BCFCoEP in a Nutshell Study Guide for Exam 143-510

Exam Preparation Materials

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BCFCoEP in a Nutshell First Edition

Objective: The BCFCoEP Nutshell guide is designed to help you prepare for the BCFCoEP Certification, exam number 143-510.

Audience: The BCFCoEP Nutshell self-study guide is intended for those who have successfully completed the FCoE 200 Brocade FCoE Professional Training course, and who wish to undertake self-study or review activities before taking the actual BCFCoEP exam. The BCFCoEP guide is not intended as a substitute for classroom training or hands-on time with Brocade products.

How to make the most of the BCFCoEP guide: The BCFCoEP guide summarizes the key topics on the BCFCoEP exam for you in an easy to use format. It is organized closely around the exam objectives. We suggest this guide be used in conjunction with our free online knowledge assessment test. To benefit from the BCFCoEP guide, we strongly recommend you have successfully completed the FCoE 200 Brocade FCoE Professional Training course.

We hope you find this useful in your journey towards BCFCoEP Certification, and we welcome your feedback by sending an email to jcannata@brocade.com.

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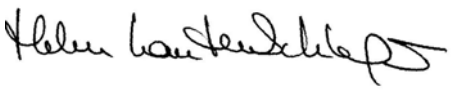


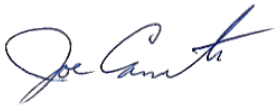


Table of Contents

List of Figures

List of Tables

1 - FCoE/CEE Concepts

Fibre Channel over Ethernet

- Encapsulates FC frames within Ethernet frames and transports them over CEE
- Leverages the rich set of FC fabric services for storage connectivity
- Preserves investment in SAN infrastructure

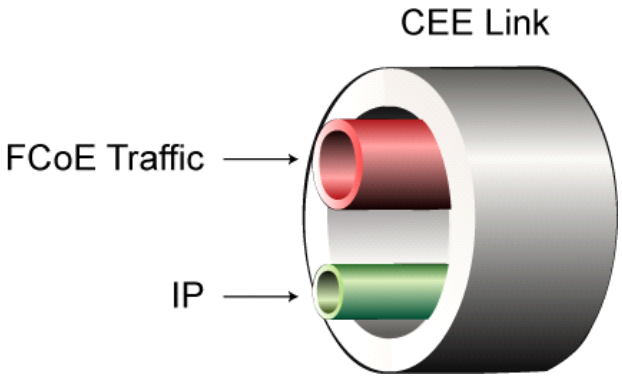


Figure 1: FCoE Converged Traffic

Some of the FC fabric services include: name services, zoning, WWN structure, management, and multi-pathing.

FCoE is not a new technology, it's an extension of an existing technology (Fiber Channel) over a new transport (CEE). Fibre Channel is simply encapsulated on top of Converged Enhanced Ethernet.

Adding FCoE to the server means the fabric edge will change, in essence, into two edges. One will be traditional Fibre Channel and the second will be CEE enabled FCoE. Both will ride on a single "wire" and connect (via routers) to the corporate LAN and to data center SAN (via switching) providing simultaneous access for client/server applications (TCP/IP), Web 2.0 applications (HTTPS/HTML) and I/O channels in the data center to disk storage and tape. FCoE doesn't give any new protocol advantages, but rather allows LAN and SAN to be stacked onto the same adapters and switches. The server shows the CNA as two separate adapters in the same hardware. FCoE does not require a dedicated Ethernet fabric, it can operate in the presence of other Ethernet traffic (converged network data I/O)

FCoE Terminology

- The Brocade 8000 switch and FCOE10-24 blade support the following FCoE port types:
  - **VF_Port:** Virtual fabric port, the FCoE equivalent of a Fibre Channel F_Port
    - FCFs support VF_Ports
  - **VN_Port:** Virtual node port, the FCoE equivalent of a Fibre Channel N_Port
    - ENodes support VN_Ports

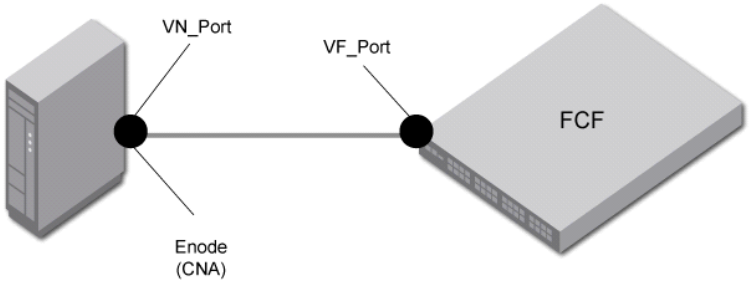


Figure 2: FCoE Port Types

In Fabric OS v6.3.1, the Brocade 8000 switch/ FCOE10-24 blade FCF does not support VE_Ports.

VE_Port: Virtual E_Port is used to connect two FCFs together and is the FCoE equivalent of a Fibre Channel E_Port.

Fabric OS v6.3.1 only supports directly connected FCoE initiators (CNAs), no FCoE target support.

CEE Enhancements to Ethernet

- Data Center Bridging eXchange (DCBX) – IEEE 802.1Qaz
  - Leverages functionality provided by IEEE 802.1AB (LLDP)
  - Used for conveying capabilities and configuration features between neighbors (single hop)
- Priority Flow Control (PFC) – IEEE 802.1Qbb
  - Link level flow control mechanism
  - Controlled independently for each Class of Service (CoS)
  - Goal of this mechanism is to ensure zero loss under congestion in DCB networks
- Enhanced Transmission Selection (ETS) – IEEE 802.1Qaz
  - Enables bandwidth management by assigning bandwidth segments to different traffic flows

The Ethernet CoS is different from the Fibre Channel CoS. It is defined as the priority level in CEE.

Priority Flow Control (IEEE 802.1Qbb)

- PFC is an extension of IEEE 802.3X Ethernet Pause
- PFC enables pauses based on priorities or classes of service
- A physical link divided into eight virtual links with PFC provides the capability to use pause on a single virtual link without affecting traffic on the other virtual links

Enabling Pause on a per-user-priority basis allows administrators to create lossless links for traffic requiring no-drop service, such as Fibre Channel over Ethernet (FCoE), while retaining frame-drop congestion management for IP traffic.

Other congestion control methods remain in place, even with PFC enabled. **Tail Drop**, for instance, is still in effect as a "just in case" backup. If, for some reason, PFC fails, the PFC buffer overrun would breach the Tail Drop threshold, and frames would begin to be dropped.

Multicast Queues

- Brocade supports four multicast queues
- Multicast traffic gets mapped from the Unicast CoS queues to one of four multicast queues

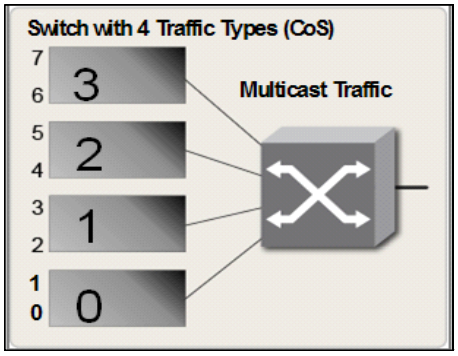


Figure 3: Multicast Queues

The functionality of the four multicast queues is somewhat different than that of the unicast queues. For multicast, there are pre-expansion queues and post expansion queues on the input side of the port. On the output side of the port, there are just four queues for multicast. The pre-expansion queues are common across all ingress ports on an Anvil ASIC. The post-expansion queues are per input per output port VoQ (just as they are for unicast). Regardless of whether a frame is unicast or multicast, it consumes space from the buffer allocated for the given incoming port/priority as soon as it arrives. However, when a multicast frame is sitting in a pre-expansion queue, we also maintain a count of the number of such packets in those queues. That limit is currently 64 packets for each of the four priorities. We rate limit the number of expansions. If the rate is exceeded, these queues could build beyond 64 packets. If we hit that limit, we will drop a frame.

Independent of all of this, PFC is operating on the port/priority. Thus the pre-expansion queue accounting and PFC accounting happen independently. A copy is generated for each output port on the local Anvil and one copy for each destination Anvil. The destination Anvil is responsible for the replication of its local queues. When all copies have left the Anvil, it gives up the occupancy for that port/priority.

FCoE Priority Mapping

- Default CoS = 3, default FCoE Priority Mapping = 0x08

CoS	FCoE Priority Map	Binary Bit Map
0	0x01	0000 0001
1	0x02	0000 0010
2	0x04	0000 0100
3	**0x08**	**0000 1000**
4	0x10	0001 0000
5	0x20	0010 0000
6	0x40	0100 0000
7	0x80	1000 0000

Table 1: FCoE Priority Map

To set FCoE to use CoS 0 use FCoE Priority Map 0x01, to set FCoE to use CoS 1 use FCoE Priority 0x02, to set FCoE to use CoS 2 use FCoE Priority 0x04 and so forth.

FIP Overview

- Since the links between FCoE entities are virtual rather than physical (as in native Fibre Channel), additional processing is required before normal Fibre Channel operations can begin
- There are three distinct initialization phases performed using FIP
    - FIP EtherType 8914

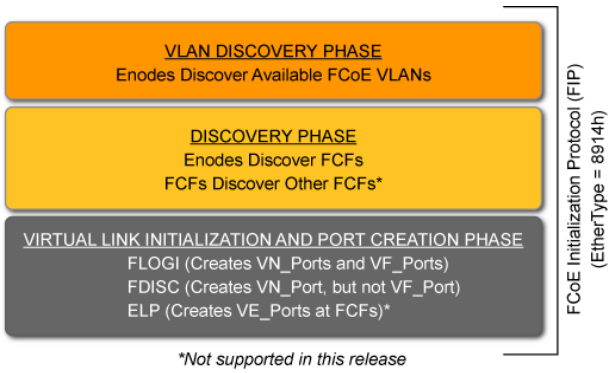


Figure 4: FIP Phases

In a native Fibre Channel environment, a node port is directly connected to a fabric port on a switch, and some switch ports may be connected to other switches. To login, the node port simply sends a FLOGI request to the fabric port on the switch. In FCoE, a node port may not be directly connected to an FCoE fabric port, but to one or more CEE switches. As a result, an FCoE node ports needs a discovery mechanism that allows it to discover any available fabric ports before it can perform a FLOGI.

Similarly, FCoE switch E_Ports may not be directly connected to other E_Ports in the same manner as they are in a Fibre Channel environment. This requires a discovery mechanism that allows one switch port to discover other switch ports before an ISL can be initialized. The mechanism used for both types of discovery is the FCoE Initialization Protocol (FIP). FIP uses EtherType 0x8914.

- VLAN Discovery Phase
    - The CNA discovers available FCoE VLANS using two FIP operations:
        - The CNA sends a **VLAN Discovery Request** to the All-FCoE-Forwarders multicast address of **01-10-18-01-00-02**
        - The FCF responds with a **VLAN Discovery Response** frame with available FCoE enabled VLANs
- The FIP VLAN Discovery Response carries the list of VLAN IDs over which the FCF offers FCoE Services to that ENode

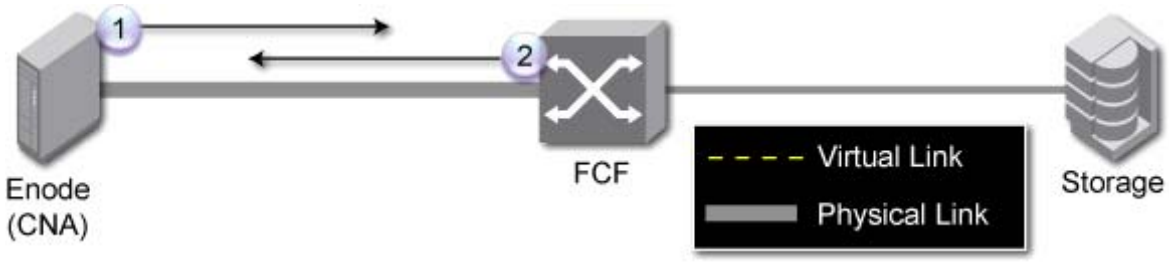


Figure 5: VLAN Discovery Phase

- When becoming operational, an ENode MAC or an FCF-MAC may invoke the FIP VLAN discovery protocol to discover the VLANs in the lossless Ethernet network that provide FCoE services (FC-BB_E)
  - The FIP VLAN discovery protocol is not needed if these VLANs are already known

- VLAN discovery will be the first FIP frame sent by the CNA
  - This takes place before the Discovery Solicitation and Advertisement
- Discovery phase:
  - The CNA discovers the FCF using two FIP operations:

1. The CNA sends a **FIP Solicitation** to the All-FCoE-Forwarders multicast address of **01-10-18-01-00-02**
   - The CNA uses its burned-in MAC as the source address (SA)
     - The FCF sends a FIP advertisement to the CNA using a unicast SA/DA
2. The advertisement is sent using a jumbo frame to verify jumbo frame support throughout the network prior to device login

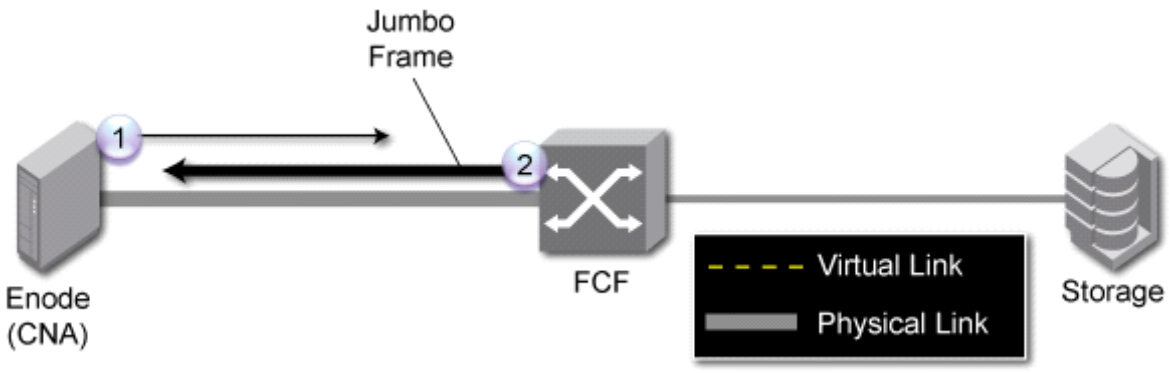


Figure 6: Discovery Phase

- Virtual Link Initialization and port creation phase:

1. The CNA sends a **FLOGI** to the FCF using a unicast SA/DA
2. An **FLOGI Accept** is sent by the FCF to the CNA with a Session MAC and an FC_ID address

3. Both a VN_Port and a VF_port are created along with the FCoE virtual link

SA would be burned in MAC address of the CNA, DA would be the MAC address of the FCF port.

ASIC Frame Flow: FIP Solicitation /Advertisement

1. The CNA sends a multicast FIP **discovery solicitation**
2. The FIP discovery solicitation is recognized by the ingress Anvil and forwarded to the CP
3. The Brocade 8000 switch creates a FIP **discovery advertisement** and forwards the response back to Anvil
4. The Anvil forwards the discovery advertisement response back to the CNA, and the ENode now knows the MAC address of the FCF

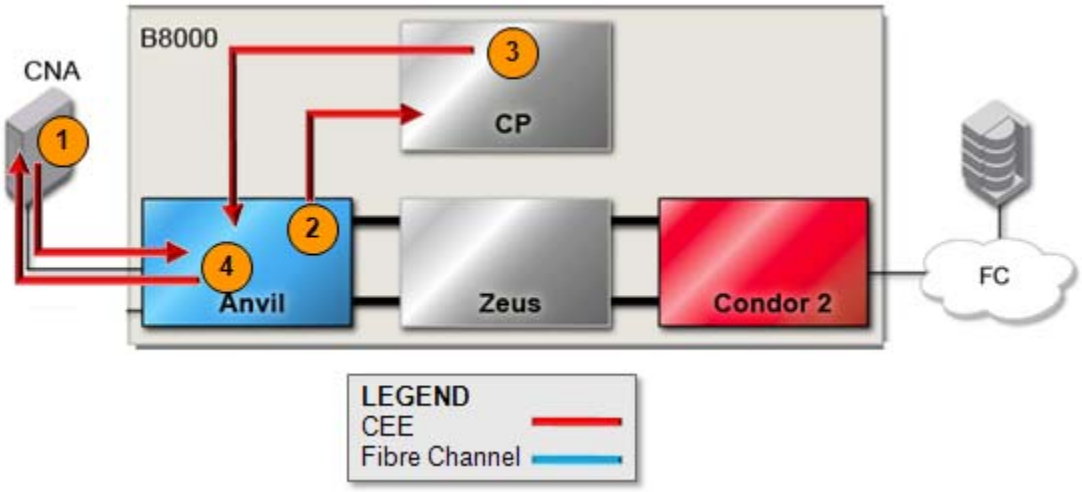


Figure 7: FIP Frame Flow

Standard Ethernet and CEE Protocol Support

Standard Ethernet and CEE Protocol Support			
Protocol	Ethernet	CEE	Replaced by Protocol
IEEE 802.1Q VLAN Tagging	Yes	Yes	
IEEE 802.1v VLAN Classification by Protocol and Port	Yes	Yes	
IEEE 802.1p CoS	Yes	Yes	
802.1x Network Access Control	Yes	Yes	
IEEE 802.1D STP	Yes	Yes	
IEEE 802.1W RSTP	Yes	Yes	
IEEE 802.1s MSTP	Yes	Yes	
IEEE 802.3ad LAG	Yes	Yes	
IEEE 802.3x Flow Control (Pause Frames)	Yes	No	IEEE 802.1Qbb PFC
IEEE 802.1Qbb Priority Flow Control	No	Yes	
IEEE 802.1AB Link Layer Discovery Protocol	Yes	Yes	
IEEE 802.1Qaz DCBX/ETS	No	Yes	

Table 2: Ethernet and CEE Protocol Support

The only protocol supported by traditional Ethernet that is not used by CEE is IEEE 802.3X Pause Flow Control. It has been replaced by IEEE 802.1Qbb Priority Flow Control.

2 - FCoE Hardware

Brocade 8000 Port Numbering and Serial Number

- There are two sets of ports: CEE and FC

1. 24 CEE ports which are numbered 0 - 23 and only support a data speed of 10 GbE
2. 8 FC ports which are numbered 0 - 7 and support data speeds from 8/4/2/1 Gbps

- The Switch ID (serial number) and WWN are available from the pull-out tab

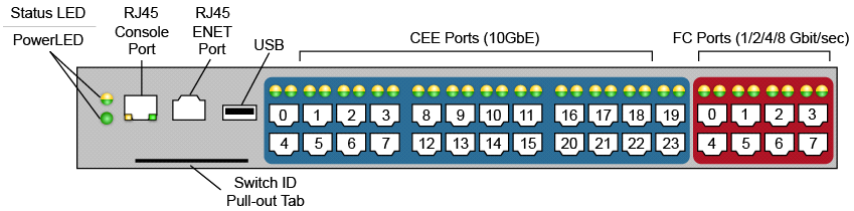


Figure 8: B8000 Port Numbering

Brocade 8000 Management

- Management access
  - 10/100 Ethernet management port (RJ-45)
  - In-band over Fibre Channel
  - Serial Console port (RJ-45)
- Diagnostics
- POST and embedded online/offline

The USB port is only used by Fabric OS commands which means only FC switch information can be backed up onto the USB drive, not CEE switch information (with the exception of some CEE data collected in supportsave). This is covered in more detail in another module.

Brocade FCOE10-24 Blade

- The FCOE10-24 blade:
  - Hot Pluggable into the DCX and DCX-4S
    - Auto leveling ensures firmware is consistent between multiple blades in the same chassis
  - 24 x 10 GbE Converged Enhanced Ethernet (CEE) external ports
    - 32 back-end 8 Gbps FC ports - There are no external-facing FC ports
  - Supports Fibre Channel over Ethernet (FCoE)
    - FCoE is enabled by default, so no FCoE license is required
  - Standard L2 Ethernet Features
  - CEE Switching

- Maximum of two FCOE10-24 blades per chassis in Fabric OS v6.3.1

If Virtual Fabrics is enabled, all CEE ports must belong to the default logical switch.

Power, nominal: 250 watts, to view the nominal power consumption, you use the `chassishow` command

Power, to view the actual power consumption, you use the `slotshow –p` command

```
sw1:admin> slotshow -p

Slot   Blade Type     ID   DC Power        Status
                           Consumption
-----------------------------------------------
  1     SW BLADE      55        95         ENABLED
  2     SW BLADE      51       110         ENABLED
  3     CORE BLADE    46       120         ENABLED
  4     CP BLADE      50       100         ENABLED
  5     CP BLADE      50       100         ENABLED
  6     CORE BLADE    46       120         ENABLED
  7     AP BLADE      74       168         ENABLED
  8     AP BLADE      74       168         ENABLED
```

The FCOE10-24 blade has an ID of 74 and in this example, the product is installed in slots 7 and 8.

FCOE10-24 Compatibility with Other Blades

Blade	FCOE10-24
FC8-16	Yes[1]
FC8-32	Yes[1]
FC8-48	Yes[1]
FC10-6	Yes[1]
FX8-24	No[2]
FS8-18	No[2]
FR4-18i	No[2]
FA4-18	No[2]

Table 3: FCOE10-24 Compatibility

Check the latest release notes for any changes to compatibility between the FCOE10-24 and other blades. The FCOE10-24 does not provide any external FC ports; FC ports must be provided by a FC blade listed in the chart. The FCOE10-24 is not supported in a chassis that has any of these blades installed; it is only supported

in a DCX or DCX-4S where there are FC8 series blades installed. If the FCOE10-24 is installed in a chassis containing another Application (AP) blade, and then powered on, a `Faulty 9` error will be displayed, and the FCOE10-24 will not power up. Also, if an AP blade is installed in a chassis containing an FCOE10-24 blade, and then powered up, a `Faulty 9` error will be displayed, and the AP blade will not power up.

Cabling and Optics

- The Brocade 8000 switch and FCOE10-24 blade only support Brocade-branded SFP/SFP+ optical transceivers
  - For Fibre Channel connections, the Brocade 8000 uses SFP/SFP+ transceivers that support any combination of Short Wavelength (SWL) and Long Wavelength (LWL) optical media
  - For CEE connections, both platforms use Brocade-branded SFP+ transceivers that support optical or Brocade-branded Twinax cables
    - The optical SFP+ supports both SR (Short Reach) and LR (Long Reach) modules
    - Brocade-branded Twinax cables can be obtained in lengths of 1, 3, and 5 meters

Check the latest release notes for supported cables and optics. LR optics are supported as of CNA driver version 2.2. Twinax cables are currently not supported on the FCOE10-24 blade.

CEE Media

Media Type	Cable Type	Max Distance	Used In
SFP+ SR (Short Reach)	MultiMode Fibre	33m (OM1) 82m (OM2) 300m (OM3)	B8000 FCOE10-24 CNAs
SFP+ LR (Long Reach)	Single Mode Fibre	2.5km (CEE)/ 10km (Ethernet)	B8000 FCOE10-24 CNAs
Twinax Cable	Copper	Available in 1m, 3m, & 5m lengths[1]	B8000 CNA

Table 4: CEE Media

These are the only lengths supported at this time.

You must use Brocade branded SFP optics. View release notes for any changes to supported CEE media. For up to the date information on SFPs as well as part numbers, go to `http://www.brocade.com/products-solutions/products/tranceivers/index.page`

OM1 cable is not recommended for 8 Gbps speeds.

Show Media CMSH Command

Displays the SFP information for all the TE interfaces on a switch

```
switch#show media
Interface TenGigabitEthernet 0/1
Identifier 3 SFP
Connector 7 LC
Transceiver 0000000000000010 10_GB/s
Name id
Encoding 6
Baud Rate 103 (units 100 megabaud)
Length 9u 0 (units km)
Length 9u 0 (units 100 meters)
Length 50u 8 (units 10 meters)
Length 62.5u 3 (units 10 meters)
Length Cu 0 (units 1 meter)
Vendor Name BROCADE
Vendor OUI 42:52:4f
Vendor PN 57-0000075-01
Vendor Rev A
Wavelength 850 (units nm)
Options 001a Loss_of_Sig,Tx_Fault,Tx_Disable

<truncated output>
```

Example of CEE Port Numbering in Web Tools

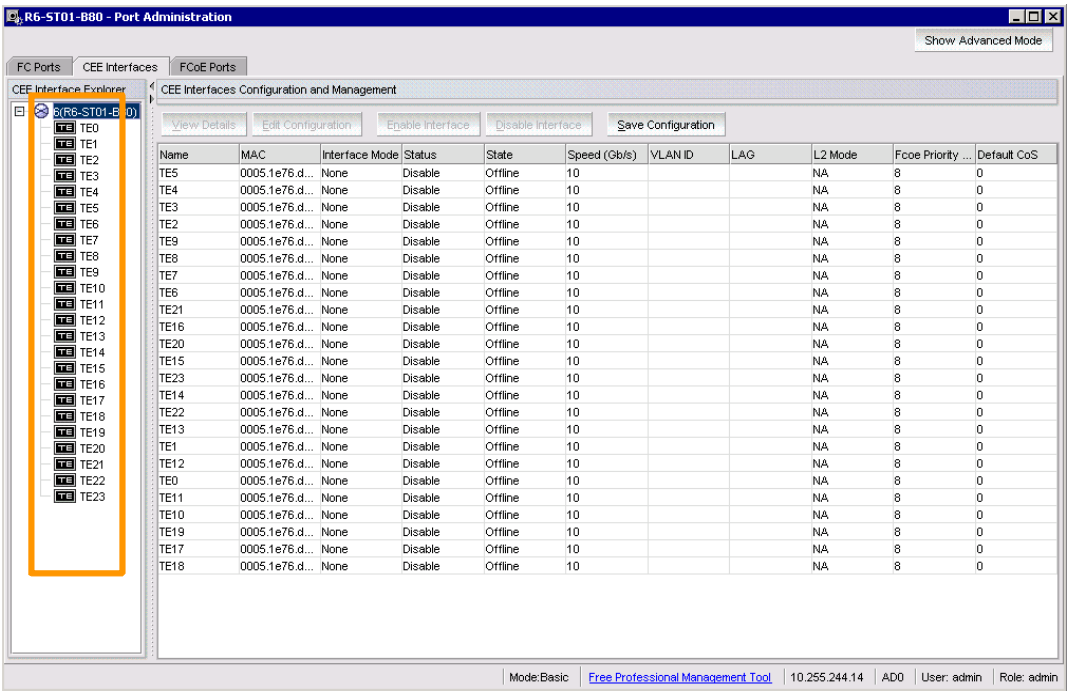


Figure 9: CEE Port Numbering in Web Tools

CEE to FCoE Port Mapping

CEE to FCoE Port Map								
TE Port	B8000	FCOE 10-24	TE Port	B8000	FCOE 10-24	TE Port	B8000	FCOE 10-24
0	8	S/0	8	16	S/8	16	24	S/16
1	9	S/1	9	17	S/9	17	25	S/17
2	10	S/2	10	18	S/10	18	26	S/18
3	11	S/3	11	19	S/11	19	27	S/19
4	12	S/4	12	20	S/12	20	28	S/20
5	13	S/5	13	21	S/13	21	29	S/21
6	14	S/6	14	22	S/14	22	30	S/22
7	15	S/7	15	23	S/15	23	31	S/23

Table 5: CEE to FCoE Port M:apping

Note: Port mappings are hard-set and cannot be changed nor does any re-routing occur for a path failure.The figure above illustrates the eight port offset in the mapping of CEE to FCoE ports in the B8000.

CNA Drivers

- Two drivers per CNA
  - Both drivers installed from a single install package
- Storage Driver for FCoE/FC
  - Referred to as BFA (Brocade Fabric Adapter)
- Network Driver for Ethernet traffic from TCP/IP stack
  - Referred to as BNA (Brocade Network Adapter)

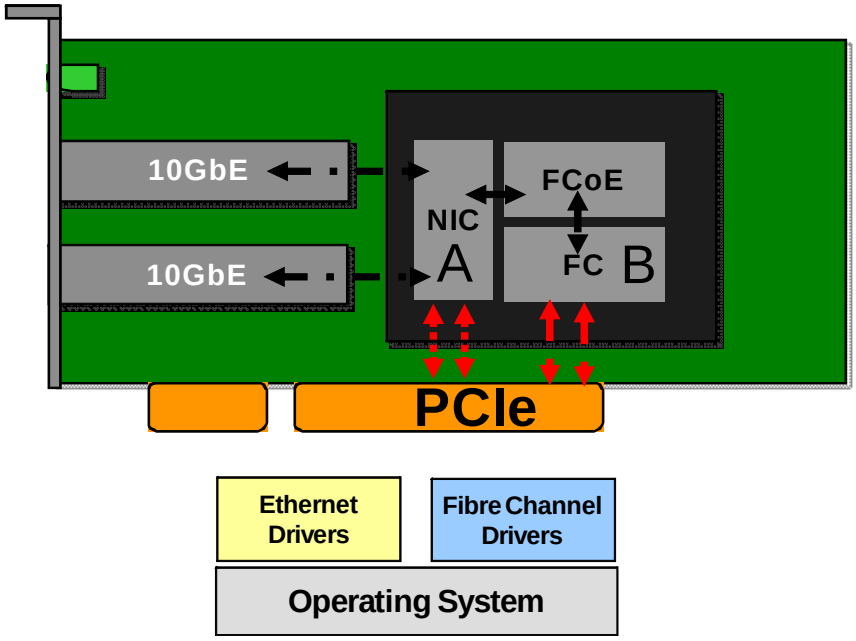


Figure 10: CNA Drivers

- Multiple CNAs installed in a single server only require a single driver installation to be performed.
- The storage driver is the same as used on all Brocade's HBAs.
- Supports CEE/Pre-CEE; automatically detects peer's supported version and runs it.

3 - FCoE Design

Brocade 8000 Switch

- The Brocade 8000 is an FCoE Forwarder (FCF)
- A POD license is required to activate FC port access
- An FCoE license is required to activate the internal FCoE ports
    - Without the FCoE license, the Brocade 8000 is a CEE-only switch
    - As a CEE-only switch, the Brocade 8000 will only pass IP traffic

The Brocade 8000 is the first FCoE switch in the Brocade family of products, and provides the following new capabilities:

CEE and Ethernet (Layer 2) Capabilities

The Brocade 8000 supports Spanning Tree Protocol (STP, MSTP, RSTP), VLAN Tagging (802.1q), MAC address learning and aging, native FCoE switching, IEEE 802.3ad Link Aggregation (LACP), 802.1Qbb Priority-based Flow Control, 4k VLANs, Priority-based Flow Control, Data Center Bridging eXchange (DCBX), and Enhanced Transmission Selection. It also supports Access Control Lists (ACLs) based on VLAN, source, destination address and port. Please note that for CEE traffic, the Brocade 8000 is not supported for connection to other 802.1 compliant LAN switches.

FCoE Capabilities

The Brocade 8000 supports T11 FCoE Entity and FCoE bridging, an FCoE Hardware Engine that performs FCoE frame encapsulation and decapsulation, FCoE VF_port (Virtual F_port) and Fabric Provided MAC Address (FPMA) discovery.

Please refer to the *Fabric OS v6.3.0 Admin Guide* for details on the Fabric OS v6.3.0 capabilities.

Brocade 8000 Fabric OS v6.3.1 Features

- Fabric OS v6.3.1 FC optionally licensed features **supported** on the Brocade 8000:
    - ISL Trunking
    - Advanced Performance Monitoring
    - Fabric Watch
    - Extended Fabrics
    - Adaptive Networking
    - FC POD License
    - FCoE License
- Access Gateway is also supported on the FC ports only (not a licensed feature)
- Fabric OS v6.3.1 FC features **not supported** on the Brocade 8000:
    - FICON

- Hot Code Load Activation
- Integrated Routing
- Admin Domains
- Traffic Isolation Zones
- Virtual Fabrics

- Optionally licensed features supported in Fabric OS v6.3.1 include:
  - **Brocade ISL Trunking** – Provides the ability to aggregate multiple physical links into one logical link for enhanced network performance and fault tolerance. This feature is applicable only to the FC ports on the Brocade 8000.
  - **Brocade Advanced Performance Monitoring** – Enables performance monitoring of networked storage resources. This license includes the Top Talkers feature. This feature is applicable only to the FC ports on the Brocade 8000.

Brocade Fabric Watch – Monitors mission-critical switch operations. Fabric Watch includes Port Fencing capabilities. This feature is applicable only to the FC ports on the Brocade 8000.

FCOE10-24 Blade Block Diagram

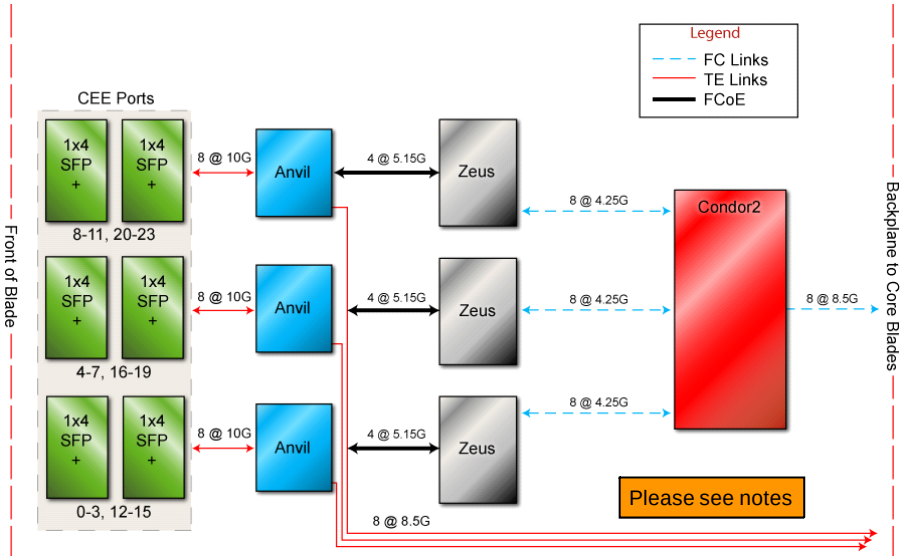


Figure 11: FCOE10-24 Block Diagram

The lines coming out of the right side of the Anvil ASICs going to the backplane of the core blades represent non-FCoE, Ethernet traffic. Since the FCOE10-24 blade has no Anvil-to-Anvil connections, traffic which enters on one Anvil, and must exit on a different Anvil, first has to go to the backplane, and then get rerouted back to the other Anvil ASIC. Traffic that can enter and exit the same Anvil does not go to the backplane.

There are eight external 10 Gbps Ethernet ports on each Anvil. The total incoming bandwidth requirement per Anvil is 80 Gbps. There are two 10 Gbps trunks between an Anvil and a Zeus, so the total bandwidth at this point is 20 Gbps. Traffic moving from the Anvil to the Zeus on its way to the Condor2 faces a 4:1 oversubscription ratio at the Zeus FPGA. Any single traffic path may use the entire 10 Gbps of trunk bandwidth if available, but it must share the bandwidth equally with the other traffic flows on the same quad. A **Best Practice** would be to connect the FCoE devices to the CEE ports as follows:

- Port 0, 4, 8, 12, 16 and 20
- Port 1, 5, 9, 13, 17 and 21
- Port 2, 6, 10, 14, 18 and 22
- Port 3, 7, 11, 15, 19 and 23

Adjustments might have to be made depending on I/O load.

FCoE Addressing using FPMA

The FC-MAP default value is 0E:FC:00 and is configurable

```
DCX4S:admin> fcoe --fcmapset -vlan 10 0efc01
```

A unique FC-MAP should be used for each fabric to prevent duplicated Session MAC's from being assigned to CNA's connected to dual fabrics

Only one FC-MAP per FCF is supported in Fabric OS v6.3.1

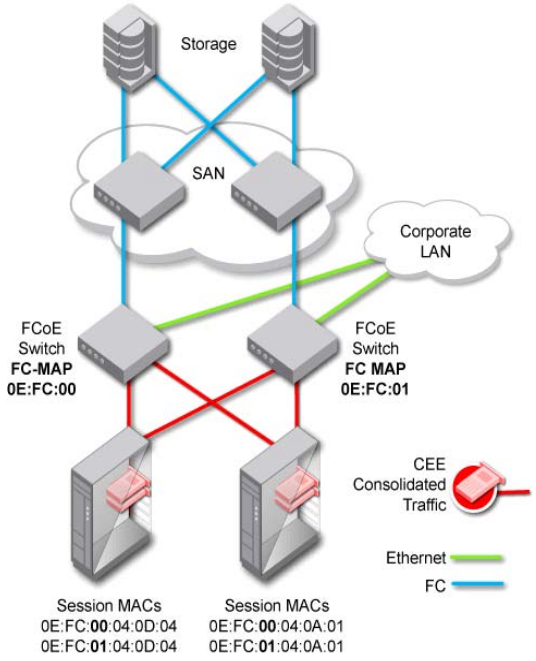


Figure 12: FPMA and FC-Maps

A single FC-MAP is supported on each FCF but all FCFs connecting to the same FC fabric may use the same FC-MAP.

To display the current FC-MAP:

```
DCX4S:admin> fcoe --fipcfgshow
FIP Unsolicited Advertisement Interval = 0
=======================================
VLAN            fcmap
=======================================
  10            0x0efc00 [Default fcmap]

=======================================
```

Fabric OS `switchshow` Command

- The `switchshow` command output on the Brocade 8000 Switch displays switch name, switch type, and switch state (status) as shown below:

```
switch login: admin
Password:
B8000:admin> switchshow
switchName:     switch
switchType:     76.6
switchState:    Online
switchMode:     Native
switchRole:     Subordinate
switchDomain:   1
switchId:       fffc01
switchWwn:      10:00:00:05:1e:76:54:00
zoning:         OFF
switchBeacon:   OFF…
Area Port Media Speed State     Proto
==================================
  0   0   --    N8   No_Module   FC
  1   1   id    N8   Online      FC  E-Port  (Trunk port, master is Port  2 )
  2   2   id    N8   Online      FC  E-Port  10:00:00:05:1e:7f:00:4e “switch
   “ (upstream)(Trunk master)
  3   3   --    N8   No_Module   FC
  4   4   --    N8   No_Module   FC
  5   5   --    N8   No_Module   FC
  6   6   --    N8   No_Module   FC
  7   7   --    N8   No_Module   FC
  8   8   --    10   Online      FCoE VF-Port  1 VN-Port(s)
  9   9   --    10   Online      FCoE VF-Port  0 VN-Port(s)
 10  10   --    10   Online      FCoE VF-Port  0 VN-Port(s)
 11  11   --    10   Online      FCoE VF-Port  0 VN-Port(s)
 12  12   --    10   Online      FCoE VF-Port  0 VN-Port(s)
```

1 VN_Port denotes that a CNA has logged into the fabric

Ports 0 – 7 are FC ports, and ports 8 - 31 are FCoE ports. This means they are the internal bridging ports between the CEE side of the switch, and the FC side of the switch. While these ports are represented as port number 8, etc., they map to corresponding physical CEE ports on the switch. FCoE port 8 maps to CEE port 0, 9 maps to CEE port 1, etc.

Fabric OS v6.3.1 VLANs Supported

- Only static VLANs are supported
- Maximum number of VLANs: 3583
  - VLAN IDs 3584-4094 are reserved
- Only one VLAN for FCoE traffic
- VLAN 1 is created by default
  - All ports are initially assigned to VLAN 1

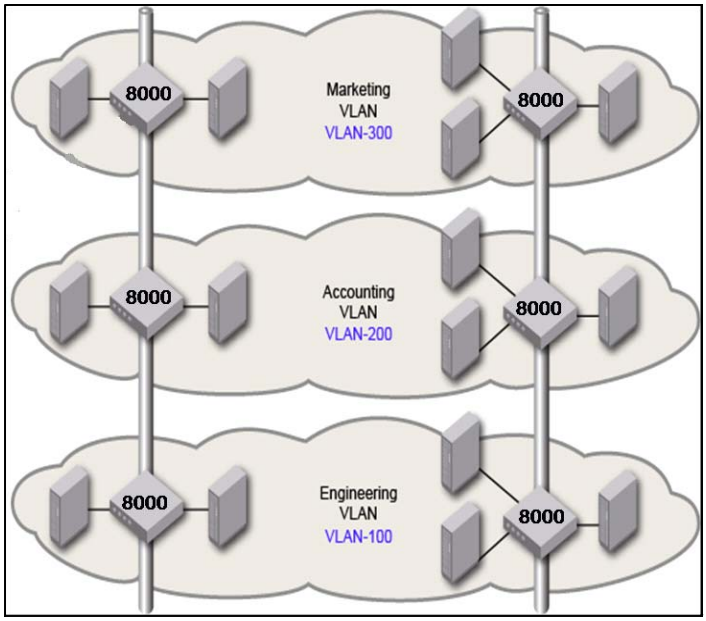


Figure 13: VLANs

Configure CEE Port

- Configuring CEE slot 7 port 0

```
DCX4s-cmsh(config)# interface tengigabitethernet 7/0
```

- Enable layer 2 switching mode on the port

```
DCX4s-cmsh(conf-if-te-7/0)# switchport
```

- Set the port to converged mode

```
DCX4s-cmsh(conf-if-te-7/0)# switchport mode converged
```

- Three mode types
  - Access - Interface can only have one VLAN association, and frames are untagged
  - Trunk - Interface allows more than one VLAN association and frames are tagged

- Converged - Interface could be untagged (access) in one VLAN and could be tagged (trunk) in another VLAN
    - Brocade CNAs require converged mode

```
switchport mode [access ] [converged] [trunk] vlan id [allowed vlan all]
```

Operands:

- **switchport mode:** Sets the switch in Layer 2 mode for configuration.
- - **access** mode allows only one VLAN association, and all frames are untagged.
- - **trunk** mode allows more that one VLAN association, and tagged frames are allowed.
- - **converged** mode interface can be Native (untagged or access) in one VLAN and it could be non-native (trunk or tagged) type in another VLAN.
- **vlan id:** Specifies the VLAN number. The range is 1-4094.
- **allowed vlan:** Configures a trunk port to participate in a single VLAN or all VLANs.
- **all**: Specifies all VLANs from 1-4094.

Link Aggregation

- The Brocade 8000 switch and FCOE10-24 blade support the following LAG types:
    - Static standards-based LAG
    - Dynamic standards-based LAG using LACP
    - Static Brocade-proprietary LAG
    - Dynamic Brocade-proprietary LAG using proprietary enhancements to LACP

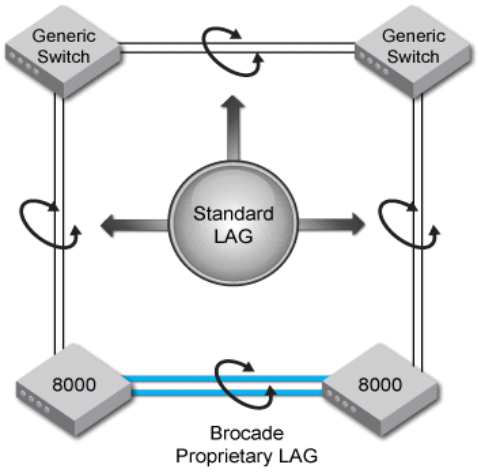


Figure 14: LAG Types

A static LAG balances the traffic load across the links in the channel. In static link aggregation, links are added into a LAG without exchanging LACPDUs between the partner systems. The distribution and collection of frames on static links is determined by the operational status and administrative state of the link. If a physical link within the static LAG fails, traffic previously carried over the failed link is moved to the remaining links. Most protocols operate over either single ports or aggregated switch ports and do not recognize the physical ports within the port group.

Standards-Based is limited to up to 16 physical ports per group.

Brocade-Proprietary is limited to up to 4 physical ports per group and requires that there is not a significant difference in the length of the fiber between the member links, and that all member links are part of the same port-group. The ports that belong to port-group 1, port-group 2, and port-group 3 are te0/0 to te0/7, te0/8 to te0/15, and te0/16 to te0/23, respectively.

The Link Aggregation Control Protocol (LACP)

LACP, specified in the IEEE standard 802.3ad, provides a standardized means for dynamically exchanging information between two switches in order to configure and maintain Link Aggregation Groups automatically. LACP can automatically detect the presence of other aggregation-capable network devices in the system. It enables the user to determine which links in a system can be aggregated.

Brocade-proprietary LAGs only—All LAG member links need to be part of the same port-group.

Brocade CNAs

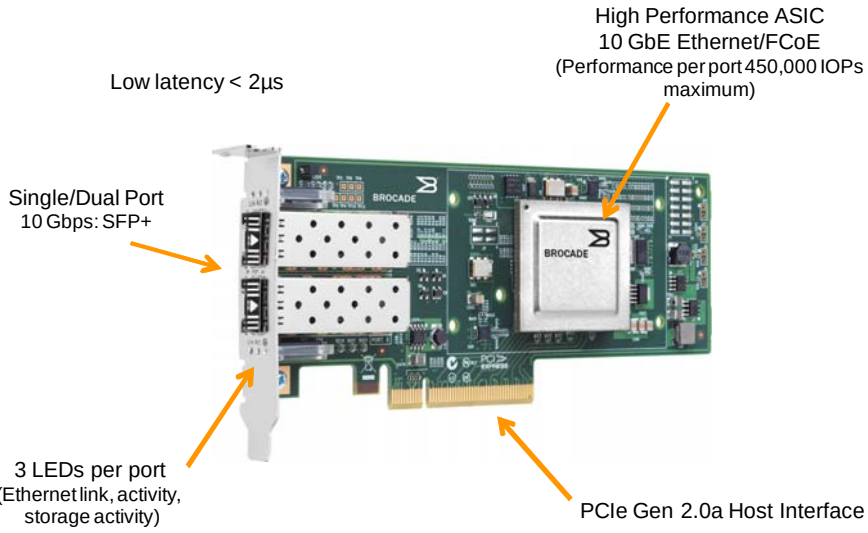


Figure 15: Brocade CNAs

Power consumption:

- ASIC ≈ 8W (Max)
- HBA + Optics ≈ 12W (Max)

Supports OM1 (62.5 µm), OM2 (50 µm), and OM3 (50 µm) optical cables with SFP+

PCI Express (Peripheral Component Interconnect Express), officially abbreviated as PCIe (or PCI-E, as it is commonly called), is a computer expansion card introduced by Intel in 2004, PCIe is the latest standard for expansion cards that is available.

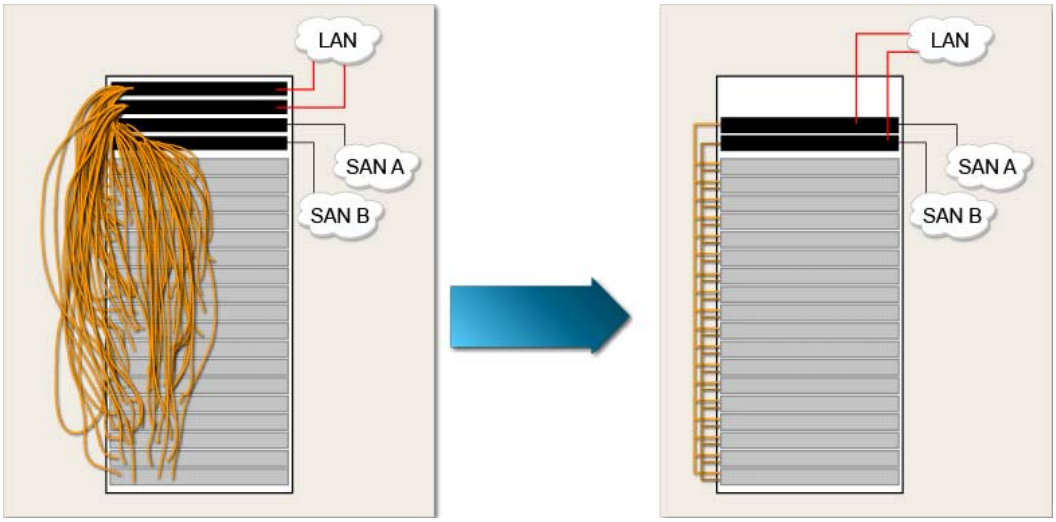
The storage activity LED indicates that FCoE activity is occurring over the link.

Supported Storage Features and Protocols

- CNA driver version 2.2:
  - Compliant with T11 FC-BB-5 standard version 1.03 and 2.0
  - Supports:
    - NIC Teaming
    - Network Priority
    - FCoE Target Rate Limiting
    - CNA FCoE Interrupt Coalescing
    - FCoE Boot over SAN
    - Direct connection to FCF only
  - Driver upgrade configuration persistence
  - Additional operating system support, please see Brocade's Compatibility Matrix for full details `http://www.brocade.com/products-solutions/technology-architecture/compatibility/index.page`
  - HCM enhancements, including:
    - Support for VLAN/Teaming configuration persistence during driver upgrade
    - Beaconing status icon

Driver v2.2 automatically saves a copy of the VLAN/Teaming configuration during the upgrade process. Upon completion of the upgrade, the configuration can be restored using HCM or BCU.

Top of the Rack Deployment Example



18 Servers	Ethernet	FC	Total
Adapters	18	18	36
Cables	36	36	72
Switches	2	2	4
Uplink Ports	2	4	6

18 Servers	CEE	Ethernet	FC	Total
Adapters[1]	18	0	0	18
Cables	36	0	0	36
Switches	2	0	0	2
Uplink Ports	2	0	4	6

Figure 16: Top of Rack Deployment Example

In this example, each server has a single dual port Ethernet NIC and a single dual port HBA. Some customers deploy switches straight in the rack, this is very typical in the Ethernet space and less typical in the FC space. This is mainly due to the use of copper versus optical cables.

In the above example on the left rack, there are both two LAN and two SAN switches inside the rack along with eighteen servers with each server having two connections to the LAN and two connections to the SAN per server. With CEE and FCoE you can reduce the number of cables inside the rack in half and therefore reduce the number of components required to deploy this. It should be noted that, on the right rack in this example, the two LAN and two SAN switches have been combined into two FCoE switches to manage both LAN and SAN traffic.

4 - FCoE Configuration

DCX/DCX-4S: Enable Ethernet Service

- Enable the Ethernet Switch Service

```
DCX4s:admin> fosconfig --enable ethsw

WARNING:  This operation will enable the Ethernet Switch Service on this
switch.

Would you like to continue [Y/N]: y

Enabling the Ethernet Switch Service. Please wait ...

The Ethernet Switch Service has been enabled. Please run slotpoweroff
and slotpoweron on all of the Blades with ID 74 now to complete the
process.
```

- Power cycle the blade

```
DCX4s:admin> slotpoweroff 7

DCX4s:admin> slotpoweron 7
```

To disable the Ethernet Switch Service run: (Note the switch will reboot)

```
DCX4s:admin> fosconfig --disable ethsw

WARNING:  This is a disruptive operation that requires a reboot to take
effect.

Would you like to continue [Y/N]: y

The Ethernet Switch Service has been disabled. Your system is being rebooted
now.
```

Configure CEE Port

- Configuring CEE slot 7 port 0

```
DCX4s-cmsh(config)# interface tengigabitethernet 7/0
```

- Enable layer 2 switching mode on the port

```
DCX4s-cmsh(conf-if-te-7/0)# switchport
```

- Set the port to converged mode

```
DCX4s-cmsh(conf-if-te-7/0)# switchport mode converged
```

  - Three mode types
    - Access - Interface can only have one VLAN association, and frames are untagged

- Trunk - Interface allows more than one VLAN association and frames are tagged
- Converged - Interface could be untagged (access) in one VLAN and could be tagged (trunk) in another VLAN

- Brocade CNAs require converged mode

```
switchport mode [access ] [converged] [trunk] vlan id [allowed vlan all]
```

Operands:

switchport mode: Sets the switch in Layer 2 mode for configuration.

- **access** mode allows only one VLAN association, and all frames are untagged.

- **trunk** mode allows more that one VLAN association, and tagged frames are allowed.

- **converged** mode interface can be Native (untagged or access) in one VLAN and it could be non-native (trunk or tagged) type in another VLAN.

vlan id: Specifies the VLAN number. The range is 1-4094.

allowed vlan: Configures a trunk port to participate in a single VLAN or all VLANs.

all: Specifies all VLANs from 1-4094.

Configure CEE Port (cont.)

- Activate group 1 rule and assign port te 7/0 to VLAN 1002

```
DCX4s-cmsh(conf-if-te-7/0)# vlan classifier activate group 1 vlan 1002
```

- Assign the CEE map to the interface

```
DCX4s-cmsh(conf-if-te-7/0)# cee dcx4s_map1
```

- Enable the port

```
DCX4s-cmsh(conf-if-te-7/0)# no shutdown
```

Note: Ports are disabled by default

LAG Setup and Configuration

- Verify the link is up

```
DCX4s-cmsh(config)#do show interface tengigabitethernet 7/1
TenGigabitEthernet 7/1 is up, line protocol is up (connected)
Hardware is Ethernet, address is 0005.1e94.004d
    Current address is 0005.1e94.004d
<truncated output>
```

Configuring VLAN

- Exit back to the global configuration mode

```
DCX4s-cmsh(conf-if-vl-1002)#exit
```

- Create VLAN rules (these two are required for FCoE)

```
DCX4s-cmsh(config)# vlan classifier rule 1 proto fcoe encap ethv2
DCX4s-cmsh(config)# vlan classifier rule 2 proto fip encap ethv2
```

- Create a VLAN classifier group and add rules

```
DCX4s-cmsh(config)# vlan classifier group 1 add rule 1
DCX4s-cmsh(config)# vlan classifier group 1 add rule 2
```

```
vlan classifier rule rule_id [mac mac_address] [proto |arp| fcoe | fip| ip]
[encap ethv2 | nosnapllc| snapllc]
```

Operands:

rule_id Specifies the VLAN identification rule. The range of valid values is 1-255.

mac Specifies the Media Access Control (MAC) list.

mac_address Specifies the MAC address-based VLAN classifier rule used to map to a specific VLAN.

proto Specifies the protocol to use for the VLAN classifier rule.

arp Specifies to use the Address Resolution Protocol.

fcoe Specifies to use the Fibre Channel over Ethernet Protocol.

fip Specifies to use the FCoE Initialization Protocol.

encap Specifies to encapsulate the Ethernet frames sent for the VLAN classifier rule.

ethv2 Specifies to use the Ethernet version 2 encapsulated frames.

nosnapllc Specifies to use the Ethernet version 2 non-SNA frames.

snapllc Specifies to use the Ethernet version 2 with SNA frames.

Priority Flow Control (IEEE 802.1Qbb)

- PFC is an extension of IEEE 802.3X Ethernet Pause
- PFC enables pauses based on priorities or classes of service
- A physical link divided into eight virtual links with PFC provides the capability to use pause on a single virtual link without affecting traffic on the other virtual links

Enabling Pause on a per-user-priority basis allows administrators to create lossless links for traffic requiring no-drop service, such as Fibre Channel over Ethernet (FCoE), while retaining frame-drop congestion management for IP traffic.

Other congestion control methods remain in place, even with PFC enabled. Tail Drop, for instance, is still in effect as a "just in case" backup. If, for some reason, PFC fails, the PFC buffer overrun would breach the Tail Drop threshold, and frames would begin to be dropped.

Create and Configure CEE-MAP

- The CEE map is used to configure two features:
  - Enhanced Transmission Selection (ETS)
  - Priority Flow Control (PFC)
- ETS is used to allocate bandwidth based on the different priority settings of the converged traffic
  - Assigns different IEEE 802.1p Class of Service (CoS) priorities (0 - 7) to different traffic types
    - The switch default is to use CoS 3 for FCoE traffic
  - IEEE 802.1p CoS priorities are placed into a Priority Group ID (PGID) used to schedule frame forwarding
    - A bandwidth percentage is assigned to each PGID
- PFC is used to provide lossless connectivity for FCoE traffic
  - In this release only one FIP/FCoE priority per CEE port is supported

802.1q-tagged Ethernet frames contain a Priority Code Point (PCP) field, which describes the 802.1p class of service priority. This field indicates that a priority level that can be applied to different classes of traffic on a CEE link, using values ranging from 0 to 7. For example, a server administrator may assign FCoE traffic priority 3 (default value). Priorities are then grouped into Priority Group IDs (PGID), which are used by the switch to schedule frame forwarding.

The default for FCoE is to use CoS 3. This can be changed on the switch or per interface level. PFC can be enabled on non-FCoE traffic; however, there is no way to signal other app types in DCBX at this time, it's something the network administrator has to manually configure the network to do. The servers/hosts/targets would have to be manually configured to use that priority for the traffic they want to be lossless. At this time, only FCoE has the requirement to be lossless and is the only one that it must be enabled for.

Verifying CEE-MAP Configuration

```
sw1-cmsh># show cee maps

CEE Map DCX-4s

   Precedence 1

   Priority Group Table

     1:  Weight 40, PFC Enabled, TrafficClass 6, BW% 40

     2:  Weight 60, PFC Disabled, TrafficClass 4, BW% 60

     15.0: PFC Disabled

     15.1: PFC Disabled

     15.2: PFC Disabled

     15.3: PFC Disabled

     15.4: PFC Disabled

     15.5: PFC Disabled

     15.6: PFC Disabled

     15.7: PFC Disabled

   Priority Table

      CoS:    0    1    2    3    4    5    6    7

     ----------------------------------------------

     PGID:    2    2    2    1    2    2    2    2

   Enabled on the following interfaces

    Te 7/0, Te 7/1, Te 7/2
```

Traffic Class: Traffic Classes are defined automatically by the switch and do not necessarily match the priority table class of service.

CEE Priority Groups / Tables

- The **CEE Priority Group Table** defines
  - Priority Group ID (PGID)
  - Percentage of Bandwidth assigned to that PGID
  - Whether PFC is enabled or not enabled on PGID

- The **CEE Priority Table** defines the CoS mapping to a Priority Group
- The **CEE Map** shows this mapping:

```
cee-map dcx-4s
priority-group-table 1 weight 50 pfc
priority-group-table 2 weight 50
priority-table 2 2 2 1 2 2 2 15.0

Priority: (CoS):  0  1  2  3  4  5  6  7
```

- Strict Priority versus DWRR is derived directly from the PGID value
- All PGIDs with prefix 15 receive Strict Priority scheduling policy
- All PGIDs in the range 0 through 7 receive DWRR scheduling policy
- Relative priority between Priority Groups is exactly the ordering of entries listed in the table, with PGID 15.0 being highest priority and PGID 15.7 being lowest strict priority
- Flow control configuration is partially specified by toggling the PFC column On or Off
  - This provides only partial configuration of flow control because the set of priorities mapped to the Priority Group is not known, which leads into the CEE Priority Table
- The following table presents the default CEE Priority Group Table configuration:

PGID	Bandwidth %	PFC
15.0	-	N
15.1	-	N
15.2	-	N
15.3	-	N
15.4	-	N
15.5	-	N
15.6	-	N
15.7	-	N
0	0	N
1	0	N
2	0	N
3	0	N
4	0	N
5	0	N
6	0	N
7	0	N

Table 6: Default CEE Priority Group Table Configuration

Configure LLDP/DCBX for FCoE

- Enable LLDP

```
DCX4s-cmsh(config)#protocol lldp
```

- Advertise the DCBX FCoE application TLV

```
DCX4s-cmsh(conf-lldp)#advertise dcbx-fcoe-app-tlv
```

- Advertise the DCBX FCoE logical link TLV
  - Provides the status of the FCoE link which must be up before the CNA can send a FIP frame

```
DCX4s-cmsh(conf-lldp)#advertise dcbx-fcoe-logical-link-tlv
```

To display LLDP information:

```
DCX4s-cmsh(conf-lldp)#do show lldp [interface | neighbors | statistics]
```

DCBX–Data Center Bridging eXchange

TLV (Time Length Value) - LLDP frames are sent by the device on the port at a fixed frequency. A frame contains a Link Layer Discovery Protocol Data Unit (LLDPDU) which is a set of TLV structures. This LLDPDU is with the destination MAC address set to the multicast address 01:80:c2:00:00:0e and the Ethernet type set to 0x88cc. The LLDP frame should start with the following mandatory TLVs:

- Chassis ID
- Port ID
- Time to live

These mandatory TLVs are followed by any number of optional TLVs. Such as the DCBX TLVs. The frame should end with a special TLV named *end of LLDPDU*. The IEEE 802.1AB specification contains a description of TLV types.

Configuring Fabric-Based Boot LUN Discovery

- Configure the zone on the switch using the Fabric OS zoneCreate command
- Refer to the *Brocade Adapters Installation and Reference Manual or the Fabric OS Administrator's Guide* for more information about creating zones

Verify CNA Connection to Switch

- Use `fcoe --loginshow` to get PWWN of CNA, then perform zoning as normal from standard Fabric OS command shell

```
DCX4s-cmsh(conf-if-te-7/0)# do fos fcoe --loginshow 7/0
Number of connected devices: 1
================================================================================
Peer Type  Connect Info  Device WWN               Device MAC
Session MAC       FCoE Port MAC     Te port
================================================================================
FCOE_DEVICE   Direct  10:00:00:05:1e:8c:d0:d9  00:05:1e:8c:d0:d9
0e:fc:00:01:80:01  00:05:1e:94:00:00   Te 7/0
```

Brocade CNAs uses a separate burned-in MAC called an FCoE MAC for FIP frames and this is the MAC that is displayed under Device MAC, the normal burned-in MAC is used for LAN traffic (not shown in this command output) and the Session MAC is used for FCoE traffic.

The FCoE Port MAC is the MAC address for the FCoE switch port and is the same as the Fabric Port WWN, see `nsshow` output for the same device below.

```
DCX4s-cmsh(config)#do fos nsshow –t
<truncated output>
Type Pid    COS     PortName                NodeName
TTL(sec)
N    018001;      3;10:00:00:05:1e:8c:d0:d9;20:00:00:05:1e:8c:d0:d9; na
    FC4s: FCP
    PortSymb: [37] "BR-1020 | 2.0.0.0 | R1-ST06-CNA |  | "
    Fabric Port Name: 20:80:00:05:1e:94:00:00
    Permanent Port Name: 20:80:00:05:1e:94:00:00
    Device type: NPIV Initiator
    Port Index: 128f
    <truncated output>
```

CMSH Configuration Management

- The current system configuration is referred to as the "`running-config`", and is not persistent
- The `running-config` can be made persistent and to be the default for reboots by saving it to the "`startup-config`"

```
B8000#copy running-config startup-config
Overwrite the startup config file (y/n): y
Building configuration…
B8000#
```

- This can also be achieved by running the `write mem` command.
- The CEE configuration is not saved nor overwritten by `configupload` and `configdownload` commands entered in the Fabric OS shell.
- Restore configurations from backup copies:
  - Download a remote configuration file by FTP or SCP
  - Copy a file from the "flash://" directory

- Copying files from any location to the running-config APPENDS the information. It does not necessarily overwrite configuration commands
  - If the running-config has configurations for port te 0 and the new config you are copying to the running-config does not, then the configurations remain and are not removed
  - This action is similar to a merge function rather than an overwrite function

Examples:

To copy the source file from a remote machine using SCP:

```
B8000#copy scp://user:password@10.10.10.10/path/file1 file2
```

To restore/overwrite the `running-config` from the `startup-config`:

```
B8000#copy startup-config running-config
Building configuration...
B8000#
```

The system loads the contents of the `startup-config` whenever the switch boots, or reboots

Saving and Backing Up the Configuration

Two ways to save the `running-config` to `startup-config`:

```
DCX4s-cmsh# copy running-config startup-config
DCX4s-cmsh# write memory
```

  - Ensures the configuration will be restored when the switch is rebooted
  - This saves the CEE configuration only

- To backup the running configuration:

```
DCX4s-cmsh# copy running-config ftp://login:password@ipaddress/path/
filename
  Building configuration...
```

  - Fabric OS `configupload` command does not backup the CEE switch configuration, it backs up the Fabric OS configuration only
  - The startup configuration can also be backed up
  - Backup to USB drive is not supported

The backup file will be a text file that is exactly like the show running config output.

```
copy startup-config (see options below)
FTP  Copy to URL ftp://[username[:password]@server/path]
SCP  Copy to URL scp://[username[:password]@server/path]
```

Also, you can perform a `copy startup-config running-config` (this command will copy the systems boot up configuration information to the running configuration).

DCFM allows both the CEE configuration and the Fabric OS configuration to be backed up from the same application. This is because the USB port is part of the Fibre Channel switch not the CEE switch. Remember the B8000 is two switches in one: CEE and Fibre Channel.

Ethernet Management Using HCM and BCU

- The HCM and BCU commands provide the provide the following functions:
  - Configuring VLANs
  - Configuring NIC teaming
  - Enabling Persistent Binding
  - Setting logging levels
  - Monitoring IOC, CEE, NIC teaming, and VLAN statistics

Configuring Fabric-Based Boot LUN Discovery

Use the following steps to configure fabric-based boot LUN discovery:

1. Set the adapter's BIOS configuration to auto-discovery using one of the following interfaces:
   - Brocade BIOS Configuration Utility
   - Adapter Settings > Boot LUN > Auto Discover
   - HCM
   - BCU

   ```
   bios --enable <port_id> -o auto
   ```

2. Enter the following BCU command to provide the zone name and zone members to use as operands in the Fabric OS `zonecreate` command

   ```
   bcu boot - -blunZone -c <cfg> -p <port_wwn> -r <rport_wwn>    -l <lun_id | lun#>
   ```

Zone Management

- Zoning can be managed using:
  - Command Line Interface (CLI)
  - Web Tools
  - DCFM
- Use the `zonehelp` command to display help information

Fabric OS Zone Management Commands					
	Create	Delete	Add	Remove	Show
Alias	`alicreate`	`alidelete`	`aliadd`	`aliremove`	`alishow`
Zone	`zonecreate`	`zonedelete`	`zoneadd`	`zoneremove`	`zoneshow`
Zone Config	`cfgcreate`	`cfgdelete`	`cfgadd`	`cfgremove`	`cfgshow`

Table 7: FOS Zone Management Commands

The following commands are used to create/modify the defined zone configuration:

`*create`– Creates a new alias, zone, or configuration

`*delete`– Deletes the entire alias, zone, or configuration

`*add`– Adds a member to an existing alias, zone, or configuration

`*remove`– Removes one or more members from an existing alias, zone, or configuration

`*show`– Displays alias, zone, and/or configuration information

Web Tools and DCFM provide a GUI to simplify the administration of zoning.

Switches running Fabric OS v6.0 or earlier must have an Advanced Zoning license installed. This license is not required starting with Fabric OS v6.1.

Note: It is recommended that zoning changes be made from the switch with the highest version of Fabric OS.

5 - FCoE Management

Brocade 8000 Port Side

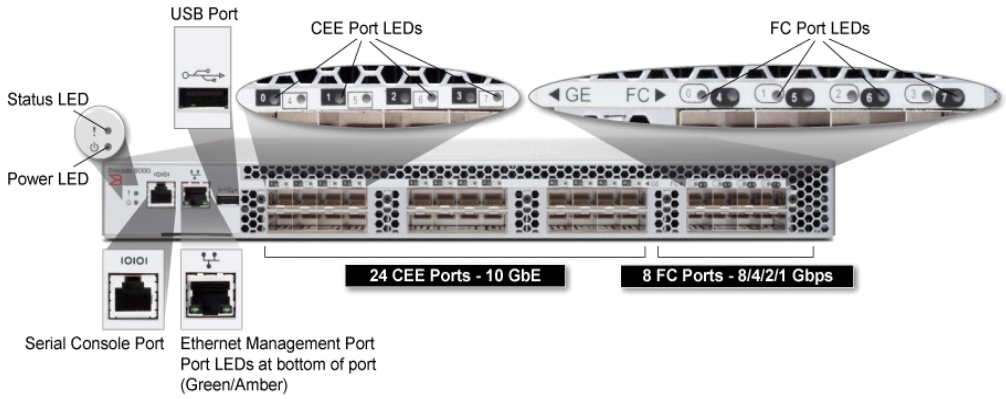


Figure 17: B8000 Port Side

The USB port is only supported by Fabric OS commands. For example, you can use the USB port with the Fabric OS `supportsave` command but to back up CEE information, such as the running-config, you would need to use an FTP server.

DCFM: CEE Access Control List

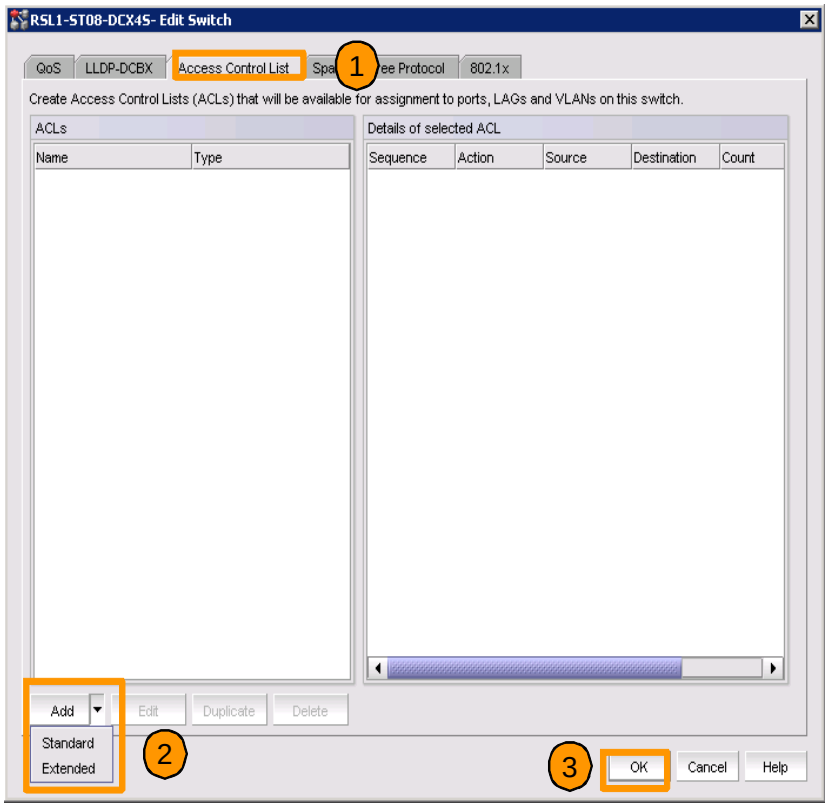


Figure 18: DCFM- CEE ACLs

1. Click on the **Access Control List** tab
2. Click on the **Add** button and select **Standard** or **Extended**
3. Click on the **OK** button; this opens the Add Access Control List window

The Extended Access Control List includes all the Standard ACL features plus two additional features: Destination and Ether Type. CMSH is also capable of configuring ACLs

DCFM – Generating a Historical Performance Graph

- The **Historical Performance Graph** dialog box enables you to customize how you want the historical performance information to display

1. Select a CEE port from the **CEE Configuration** dialog box, and select **Historical Graph** from the **Performance** list
    - A message displays, prompting you to close the **CEE Configuration** dialog

2. Click **OK** to close the **CEE Configuration** dialog and open the **Performance** dialog box

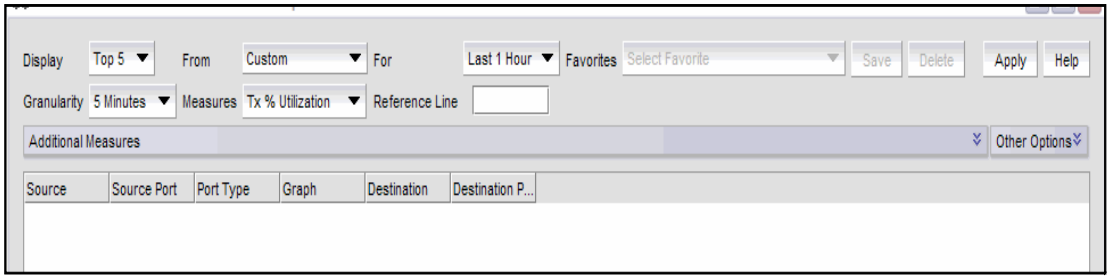


Figure 19: CEE Performance Dialog Box

DCFM – Generating a Historical Performance Report

- The **Historical Performance Report** dialog box enables you to customize how you want the historical performance information to display

1. Select a CEE port from the **CEE Configuration** dialog box, and select **Historical Report** from the **Performance** list
    - A message displays, prompting you to close the **CEE Configuration** dialog box
2. Click **OK** to close the **CEE Configuration** dialog and open the **Performance** dialog box

- The **Historical Performance Report** dialog box displays:

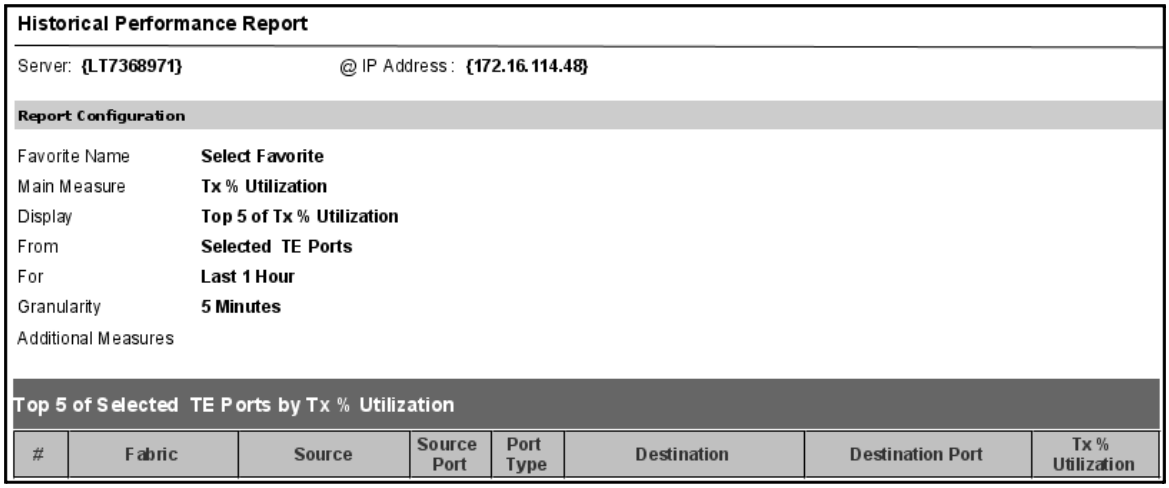


Figure 20: Historical Performance Report Dialog Box

Virtual FCoE Port Configuration

- The Brocade 8000 has the following configuration features:
  - 24 - 10 Gbps Ethernet ports, which can be enabled for FCoE traffic
  - One-to-one mapping of FCoE ports with 10 Gbps Ethernet ports
  - Eight, 8 Gbps FC ports
  - 24 internal FCoE ports, which provide the Ethernet-to-FC bridging capability
  - Each FCoE trunk can be enabled or disabled individually

Viewing Virtual FCoE Ports

1. Select **Configure** > **CEE Switch** > **FCoE** from the menu bar
   - The **FCoE Configuration** dialog box displays
2. Select the **Virtual FCoE Ports** tab

- The **Virtual FCoE Ports** tab displays

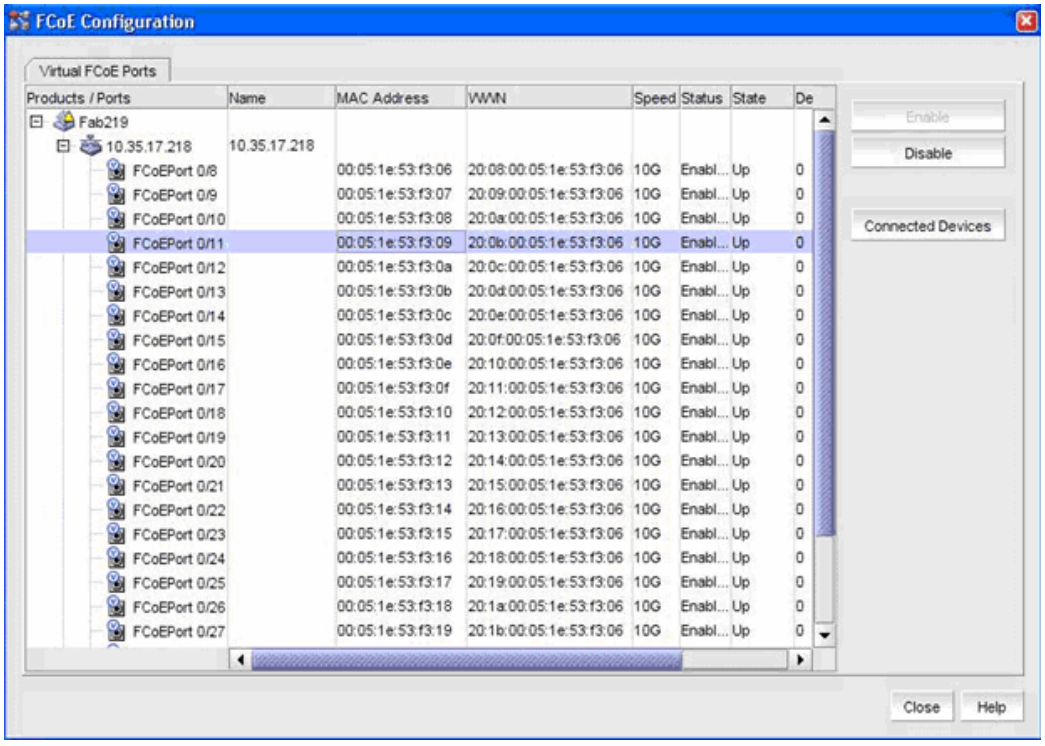


Figure 21: Virtual FCoE Port Configuration Window

- The **Virtual FCoE Configuration** dialog box enables you to perform the following tasks:
  - Click **Enable** to enable a selected virtual FCoE port for CEE configuration
  - Click **Disable** to disable a selected virtual FCoE port from CEE configuration
  - View a list of FCoE virtual ports and to what they are directly connected
  - Display performance statistics for FCoE ports

3. Click **Close** to close the dialog box

LLDPDU Packet Dump

- First enable console dump to terminal session:

```
sw1-cmsh># terminal monitor
```

- Enable LLDP debug

```
sw1-cmsh># debug lldp packet all
2009/02/25-17:24:12: ---------------- RX ----------------------
2009/02/25-17:24:12: Handles IEEE DCBX TLVs.....
2009/02/25-17:24:12: ................................
2009/02/25-17:24:12: END LLDPDU:[0|0|0]
2009/02/25-17:24:18: ---------------- TX ----------------------
2009/02/25-17:24:18: LLDP[TX]: Encoding CHASSIS_ID_TLV
2009/02/25-17:24:18: LLDP[TX]: Encoding PORT_ID_TLV
2009/02/25-17:24:18: LLDP[TX]: Encoding TTL_TLV of TTL value 120
2009/02/25-17:24:18: LLDP[TX]: Encoding LINK_PRIM_TLV
2009/02/25-17:24:18: LLDP[TX]: Encoding BRCD_LINK_TLV
2009/02/25-17:24:18: LLDP[TX]: Encoding IEEE_DCBX_ORG_SPECIFIC_TLV
- sw1-cmsh># undebug all
```

- This turns off the debug

LLDPDU–Link Layer Discovery Protocol Data Unit

Run `show debug` command will show which debugs are enabled.

Other tools

- Analyzer
  - Captures everything
  - Requires downtime to insert analyzer – port mirroring is not supported for FCoE ports
- Wireshark
  - Wireshark.org: Free network protocol analyzer
  - Does not Capture FCoE traffic
- Brocade CNA: `debug --portlog`
  - Captures FCoE traffic, embedded port, PLOGI and PRLI to target
  - Does not capture FIP, or other non-FCoE traffic
- FCF: Fabric OS - `portlogdump`
  - Does not capture FIP (except FLOGI) or other non-FCoE traffic
- RMON (Remote Network Monitoring): Used to monitor and do protocol analysis of LANs

Wireshark captures network traffic, FCoE traffic does not use the network driver it uses the FCoE (Fibre Channel) driver. Wireshark could be used to capture non-FCOE (non-FIP) communications between CNA and B8000. This could be useful for troubleshooting network type issues such as LLDP, Spanning Tree etc. Additionally, it doesn't capture brocade CNAs as they have a dual driver setup, but will work if there is a software implementation, like SUN uses.

The FCF will convert the FLOGI to an FDISC command. Remember the internal FCoE port does the FLOGI.

There is no `portlogdump` for the CEE ports, so an external analyzer would be required to see what is happening on the line.

In addition to Fibre Channel traffic, the `portlogdump` captures FCoE traffic (FCoE EtherType = 8906) between the host and switch but does not capture FIP (except FLOGI/FDISK) or other EtherType frames.

Firmware Upgrades and Downgrades

- A code load of DCX or DCX-4s with one or more FCOE10-24 blades from FOS 6.3 to another version will disrupt traffic through the blade
  - Traffic not traveling through the blade will not be disrupted
- The Brocade 8000 does not support non-disruptive hot code loads (HCL)
- Upgrading the Brocade 8000 from FOS v6.1.2_cee1 to FOS v6.3 or from FOS 6.3 to a later FOS version will be disruptive to the IO through the switch
- When upgrading a Brocade 8000 from FOS v6.1.2_CEE or v6.1.2_CEE1 to v6.3, verify that the unit has both the FCoE and FC POD licenses installed
  - Units missing these licenses that are upgraded to FOS v6.3 will lose functionality following a restart or disabling of ports

Target Rate Limiting

- With Target Rate Limiting in effect the host will throttle down the traffic to match the speed of the target

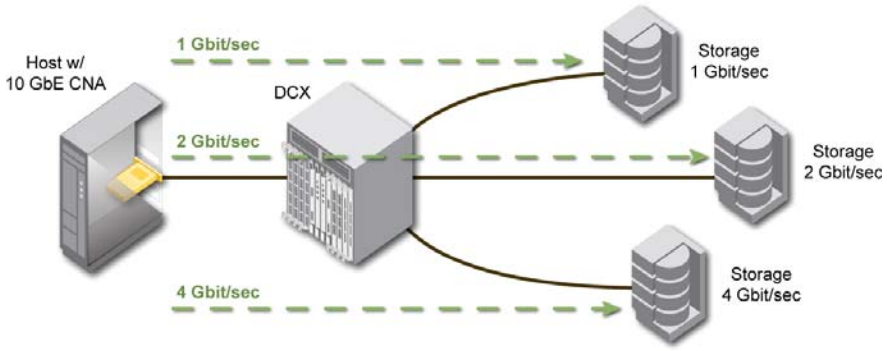


Figure 22: Target Rate Limiting Example

BCU Commands - CEE

- This command queries the CEE information on the port and displays statistics. The <*port_id*> could be any of the following:
  - Adapter ID or port ID
  - Port name
  - Port hardware path

Example:

```
cee --query <port_id>
CEE status: Active
_____________________________
LLDP-Attributes
_____________________________
Time to Live 120
Chassis ID 00:05:1e:53:ea:a6
Port ID Te 0/3
Port Desc --
System Name --
System Desc --
System Cap BRIDGE, ROUTER
<truncated output>
```

6 - FCoE Troubleshooting

DCFM/Web Tools CEE/FCoE Comparison

Feature	DCFM	Web Tools
Create CEE Map		
Configure & Enable ETS and PFC		
Assign CEE map to port		
Create Traffic Class Map		
Assign Traffic Class Map to port		
Enable LLDP/DCBX and create Profiles		
Assign LLDP/DCBX Profiles Globally or per port		
Create Standard & Extended ACLs		
Assign ACLs to port		
Enable/disable xSTP globally		
Disable xSTP on a per-port basis		
Enable/disable 802.1X		
Configure 802.1X parameters per-port		
Enable/disable CEE port		
Configure Interface Mode		
Configure L2 Mode		
Create VLANs		
Create Link Aggregation Groups		
Create FCoE Login Groups		
Enable/disable FCoE ports		

Table 8: DCFM/Web Tools CEE/FCoE Comparison

The table was compiled from DCFM v10.3.3, and Web Tools from Fabric OS v6.3.1a.

Check CEE Map

- Issue the `show running-config` command and confirm the CEE Map has been created and that PFC is enabled for FCoE traffic

```
cee-map dcx-4s
 priority-group-table 1 weight 40 pfc
 priority-group-table 2 weight 60
 priority-table 2 2 2 1 2 2 2 2
<truncated output>
interface TenGigabitEthernet 7/0
 cee dcx-4s
<truncated output>
```

Priority table entries go from 0 to 7 so in the prior example the "1" is in the "3" position therefore priority group 1 will be used for FCoE traffic (Unless the default has been changed).

Check Spanning Tree

- Spanning Tree:
  - Should be disabled on interfaces attached directy to CNA:
  - From the `show running-config` output
    `spanning-tree shutdown`
  - Another option: `spanning-tree portfast`
    - Enables the Port Fast feature on an interface to allow the interface to quickly transition to forwarding state
- Brocade recommends that Spanning Tree be disabled on interfaces in which CNAs are directly attached:
  - Spanning Tree in not required on these links (as there are no loops)
  - It has been found during testing that some CNAs may have issues logging in when Spanning Tree is running on the link

`show lldp interface te 0/1`

```
sw1-cmsh># show lldp interface tengigabitethernet 0/1

LLDP information for Te 0/1
  State:                   Enabled
  Mode:                    Receive/Transmit
  Advertise Transmitted:   30 seconds
  Hold time for advertise: 120 seconds
  Re-init Delay Timer:     2 seconds
  Tx Delay Timer:          1 seconds
  DCBX Version :           CEE
  Auto-Sense :             Yes
  Transmit TLVs:           Chassis ID          Port ID
                           TTL                 IEEE DCBx
                         DCBx FCoE App         DCBx FCoE Logical Link
                         Link Prim             Brocade Link
DCBx FCoE Priority Bits: 0x8
```

Ensure that the `show running-config` shows that the following DCBX TLVs are enabled:

```
protocol lldp
 advertise dcbx-fcoe-app-tlv
 advertise dcbx-fcoe-logical-link-tlv
```

LLDP DCBX Version can be set for Auto, CEE or Pre-CEE. This is set by the FCF, and shows what the setting is.

Check Security

- Three types of security could be used which could result in the CNA not being able to login
  - ACLs (Access Control Lists)
  - 802.1x (Use of a RADIUS Server to perform authentication)
  - FCoE Login Tables (List of WWNs that are allowed to login to the switch)
    - This could be done at a switch or interface level

Traffic Flows by Type

```
sw1-cmsh># show qos queue interface tengigabitethernet 7/0
Interface TenGigabitEthernet 7/0
```

	RX	RX		TX	TX
CoS	frames	Bytes	TC	frames	Bytes
0	56293010	3602809984	0	0	0
1	0	0	1	0	0
2	0	0	2	0	0
3	381921020	799835548552	3	0	0
4	0	0	4	2952	476432
5	0	0	5	0	0
6	0	0	6	406676332	799855980104
7	0	0	7	0	0

- These counters can be cleared:
  - Clear counters on all ports:

```
sw1-cmsh># clear counter all
```

  - Clear counters on one interface:

```
sw1-cmsh># clear counters interface tengigabitethernet 7/0
```

For RX traffic look at the CoS in the CEE Map. For TX traffic look at the Traffic Class (TC) in the CEE map.

Looking at Port Errors on the CEE Port

```
SW1-cmsh># show interface tengigabitethernet 7/0
TenGigabitEthernet 7/0 is up, line protocol is up (connected)
<truncated outputs>
Receive Statistics:
    46586 frames, 5639104 bytes
    Unicasts: 28464, Multicasts: 16386, Broadcasts: 1736
    64-byte pkts: 5952, Over 64-byte pkts: 29679, Over 127-byte pkts:
6826
    Over 255-byte pkts: 4129, Over 511-byte pkts: 0, Over 1023-byte
pkts: 0
    Over 1518-byte pkts(Jumbo): 0
    Runts: 0, Jabbers: 0, CRC: 0, Overruns: 0
    Errors: 0, Discards: 0
Transmit Statistics:
    62035 frames, 8248221 bytes
    Unicasts: 0, Multicasts: 16697, Broadcasts: 7104
    Underruns: 0
    Errors: 0, Discards: 0
Rate info (interval 299 seconds):
    Input 15.000196 Mbits/sec, 32 frames/sec, 5.20% of line-rate
    Output 24.000000 Mbits/sec, 41 frames/sec, 7.32% of line-rate
Time since last interface status change: 5d19h06m
```

These counters can be cleared using the following command:

```
SW1-cmsh># clear counters interface tengigabitethernet 7/0
```

Note: If looking at a performance issue, `portperfshow` could be used to check the IO running on the FCoE ports.

Runt frames: a runt is a packet that is too small. For example, the Ethernet protocol requires that each packet be at least 64 bytes long.

Jabbers: Jabber is described most often as a frame greater than the maximum of 1518 bytes with a bad CRC. A jabbering NIC is often indicative of a hardware problem with a NIC or transceiver.

Overruns: An overrun occurs when a packet is longer than expected. Either the device produces a packet which is larger than max packet size (commonly this is a bad device) or a read is expecting less than max packet size, and the device produces a packet larger than was expected (but not greater than max packet size), this is the driver not agreeing with the device on what should happen, bad driver or bad device, depending.

Looking at the `porterrshow` output would not provide the CEE port statistics for the FCoE ports, it only provides internal statistics for the Zeus to Condor2 connections.

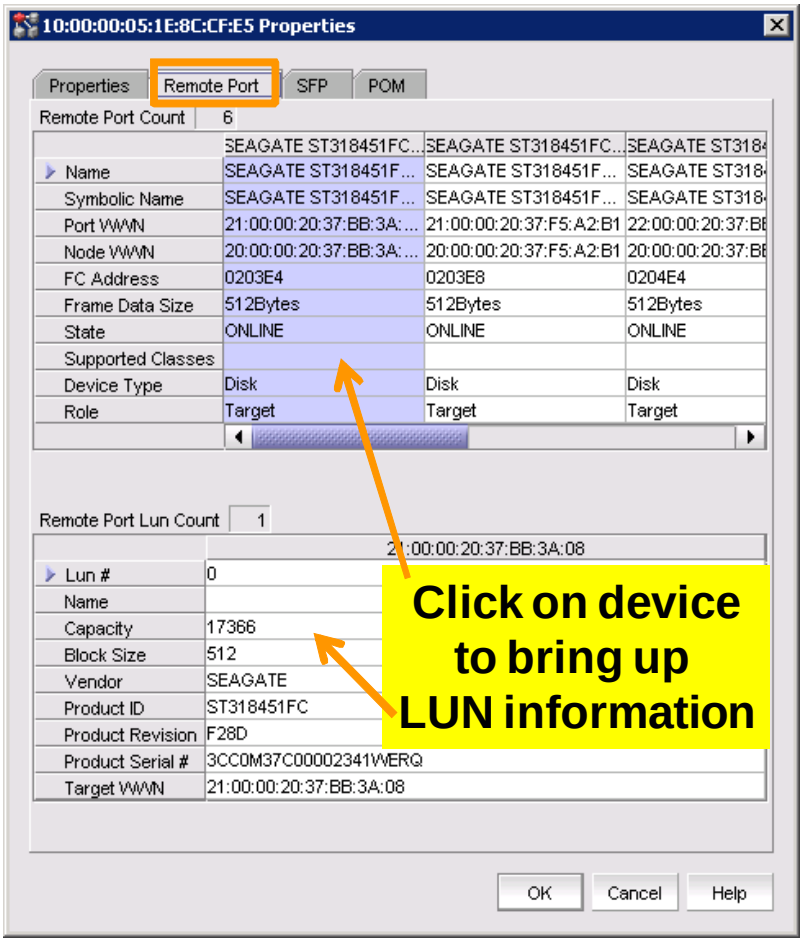


Figure 23: CNA Port Properties Remote Ports Tab

- Key information:
  - Device Count
  - Symbolic Name
  - Port WWN
  - 24 bit FCID
  - Frame Data Size
  - State
  - Device Type
  - Role
  - LUN #
  - Capacity
  - Block Size
  - Vendor
  - Target WWN

CEE to FCoE Port Mapping

```
B8000:admin> switchshow
<truncated output>
Index Port Address Media Speed State     Proto
==========================================
<truncated output>
 0    0    020000   id    N8   Online      FC  E-Port
 1    1    020100   id    N8   Online      FC  E-Port
 2    2    020200   id    N8   Online      FC  E-Port
 3    3    020300   --    N8   No_Module   FC
 4    4    020400   --    N8   No_Module   FC
 5    5    020500   --    N8   No_Module   FC
 6    6    020600   --    N8   No_Module   FC
 7    7    020700   --    N8   No_Module   FC
 8    8    020800   --    10G   Online     FCoE VF-Port  1 VN-Port(s)
 9    9    020900   --    10G   Online     FCoE VF_Port  0 VN_Port(s)
10   10    020a00   --    10G   Online     FCoE VF-Port  0 VN-Port(s)
```

DCFM: CNA Information

- CNA information:
  - Link State, Port WWN, Supported Fibre Channel CoS, Symbolic Name, MTU size and 24 bit FC_ID
- CNA Target Devices:
  - Device Count, Target 24 bit FC_ID, LUN #, Capacity, Vendor and Target WWN
- SFP information: (Attached to CNA)
  - Connector Type, Transceiver, Part Number and Serial Number
  - Power:
    - Tx Power and Rx Power
- CNA supportsave logs

This information also available using HCM.

Target Rate Limiting

- The Target Rate Limiting (TRL) feature is same as FC TRL release 1.x and has been extended to FCoE

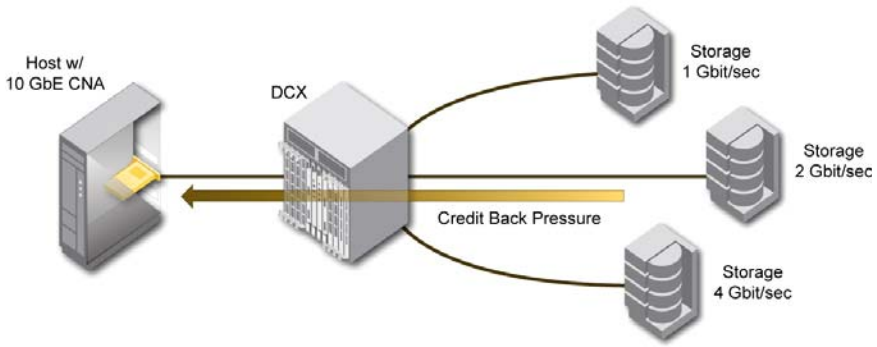


Figure 24: Target Rate Limiting Example 2

Let's assume the CNA is zoned to the three storage devices. When the CNA sends data to the storage at the speed of 10GbE. The targets will not be able to receive frames at that rate. Example: If the 1 Gbps storage receives too much data, this results in back pressure and limits the ability to send data to the other two storage devices.

The frames will be in the switch longer and this causes the switch port to delay in issuing buffer credits back to the Zeus FPGA in the Brocade FCOE10-24 blade, which will result in Priority Pause frames being sent to the CNA, thus stopping data traffic.

BCU - Key Commands Used in Supportsave

- `lport --query 1/x` - Link State, WWN, Symbolic name, WWN of FCF, IP address of FCF management port
- `lport --stats 1/x` - Shows Fibre Channel ELS and Common Transport commands
- `rport --list 1/x` - Shows FCID, WWN and link status of target devices
- `rport --osname 1/x` - Maps WWN and OS device name
- `rport --query 1/x Target_WWN` - Target: FCID, WWN, Link Status, Symbolic Name, Vendor, Product ID
- `rport --stats 1/x Target_WWN` - Shows stats between CNA port and target port such as online, offline, PLOGIs, logouts, etc...

Logical port (lport) commands. A logical port is a port that is logged into a fabric.

Remote port (rport) commands. Commands for the remote port (Target device) in a fabric.

Host Connectivity Manager (HCM)

- CNA and HCM events and error messages
- CNA: Driver versions, part number, serial number
- Fabric Statistics
    - FLOGIs, Name Server (PLOGIs, Registrations / Queries)
    - Onlines, Offlines, RSCNs
- Remote Port (Target Device) Statistics
    - PLOGIs, PRLI, RSCN, IO Requests / Completions
- Ethernet Statistics
    - LLDP, Tx, Rx
- HCM Supportsave
    - Used to gather HCM application and Agent information for troubleshooting HCM but not for trouble-shooting the adapter
- Master Log
- CNA/HBA statistics
- CNA supportsave - HCM version 2.1 or later required.

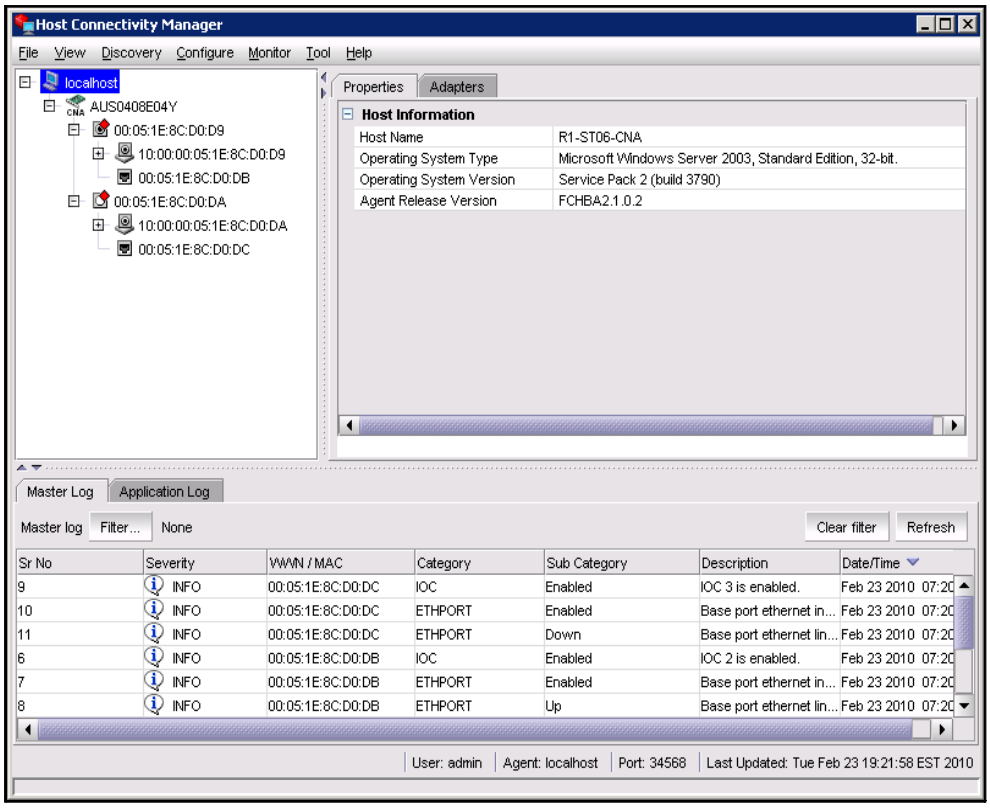


Figure 25: HCM Main Window

CNA Performance

- CNA performance is dependent on the capabilities of the host
  - How many PCI Express lanes are supported by the host?
- CNA can experience performance issues due to bad or incorrect hardware:
  - Cables
  - SFP+
  - Patch panel connections

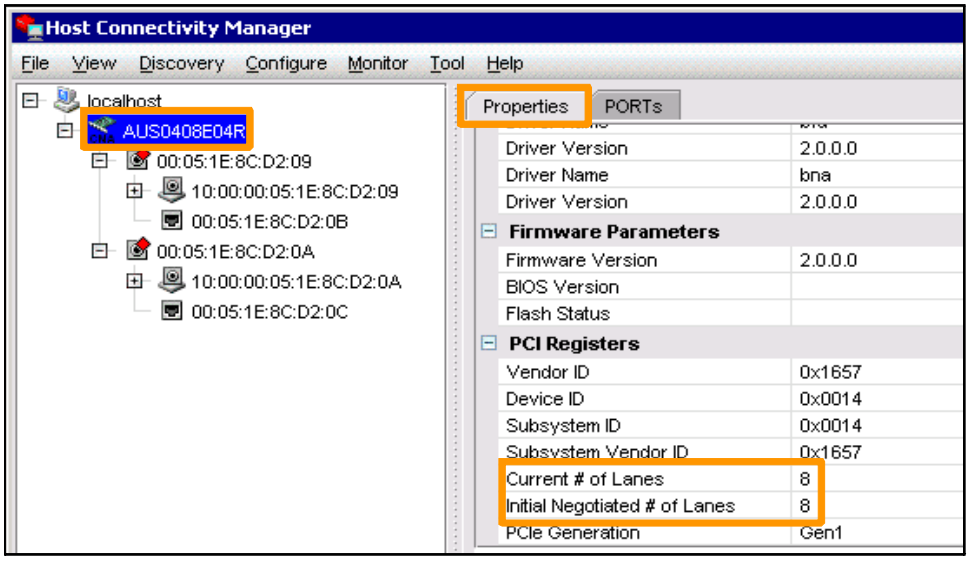


Figure 26: HCM - CNA Performance

This information can also be obtained from the BCU.

Brocade CNAs

- BR-1010: One 10 GbE port
- BR-1020: Two 10 GbE ports
- Both full height and low profile brackets supported and shipped with each CNA
- FCoE traffic support requires direct connect to FCoE Forwarder (FCF)

An FCoE Forwarder (FCF) is an FCoE device that supports FCoE VF_Ports and/or FCoE VE_Ports; the equivalent of an FC switch

Catapult ASIC:

- 2 x 10 GbE Ethernet-FCoE ports per ASIC
- Supports 10 GbE Ethernet Controller module and Catapult's FC / FCoE module with acceleration engines
- Extends the Catapult FC capabilities to support FCoE protocol
- Compliant with T11 FC-BB-5 standard

Taking the Test

After the Introduction Screen, once you click on **Next**, you will see the non-disclosure agreement:

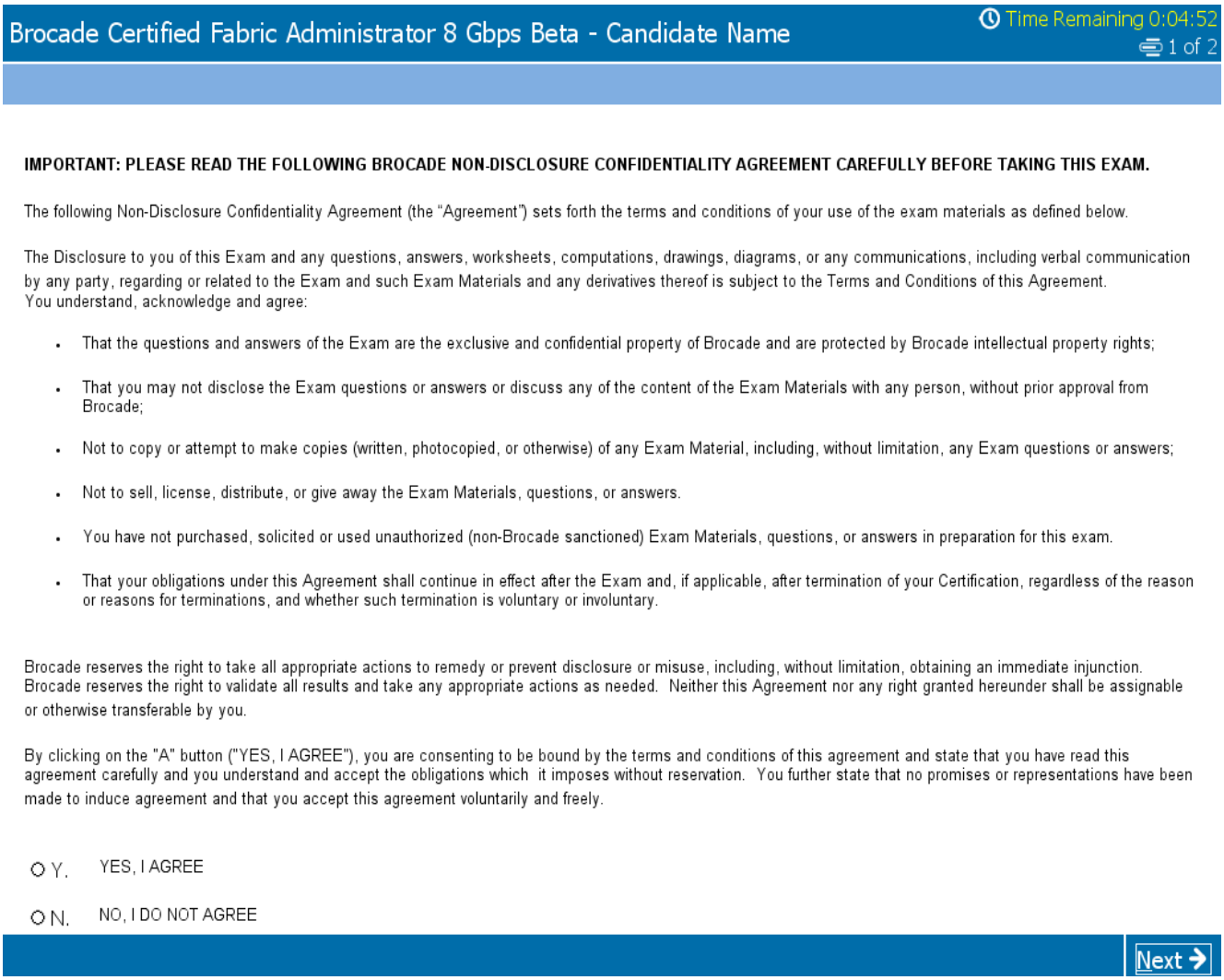


Figure 27: Sample NDA