

ENTERPRISE CAMPUS NETWORKING

Brocade ICX 6610 Series Switches Architecture Brief

This architecture brief describes the system architecture for the Brocade® ICX 6610 (Integrated Campus Switch) stackable switch series. The Brocade ICX 6610 delivers wire-speed, non-blocking performance across all ports to support latency-sensitive applications. The switches can be stacked using 4 x 40 Gbps stacking ports that provide 160 Gbps of backplane stacking bandwidth. Additionally, each switch can provide up to 8 x 10 GbE (Gigabit Ethernet) uplink ports.

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OVERVIEW

The Brocade ICX 6610 series includes five base models, each with an option of front-to-back (Exhaust) or back-to-front (Intake) airflow.

- **Brocade ICX6610-24-E** with 24 10/100/1000 Mbps RJ-45 ports, 8 x 1 GbE uplink ports (upgradable to 10 GbE), 160 Gbps stacking bandwidth, Exhaust airflow
- **Brocade ICX6610-24-I** with 24 10/100/1000 Mbps RJ-45 ports, 8 x 1 GbE uplink ports (upgradable to 10 GbE), 160 Gbps stacking bandwidth, Intake airflow
- **Brocade ICX6610-24P-E** with 24 10/100/1000 Mbps RJ-45 Power over Ethernet plus (PoE+) ports, 8 x 1 GbE uplink ports (upgradable to 10 GbE), 160 Gbps stacking bandwidth, Exhaust airflow
- **Brocade ICX6610-24P-I** with 24 10/100/1000 Mbps RJ-45 PoE+ ports, 8 x 1 GbE uplink ports (upgradable to 10 GbE), 160 Gbps stacking bandwidth, Intake airflow
- **Brocade ICX6610-48-E** with 48 10/100/1000 Mbps RJ-45 ports, 8 x 1 GbE uplink ports (upgradable to 10 GbE), 160 Gbps stacking bandwidth, Exhaust airflow
- **Brocade ICX6610-48-I** with 48 10/100/1000 Mbps RJ-45 ports, 8 x 1 GbE uplink ports (upgradable to 10 GbE), 160 Gbps stacking bandwidth, Intake airflow
- **Brocade ICX6610-48P-E** with 48 10/100/1000 Mbps RJ-45 PoE+ ports, 8 x 1 GbE uplink ports (upgradable to 10 GbE), 160 Gbps stacking bandwidth, Exhaust airflow
- **Brocade ICX6610-48P-I** with 48 10/100/1000 Mbps RJ-45 PoE+ ports, 8 x 1 GbE uplink ports (upgradable to 10 GbE), 160 Gbps stacking bandwidth, Intake airflow
- **Brocade ICX6610-24F-E** with 24 100/1000 Mbps SFP fiber ports, 8 x 1 GbE uplink ports (upgradable to 10 GbE), 160 Gbps stacking bandwidth, Exhaust airflow
- **Brocade ICX6610-24F-I** with 24 100/1000 Mbps SFP fiber ports, 8 x 1 GbE uplink ports (upgradable to 10 GbE), 160 Gbps stacking bandwidth, Intake airflow

All models include up to eight uplink ports; the ports run at 1 GbE speeds by default and can be upgraded to 10 GbE speeds via a license. This is different from the other Brocade stackable products. For example, in the Brocade FCX Series Switches, a customer has to order a 10 GbE physical module and physically insert this into the switch. With the Brocade ICX 6610, the operational inefficiencies are reduced by providing the ports in the switch that, by default, run at 1 GbE speeds. If customers want to upgrade to 10 GbE speeds, they simply have to add a software license to do so, reducing the operating expense and downtime.

The Brocade ICX 6610 is the next-generation Brocade stackable switch platform, delivering high-performance 10/100/1000-Mbps Ethernet, with full 803.2at PoE+ (up to 30 W), redundant power supplies and redundant fans, and 10 GbE uplinks, in a high-density stackable form factor. It is hardware (HW)-ready for Energy Efficient Ethernet (EEE), as well as HW-ready for encryption via MACsec (MAC security). The Brocade ICX 6610 units are 1U high, 16.89 inches (42.9cm) wide and 16 inches (41 cm) deep.

High-density PoE+ supporting power supplies are 750–1000 W for PoE/PoE+ with 250 W for the system. They are redundant, removable, and have load-sharing capabilities. Non-PoE power supplies are 250 W. All power supply units (PSUs) have intake (I) and exhaust (E) airflows.

The Brocade ICX 6610 packet processors (PP) supports 16,000 routes, 32K MAC address capacity for Ethernet bridging, 4000 access control lists (ACLs), and 8000 multicast groups.

The Brocade ICX 6610 unit boot time is between 1.5 and 2 minutes.

For the Brocade ICX 6610 specifications, refer to the datasheet located on the Brocade website, www.brocade.com.

The rest of this document provides details about the Brocade ICX 6610 architecture, including the packet processors, system packet walkthrough, and newer features.

BROCADE ICX 6610 HARDWARE ARCHITECTURE

The Brocade ICX 6610 switch models are powered by an onboard CPU with 512 MB of DRAM.

Packet Forwarding on the Brocade ICX 6610

The hardware architecture of the Brocade ICX 6610-48 platform is shown in Figure 1.

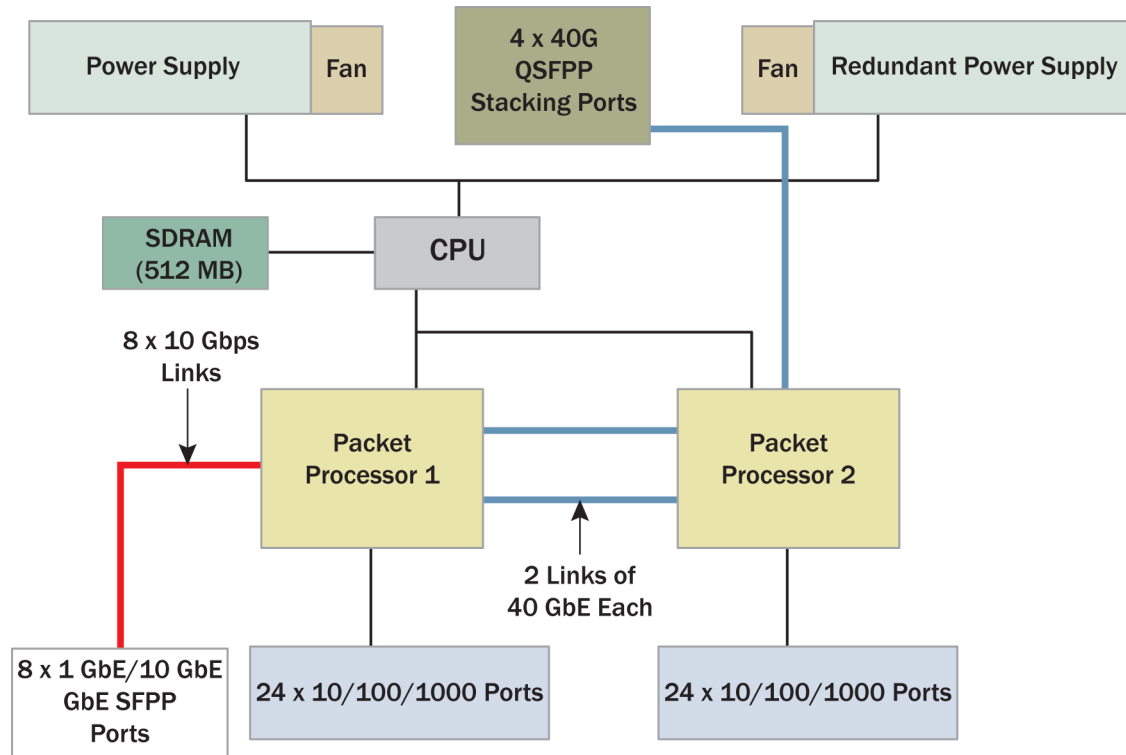


Figure 1. Brocade ICX 6610-48 hardware architecture

The 48-port switch is made up of two PPs. These are 4-core packet processors with 268 Gbps switching capacity each. As per Figure 1, PP1 supports the 8 uplink ports and 24 ports of 1 GbE. PP2 supports the 4 x 40 GbE ports and 24 ports of 1 GbE. The interpacket processor capacity is 80 GbE. Depending on the design, you can design a non-oversubscribed stacking solution with the Brocade ICX 6610. If all traffic from the 8 x 10 GbE ports and the 24 ports of 1 GbE goes out the stacking ports, then there is a potential congestion in the interpacket link. Ideally, you should look at the traffic patterns and designate the uplink ports on switches that have a large traffic input/output.

A 24-port model has one PP and can drive all 24 ports of 1 GbE, 8 x 10 GbE and 4 x 40 GbE ports without any oversubscription.

The switch comes with one power supply and one fan tray. One fan tray is sufficient to cool the switch. For redundancy, you can place a second power supply and fan into the switch.

Fans

The Brocade ICX 6610 is cooled with two integral fans that provide airflow to the system. The Brocade ICX6610-FAN-I fans are intake fans. They take in air from the power supply side of the switch and blow air out on the port side of the switch. The Brocade ICX6610-FAN-E fans are exhaust fans. They take in air from the RJ45 port side and blow air out on the power supply side.

Each field replaceable unit (FRU) has an I/E label to indicate whether the airflow is ingress or egress, with respect to the FRU. Temperature thresholds are different for each SKU, mode, and airflow direction.

Airflow Direction

Intake Airflow

The intake airflow, shown in Figure 2, takes air in from the back of the switch (the PSU side) and pushes it out at the front (port side switch). The intake PSUs and fans are labeled with the suffix "I." The PSUs and fans have to be the same airflow direction for the switch to operate.

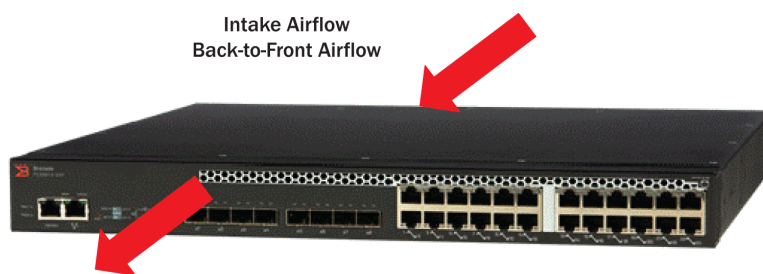


Figure 2. Intake airflow

The exhaust airflow, shown in Figure 3, takes air in from the front of the switch (the port side) and pushes it out at the back (PSU side switch). The exhaust PSUs and fans are labeled with the suffix "E." The PSUs and fans have to be the same airflow direction for the switch to operate.

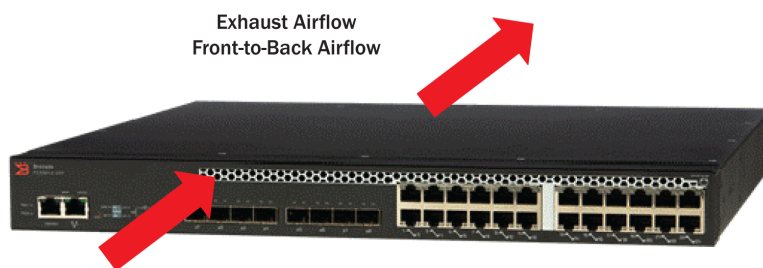


Figure 3. Exhaust airflow

PACKET PROCESSOR ARCHITECTURE

Each packet processor is divided into four cores. Each core supports 1000 ACLs and 1 MB of packet buffers. The resources are reserved for the ports that each core serves.

<p>1MB Buffers 1K ACLs Serves – 6 x 1 GbE ports + 2 10 GbE Ports + 1 x 40 GbE Port</p>	<p>1MB Buffers 1K ACLs Serves – 6 x 1 GbE Ports + 2 10 GbE Ports + 1 x 40 GbE Port</p>
<p>1MB buffers 1K ACLs Serves – 6 x 1 GbE Ports + 2 10 GbE Ports + 1 x 40 GbE Port</p>	<p>1MB Buffers 1K ACLs Serves – 6 x 1 GbE Ports + 2 10 GbE Ports + 1 x 40 GbE Port</p>

Figure 4. Each packet processor is divided into four cores.

PACKET PROCESSING, QoS, BUFFERING

Within a stack, the packet processors are numbered accordingly:

- Stack Unit 1 – PPs 0 and 1
- Stack Unit 2 – PPs 2 and 3
- Stack Unit 3 – PPs 4 and 5
- Stack Unit 4 – PPs 6 and 7
- Stack Unit 5 – PPs 8 and 9
- Stack Unit 6 – PPs 10 and 11
- Stack Unit 7 – PPs 12 and 13
- Stack Unit 8 – PPs 14 and 15

If a unit is a 24-port device, the odd-numbered packet processor cannot be configured, but is still reserved. This is to help maintain the numbering scheme throughout the stack. For example, when swapping out a 24-port device for a 48-port device, the packet processors do not have to be renumbered.

The Brocade ICX 6610 is powered by a 4-core PP. Each core has its dedicated memory, ACLs, buffers, and ternary content addressable memory (TCAM) resources.

The packet buffer size on each Brocade ICX 6610 is 4 MB. These are divided into 8K buffers of 512 B (bytes) each. The 8K buffers are further divided into 2K per core (4 core PPs x 2K per core = 8-MB buffers) using 8K buffers (2 from each core) and 8K descriptors. Each buffer is 512 bytes deep and is used for egress and ingress packet buffering. Buffers are used to store the packet payload in the PP. A unique descriptor is assigned to each unicast packet. Depending on packet length, multiple buffers may be used to store a unicast packet.

Brocade ICX 6610 Buffer Management

There is 4 MB packet memory available in each Brocade ICX 6610 packet processor. There are a total of 8K buffers with 2K per core. The size of buffer is 512 bytes. There are a total of 8K descriptors per device.

Descriptor to Buffer Conversion: Each descriptor points to a 512-byte block of buffer. 8K descriptors

* 512-byte = 4 MB buffers per PP.

Table 1. Brocade ICX 6610 global buffer limit

Total buffer	8 K descriptors
Total descriptor	8 K
Total descriptors per core	2 K
Size of buffer	512 B

The Brocade ICX 6610 buffers are divided into four cores.

The following paragraphs describe common buffering issues and their solutions. From the system point of view, the primary considerations are Head of Line (HOL) blocking, quality of service (QoS), burst ability, and integrity of stacking.

Quality of Service

To support QoS, dedicated buffers per port or per priority are required. The weighted round robin (WRR)/Mixed QoS mechanism needs more priority-based buffers than needed by strict mode.

The table shows the default descriptor limits for WRR and Mixed QoS scheduling.

Table 2. Egress buffer limits

Port Type	Egress Buffer/Descriptor per Port	Egress Buffer/Descriptor per Queue							
		0	1	2	3	4	5	6	7
1 GbE	8096	128	32	32	32	32	64	64	64
10 GbE	8096	160	48	48	48	48	96	96	96
40 GbE	8096	256	64	64	64	64	144	144	144

Bursty Traffic Management

By default, the buffers are distributed as shown in Table 3. These are optimized for a non-bursty, constant rate of traffic on all ports.

Some real network traffic is bursty in nature. It is common for a few 10 GbE ports to distribute traffic to a group of 1 GbE ports.

A new command, **qd-share-level**, is added. This allows users to configure sharing pools at eight different levels.

ICX6610-24P POE Switch(config)#qd-share-level

The different sharing levels help adjust the buffers based on the expected burstiness of the traffic. The systems engineer should identify the traffic profiles and choose any of the sharing levels mentioned below to match the performance requirements of the traffic patterns.

Note that the Brocade ICX 6610 does not support Level 1.

Table 3. Buffer sharing pool configuration

Sharing Level	Brocade ICX 6610 Sharing Pools Limit				Total Sharing Buffers in Kilobytes	Brocade ICX 6610 TCO Sharing Buffers in Kilobytes
	Pool 1 TC 0, 1	Pool 2 TC 2,3,4	Pool 3 TC 5, 6	Pool 4 TC7		
1	Not Supported				64	N/A
2	128	128	192	192	250	64
3	256	128	192	192	375	125
4	512	128	192	192	500	250
5 (default)	768	128	192	192	625	375
6	1024	128	192	192	750	500
7	1280	128	192	192	875	625
8	1536	128	192	192	1000	750

Please note that if Level 8 is configured, HOL blocking is likely to happen, since the total size of the sharing buffers is 2K, which is the per-core limit.

HARDWARE FEATURE BREAKDOWN

Flexible Uplinks

There are eight 1/10 GbE uplink ports in each unit. They are 1 GbE by default, but are upgradable to 10 GbE via licensing.

Power Scalability

Each unit with one 1000-W PSU can provide up to 48 ports of Class 3 PoE. (Each 1000-W PSU provides 750 W of PoE power and 250 W of system power.) Adding an additional PSU provides full Class 3 PoE with redundancy. Additionally, 2 PSUs can provide 48 ports of PoE+.

APPENDIX A – PERFORMANCE DATA FOR THE BROCADE ICX 6610-48P (10 GBE)

The following tables show latency and performance test results from candidate build FCXS07300q048.bin & FCXR07300q048.bin. The results are based on 100% load of various frame sizes, port pairing, and a store and forward test pattern.

The throughput test was configured as follows:

- Each frame size is started with a 100% load. In the event of packet loss, the test falls back 50% and then performs a binary search for the load that results in no packet loss.
- The traffic burst time is 300 seconds for each iteration.
- The test was run serially from 64 bytes to 1518 bytes, and for the other sizes mentioned in Table 4 and Table 5.

The Frame Loss test was configured as follows:

- Each frame size was one test iteration at line-rate (100% load).
- The traffic burst time was 300 seconds for each iteration.
- The test was run serially 64 bytes to 1518 bytes and other sizes mentioned below.

Table 4. Results for Brocade ICX 6610 48P (10 GbE) 1-Unit L2 full mesh throughput

Frame Size (bytes)	64	128	256	512	1024	1518	2048	5000	9212
Percent load	100%	100%	100%	100%	100%	100%	100%	100%	100%
Drop rate	0%	0%	0%	0%	0%	0%	0%	0%	0%

Table 5. Results for Brocade ICX 6610 48P (10 GbE) 1-Unit L3 full mesh throughput

Frame Size (bytes)	64	128	256	512	1024	1518	2048	5000	9212
Percent load	100%	100%	100%	100%	100%	100%	100%	100%	100%
Drop rate	0%	0%	0%	0%	0%	0%	0%	0%	0%

APPENDIX B – ACOUSTIC PERFORMANCE

Table 6. Noise Levels for Brocade ICX 6610

SKU	Non-Redundant Mode		Redundant Mode	
	“E” SKU	“I” SKU	“E” SKU	“I” SKU
	1 FAN + 1 PSU	1 FAN + 1 PSU	2 FAN + 2 PSU	2 FAN + 2 PSU
ICX 6610-48P	47.2 dB	50.9 dB	48.7 dB	47.3 dB
ICX 6610-48	41.6 dB	51.4 dB	39.5 dB	39.6 dB
ICX 6610-24P	47.7 dB	46.6 dB	49.1 dB	47.5 dB
ICX 6610-24	40.3 dB	40.9 dB	39.7 dB	39.8 dB
ICX 6610-24F	39.6 dB	39.6 dB	40.3 dB	40.8 dB

APPENDIX C – BROCADE ICX 6610 HW AND PORT DENSITY**Table 7.** Brocade ICX 6610 Hardware and Port Density

	24/48 RG-45 Ports		24 SFP Ports	24/48 PoE+ Ports	
	ICX 6610-24	ICX 6610-48	ICX 6610-24F	ICX 6610-24P	ICX 6610-48P
Switching bandwidth (data rate, full duplex)	528 Gbps	576 Gbps	528 Gbps	528 Gbps	576 Gbps
Forwarding bandwidth (data rate, full duplex)	396 Mpps	432 Mpps	396 Mpps	396 Mpps	432 Mpps
Stacking bandwidth (data rate, full duplex)	320 Gbps	320 Gbps	320 Gbps	320 Gbps	320 Gbps
10/100/1000 Mbps RJ-45 ports	24	48	n/a	24	48
100/1000 Mbps SFP Ports	n/a	n/a	24	n/a	n/a
Dual mode 10 GbE SFP/SFP+ ports	8 (10 GbE optional)	8 (10 GbE optional)	8 (10 GbE optional)	8 (10 GbE optional)	8 (10 GbE optional)
40 Gbps QSFP stacking ports	4	4	4	4	4
PoE power budget (2 power supplies)	n/a	n/a	n/a	1750 W	1750 W
Maximum PoE class 3 ports	n/a	n/a	n/a	24	48
Maximum PoE+ ports	n/a	n/a	n/a	24	48
Redundant power supplies (Second optional)	2 x 250 W Load sharing Hot swappable	2 x 250 W Load sharing Hot swappable	2 x 250 W Load sharing Hot swappable	2 x 1000 W Load sharing Hot swappable	2 x 1000 W Load sharing Hot swappable
Dimensions	429 mm (W) 406.4 mm (D) 44 mm (H)	429 mm (W) 406.4 mm (D) 44 mm (H)	429 mm (W) 406.4 mm (D) 44 mm (H)	429 mm (W) 406.4 mm (D) 44 mm (H)	429 mm (W) 406.4 mm (D) 44 mm (H)
Weight	4 kg (8.8 lbs)	4 kg (8.8 lbs)	4 kg (8.8 lbs)	4 kg (8.8 lbs)	4 kg (8.8 lbs)

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