JUNIPER NETWORKS QFX3500 SWITCH AND QLOGIC CONVERGED NETWORK IMPLEMENTATION GUIDE
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Introduction
A converged network is a fabric that combines traditional LAN and storage area network (SAN) traffic on the same physical network. The goal of a combined fabric is to reduce infrastructure complexity, and enhance data flow and access. Data Center Bridging (DCB) encompasses the requirements which enable convergence of the network fabric.

Implementing Converged networks and Lossless Ethernet—Data Center Bridging
DCB encompasses various capabilities that were added to the Ethernet 802.1Q specifications to support these new requirements:

1. Enhanced Transmission Selection (ETS: 802.1Qaz) builds on 802.1p for classifying traffic into groups with similar requirements and configuring bandwidth to those different groups.
2. Priority-based Flow Control (PFC: 802.1Qbb) builds on pause and 802.1p and allows pause to be configured and applied on a per priority rather than per port basis so that individual traffic classes can be given lossless treatment without blocking each other or blocking those flows not requiring lossless treatment.
3. Data Center Bridging eXchange Protocol (DCBX: 802.1Qaz) builds on LLDP for devices that support DCB to communicate and negotiate the configuration of their DCB capabilities and their application to higher level applications such as FCoE and iSCSI.

DCB also leverages and builds upon many existing capabilities of standard Ethernet devices. It is also complementary to many other existing capabilities of standard Ethernet devices many of which are valuable as part of the full datacenter requirement.

This guide describes how to install a pilot 10GbE converged network in preparation for production deployment. The pilot network uses the following devices (described in detail in Appendix A—Required Devices):

- QLogic 8200 Series Converged Network Adapter
- QLogic 5800V Stackable Fibre Channel Switch
- Juniper Networks® QFX3500 FCoE Convergence capable Switch

Scope
This guide is for system engineers and administrators who want to provide converged networking products, solutions, and services to their customers. It is also intended for network planners and administrators who are implementing a converged network for their company.

In this guide, a summary of planning considerations for implementing a converged fabric in your data center is presented, followed by detailed step-by-step instructions on configuring a converged network using QLogic and Juniper Networks equipment. It assumes basic knowledge of Enhanced Ethernet and the associated standards. If you are not familiar with Fibre Channel over Ethernet (FCoE) and Enhanced Ethernet, please review the documents listed in Appendix B—Related Materials.

Design Considerations
Selecting a Test Architecture
When planning the installation of a converged network, it is important to consider both Fibre Channel (FC) and traditional Ethernet-based traffic flows. Combining a test SAN infrastructure and a test LAN infrastructure is often the easiest and most available option for a first project. Alternatively, a critical business application test system can closely simulate a production environment. The architecture you choose must demonstrate that a converged network improves efficiency and performance in your environment. The reference architecture described in this guide was assembled from equipment that was available in the QLogic NETtrack Developer Center. You will need to substitute your own equipment, and modify the installation and validation process accordingly.

Organizational Ownership—Fibre Channel/Storage, Ethernet/Networking
A critical factor for successfully implementing a converged data center fabric is the stability of network and storage management practices. Cooperation between the network and storage management teams is essential to properly configure the converged data center fabric.
Protocol Operation

Where and How to Deploy

This converged fabric has three components:

1. Juniper Networks QFX3500 Switch configured as an FCoE-FC Gateway—This high-performance switch supports connecting traditional Ethernet and FC infrastructures. The FCoE-FC gateway handles FCoE Initialization Protocol (FIP) and FCoE traffic on interfaces to FCoE devices. It forwards native FC traffic on interfaces to the FC switch. Although the QFX3500 does have a feature rich Fibre Channel stack it does not provide directly FC services that are unique to an FCF (such as fabric login server or name server). Rather it is a proxy to the Fibre Channel Forwarder (FCF) using N_Port ID Virtualization. The gateway transparently substitutes for FCoE devices when communicating with the FC switch and transparently substitutes for the FC switch when communicating with FCoE devices.

2. QLogic 8200 Series 10GbE Converged Network Adapters—These adapters support both Ethernet LAN and Fibre Channel SAN over 10GbE media. The adapters replace the network interface card (NIC) and FC host bus adapter, and connect to a DCB-enabled 10GbE switch.

3. QLogic 5800V Fibre Channel Switch—This switch provides connection to FC devices and FC services such as fabric login server or name server.

There are various ways to connect FCoE Servers to an existing Fibre Channel SAN:

1. Converged Network Adapter > FCoE-FC gateway > FC switch > FC storage
   - The FCoE-FC Gateway provides a converged access layer to an existing FC SAN without the scaling and management challenges that come from increasing the number of FCFs in the SAN.

2. Converged Network Adapter > FCoE-Transit-Switch > FCoE-FC switch > FC storage
   - Where the existing FC SAN can be FCoE enabled an FCoE-Transit-Switch provides a simple multiplexing in to the FCoE ports of the FCF with a very low overhead whilst maintaining critical FCoE Security and monitoring capabilities.

3. Converged Network Adapter > FCoE-Transit-Switch > FCoE-FC gateway > FC switch > FC storage
   - For larger environments a combination of approaches may be appropriate.

Implementation

This section describes how to configure a QLogic and Juniper Networks converged networking solution. The configuration assumed is Converged Network Adapter > FCoE-FC gateway > FC switch > FC storage.

Prerequisites

Before beginning the configuration, be sure that the following prerequisites have been satisfied:

- Hardware, cabling, and driver installation are complete and done in accordance with the manufacturer’s setup instructions.
  - (For information on adapter driver installation, refer to the User’s Guide, Converged Network Adapters and Intelligent Ethernet Adapters, 8200 and 3200 Series. If the hyperlink is broken, see “QLogic 8200 Series Converged Network Adapter” below for download instructions.)
- There is Fibre Channel storage with exposed LUN.
- Access to some form of Ethernet traffic is available to demonstrate converged traffic.
- There is familiarity with DCBX terminology.
- There is a general understanding of storage (zoning, LUNs, and OS disk management).

Configuration Diagram

The following diagram shows an example of the QLogic/Juniper Networks solution. The step-by-step instructions that follow are based on this configuration. When planning a specific implementation, you will need to add the appropriate iterations of these steps for your specific configuration.

Figure 1: Implementation of converged network solution
Configuring the Ethernet Interfaces on the QFX3500 Switch

1. Launch the command-line interface (CLI) on the switch using telnet, as described in Connecting and Configuring a QFX3500 Switch.

2. Create VLANs:
   
   ```
   # edit
   # edit vlans
   # set FCoE-1 vlan-id 1002
   # set native vlan-id 1
   # exit
   ```

3. Configure the Ethernet Interfaces for the FCoE VLAN in trunk mode:
   
   ```
   # edit interfaces
   # set xe-0/0/<port> unit 0 family ethernet-switching port-mode trunk
   ```
   
   where `<port>` is the number where the Converged Network Adaptor (CNA) is connected. Repeat this command for every connected CNA port.

4. Configure the Ethernet Interfaces for the FCoE VLAN with the native VLAN:
   
   ```
   # set xe-0/0/<port> unit 0 family ethernet-switching native-vlan-id 1
   ```
   
   where `<port>` is the number where the CNA is connected. Repeat this command for every connected CNA port.

5. Configure the maximum transmission unit (MTU) size for the Ethernet Interface:
   
   ```
   # set xe-0/0/<port> mtu 2180
   ```
   
   where `<port>` is the number where the CNA is connected. Repeat this command for every connected CNA port.

6. Configure Ethernet Port membership in VLAN FCoE-1:
   
   ```
   # set xe-0/0/<port> unit 0 family ethernet-switching vlan members FCoE-1
   # exit
   ```
   
   where `<port>` is the number where the CNA is connected. Repeat this command for every connected CNA port.

7. Assign the Ethernet Interfaces to the VLAN FCoE-1:
   
   ```
   # edit vlans FCoE-1 interface
   # set xe-0/0/<port>.0
   # exit
   ```
   
   where `<port>` is the number where the CNA is connected. Repeat this command for every connected CNA port.

Connecting and Configuring a QFX3500 Switch

You must perform the initial configuration of the QFX3500 Switch through the console port using the CLI. Before you begin connecting and configuring a QFX3500, set the following parameter values on the console server or PC:

- Baud rate—9600
- Flow control—none
- Data—8
- Parity—none
- Stop bits—1
- DCD state—disregard

To connect and configure the device from the console:

1. Connect the console port to a laptop or PC using the supplied RJ-45 cable and RJ-45 to DB-9 adapter. The console (CON) port is located on the front panel of the device.

2. Log in as root:
   
   ```
   login: root
   ```

   There is no password. If the software booted before you connected to the console port, you may need to press the Enter key for the prompt to appear.

3. Start the CLI:
   
   ```
   root@% cli
   ```

4. Enter configuration mode:
   
   ```
   root> configure
   ```

5. Add a password to the root administration user account:
   
   ```
   root@# set system root-authentication plain-text-password
   ```

   New password: password
   Retype new password: password
6. (Optional) Configure the name of the device. If the name includes spaces, enclose the name in quotation marks (" "):
   root@# set system host-name host-name

7. Configure the default gateway:
   root@# set routing-options static route default next-hop address

8. Configure the IP address and prefix length for the device management interface:
   root@# set interfaces me0 unit 0 family inet address address/prefix-length
   **NOTE:** The management ports are on the front panel of the QFX3500 switch and are labeled C0 and C1. In the CLI, they are referred to as me0 and me1.

9. (Optional) Configure the static routes to remote prefixes with access to the management port:
   root@# set routing-options static route remote-prefix next-hop destination-ip retain no-readvertise

10. Enable telnet service:
    root@# set system services telnet

11. Commit the configuration to activate it on the device:
    root@# commit

**Configuring the Fibre Channel Interface on the QFX3500 Switch**

1. Configure the FCoE VLAN interface and port mode for FCoE traffic:
   # edit interfaces
   # set vlan unit 1002 family fibre-channel port-mode f-port
   # exit

2. Give the VLAN name and value the right interface type:
   # edit vlans
   # set FCoE-1 l3-interface vlan.1002
   # exit

3. Identify the ports to connect to FC switches:
   # edit chassis fpc 0 pic 0
   # set fibre-channel port-range 0 5
   # exit

4. Configure the native FC interfaces and port modes:
   # edit interfaces
   # set fc-0/0/0 unit 0 family fibre-channel port-mode np-port
   # set fc-0/0/1 unit 0 family fibre-channel port-mode np-port
   # set fc-0/0/2 unit 0 family fibre-channel port-mode np-port
   # set fc-0/0/3 unit 0 family fibre-channel port-mode np-port
   # set fc-0/0/4 unit 0 family fibre-channel port-mode np-port
   # set fc-0/0/5 unit 0 family fibre-channel port-mode np-port

5. Set the port speed:
   # set fc-0/0/0 fibrechannel-options speed 8g
   # set fc-0/0/1 fibrechannel-options speed 8g
   # set fc-0/0/2 fibrechannel-options speed 8g
   # set fc-0/0/3 fibrechannel-options speed 8g
   # set fc-0/0/4 fibrechannel-options speed 8g
   # set fc-0/0/5 fibrechannel-options speed 8g
   # exit

6. Configure the FC fabric name and unique direct inward dialing (DID):
   # edit fc-fabrics
   # set fcproxy1 fabric-id 1
   # set fcproxy1 fabric-type proxy

7. Define this as FCoE/FC Gateway:
   # set fcproxy1 fabric-type proxy
8. Marry the proxy to the VLAN:
   # set fcproxy1 interface vlan.1002

9. Add the physical ports to the proxy fabric:
   # set fcproxy1 interface fc-0/0/0.0
   # set fcproxy1 interface fc-0/0/1.0
   # set fcproxy1 interface fc-0/0/2.0
   # set fcproxy1 interface fc-0/0/3.0
   # set fcproxy1 interface fc-0/0/4.0
   # set fcproxy1 interface fc-0/0/5.0
   # exit

Marrying the Interfaces Together on the QFX3500 Switch

1. Set the protocols and class of service for Priority-based Flow Control (PFC):
   # set protocols igmp-snooping vlan FCoE-1 disable
   # set protocols igmp-snooping vlan native disable
   # set protocols dcdbx interface all
   # set protocols lldp interface all
   # set class-of-service classifiers ieee-802.1 pFC forwarding-class fcoe loss-priority low code-points 011
   # set class-of-service classifiers ieee-802.1 pFC forwarding-class best-effort loss-priority high code-points 000
   # set class-of-service classifiers ieee-802.1 pFC forwarding-class best-effort loss-priority high code-points 001
   # set class-of-service classifiers ieee-802.1 pFC forwarding-class best-effort loss-priority high code-points 100
   # set class-of-service classifiers ieee-802.1 pFC forwarding-class best-effort loss-priority high code-points 101
   # set class-of-service classifiers ieee-802.1 pFC forwarding-class best-effort loss-priority high code-points 110
   # set class-of-service classifiers ieee-802.1 pFC forwarding-class best-effort loss-priority high code-points 111
   # set class-of-service traffic-control-profiles fcoe_tcp scheduler-map fcoe_map
   # set class-of-service traffic-control-profiles fcoe_tcp guaranteed-rate 6g
   # set class-of-service traffic-control-profiles lan_tcp scheduler-map lan_map
   # set class-of-service traffic-control-profiles lan_tcp guaranteed-rate 4g
   # set class-of-service forwarding-class-sets fcoe_fc_set class fcoe
   # set class-of-service forwarding-class-sets lan_fc_set class best-effort
   # set class-of-service congestion-notification-profile CNp input ieee-802.1 code-point 011 pFC
   # set class-of-service scheduler-maps fcoe_map forwarding-class fcoe scheduler fcoe_sch
   # set class-of-service scheduler-maps lan_map forwarding-class best-effort scheduler lan_sch
   # set class-of-service schedulers fcoe_sch transmit-rate 6g
   # set class-of-service schedulers lan_sch transmit-rate 4g

2. Add the CNA ports to the fabric and with class of service and PFC—issue the following commands for each CNA port
   that you are adding to the fabric:
   # set class-of-service interfaces xe-0/0/<port> forwarding-class-set fcoe_fc_set
   output-traffic-control-profile fcoe_tcp
   # set class-of-service interfaces xe-0/0/<port> forwarding-class-set lan_fc_set
   output-traffic-control-profile lanTCP
   # set class-of-service interfaces xe-0/0/<port> congestion-notification-profile CNP
   # set class-of-service interfaces xe-0/0/<port> unit 0 classifiers ieee-802.1 PFC

3. Commit the changes to the configuration:
   # commit
Summary
This guide has presented a summary of planning considerations for implementing a converged fabric in your data center. It has included detailed step-by-step instructions for configuring a converged network using the QLogic 8200 Series Converged Network Adapter, QLogic 5800V Stackable Switch, and Juniper Networks QFX3500 Switch. After the configuration steps are completed, it is important to validate connectivity and make sure that FCoE is working properly. This can be done using load generators and other measurement tools.

Appendix A—Required Devices
The implementation requires the following devices:

- **QLogic 5800V Stackable Switch**
  - Line-rate throughput
  - Non-blocking multi-switch configuration
  - Adaptive trunking

- **QLogic 8200 Series Converged Network Adapter**
  - Single-port or dual-port 10Gbe line-rate throughput with low CPU utilization (If you are connecting a single cable and do not want to do multipathing on all servers, a single-port card will do)
  - ConvergeFlex—supports multiprotocol over one wire simultaneously
  - Supports all enterprise-class NIC features (for example, teaming, VLAN, and offloads)

- **Juniper Networks QFX3500 Switch (Gateway/Bridge)**
  - 1.28 Tbps of throughput
  - 960 Mpps of switching capacity
  - Ultra low latency (< 1 µs) and low jitter
  - Full wire-speed capacity with all ports delivering full performance in both Layer 2 and Layer 3 operation
  - Line-rate throughput for all frame sizes on all ports
  - Standards-based L2, L3, and I/O convergence
  - Supports feature-rich implementation of IEEE DCB standards for converged networks, enabling FCoE, iSCSI, and network access service (NAS) deployments
  - FCoE transit and FCoE-FC gateway, interoperability with both Brocade and Cisco Fibre Channel SANs (including support for multihop FCoE)
  - Interoperability with major converged network adapter vendors
  - Green compliance: RoHS, China RoHS, Gold B0 Plus, Green Recycle, WEEE, REACH
Appendix B—Related Materials

Data Center Bridging (DCB)
The following links provide more detailed information, and connect to the IEEE documents that define the Enhanced Ethernet functions:

- **P802.1Qbb Priority-based Flow Control:**

- **P802.1Qaz Enhanced Transmission Selection (Priority Groups):**

- **P802.1Qaz DCB Capability Exchange Protocol (DCBX):**

- **Ethernet Alliance white papers that further describe Enhanced Ethernet:**
  www.ethernetalliance.org/library/whitepapers/

Juniper Networks QFX3500 Switch
To access the technical documentation online at [www.juniper.net](http://www.juniper.net):
1. Click **SUPPORT**
2. Click **Technical Documentation, QFX Series, QFX3500**

QLogic 5800V Stackable Switch

*Note:* The following hyperlinks are correct as of this writing. If a hyperlink is broken, download the latest revision of the document as follows:

1. Go to the QLogic website’s download page at [http://driverdownloads.qlogic.com/](http://driverdownloads.qlogic.com/)
2. Click **Guided Search**
3. Make the following selections, and then click **Search**
   - **Product Type:** Switches
   - **Select by Model or OS:** by Model
   - **Product Technology:** Fibre Channel Switches
   - **Model:** QLogic 5800V
   - **Desired Item:** Documentation
4. Scroll through the list of documentation and select the desired document
5. Click **Download Now**, and then click **Download**
6. Save the document to a local folder
   - **User’s Guide, Command Line Interface, 5800V Series Stackable Fibre Channel Switch**
   - **User’s Guide, QuickTools Switch Management, 5800V Series Stackable Fibre Channel Switch**
   - ** Rack Mounting Guide, Fibre Channel Switch 3800/5800 Series**
   - **Reference Guide, Fibre Channel Event Message, QLogic 3500/5000/9000 Series Fibre Channel Switch**
   - **Reference Guide, CIM Agent, QLogic 3000/5000/9000 Series Fibre Channel Switch**
   - **User’s Guide, Enterprise Fabric Suite, 5800V Series Fibre Channel Switches**
   - **Quick Reference Guide, Command Line Interface, 3000/5000/9000 Series Fibre Channel Switch**
   - **Stacking Cable Instructions, SANbox 5000/9000 Series Stackable Chassis Switch**
   - **Installation Guide, Stackable Fibre Channel Switch, 5800V Series**
QLogic 8200 Series Converged Network Adapter

Note: The following hyperlinks are correct as of this writing. If a hyperlink is broken, download the latest revision of the document as follows:

1. Go to the QLogic website's download page at http://driverdownloads.qlogic.com/
2. Click Guided Search
3. Make the following selections, and then click Search
   - Product Type: Adapters
   - Select by Model or OS: by Model
   - Product Technology: Converged Network Adapters
   - Model: QLE8240 (single-port) or QLE8242 (dual-port)
   - Desired Item: Documentation
4. Scroll through the list of documentation and select the desired document for your operating system
5. Click Download Now, and then click Download
6. Save the document to a local folder.
   - User's Guide, Converged Network Adapters and Intelligent Ethernet Adapters, 8200 and 3200 Series
   - User's Guide, QConvergeConsole CLI, 2400, 2500, 3200, 8100, 8200 Series
   - User's Guide, QConvergeConsole, 2400, 2500, 3200, 8100, 8200 Series

About Juniper Networks

Juniper Networks is in the business of network innovation. From devices to data centers, from consumers to cloud providers, Juniper Networks delivers the software, silicon and systems that transform the experience and economics of networking. The company serves customers and partners worldwide. Additional information can be found at www.juniper.net.