members. When one switch reboots, it will be the NIC teaming or Link-Aggregation of the peer device which will perform the failover and use the other link.

When using more than two units in the IRF system, ISSU assumes the peer devices are connected to all switches in the IRF system. For example, if you have a server IRF system with four switches, the server is assumed to be connected to each of the four switches. This is highly unlikely, and therefore in storage configurations, Hewlett Packard Enterprise recommends two units in the IRF system for any deployment which requires ISSU. When a customer can have a maintenance window and accepts downtime, more than two switches in the IRF can be used. There are 3 versions of ISSU:

- Compatible: Two software versions can actively exist in the same IRF system. Procedure can be done with
  \texttt{issu} CLI commands.

- Incompatible: Only one version can exist in the IRF system. Procedure can be done with
  \texttt{issu} CLI commands.

- Unknown: Official ISSU update to and from that version is not possible. ISSU-like update is possible with a manual procedure (not through
  \texttt{issu} CLI commands), using MAD assistance.

L

LACP

Link Aggregation Control Protocol. A protocol within the IEEE specification that provides a method to control the bundling of several physical ports together to form a single logical channel. LACP allows a network device to negotiate an automatic bundling of links by sending LACP packets to the peer (directly connected device that also implements LACP).

LUN

Logical Unit Number. A number used to identify a logical unit, which is a device addressed by the SCSI protocol or protocols that encapsulate SCSI, such as Fibre Channel or iSCSI Channel. A LUN may be used with any device which supports read/write operations, such as a tape drive, but is most often used to refer to a logical disk as created on a SAN.

M

MPIO

Multipath I/O. A facility for a host to direct I/O requests to a storage device on more than one access path. This requires that devices be uniquely identifiable by some means other than bus address.
**N**

_N_Port_

Node Port. Ports that are located on the server or storage ports. These ports connect directly to F_Ports.

**NPIV**

_N_Port ID Virtualization. An industry-standard protocol._

**NP_Port**

_N_Port Virtualization Port. These ports connect to F_Ports and act as a proxy for other N_Ports located on the NPV-enabled switch. Essentially, the NP_Port is able to present multiple pWWNs to the fabric over a single physical port._

**NPV**

_N_PORT Virtualization. A switch-based technology designed to reduce switch management and overhead in larger SAN deployments. NPV introduces a type of Fibre Channel port, the NP_Port. The NP_Port connects to an F_Port and acts as a proxy for other N_Ports on the NPV-enabled switch. Essentially, the NP_Port looks like an NPIV-enabled host to the F_Port on the other end. An NPV-enabled switch will register additional WWPNs (and receive additional N_Port_IDs) through NPIV on behalf of the N_Ports connected to it. The physical N_Ports do not have any knowledge this is occurring and do not need any support for it. It is all handled by the NPV-enabled switch._

**P**

**PFC**

Priority flow control. An extension of the 802.3x mechanism and defined in IEEE 802.1Qbb to define a lossless Ethernet connection. The PAUSE frame contains an 8–bit bit mask of the 802.1p priorities (specifying which traffic classes should be paused) and a timer for each priority specifying how long the traffic in that priority class should be paused. The per-priority PAUSE mechanism allows the storage array to tell the switch that it should stop sending just the FCoE traffic (assuming FCoE traffic is marked with priority value=3).

**Q**

**QoS**

Quality of service. A traffic management feature.

**QSFP+**

Quad Small form-factor pluggable, plus transceiver. A hot-pluggable, high-density transceiver which provides four channels of traffic in each direction (Tx and Rx). QSFP+ supports up to 16 Gb/s per channel for applications such as 40G Ethernet and InfiniBand 4xQDR. Both multimode and single mode versions of the QSFP+ module are available, as well as QSFP-based active optical cables.

**S**

**SFP+**

Small form-factor pluggable, plus transceiver. A compact, hot-pluggable transceiver which provides one channel of traffic in each direction (Tx and Rx). SFP+ supports up to 16 Gb/s per channel for applications such as 10G Ethernet, 16/8/4 G FC and is used for both telecom and datacom applications.

**soft zone**

A fabric name service that allows each device to query the addresses of all other devices. Soft zoning restricts only the fabric name service to show only an allowed subset of devices. Therefore, when a server
looks at the content of the fabric, it will only see the devices it is allowed to see. However, any server can still attempt to contact any device on the network by address. Soft zoning is similar to the computing concept of security through obscurity.

T

ToR

Top of Rack. A design that contains servers connected to one or two converged network switches installed inside the rack. The term top of rack has been coined for this design. However, the actual physical location of the switch does not necessarily need to be at the top of the rack. Other switch locations could be bottom of the rack or middle of rack, however, top of the rack is most common due to easier accessibility and cleaner cable management. This design may also sometimes be referred to as In-Rack. The key characteristic and appeal of the Top of Rack design is that all copper cabling for servers stays within the rack as relatively short patch cables from the server to the rack switch. The switch links from the rack to the data center network using fiber running directly from the rack to a common aggregation area connecting to redundant Distribution or Aggregation high density modular converged switches.

V

vE_Port

Virtual Extension port. FCoE switch ports that provide direct switch-to-switch connections within the fabric.

vF_Port

Virtual Fabric Port. FCoE switch ports that attach to vN_Ports or vNP ports. The data forwarding component of an FC entity that emulates an F_Port and is dynamically instantiated on successful completion of an FLOGI Exchange. The term virtual indicates the use of a non Fibre Channel link connecting a VF_Port with a VN_Port.

VFC

Virtual Fibre Channel. An interface that must be enabled and mapped to and FCoE VSAN, which has an associated VLAN. Each physical switch port that will carry FCoE traffic must have a corresponding VFC interface.

VLAN

Virtual LAN (ID). A group of end stations with a common set of requirements, independent of physical location. VLANs have the same attributes as a physical LAN but allow you to group end stations even if they are not located physically on the same LAN segment. VLANs are usually associated with IP subnetworks. For example, all the end stations in a particular IP subnet belong to the same VLAN. Traffic between VLANs must be routed. LAN port VLAN membership is assigned manually on a port-by-port basis.

vN_Port

Virtual Node Port. vN_Ports are CNAs on node ports and FCoE storage ports.

vN_Port MAC address

Virtual Node Port MAC address. vN_Port MAC address is the Name_Identifier of a vN_Port. The MAC address used by an ENode for a particular address identifier during FC operation using FCoE frames. Access Control List (ACL) is a persistent list, commonly composed of Access Control Entries (ACEs) that enumerate the rights of principals (users and groups of users and/or groups) to access resources.
vNP_Port

Virtual N_Port Virtualization Port. vNP_Ports connect to vF_Ports and act as a proxy for other N_Ports located on the NPV-enabled switch. The data forwarding component of an FC entity that emulates an N_Port and is dynamically instantiated on successful completion of an FLOGI or FDISC Exchange. The term virtual indicates the use of a non Fibre Channel link connecting a VN_Port to a VF_Port.

Zoning

A method of subdividing a storage area network into disjoint zones or subsets of nodes on the network. Storage area network nodes outside a zone, except those with well-known addresses, are invisible to nodes within the zone. Moreover, with switched SANs, traffic within each zone may be physically isolated from traffic outside the zone.

Zone Set

A set of zone definitions for a fabric. Zones in a zone set may overlap. For example, a port may be a member of more than one zone. Fabric management may support switching between zone sets to enforce different access restrictions, for example, at different times of day.
Support and other resources

Accessing Hewlett Packard Enterprise Support

- For live assistance, go to the Contact Hewlett Packard Enterprise Worldwide website:
  http://www.hpe.com/assistance

- To access documentation and support services, go to the Hewlett Packard Enterprise Support Center website:
  http://www.hpe.com/support/hpesc

Information to collect

- Technical support registration number (if applicable)
- Product name, model or version, and serial number
- Operating system name and version
- Firmware version
- Error messages
- Product-specific reports and logs
- Add-on products or components
- Third-party products or components

Accessing updates

- Some software products provide a mechanism for accessing software updates through the product interface. Review your product documentation to identify the recommended software update method.

- To download product updates:
  Hewlett Packard Enterprise Support Center
  www.hpe.com/support/hpesc
  Hewlett Packard Enterprise Support Center: Software downloads
  www.hpe.com/support/downloads
  Software Depot
  www.hpe.com/support/softwaredepot

- To subscribe to eNewsletters and alerts:
  www.hpe.com/support/e-updates

- To view and update your entitlements, and to link your contracts and warranties with your profile, go to the Hewlett Packard Enterprise Support Center More Information on Access to Support Materials page:
  www.hpe.com/support/AccessToSupportMaterials
IMPORTANT:
Access to some updates might require product entitlement when accessed through the Hewlett Packard Enterprise Support Center. You must have an HPE Passport set up with relevant entitlements.

Customer self repair

Hewlett Packard Enterprise customer self repair (CSR) programs allow you to repair your product. If a CSR part needs to be replaced, it will be shipped directly to you so that you can install it at your convenience. Some parts do not qualify for CSR. Your Hewlett Packard Enterprise authorized service provider will determine whether a repair can be accomplished by CSR.

For more information about CSR, contact your local service provider or go to the CSR website:
http://www.hpe.com/support/selfrepair

Remote support

Remote support is available with supported devices as part of your warranty or contractual support agreement. It provides intelligent event diagnosis, and automatic, secure submission of hardware event notifications to Hewlett Packard Enterprise, which will initiate a fast and accurate resolution based on your product's service level. Hewlett Packard Enterprise strongly recommends that you register your device for remote support.

If your product includes additional remote support details, use search to locate that information.

Remote support and Proactive Care information
HPE Get Connected
www.hpe.com/services/getconnected
HPE Proactive Care services
www.hpe.com/services/proactivecare
HPE Proactive Care service: Supported products list
www.hpe.com/services/proactivecaresupportedproducts
HPE Proactive Care advanced service: Supported products list
www.hpe.com/services/proactivecareadvancedsupportedproducts

Proactive Care customer information
Proactive Care central
www.hpe.com/services/proactivecarecentral
Proactive Care service activation
www.hpe.com/services/proactivecarecentralgetstarted

Warranty information

To view the warranty for your product or to view the Safety and Compliance Information for Server, Storage, Power, Networking, and Rack Products reference document, go to the Enterprise Safety and Compliance website:
www.hpe.com/support/Safety-Compliance-EnterpriseProducts

Additional warranty information
HPE ProLiant and x86 Servers and Options
www.hpe.com/support/ProLiantServers-Warranties
Regulatory information

To view the regulatory information for your product, view the Safety and Compliance Information for Server, Storage, Power, Networking, and Rack Products, available at the Hewlett Packard Enterprise Support Center:

www.hpe.com/support/Safety-Compliance-EnterpriseProducts

Additional regulatory information

Hewlett Packard Enterprise is committed to providing our customers with information about the chemical substances in our products as needed to comply with legal requirements such as REACH (Regulation EC No 1907/2006 of the European Parliament and the Council). A chemical information report for this product can be found at:

www.hpe.com/info/reach

For Hewlett Packard Enterprise product environmental and safety information and compliance data, including RoHS and REACH, see:

www.hpe.com/info/ecodata

For Hewlett Packard Enterprise environmental information, including company programs, product recycling, and energy efficiency, see:

www.hpe.com/info/environment

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