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Howard Technology Solutions,
A division of Howard Industries, Inc.

Response to
Washington Parish School Board

Erate RFP 2015-16

Due: January 8, 2015 @ 10:00am CST

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888.323.3151 *technical support*
www.Howard.com

Letter of Transmittal

January 07, 2015

Washington Parish School District
800 Main Street
Franklinton, Louisiana 70438

RFP ID: RFP 2015-16

Dear Washington Parish School District:

Howard Technology Solutions (a division of Howard Industries, Inc. -- Federal ID Number 64-0466143 and SPIN 143022153) is pleased to offer the attached response for your bid RFP 2015-16.

Melissa Reeves Ward, ERate Program/Contract Manager, is authorized to contractually bind Howard Technology Solutions in this regard. Melissa's contact information is as follows: (Address): 36 Howard Drive, Ellisville, Mississippi 39437; (Phone): 601.399.5680; (Fax): 601.399.5077; (Email): mward@howard.com.

Thank you for allowing Howard Technology Solutions to submit a proposal for this project. We look forward to working with your school district.

Sincerely,

Melissa Reeves Ward
Contract Manager
601.399.5680
mreeves@howard.com

Howard Technology Solutions

Company Overview

Howard Technology Solutions (HTS) is a division of Howard Industries, which is headquartered in Ellisville, MS and employs more than 3300 people in locations all across the United States. Howard Industries has been in business since 1968 and began offering technology solutions in 1998, a venture that quickly spiraled into a viable business that today includes a successful line of Howard-manufactured servers, desktops, notebooks, and presentation carts.

Howard Technology Solutions further accelerated its growth by partnering with other industry leaders, such as Cisco, Polycom, Enterasys, Xirrus, Fujitsu, and Panasonic; Crestron, Toshiba, Lenovo, and Mimio, securing its position as a leader in technology.

While Howard clients range from state governments and hospitals to the Kennedy Space Center, the HTS education department focuses solely on the needs of K12 school and higher education facilities, supplying them with affordable, advanced technology—everything from distance learning and interactive 21st Century classroom products to network security and storage solutions.

An E-Rate solutions provider since 2001, Howard understands both the requirements and challenges associated with education networks. This insight, coupled with product knowledge, makes Howard account managers and customer service representatives uniquely qualified to assist you in choosing the right technology for your network.

Contact
Melissa Ward
Howard E-Rate specialist
at mward@howard.com

DID YOU KNOW?

HOWARD TECHNOLOGY SOLUTIONS IS CERTIFIED!

Specialized knowledge of industry technologies and standards, proven capabilities, and a strong commitment to customer service enable Howard technicians to achieve and maintain high-level, technical certifications with our partners.

We hold certifications for the following brands and services:

Aerohive
- Aerohive Essential WLAN Configuration

Allot
- Allot Certified Technical Engineer

Audio Enhancement
- Audio Enhancement Certification

BiAmp
- Nexia Certification
- Tesira Certification
- Audia Certification

Brocade Networks
- Brocade Certified Network Professional
- Brocade Certified Network Associate

Certified Wireless Network Professional
- Certified Wireless Network Associate

Cisco
- Cisco Certified Network Professional
- Cisco Certified Network Associate
- Cisco Certified Design Associate
- Cisco Sales Expert
- Foundation Express Field Specialist
- Foundation Express Design Specialist
- Cisco Certified Entry Networking Technician

CompTia
- Security+
- STRATA
- A+
- Network+

Crestron
- Crestron Digital Media Certification DMC-T-4K
- Crestron Digital Media Certification DMC-D-4K
- Crestron Digital Media Certification DMC-E-4K
- Crestron Certified Programmer
- Crestron Advanced System Builder
- Crestron D3

Enterasys
- Certified Specialist - Wireless

Extreme Networks
- ECSP - Extreme Certified Sales Professional
- ECDP - Extreme Certified Design Professional
- ENA - Extreme Network Associate
- ENS - Extreme Network Specialist

Extron
- Extron Audio Video Associate (EAVA)
- Extron Configurable Control Systems
- Extron Control Specialist
- Extron XTP-E Systems Engineer
- Extron XTP-E Systems Technician

FrontRow
- Front Row Campus Certification

Google
- Google Apps for Education

HP
- Enterprise Server and Storage - HP2-D13

InfoComm
- InfoComm Certified Technology Specialist (CTS)
- Infocomm Design Prep Level 1
- Infocomm Design Prep Level 2
- Infocomm Design Prep Level 3

Listen Technologies
- DIS DCS 6000 Certification

Microsoft
- Microsoft Certified Systems Administrator
- Microsoft Certified Professional
- Microsoft Certified Systems Engineer

Mimio
- Mimio Authorized Trainer

Polycom
- Polycom Infrastructure Solutions
- Polycom Video Solutions Technical Training
- Polycom Real Presence Immersive
- Polycom Real Presence Platform
- Polycom Real Presence Environments

State Certifications
- Alabama General Contractor's License #48395
- Arkansas General Contractor's License #38781
- Louisiana General Contractor's License #57836
- Mississippi General Contractor's License #19937-SC
- Tennessee General Contractor's License #67207
- *Coming Soon: General Contractor's License for GA, FL, NC, & TX. InfoComm CTS-I and CTS-D*

VMware
- IVC
- VMware Certified Associate
- VMware Certified Professional
- VMware Technical Sales Professional

Xirrus
- Xirrus Technical Professional

FOR SALES INFORMATION CONTACT

HOWARD
howardcomputers.com

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References

Below is a list of just some of our satisfied K12 School District Customers. If you need to speak to more references, please contact a Howard team member. We work with higher education, governments, and other types of customers as well.

Amory School District
Amory, MS
Janice Russell
jrussell@amory.k12.ms.us
601-256-5991
21st Century Classroom
Since 2003
ERate 2011 pending - Xirrus network upgrade

Bedford County Schools
Shelbyville, TN
Ben Berrett
barrettb@bedfordk12tn.net
931.684.3285
Howard brand desktop computers
Since 2003

Bossier Parish School Board
Benton, LA
Bill Allred
Bill.allred@bossierschools.org
318-549-6201
21st Century Classrooms, all non-network IT technology
Since 2005
Dec 2010 - $275k NComputing

Cabot School District
Cabot, AR
Kendal Wells
kendal.wells@cps.k12.ar.us
501-843-3363
Printers, projectors
Since 2011

Calcasieu Parish School Board
Lake Charles, LA
Roger Creel
Roger.creel@cpsb.org
337-217-4080
Desktops, Projectors, Mimio, Etc
Since 2006

Cossatot River School District
Wickes, AR
Kenny Davis
RFoster@cossatot.k12.ar.us
870-385-7101
computer, projectors
Since 2011
August 2011 – Enterasys Network upgrade

Cutter Morning Star Schools
Hot Springs Township, AR
Peggy Stanley
peggys@cms.dsc.k12.ar.us
501-262-2414
Epson, Mimio, Computers
Since 2009

Dekalb County Schools
Rainsville, AL
Cyndy Smith
cyndy@dekalbk12.org
(256) 638-6921 ext: 102
Howard brand laptops and desktops, Enterasys, all non-network IT technology
Since 2007
Feb 2011 – Erate Enterasys network upgrade

Farmington Public School
Farmington, AR
Jarrod Morrison
jmorriso@farmcards.org
479-266-1819
Mimio, Projectors, Computers
Since 2008

Fort Smith School District
Fort Smith, AR
Jeff Mosby
jmosby@fortsmithschools.org
479-784-8130 Ext. 2274
Mimio
Since 2010

Franklin County Schools
Winchester, TN
Alan Clark
alan.clark@fcstn.net
(931) 967-0626
Enterasys switches
Since 2006

Grant Parish School Board
Colfax, LA
David Smith
dsmith@gpsb.org
Rhonda Norris
rnorris@gpsb.org
318-392-0254
21st Century Classrooms, all non-network related IT technology
Since 2009

Hancock County Schools
Kiln, MS
Jon McCraw
jmccraw@hancock.k12.ms.us
228-255-0376
Computers, ERate switches, projectors, PET carts, servers
Since 2002
July 2011 - Installed 275 desktops

Hartselle City Schools
Hartselle, AL
Tim Southerland
tim.southerland@hcs.k12.al.us
(256) 773-6802
AV equipment
Since 2007

Haywood County Schools
Brownsville, TN
Lisa Prescott
prescottL@k12tn.net
731.772.9613
ERate Basic Maintenance, Mimio, laptops
Since 2011
2011 Erate pending - Wireless Network upgrade

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Jones County Schools
Ellisville, MS
Patrick Robinson
probinson@jones.k12.ms.us
601-649-5201
computers, interactive products, SAN solution.
Since 1999

Lauderdale County Schools
Florence, AL
Mark Wilson
mark.wilson@lcschools.org
(256) 757-2101 ext: 224
Computers, Enterasys network upgrade
Since 2006

Lauderdale County Schools
Meridian, MS
Lisa Hull
lhull@lauderdale.k12.ms.us
601-485-1761
interactive technology (Mimio, document cameras, projectors, etc.), Xirrus
Since 2003
Aug 2011 - Xirrus network upgrade

Lincoln County Schools
Fayetteville, TN
Terry Sue Fanning
tsfanning@kdoe.org
931.438.1467
Mimio and Howard desktops
Since 2006

Magnet Cove School District
Malvern, AR
Jeff Blakeney
jeffb@magnetcove.k12.ar.us
501-332-5468
Extron, Computers, Servers, projectors
Since 2008

Marengo County Schools
Linden, AL
Jana Hoggle
jhoggle@marengo.k12.al.us
334-295-223
Howard brand Desktops; Fujitsu Laptops; all non-network IT technology
Since 2007

Ozark City Schools
Ozark, AL
Mike Parrish
mkparrish@ocbe.k12.al.us
(334) 445-3800
AV equipment, laptops, servers, desktops, laptops and accessories.
Since 2008

Parker Core Knowledge Charter
Parker, CO
Sheree Gerhard
Sgerhard@Ckcs.Net
303-840-7070
AV Media Equipment, MIMIO, LCD
Since 2010

Pea Ridge School District
Pea Ridge, AR
Brent Kinkade
bkinkade@prs.k12.ar.us
479-451-8181
Computers
Since 2009

Pontotoc County Schools
Pontotoc, MS
Melanie Kidd
mkidd@pcsd.k12.ms.us
662-489-2042
all non-network IT technology, Mimio, Enterasys
Since 2007
Aug 2009 – Erate Enterasys network upgrade

Poudre School District
Fort Collins, CO
Karen Wailly
Kwailly@Psdschools.Org
(970) 490-3518
Mimio products
Since 2010

McCrory School District
McCrory, AR
Phillip Millwee
millweep@mccrory.k12.ar.us
870-731-0082
Mimio, Xirrus
Since 2010

Searcy School District
Searcy, AR
John Brown
jbrown@searcyschools.org
501-268-6954
Mimio
Since 2010

Thompson School
Loveland, CO
Mandy Zila
Amanda.Zila@Thompsonschools.org
970-613-5146
Mimio, and HP Products
Since 2010

Starkville School District
Starkville, MS
Ray New
mew@starkville.k12.ms.us
662-324-4170
PC's, interactive products, switches
Since 2002
June 2007 – Installation of STEM labs

Washington Parish School BOE
Franklinton, LA
Jimmy Thigpen
jthigpen@wpsb.org
985-839-7785
Desktops, Laptops, Mimio, Printers, Etc
Since 2005

Watson Chapel
Pine Bluff, AR
Brenda Sharpmack
bks@wcmail.k12.ar.us
870-879-7206
Mimio, projectors
Since 2008

Webster Parish School Board
Minden, LA
Patsy Whitlow
pwhitlow@websterpsb.org
318-377-5434

HOWARD™
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Desktops, Printers, 21st Century Classrooms
Since 2002
January 2010 - $250k Howard brand Desktops

Widefield School District
Colorado Springs, CO
Betty Heinsman
heinsmanb@wsd3.k12.co.us
719-391-3023
Servers, laptops, desktops, mimio
Since 2007
July 2011 - Xirrus wireless network
March 2011 – 21st Century Classroom

Wilcox County BOE
Camden, AL
Angela Parham
aparham@wilcox.k12.al.us
334-682-4178
Computers, 21st Century Classroom, servers, wireless network
Since 2007

Wilson County Schools
Lebanon, TN
Tom Waller
wallert@wcschools.com
615-443-2702
Mimio, Professional services
Since 2011

BROCADE 1G OPTION

Phone: 1.888.912.3151
Fax: 1.601.399.5077
Online: www.howardcomputers.com

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Howard Computers
P.O. Box 1588
Laurel, MS 39441

Online Quotation

Quote No: AS5 642947.02
Customer Name: Leslie Ezell
Company Name: WASHINGTON PARISH SCHOOL BOARD
Quote Name: ERATE-Internal Connections - 1G Option

Quote Date: December 23, 2014
Phone Number: 9858393436
Fax Number:

Item 1

Category	Equivalent to: Cisco WS-C3750X-24P-E, C3KX-NM-1G, CAB-STACK-50CM, and Cisco CAB-SPWR-30CM	Qty.	Unit Price	Ext. Price
System Type:	Accessories			
1:	Brocade ICX6610-24P-PE - 24 port 1G RJ45 PoE+, plus 8 x 1G SFPP uplinks ports (upgradeable to 10G), 4 x 40G stacking ports, Exhaust air flow, Premium S/W **MPN:** ICX6610-24P-PE	5	$3,414.00	$17,070.00
2:	Brocade ICX6610 Premium to Advance software upgrade **MPN:** ICX6610-ADV-UPG-LIC	5	$1,476.00	$7,380.00
3:	Brocade ICX7450/6610 PoE 1000W AC PSU, exhaust airflow **MPN:** RPS16-E	5	$422.00	$2,110.00
4:	Brocade Exhaust direction - Fan unit - for P/N: ICX6610-24-DC-E, ICX6610-24F-DC-E, ICX6610-24-PE-BUN2, ICX6610-48-DC-E **MPN:** ICX6610-FAN-E	5	$105.00	$525.00
5:	Brocade 1 YEAR ESSENTIAL REMOTE SUPPORT **MPN:** ICX6610-SVL-RMT-1	5	$332.00	$1,660.00

Sub-Total: $28,745.00
Parts & Accessories Shipping: Included
Taxes: Tax Exempt
Total for Item 1: $28,745.00

To expedite your order, please include your quote number with your Purchase Order.

Item 2

Category	Equivalent to: Cisco WS-C3750X-48P-E, C3KX-NM-1G, CAB-STACK-50CM, and Cisco CAB-SPWR-30CM	Qty.	Unit Price	Ext. Price
System Type:	Accessories			
1:	Brocade ICX6610 - 48 port 1G RJ45 PoE+, plus 8 x 1G SFPP uplinks ports(upgradeable to 10G), 4 x 40G stacking ports, Exhaust air flow, premium S/W **MPN:** ICX6610-48P-PE	20	$5,059.00	$101,180.00
2:	Brocade ICX6610 Premium to Advance software upgrade **MPN:** ICX6610-ADV-UPG-LIC	20	$1,476.00	$29,520.00
3:	Brocade ICX7450/6610 PoE 1000W AC PSU, exhaust airflow **MPN:** RPS16-E	20	$422.00	$8,440.00
4:	Brocade Exhaust direction - Fan unit - for P/N: ICX6610-24-DC-E, ICX6610-24F-DC-E, ICX6610-24-PE-BUN2, ICX6610-48-DC-E **MPN:** ICX6610-FAN-E	20	$106.00	$2,120.00

5:	Brocade 1 YEAR ESSENTIAL REMOTE SUPPORT **MPN:** ICX6610-SVL-RMT-1	20	**$332.00**	**$6,640.00**

Sub-Total: $147,900.00

Parts & Accessories Shipping: Included

Taxes: Tax Exempt

Total for Item 2: $147,900.00

To expedite your order, please include your quote number with your Purchase Order.

Item 3

Category	Equivalent to: **Cisco WS-C2960S-24PD-L**	Qty.	Unit Price	Ext. Price
System Type:	Accessories			
1:	Brocade ICX 6450-24P - Switch - L3 - managed - 24 x 10/100/1000 (PoE+) + 2 x 10 Gigabit Ethernet / 1 Gigabit Ethernet SFP+ - rack-mountable - PoE+ **MPN:** ICX6450-24P	4	**$1,432.00**	**$5,728.00**
2:	Brocade ICX 6450 2X10G Capacity Based License, Upgrade 1G Uplink/Stacking Ports to 1G/10G **MPN:** ICX6450-2X10G-LIC-POD	4	**$422.00**	**$1,688.00**

Sub-Total: $7,416.00

Parts & Accessories Shipping: Included

Taxes: Tax Exempt

Total for Item 3: $7,416.00

To expedite your order, please include your quote number with your Purchase Order.

Item 4

Category	Equivalent to: **Cisco WS-C2960S-48LPD-L**	Qty.	Unit Price	Ext. Price
System Type:	Accessories			
1:	Brocade 48-port 1G Switch PoE+ 780W, 2x1G SFP+ (upgradable to 10G) & 2x1G/10G SFP+ Uplink/Stacking Ports **MPN:** ICX6450-48P	37	**$2,233.00**	**$82,621.00**
2:	Brocade ICX 6450 2X10G Capacity Based License, Upgrade 1G Uplink/Stacking Ports to 1G/10G **MPN:** ICX6450-2X10G-LIC-POD	37	**$422.00**	**$15,614.00**

Sub-Total: $98,235.00

Parts & Accessories Shipping: Included

Taxes: Tax Exempt

Total for Item 4: $98,235.00

To expedite your order, please include your quote number with your Purchase Order.

Item 5

Category	Equivalent to: **Cisco WS-C2960S-24PS-L**	Qty.	Unit Price	Ext. Price
System Type:	Accessories			
1:	Brocade ICX 6450-24P - Switch - L3 - managed - 24 x 10/100/1000 (PoE+) + 2 x 10 Gigabit Ethernet / 1 Gigabit Ethernet SFP+ - rack-mountable - PoE+ **MPN:** ICX6450-24P	36	**$1,432.00**	**$51,552.00**

Sub-Total:	$51,552.00
Parts & Accessories Shipping:	Included
Taxes:	Tax Exempt
Total for Item 5:	$51,552.00

To expedite your order, please include your quote number with your Purchase Order.

Item 6

Category	Equivalent to: Cisco WS-C2960S-48LPS-L	Qty.	Unit Price	Ext. Price
System Type:	Accessories			
1:	Brocade 48-port 1G Switch PoE+ 780W, 2x1G SFP+ (upgradable to 10G) & 2x1G/10G SFP+ Uplink/Stacking Ports MPN: ICX6450-48P	26	$2,233.00	$58,058.00

Sub-Total:	$58,058.00
Parts & Accessories Shipping:	Included
Taxes:	Tax Exempt
Total for Item 6:	$58,058.00

To expedite your order, please include your quote number with your Purchase Order.

Item 7

Category	Equivalent to: Cisco GLC-SX-MM=	Qty.	Unit Price	Ext. Price
System Type:	Accessories			
1:	Brocade 1000Base-SX SFP optic, MMF, LC connector, Optical Monitoring Capable MPN: E1MG-SX-OM	210	$220.00	$46,200.00

Sub-Total:	$46,200.00
Parts & Accessories Shipping:	Included
Taxes:	Tax Exempt
Total for Item 7:	$46,200.00

To expedite your order, please include your quote number with your Purchase Order.

Item 8

Category	Equivalent to: Cisco GLC-LH-SM=	Qty.	Unit Price	Ext. Price
System Type:	Accessories			
1:	Brocade - SFP (mini-GBIC) transceiver module - 1000Base-LX - LC single mode - up to 6.2 miles - 1310 nm - for ICX 6430, 6450, 7750; VDX 6710, 6720, 6730, 6740 MPN: E1MG-LX-OM	3	$464.00	$1,392.00

Sub-Total:	$1,392.00
Parts & Accessories Shipping:	Included
Taxes:	Tax Exempt
Total for Item 8:	$1,392.00

To expedite your order, please include your quote number with your Purchase Order.

Item 9

Category	Equivalent to: Cisco C2960S-STACK= and Cisco CAB-STK-E-0.5M	Qty.	Unit Price	Ext. Price
System Type:	Accessories			
1:	Brocade 10 Gbps Direct Attached SFP+ Copper Cable - Twinaxial cable - SFP+ - SFP+ - 3.3 ft - black - for BigIron RX-32, RX-4; ICX 6430, 6450, 7750; TurboIron 24; VDX 6710, 6720, 6730, 6740 **MPN:** 10G-SFPP-TWX-0101	50	$64.00	$3,200.00
			Sub-Total:	**$3,200.00**
			Parts & Accessories Shipping:	**Included**
			Taxes:	**Tax Exempt**
			Total for Item 9:	**$3,200.00**

To expedite your order, please include your quote number with your Purchase Order.

Item 10

Category	Miscellaneous	Qty.	Unit Price	Ext. Price
System Type:	Accessories			
1:	Cisco Aironet 1602i Standalone - Wireless access point - 802.11 a/b/g/n - Dual Band **MPN:** AIR-SAP1602I-A-K9	79	$403.00	$31,837.00
2:	APC Smart-UPS 3000 LCD - UPS - AC 120 V - 2700 Watt - 3000 VA - RS-232, USB - 10 output connector(s) **MPN:** SMT3000	10	$1,097.00	$10,970.00
3:	C2G Cat6 Snagless Unshielded (UTP) Network Patch Cable - Patch cable - RJ-45 (M) - RJ-45 (M) - 1 ft - CAT 6 - molded, stranded, snagless - gray **MPN:** 27130	3000	$2.50	$7,500.00
4:	C2G Cat6 Snagless Unshielded (UTP) Network Patch Cable - Patch cable - RJ-45 (M) - RJ-45 (M) - 3 ft - CAT 6 - molded, snagless - gray **MPN:** 27131	100	$2.75	$275.00
			Sub-Total:	**$50,582.00**
			Parts & Accessories Shipping:	**Included**
			Taxes:	**Tax Exempt**
			Total for Item 10:	**$50,582.00**

To expedite your order, please include your quote number with your Purchase Order.

Item 11

Category	Installation	Qty.	Unit Price	Ext. Price
System Type:	Accessories			
1:	INSTALLATION Rack, stack and configure 128 Brocade switches. Hang and configure 79 Cisco access points in Washington Parish. **MPN:** Installation	1	$19,500.00	$19,500.00
			Sub-Total:	**$19,500.00**
			Parts & Accessories Shipping:	**Included**
			Taxes:	**Tax Exempt**
			Total for Item 11:	**$19,500.00**

To expedite your order, please include your quote number with your Purchase Order.

Item 12

Category	Services At No Charge	Qty.	Unit Price	Ext. Price
System Type:	Accessories			
1:	Brocade: Adds IP management SW license FOR 100 devices; Pre-requisite are IP-BASE or INM Upgrade or IP Extension; minimum of one year support is required. **MPN:** BR-NTWADV-IP-100	1	**$0.00**	**$0.00**
2:	BROCADE CERTIFIED NETWORK ENGINEER WEB BASED TRAINING **MPN:** CNE200WBT	1	**$0.00**	**$0.00**
3:	BROCADE NETWORK ADVISOR WEB BASED TRAINING **MPN:** BNA200WBT	1	**$0.00**	**$0.00**
4:	BROCADE IP TROUBLESHOOTING OVERVIEW WEB BASED TRAINING **MPN:** IP-TS101WBT	1	**$0.00**	**$0.00**
			Sub-Total:	**$0.00**
			Parts & Accessories Shipping:	**Included**
			Taxes:	**Tax Exempt**
			Total for Item 12:	**$0.00**

To expedite your order, please include your quote number with your Purchase Order.

Total for all pre-configured items

Sub-Total:	**$512,780.00**
Parts & Accessories Shipping:	**Included**
Taxes:	**Tax Exempt**
Total:	**$512,780.00**

Notes:

Pricing and availability subject to change without notice.
Packaging, Shipping, and Handling fees are not included unless specifically stated.
Prices and lease payments do not include applicable taxes.
Ship dates are approximations and are not guarantees.
Quick ship items not available in Alaska, Hawaii, or outside the United States.
Specific state laws may affect shipment of products.
If Purchaser fails to pay any invoice in full within the time quoted herein, Seller may, without notice, accelerate the due date of all outstanding invoices and require that all outstanding invoices, including any interest thereon, be immediately due and payable in full.
For product return policies and information please visit:
http://www.howardcomputers.com/pdf/warranties/HTS_ReturnPolicy.pdf

BROCADE 10G OPTION

Phone: 1.888.912.3151
Fax: 1.601.399.5077
Online: www.howardcomputers.com

HOWARD™
TECHNOLOGY SOLUTIONS

Howard Computers
P.O. Box 1588
Laurel, MS 39441

Online Quotation

Quote No: AS5 642967.02
Customer Name: Leslie Ezell
Company Name: WASHINGTON PARISH SCHOOL BOARD
Quote Name: ERATE-Internal Connections - 10G Option

Quote Date: December 23, 2014
Phone Number: 9858393436
Fax Number:

Item 1

Category	Equivalent to: Cisco WS-C3750X-24P-E, C3KX-NM-1G, CAB-STACK-50CM, and Cisco CAB-SPWR-30CM	Qty.	Unit Price	Ext. Price
System Type:	Accessories			
1:	Brocade ICX6610-24P-PE - 24 port 1G RJ45 PoE+, plus 8 x 1G SFPP uplinks ports (upgradeable to 10G), 4 x 40G stacking ports. Exhaust air flow. Premium S/W **MPN:** ICX6610-24P-PE	5	$3,414.00	$17,070.00
2:	Brocade ICX6610 Premium to Advance software upgrade **MPN:** ICX6610-ADV-UPG-LIC	5	$1,476.00	$7,380.00
3:	Brocade ICX7450/6610 PoE 1000W AC PSU, exhaust airflow **MPN:** RPS16-E	5	$422.00	$2,110.00
4:	Brocade Exhaust direction - Fan unit - for P/N: ICX6610-24-DC-E, ICX6610-24F-DC-E, ICX6610-24-PE-BUN2, ICX6610-48-DC-E **MPN:** ICX6610-FAN-E	5	$105.00	$525.00
5:	Brocade 1 YEAR ESSENTIAL REMOTE SUPPORT **MPN:** ICX6610-SVL-RMT-1	5	$332.00	$1,660.00
6:	Brocade License to upgrade 4 ports of 1G SFPP uplink to 10G speeds **MPN:** ICX6610-10G-LIC-POD	5	$1,055.00	$5,275.00
			Sub-Total:	$34,020.00
			Parts & Accessories Shipping:	Included
			Taxes:	Tax Exempt
			Total for Item 1:	$34,020.00

To expedite your order, please include your quote number with your Purchase Order.

Item 2

Category	Equivalent to: Cisco WS-C3750X-48P-E, C3KX-NM-1G, CAB-STACK-50CM, and Cisco CAB-SPWR-30CM	Qty.	Unit Price	Ext. Price
System Type:	Accessories			
1:	Brocade ICX6610 - 48 port 1G RJ45 PoE+, plus 8 x 1G SFPP uplinks ports(upgradeable to 10G), 4 x 40G stacking ports. Exhaust air flow. premium S/W **MPN:** ICX6610-48P-PE	20	$5,059.00	$101,180.00
2:	Brocade ICX6610 Premium to Advance software upgrade **MPN:** ICX6610-ADV-UPG-LIC	20	$1,476.00	$29,520.00
3:	Brocade ICX7450/6610 PoE 1000W AC PSU, exhaust airflow **MPN:** RPS16-E	20	$422.00	$8,440.00
4:	Brocade Exhaust direction - Fan unit - for P/N: ICX6610-24-DC-E, ICX6610-24F-DC-E.	20	$105.00	$2,100.00

	ICX6610-24-PE-BUN2, ICX6610-48-DC-E **MPN:** ICX6610-FAN-E			
5:	Brocade 1 YEAR ESSENTIAL REMOTE SUPPORT **MPN:** ICX6610-SVL-RMT-1	20	**$332.00**	**$6,640.00**
6:	Brocade License to upgrade 4 ports of 1G SFPP uplink to 10G speeds **MPN:** ICX6610-10G-LIC-POD	20	**$1,055.00**	**$21,100.00**
			Sub-Total:	**$168,980.00**
			Parts & Accessories Shipping:	**Included**
			Taxes:	**Tax Exempt**
			Total for Item 2:	**$168,980.00**

To expedite your order, please include your quote number with your Purchase Order.

Item 3

Category	**Equivalent to:** **Cisco WS-C2960S-24PD-L**	**Qty.**	**Unit Price**	**Ext. Price**
System Type:	Accessories			
1:	Brocade ICX 6450-24P - Switch - L3 - managed - 24 x 10/100/1000 (PoE+) + 2 x 10 Gigabit Ethernet / 1 Gigabit Ethernet SFP+ - rack-mountable - PoE+ **MPN:** ICX6450-24P	4	**$1,432.00**	**$5,728.00**
2:	Brocade ICX 6450 2X10G Capacity Based License, Upgrade 1G Uplink/Stacking Ports to 1G/10G **MPN:** ICX6450-2X10G-LIC-POD	4	**$422.00**	**$1,688.00**
			Sub-Total:	**$7,416.00**
			Parts & Accessories Shipping:	**Included**
			Taxes:	**Tax Exempt**
			Total for Item 3:	**$7,416.00**

To expedite your order, please include your quote number with your Purchase Order.

Item 4

Category	**Equivalent to:** **Cisco WS-C2960S-48LPD-L**	**Qty.**	**Unit Price**	**Ext. Price**
System Type:	Accessories			
1:	Brocade 48-port 1G Switch PoE+ 780W, 2x1G SFP+ (upgradable to 10G) & 2x1G/10G SFP+ Uplink/Stacking Ports **MPN:** ICX6450-48P	37	**$2,233.00**	**$82,621.00**
2:	Brocade ICX 6450 2X10G Capacity Based License, Upgrade 1G Uplink/Stacking Ports to 1G/10G **MPN:** ICX6450-2X10G-LIC-POD	37	**$422.00**	**$15,614.00**
			Sub-Total:	**$98,235.00**
			Parts & Accessories Shipping:	**Included**
			Taxes:	**Tax Exempt**
			Total for Item 4:	**$98,235.00**

To expedite your order, please include your quote number with your Purchase Order.

Item 5

Category	**Equivalent to:** **Cisco WS-C2960S-24PS-L**	**Qty.**	**Unit Price**	**Ext. Price**

System Type:	Accessories			
1:	Brocade ICX 6450-24P - Switch - L3 - managed - 24 x 10/100/1000 (PoE+) + 2 x 10 Gigabit Ethernet / 1 Gigabit Ethernet SFP+ - rack-mountable - PoE+ **MPN:** ICX6450-24P	36	**$1,432.00**	**$51,552.00**
2:	Brocade ICX 6450 2X10G Capacity Based License, Upgrade 1G Uplink/Stacking Ports to 1G/10G **MPN:** ICX6450-2X10G-LIC-POD	36	**$422.00**	**$15,192.00**
			Sub-Total:	**$66,744.00**
			Parts & Accessories Shipping:	**Included**
			Taxes:	**Tax Exempt**
			Total for Item 5:	**$66,744.00**

To expedite your order, please include your quote number with your Purchase Order.

Item 6

Category	**Equivalent to:** **Cisco WS-C2960S-48LPS-L**	**Qty.**	**Unit Price**	**Ext. Price**
System Type:	Accessories			
1:	Brocade 48-port 1G Switch PoE+ 780W, 2x1G SFP+ (upgradable to 10G) & 2x1G/10G SFP+ Uplink/Stacking Ports **MPN:** ICX6450-48P	26	**$2,233.00**	**$58,058.00**
2:	Brocade ICX 6450 2X10G Capacity Based License, Upgrade 1G Uplink/Stacking Ports to 1G/10G **MPN:** ICX6450-2X10G-LIC-POD	26	**$422.00**	**$10,972.00**
			Sub-Total:	**$69,030.00**
			Parts & Accessories Shipping:	**Included**
			Taxes:	**Tax Exempt**
			Total for Item 6:	**$69,030.00**

To expedite your order, please include your quote number with your Purchase Order.

Item 7

Category	**Equivalent to:** **GLC-SX-MM**	**Qty.**	**Unit Price**	**Ext. Price**
System Type:	Accessories			
1:	Brocade 10GBASE-LRM SFP+ optic (LC), for up to 220m over MMF **MPN:** 10G-SFPP-LRM	210	**$631.00**	**$132,510.00**
			Sub-Total:	**$132,510.00**
			Parts & Accessories Shipping:	**Included**
			Taxes:	**Tax Exempt**
			Total for Item 7:	**$132,510.00**

To expedite your order, please include your quote **number with your Purchase Order.**

Item 8

Category	**Equivalent to:** **GLC-LH-SM**	**Qty.**	**Unit Price**	**Ext. Price**
System Type:	Accessories			
1:	Brocade 10GBASE-LR, SFP+ optic (LC), for up to 10km over SMF **MPN:** 10G-SFPP-LR	3	**$1,158.00**	**$3,474.00**
			Sub-Total:	**$3,474.00**

Parts & Accessories Shipping:	**Included**
Taxes:	**Tax Exempt**
Total for Item 8:	**$3,474.00**

To expedite your order, please include your quote number with your Purchase Order.

Item 9

Category	Equivalent to: Cisco C2960S-STACK= and Cisco CAB-STK-E-0.5M	Qty.	Unit Price	Ext. Price
System Type:	Accessories			
1:	Brocade 10 Gbps Direct Attached SFP+ Copper Cable - Twinaxial cable - SFP+ - SFP+ - 3.3 ft - black - for BigIron RX-32, RX-4; ICX 6430, 6450, 7750; TurboIron 24; VDX 6710, 6720, 6730, 6740 **MPN:** 10G-SFPP-TWX-0101	50	**$64.00**	**$3,200.00**

Sub-Total:	**$3,200.00**
Parts & Accessories Shipping:	**Included**
Taxes:	**Tax Exempt**
Total for Item 9:	**$3,200.00**

To expedite your order, please include your quote number with your Purchase Order.

Item 10

Category	Miscellaneous	Qty.	Unit Price	Ext. Price
System Type:	Accessories			
1:	Cisco Aironet 1602i Standalone - Wireless access point - 802.11 a/b/g/n - Dual Band **MPN:** AIR-SAP1602I-A-K9	79	**$403.00**	**$31,837.00**
2:	APC Smart-UPS 3000 LCD - UPS - AC 120 V - 2700 Watt - 3000 VA - RS-232, USB - 10 output connector(s) **MPN:** SMT3000	10	**$1,097.00**	**$10,970.00**
3:	C2G Cat6 Snagless Unshielded (UTP) Network Patch Cable - Patch cable - RJ-45 (M) - RJ-45 (M) - 1 ft - CAT 6 - molded, stranded, snagless - gray **MPN:** 27130	3000	**$2.50**	**$7,500.00**
4:	C2G Cat6 Snagless Unshielded (UTP) Network Patch Cable - Patch cable - RJ-45 (M) - RJ-45 (M) - 3 ft - CAT 6 - molded, snagless - gray **MPN:** 27131	100	**$2.75**	**$275.00**

Sub-Total:	**$50,582.00**
Parts & Accessories Shipping:	**Included**
Taxes:	**Tax Exempt**
Total for Item 10:	**$50,582.00**

To expedite your order, please include your quote number with your Purchase Order.

Item 11

Category	Installation	Qty.	Unit Price	Ext. Price
System Type:	Accessories			
1:	INSTALLATION Rack, stack and configure 128 Brocade switches. Hang and configure 79 Cisco access points in Washington Parish. **MPN:** Installation	1	**$19,500.00**	**$19,500.00**

Sub-Total:	**$19,500.00**
Parts & Accessories Shipping:	**Included**

Taxes:	**Tax Exempt**
Total for Item 11:	**$19,500.00**

To expedite your order, please include your quote number with your Purchase Order.

Item 12

Category	Services At No Charge	Qty.	Unit Price	Ext. Price
System Type:	Accessories			
1:	Brocade: Adds IP management SW license FOR 100 devices; Pre-requisite are IP-BASE or INM Upgrade or IP Extension; minimum of one year support is required. **MPN:** BR-NTWADV-IP-100	1	**$0.00**	**$0.00**
2:	BROCADE CERTIFIED NETWORK ENGINEER WEB BASED TRAINING **MPN:** CNE200WBT	1	**$0.00**	**$0.00**
3:	BROCADE NETWORK ADVISOR WEB BASED TRAINING **MPN:** BNA200WBT	1	**$0.00**	**$0.00**
4:	BROCADE IP TROUBLESHOOTING OVERVIEW WEB BASED TRAINING **MPN:** IP-TS101WBT	1	**$0.00**	**$0.00**

Sub-Total:	**$0.00**
Parts & Accessories Shipping:	**Included**
Taxes:	**Tax Exempt**
Total for Item 12:	**$0.00**

To expedite your order, please include your quote number with your Purchase Order.

Total for all pre-configured items

Sub-Total:	**$653,691.00**
Parts & Accessories Shipping:	**Included**
Taxes:	**Tax Exempt**
Total:	**$653,691.00**

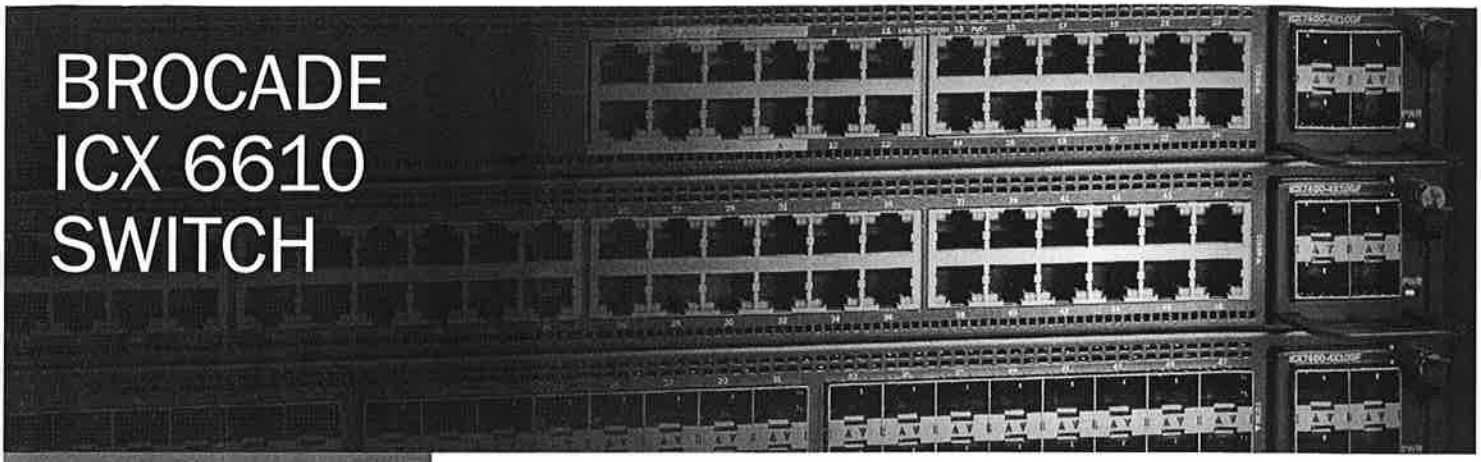
Notes:

WSCA B27165

Pricing and availability subject to change without notice.
Packaging, Shipping, and Handling fees are not included unless specifically stated.
Prices and lease payments do not include applicable taxes.
Ship dates are approximations and are not guarantees.
Quick ship items not available in Alaska, Hawaii, or outside the United States.
Specific state laws may affect shipment of products.
If Purchaser fails to pay any invoice in full within the time quoted herein, Seller may, without notice, accelerate the due date of all outstanding invoices and require that all outstanding invoices, including any interest thereon, be immediately due and payable in full.
For product return policies and information please visit:
http://www.howardcomputers.com/pdf/warranties/HTS_ReturnPolicy.pdf

SPECIFICATION/PRODUCT SHEETS

BROCADE ICX 6610 SWITCH



ENTERPRISE LAN SWITCHING

Chassis-Like Capabilities in a Stackable Form Factor

HIGHLIGHTS

- Delivers chassis-level performance and availability, providing an optimal user experience for streaming video, VDI, UC, and other critical applications
- Offers unprecedented stacking performance with 320 Gbps of stacking bandwidth, eliminating inter-switch bottlenecks
- Provides up to 1 Tbps of total switching capacity with up to 384 1 GbE and 64 10 GbE per stack for campus network edge and aggregation layers
- Provides unmatched availability with four redundant 40 Gbps stacking ports per switch, hitless stacking failover, hot switch replacement, and dual hot-swappable power supplies and fans
- Simplifies network operations and protects investments with the Brocade HyperEdge® Architecture, enabling consolidated network management and advanced services sharing across heterogeneous switches

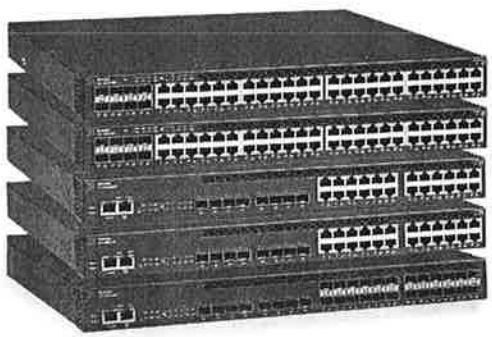
Today's enterprise networks are expected to deliver services thought impossible just a few years ago. High-Definition (HD) video conferencing, real-time collaboration, Unified Communications (UC), and Virtual Desktop Infrastructure (VDI) are only a few of the applications that organizations are deploying to enhance employee productivity, improve customer service, and create a competitive advantage. These same networks must also provide anytime, anywhere mobile access and scale to meet rising user expectations. At the same time, organizations face continued pressure to reduce costs and do more with less. More than ever, campus networks need to quickly and efficiently evolve with the ever-changing business environment.

COMBINING THE BEST OF A CHASSIS AND A STACKABLE SWITCH

The Brocade® ICX® 6610 Switch redefines the economics of enterprise networking by providing unprecedented levels of performance, availability, and flexibility in a stackable form factor—delivering the capabilities of a chassis with the flexibility and cost-effectiveness of a stackable switch.

Class-Leading Performance for Today and Tomorrow

The Brocade ICX 6610 delivers wire-speed, non-blocking performance across all ports to support latency-sensitive applications such as real-time voice/video streaming and VDI. Brocade ICX 6610 Switches can be stacked using four full-duplex 40 Gbps stacking ports that provide an



BROCADE

unprecedented 320 Gbps of backplane stacking bandwidth with full redundancy, eliminating inter-switch bottlenecks. Additionally, each switch can provide up to eight 10 Gigabit Ethernet (GbE) ports for high-speed connectivity to the aggregation or core layers.

High Availability

When every second matters, Brocade ICX 6610 Switches help deliver continuous availability to optimize the user experience. Brocade stacking technology delivers high availability, performing real-time state synchronization across the stack and enabling instantaneous hitless failover to a standby controller in the unlikely event of a failure of the master stack controller. Organizations also can use hot-insertion/removal of stack members to avoid interrupting service when adding a switch to increase the capacity of a stack or replacing a switch that needs servicing.

In addition to stack-level high availability, Brocade ICX 6610 Switches include system-level high-availability features, such as dual hot-swappable, load-sharing, and redundant power supplies. The modular design also has dual hot-swappable fan trays. These features provide another level of availability for the campus wiring closet in a compact form factor. Additional design features include intake and exhaust temperature sensors and fan spin detection to quickly identify abnormal or failed operating conditions—helping to minimize mean time to repair.

Figure 1.

Brocade ICX 6610 Switches can be stacked using four standard 40 Gbps QSFP ports that provide a fully redundant virtual chassis backplane with 320 Gbps of stacking bandwidth.

Unmatched Simplicity and Investment Protection

The Brocade ICX 6610 is easy to deploy, manage, and integrate into both new and existing networks. Organizations can buy only what they need today and easily scale up as demand grows and new technologies emerge.

The flexibility of a stackable switch allows organizations to forgo investing in a chassis upfront and put precious capital to better use elsewhere. Organizations can purchase an initial switch to get started and add a new Brocade ICX 6610 Switch to the stack as their business grows.

With capabilities such as bandwidth on demand, the Brocade ICX 6610 enables organizations to grow their networks when necessary. Organizations can initially deploy 1 GbE uplink ports and upgrade to 10 GbE ports when desired with an easy-to-activate software license.

Organizations also have peace of mind with the Brocade Assurance® Limited Lifetime Warranty. This warranty can help improve Total Cost of Ownership (TCO) while freeing up both capital and resources to re-invest into the business. For warranty details, visit www.brocade.com/warranty.

The Brocade ICX 6610 uses standard 40 GbE ports and QSFP cables for stacking. This not only delivers class-leading stacking performance and availability, but also increases cabling options and reduces cable costs—unlike competitive offerings, which rely on proprietary stacking ports and cables.

Support for the new MACsec standard, and hardware support for the Energy Efficient Ethernet (EEE) and 40 GbE standards, provides maximum future-proofing and investment protection. This enables organizations to deploy these capabilities as needed when more network devices supporting them become available.

BUILT FOR THE MOST DEMANDING ENTERPRISE NETWORK ENVIRONMENTS

Brocade stacking technology makes it possible to stack up to eight Brocade ICX 6610 Switches into a single logical chassis switch, providing simple and robust expandability for future growth at the network edge or aggregation layer. Also, this stacked virtual switch has only a single IP address to simplify management, and offers transparent forwarding across a pool of up to 384 1 GbE and 64 10 GbE ports. When new switches are added to the stack, they automatically inherit the stack's existing configuration file, enabling true plug-and-play network expansion.

Brocade stacking technology also delivers high availability, performing real-time state synchronization across the stack and enabling instantaneous hitless failover to a standby controller, if the master stack controller fails. In addition, organizations can use hot-insertion/removal of stack members to avoid interrupting service.

Brocade ICX 6610 Switches offer four dedicated full-duplex 40 Gbps stacking ports that provide full redundancy and an unprecedented 320 Gbps of stacking bandwidth, essentially eliminating the need to work around inter-switch bottlenecks (see Figure 1).

Unlike competitive offerings that use proprietary stacking ports, the use of standard 40 Gbps QSFP ports offers optimum flexibility and future-proofing. These dedicated stacking ports free up the 10 GbE ports for high-speed connectivity to the aggregation or core layers.

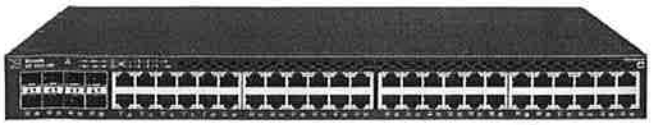


Figure 2.

Brocade ICX 6610 Switches support eight dual-mode 1 GbE/10 GbE SFP/SFP+ ports (left) and up to 48 1 GbE RJ-45 or 24 1 GbE SFP ports (right).

Up to Eight 10 GbE Ports on Demand per Switch

Brocade ICX 6610 Switches offer eight dual-mode Small Form-Factor Pluggable (SFP)/SFP+ ports, enabling high-bandwidth connectivity to the aggregation or core layers. These ports can be upgraded from 1 GbE to 10 GbE by simply applying a software license, eliminating the need to install a hardware module. In addition, organizations can aggregate these ports across the stack to provide high-speed, redundant links between the wiring closet and the aggregation layer, or between the aggregation and the core layer. With the ability to use short-range and long-range optics, along with copper Twinax cables, the Brocade ICX 6610 supports flexible and cost-effective network architectures (see Figure 2).

The Brocade ICX 6610 delivers industry-leading 8-port 10 GbE density in a 1U switch, providing up to 80 Gbps of uplink bandwidth to the aggregation or core layers of the network. This bandwidth enables a 1:1 subscription ratio throughout the network. As a result, organizations can deploy highly utilized networks to avoid congestion during peak hours.

Built to Power Next-Generation Edge Devices

The Brocade ICX 6610 can deliver both power and data across network connections, providing a single-cable solution for the latest edge devices. Brocade ICX 6610 Switches are compatible with industry-standard VoIP equipment as well as legacy IP phones. In addition, they support the Power over Ethernet (PoE+) standard (802.3at) to provide up to 30 watts of power to each device. This high-powered solution simplifies wiring for next-generation edge devices, such as video conferencing and Voice over IP (VoIP) phones, pan/tilt surveillance cameras, and 802.11n wireless Access Points (APs). The PoE capability reduces the number of power receptacles and power adapters while increasing reliability and wiring flexibility. With a 1500-watt power budget per switch (with two power supplies), the Brocade ICX 6610 24- and 48-port PoE models can supply up to Class 4 PoE+ (30 watts) power to every port.

Plug-and-Play Operations for Powered Devices

The Brocade ICX 6610 supports the IEEE 802.1AB Link Layer Discovery Protocol (LLDP) and ANSI TIA 1057 Link Layer Discovery Protocol-Media Endpoint Discovery (LLDP-MED) standards that enable organizations to deploy interoperable multivendor solutions for UC. Configuring IP endpoints such as VoIP phones can be a complex task, requiring manual and time-consuming configuration. LLDP and LLDP-MED address this challenge by providing a standard, open method for configuring, discovering, and managing network infrastructure. The LLDP protocols also help reduce operational costs by simplifying and automating network operations. For example, LLDP-MED provides an open protocol for configuring Quality of Service (QoS), security policies, Virtual LAN (VLAN) assignments, PoE power levels, and service priorities.

Flexible Cooling Options

All Brocade ICX 6610 Switches support reversible front-to-back airflow options. This data center-friendly design improves mounting flexibility in racks, while adhering to the cooling guidelines of the hosting environment. Organizations can specify airflow direction at the time of order and can reverse the direction after deployment by swapping the power supplies and fan assembly (see Figure 3).

Figure 3.

The Brocade ICX 6610 provides four 40 Gbps high-performance QSFP stacking ports (center) and dual, hot-swappable load-sharing power supplies and fan trays (left and right).

BROCADE HYPEREDGE ARCHITECTURE

The Brocade HyperEdge Architecture brings campus networks into the modern era to better support mobility, security, and application agility. This evolutionary architecture integrates innovative wired and wireless technologies to streamline application deployment, simplify network management, and reduce operating costs.

The HyperEdge Architecture enables organizations to build networks that are:

- **Agile:** By eliminating Spanning Tree Protocol (STP) between HyperEdge Domain switches through a flatter Layer 2 design, the HyperEdge Architecture increases link utilization and reduces application deployment complexity. The Distributed AP Forwarding functionality of Brocade wireless Access Points (APs) efficiently secures and directs mobile traffic at the network edge without tunneling data back to a central controller at the network core.
- **Automated:** By grouping premium and entry-level switches with intelligent wireless APs into a consolidated management domain, HyperEdge Domains eliminate the need to provision and manage devices individually—simplifying network deployment and management.
- **Cost-effective:** The HyperEdge Architecture enables the propagation of advanced features and services from premium switches to entry-level switches, allowing IT organizations to purchase only what they need today and add intelligent services as the business evolves. Further cost savings is achieved with Brocade wireless solutions using controller-less or controller-shared license deployment options.

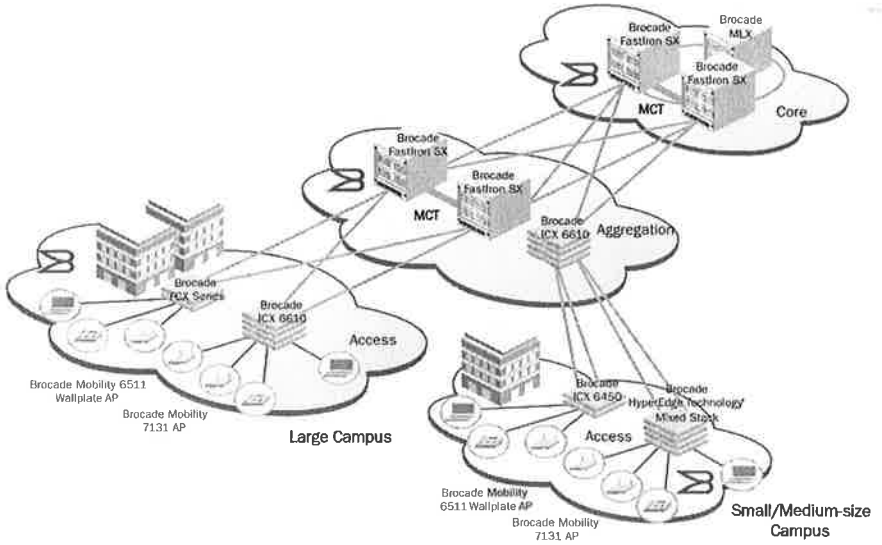


Figure 4.

The Brocade ICX 6610 is suitable for deployment at the network access and aggregation layers, thanks to its high performance, availability, and flexibility.

Full Layer 3 Capabilities

Brocade ICX 6610 Switches also offer powerful IPv4 and IPv6 Layer 3 switching capabilities. Organizations can use premium Layer 3 features—such as IPv4/IPv6 OSPF and RIP routing, Policy-Based Routing (PBR), VRRP, and Protocol-Independent Multicast (PIM)—to reduce complexity and enhance the reliability of large enterprise networks by bringing Layer 3 capabilities to the network edge and/or aggregation layer (see Figure 4). Advanced Layer 3 capabilities include BGP routing, enabling remote offices to connect Brocade ICX 6610 Switches to service provider networks. Premium and advanced routing capabilities can be added to any Brocade ICX 6610 Switch model through software key-based activation.

SDN-ENABLED PROGRAMMATIC CONTROL OF THE NETWORK

Software-Defined Networking (SDN) is a powerful new network paradigm designed for the world's most demanding networking environments and promises breakthrough levels of customization, scale, and efficiency. The Brocade ICX 6610 enables SDN by supporting the OpenFlow 1.3 protocol, which allows communication between an OpenFlow controller and an OpenFlow-enabled switch. Using this approach, organizations can control their networks programmatically, transforming the network into a platform for innovation through new network applications and services. The Brocade ICX 6610 delivers OpenFlow in true hybrid port mode. With Brocade hybrid port mode, organizations can simultaneously deploy traditional Layer 2/3 forwarding with OpenFlow on the same port. This unique capability provides a pragmatic path to SDN by enabling network administrators to progressively integrate OpenFlow into existing networks, giving them the programmatic control offered by SDN for specific flows while the remaining traffic is forwarded as before. Brocade ICX 6610 hardware support for OpenFlow enables organizations to apply these capabilities at line rate.

SIMPLIFIED, SECURE STANDARDS-BASED MANAGEMENT AND MONITORING

The Brocade ICX 6610 provides simplified, standards-based management capabilities that help organizations reduce administrative time and effort while securing their networks.

sFlow-based "Always-On" Network Monitoring

sFlow is a modern, standards-based network export protocol (RFC 3176) that addresses many of the challenges that network managers face today. By embedding sFlow into the Brocade ICX 6610, Brocade delivers an "always-on" technology that operates with wire-speed performance. sFlow dramatically reduces implementation costs compared to traditional network monitoring solutions that rely on mirrored ports, probes, and line-tap technologies. Moreover, sFlow gives organizations full, enterprise-wide monitoring capability for every port in the network.

Simplified Deployment with Auto-Configuration

The Brocade ICX 6610 supports auto-configuration, simplifying deployment with a truly plug-and-play experience. Organizations can use this feature to automate IP address and feature configuration of the switches without requiring a highly trained network engineer onsite. When the switches power up, they automatically receive an IP address and configuration from DHCP and Trivial File Transport Protocol (TFTP) servers. At this time, the switches can also automatically receive a software update to be at the same code revision as currently installed switches.

Open-Standards Management

The Brocade ICX 6610 includes an industry-standard Command Line Interface (CLI) and supports Secure Shell (SSHv2), Secure Copy (SCP), and SNMPv3 to restrict and encrypt management communications to the system. In addition, support for Terminal Access Controller Access Control System (TACACS/TACACS+) and RADIUS authentication helps ensure secure operator access.

Out-of-Band Management

The Brocade ICX 6610 includes a 10/100/1000 Mbps RJ-45 Ethernet port dedicated to out-of-band management, providing a remote path to manage the switches, regardless of the status or configuration of the data ports.

BROCADE ICX 6610 SWITCH AND CONTROLLER INTEROPERABILITY

The Brocade ICX 6610 Switch operates seamlessly under the Brocade Vyatta Controller. This controller is a quality-assured edition of the OpenDaylight controller code supported by an established networking provider and its leaders within the OpenDaylight community.

Data Center ToR Switch for 1 GbE and 10 GbE Server Connectivity

Thanks to its class-leading 10 GbE port count, the Brocade ICX 6610 is an ideal solution as a Top-of-Rack (ToR) switch in a mixed 1 GbE/10 GbE server connectivity environment. It is designed to fit in server racks, consuming only one rack unit and offering dual integrated power supplies and fan assemblies with reversible front-to-back/back-to-front airflow for flexible cooling options. In data center environments where most servers have 1 GbE and some 10 GbE network interfaces, the Brocade ICX 6610 provides a compact and cost-effective 1 GbE/10 GbE ToR switch (see Figure 5). This configuration uses 10 GbE links to connect to Brocade ICX data center aggregation switches.

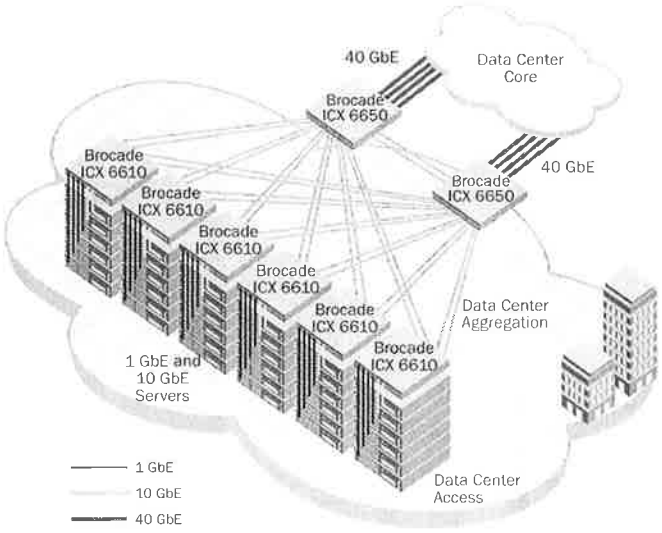


Figure 5.

The Brocade ICX 6610 provides ToR 1 GbE and 10 GbE server connectivity with the Brocade ICX 6650 providing data center aggregation.

UNIFIED WIRED/WIRELESS NETWORK MANAGEMENT WITH BROCADE NETWORK ADVISOR

Managing enterprise campus networks continues to become more complex due to the growth in services that rely on wired and wireless networks. Services such as Internet, e-mail, video conferencing, real-time collaboration, and distance learning all have specific configuration and management requirements. At the same time, organizations face increasing demand to provide uninterrupted services for high-quality voice and Unified Communications (UC), wireless mobility, and multimedia applications.

To reduce complexity and the time spent managing these environments, the easy-to-use Brocade Network Advisor discovers, manages, and deploys configurations to groups of IP devices. By using Brocade Network Advisor, organizations can configure Virtual LANs (VLANs) within the network, manage wireless access points, and execute commands on specific IP devices or groups of IP devices. sFlow-based proactive monitoring is ideal for performing network-wide troubleshooting, generating traffic reports, and gaining visibility into network activity from the edge to the core. Brocade Network Advisor centralizes management of the entire family of Brocade wired products and Aruba wireless products.

WARRANTY

The Brocade ICX 6610 Switch is covered by the Brocade Assurance Limited Lifetime Warranty. For details, visit www.brocade.com/warranty.

MAXIMUM OPERATIONAL-EFFICIENCY AND INVESTMENT PROTECTION

To further improve operational efficiency, Brocade ICX 6610 Switches come with 90 days of free technical support from the Brocade Technical Assistance Center and free software updates. With these capabilities, organizations gain peace of mind while freeing up IT budget and resources to grow their businesses.

BROCADE GLOBAL SERVICES

Brocade Global Services has the expertise to help organizations build scalable, efficient cloud infrastructures. Leveraging 15 years of expertise in storage, networking, and virtualization, Brocade Global Services delivers world-class professional services, technical support, network monitoring services, and education, enabling organizations to maximize their Brocade investments, accelerate new technology deployments, and optimize the performance of networking infrastructures.

AFFORDABLE ACQUISITION OPTIONS

Brocade Capital Solutions helps organizations easily address their IT requirements by offering flexible network acquisition and support alternatives. Organizations can select from purchase, lease, Brocade Network Subscription, and Brocade Subscription Plus options to align network acquisition with their unique capital requirements and risk profiles. To learn more, visit www.brocade.com/CapitalSolutions.

MAXIMIZING INVESTMENTS

To help optimize technology investments, Brocade and its partners offer complete solutions that include professional services, technical support, and education. For more information, contact a Brocade sales partner or visit www.brocade.com.

BROCADE ICX 6610 FEATURE/MODEL COMPARISON

	24 or 48 RJ-45 Ports		24 SFP Ports	24 or 48 PoE+ Ports	
	Brocade ICX 6610-24	**Brocade ICX 6610-48**	**Brocade ICX 6610-24F**	**Brocade ICX 6610-24P**	**Brocade ICX 6610-48P**
Switching capacity (data rate, full duplex)	528 Gbps	576 Gbps	528 Gbps	528 Gbps	576 Gbps
Forwarding capacity (data rate, full duplex)	396 Mpps (wire speed)	432 Mpps (wire speed)	396 Mpps (wire speed)	396 Mpps (wire speed)	432 Mpps (wire speed)
Stacking bandwidth (data rate, full duplex)	320 Gbps	320 Gbps	320 Gbps	320 Gbps	320 Gbps
Units per stack	8	8	8	8	8
Long-distance stacking (maximum distance between two stacked switches)	150 m	150 m	150 m	150 m	150 m
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 1/10 GbE SFP/SFP+ ports (10 GbE SFP+ optional upgrade license)	8	8	8	8	8
40 Gbps QSFP stacking ports	4	4	4	4	4
PoE power budget (two AC power supplies)	N/A	N/A	N/A	1,500 W	1,500 W
PoE power budget (two DC power supplies)	N/A	N/A	N/A	516 W	516 W
Maximum PoE Class 3 ports	N/A	N/A	N/A	24 (one power supply)	48 (one power supply)
Maximum PoE+ ports	N/A	N/A	N/A	24 (one power supply)	48 (two power supplies)
Redundant/load sharing; hot-swappable power supplies Max output (second optional)	2×250 W	2×250 W	2×250 W	2×1,000 W	2×1,000 W
Weight (one power supply/one fan tray)	6.42 kg (14.15 lb)	6.78 kg (14.95 lb)	6.69 kg (14.75 lb)	7.10 kg (15.65 lb)	7.46 kg (16.45 lb)
Dimensions	429 mm (16.880 in.) W × 406.4 mm (16.00 in.) D × 44 mm (1.732 in.) H - 1U				
Airflow	Front to back (reversible)				
MTBF (25°C, CL: 60%)	474,527 hours	408,144 hours	400,449 hours	416,567 hours	336,984 hours

BROCADE ICX 6610 SPECIFICATIONS

System Architecture	
Connector options	• 10/100/1000 ports: RJ-45 • 1 Gbps SFP ports: SX, LX, LHA, LHB, 1000Base-BX, CWDM • 10 Gbps SFP+ ports: Direct-attached copper (Twinax), SR, LR • Stacking ports: 40 GbE QSFP for use with direct-attached 1 meter or 5 meter stacking cable • Out-of-band Ethernet management: 10/100/1000 Mbps RJ-45 • Console management: RJ-45 serial
Maximum MAC addresses	32,000
Maximum VLANs	4096
Maximum STP (spanning trees)	254
Maximum routes (in hardware)	16,000
Trunking	Maximum ports per trunk: 8 Maximum trunk groups: 124
Maximum jumbo frame size	9216 bytes
Layer 2 switching	• 802.1s Multiple Spanning Tree • 802.1x Authentication • Auto MDI/MDIX • BPDU Guard, Root Guard • Dual-Mode VLANs • Dynamic VLAN Assignment • Dynamic Voice VLAN Assignment • Fast Port Span • GARP VLAN Registration Protocol • IGMP Snooping (v1/v2/v3) • Link Fault Signaling (LFS) • MAC Address Locking; Port Security • MAC-Layer Filtering • MAC Learning Disable • MLD Snooping (v1/v2) • Multi-device Authentication • Per-VLAN Spanning Tree (PVST/PVST+/PVRST) • Mirroring - Port-based, ACL-based, MAC Filter-based, and VLAN-based • Port Loop Detection • Private VLAN • Protected Link Groups • Protocol VLAN (802.1v), Subnet VLAN • Remote Fault Notification (RFN) • Single-instance Spanning Tree • Single-link LACP • Trunk Groups • Uni-Directional Link Detection (UDLD)
Base Layer 3 routing	• IPv4 static routes • ECMP • Port-based Access Control Lists • L3/L4 ACLs • Host routes • Virtual Interfaces • Routed Interfaces • Route-only Support • Routing Between Directly Connected Subnets • HyperEdge service propagation
Premium Layer 3 routing	• IPv4 and IPv6 static and dynamic routes • OSPF v2, OSPF v3 (IPv6) • PIM-SM, PIM-SSM, PIM-DM, PIM passive (IPv4/IPv6 multicast routing functionality) • PBR • RIP v1/v2, RIPng (IPv6) • Virtual Route Redundancy Protocol (VRRP) • VRRP-E, VRRP-E (IPv6) • VRRPv3 (IPv6)
Advanced Layer 3 routing	• BGP4, BGP4+(IPv6) • GRE • IPv6 over IPv4 tunnels • VRF (IPv4 and IPv6)
SDN features	• Support for OpenFlow v1.0 and v1.3 • OpenFlow support with true hybrid port mode • OpenFlow support with stacking, including mixed stacks • Operates seamlessly under the Brocade Vyatta Controller
Metro features	• Metro-Ring Protocol (v1, v2) • Virtual Switch Redundancy Protocol (VSRP) • VLAN Stacking (Q-in-Q) • VRRP • Topology Groups
Quality of Service (QoS)	• ACL Mapping and Marking of ToS/DSCP • ACL Mapping and Marking of 802.1p • ACL Mapping to Priority Queue • ACL Mapping to ToS/DSCP • Classifying and Limiting Flows Based on TCP Flags • DHCP Relay • DiffServ Support • Honoring DSCP and 802.1p • MAC Address Mapping to Priority Queue • Priority Queue Management using Weighted Round Robin (WRR), Strict Priority (SP), and a combination of WRR and SP

IEEE standards compliance	• 802.1AB LLDP/LLDP-MED • 802.1D-2004 MAC Bridging • 802.1p Mapping to Priority Queue • 802.1s Multiple Spanning Tree • 802.1w Rapid Spanning Tree • 802.1x Port-based Network Access Control • 802.3 10 Base-T • 802.3ab 1000 Base-T • 802.3ad Link Aggregation (Dynamic and Static) • 802.3ae 10 Gigabit Ethernet • 802.3af Power over Ethernet • 802.3at Power over Ethernet Plus • 802.3u 100 Base-TX • 802.3x Flow Control • 802.3z 1000Base-SX/LX • 802.3 MAU MIB (RFC 2239) • 802.3ba 40 Gbps Ethernet • 802.1AE MACsec • 802.3az-2010 - EEE (HW Capable) • 802.1Q VLAN Tagging
Traffic management	• ACL-based inbound rate limiting and traffic policies • Broadcast, multicast, and unknown unicast rate limiting • Inbound rate limiting per port • Outbound rate limiting per port and per queue
High availability	• Redundant hot-swappable internal power supplies • Hot-swappable fan trays • L3 VRRP protocol redundancy • Real-time state synchronization across the stack • Hitless failover from master to standby stack controller • Protected link groups • Hot insertion and removal of stacked units

Management	
Management and control	• Auto Configuration • Brocade HyperEdge technology • Configuration Logging • Digital Optical Monitoring • Display Log Messages on Multiple Terminals • Embedded Web Management • Embedded DHCP Server • Industry-standard Command Line Interface (CLI) • Key-based activation of optional software features • Integration with HP OpenView for Sun Solaris, HP-UX, IBM AIX, and Windows • Brocade Network Advisor support • MIB Support for MRP, Port Security, MAC Authentication, and MAC-based VLANs • Out-of-band Ethernet Management • RFC 783 TFTP • RFC 854 TELNET Client and Server • RFC 951 Bootp • RFC 1157 SNMPv1/v2c • RFC 1213 MIB-II • RFC 1493 Bridge MIB • RFC 1516 Repeater MIB • RFC 1573 SNMP MIB II • RFC 1643 Ethernet Interface MIB • RFC 1643 Ethernet MIB • RFC 1724 RIP v1/v2 MIB • RFC 1757 RMON MIB • RFC 2068 Embedded HTTP • RFC 2131 DHCP Server and DHCP Relay • RFC 2570 SNMPv3 Intro to Framework • RFC 2571 Architecture for Describing SNMP Framework • RFC 2572 SNMP Message Processing and Dispatching • RFC 2573 SNMPv3 Applications • RFC 2574 SNMPv3 User-based Security Model • RFC 2575 SNMP View-based Access Control Model SNMP • RFC 2818 Embedded HTTPS • RFC 3176 sFlow • SNTP Simple Network Time Protocol • Support for Multiple Syslog Servers

Embedded security	• 802.1X Accounting • MAC Authentication • Bi-level Access Mode (Standard and EXEC Level) • EAP pass-through support • IEEE 802.1X username export in sFlow • Protection against Denial of Service (DoS) attacks
Secure management	• Authentication, Authorization, and Accounting (AAA) • Advanced Encryption Standard (AES) with SSHv2 • RADIUS/TACACS/TACACS+ • Secure Copy (SCP) • Secure Shell (SSHv2) • Username/Password • Web authentication

Environment	
Temperature	Operating temperature: 0°C to 55°C 32°F to 131°F Storage temperature: –25°C to 70°C –13°F to 158°F
Humidity	Relative humidity: 5% to 95%, non-condensing
Altitude	Storage altitude: 10,000 ft (3000 m) maximum
Acoustic	From 39.6 dB (24 ports, 1 fan, 1 PSU) to 48.7 dB (48 ports, 2 fans, 2 PSUs)

Power	
Power supplies	Up to two internal, redundant, field-replaceable, load-sharing AC or DC power supplies with dedicated system and PoE power
Power inlet	C13
Input voltage	Typical 100 to 240 VAC
Input line frequency	50 to 60 Hz

Power Draw (no PoE loads)		
Models	**With 1 Power Supply**	**With 2 Power Supplies**
Brocade ICX 6610-24	120 W	140 W
Brocade ICX 6610-48	165 W	185 W
Brocade ICX 6610-24F	125 W	145 W
Brocade ICX 6610-24P	120 W	140 W
Brocade ICX 6610-48P	165 W	185 W

Compliance/Certification	
Electromagnetic emissions	FCC Class A (Part 15); EN 55022/CISPR-22 Class A; VCCI Class A; ICES-003 Electromagnetic Emission; AS/NZS 55022; EN 61000-3-2 Power Line Harmonics; EN 61000-3-3 Voltage Fluctuation and Flicker; EN 61000-6-3 Emission Standard (supersedes: EN 50081-1)
Safety	CAN/CSA-C22.2 NO. 60950-1-07; UL 60950-1 Second Edition; IEC 60950-1 Second Edition; EN 60950-1:2006 Safety of Information Technology Equipment; EN 60825-1 Safety of Laser Products—Part 1: Equipment Classification, Requirements and User's Guide; EN 60825-2 Safety of Laser Products—Part 2: Safety of Optical Fibre Communication Systems
Immunity	EN 61000-6-1 Generic Immunity and Susceptibility (supersedes EN 50082-1); EN 55024 Immunity Characteristics (supersedes EN 61000-4-2 ESD); EN 61000-4-3 Radiated, Radio Frequency, Electromagnetic Field; EN 61000-4-4 Electrical Fast Transient; EN 61000-4-5 Surge; EN 61000-4-6 Conducted Disturbances Induced by Radio-Frequency Fields; EN 61000-4-8 Power Frequency Magnetic Field; EN 61000-4-11 Voltage Dips and Sags
Environmental regulatory compliance	RoHS-compliant (6 of 6); WEEE-compliant

BROCADE ICX 6610 ORDERING INFORMATION

Part Number	Description
ICX6610-24-E	24-port 1 GbE RJ45, plus 8×1 GbE SFPP uplink ports (upgradable to 10 GbE). 4×40 GbE QSFP stacking ports. 1 power-supply-side exhaust, hot-swappable fan assembly and 250 W power supply. Base software.
ICX6610-24-PE	24-port 1 GbE RJ45, plus 8×1 GbE SFPP uplink ports (upgradable to 10 GbE). 4×40 GbE QSFP stacking ports. 1 power-supply-side exhaust, hot-swappable fan assembly and 250 W power supply. Premium software.
ICX6610-24-I	24-port 1 GbE RJ45, plus 8×1 GbE SFPP uplink ports (upgradable to 10 GbE). 4×40 GbE QSFP stacking ports. 1 power-supply-side intake, hot-swappable fan assembly and 250 W power supply. Base software.
ICX6610-24-PI	24-port 1 GbE RJ45, plus 8×1 GbE SFPP uplink ports (upgradable to 10 GbE). 4×40 GbE QSFP stacking ports. 1 power-supply-side intake, hot-swappable fan assembly and 250 W power supply. Premium software.
ICX6610-24P-E	24-port 1 GbE RJ45 PoE+, plus 8×1 GbE SFPP uplink ports (upgradable to 10 GbE). 4×40 GbE QSFP stacking ports. 1 power-supply-side exhaust, hot-swappable fan assembly and 1000 W power supply. Base software.
ICX6610-24P-PE	24-port 1 GbE RJ45 PoE+, plus 8×1 GbE SFPP uplink ports (upgradable to 10 GbE). 4×40 GbE QSFP stacking ports. 1 power-supply-side exhaust, hot-swappable fan assembly and 1000 W power supply. Premium software.
ICX6610-24P-I	24-port 1 GbE RJ45 PoE+, plus 8×1 GbE SFPP uplink ports (upgradable to 10 GbE). 4×40 GbE QSFP stacking ports. 1 power-supply-side intake, hot-swappable fan assembly and 1000 W power supply. Base software.
ICX6610-24P-PI	24-port 1 GbE RJ45 PoE+, plus 8×1 GbE SFPP uplink ports (upgradable to 10 GbE). 4×40 GbE QSFP stacking ports. 1 power-supply-side intake, hot-swappable fan assembly and 1000 W power supply. Premium software.
ICX6610-24F-E	24-port 1 GbE SFP, plus 8×1 GbE SFPP uplink ports (upgradable to 10 GbE). 4×40 GbE QSFP stacking ports. 1 power-supply-side exhaust, hot-swappable fan assembly and 250 W power supply. Base software.
ICX6610-24F-PE	24-port 1 GbE SFP, plus 8×1 GbE SFPP uplink ports (upgradable to 10 GbE). 4×40 GbE QSFP stacking ports. 1 power-supply-side exhaust, hot-swappable fan assembly and 250 W power supply. Premium software.
ICX6610-24F-I	24-port 1 GbE SFP, plus 8×1 GbE SFPP uplink ports (upgradable to 10 GbE). 4×40 GbE QSFP stacking ports. 1 power-supply-side intake, hot-swappable fan assembly and 250 W power supply. Base software.
ICX6610-24F-PI	24-port 1 GbE SFP, plus 8×1 GbE SFPP uplink ports (upgradable to 10 GbE). 4×40 GbE QSFP stacking ports. 1 power-supply-side intake, hot-swappable fan assembly and 250 W power supply. Premium software.
ICX6610-48-E	48-port 1 GbE RJ45, plus 8×1 GbE SFPP uplink ports (upgradable to 10 GbE). 4×40 GbE stacking ports. 1 power-supply-side exhaust, hot-swappable fan assembly and 250 W power supply. Base software.
ICX6610-48-PE	48-port 1 GbE RJ45, plus 8×1 GbE SFPP uplink ports (upgradable to 10 GbE). 4×40 GbE QSFP stacking ports. 1 power-supply-side exhaust, hot-swappable fan assembly and 250 W power supply. Premium software.
ICX6610-48-I	48-port 1 GbE RJ45, plus 8×1 GbE SFPP uplink ports (upgradable to 10 GbE). 4×40 GbE QSFP stacking ports. 1 power-supply-side intake, hot-swappable fan assembly and 250 W power supply. Base software.
ICX6610-48-PI	48-port 1 GbE RJ45, plus 8×1 GbE SFPP uplink ports (upgradable to 10 GbE). 4×40 GbE QSFP stacking ports. 1 power-supply-side intake, hot-swappable fan assembly and 250 W power supply. Premium software.
ICX6610-48P-E	48-port 1 GbE RJ45 PoE+, plus 8×1 GbE SFPP uplink ports (upgradable to 10 GbE). 4×40 GbE QSFP stacking ports. 1 power-supply-side exhaust, hot-swappable fan assembly and 1000 W power supply. Base software.
ICX6610-48P-PE	48-port 1 GbE RJ45 PoE+, plus 8×1 GbE SFPP uplink ports (upgradable to 10 GbE). 4×40 GbE QSFP stacking ports. 1 power-supply-side exhaust, hot-swappable fan assembly and 1000 W power supply. Premium software.
ICX6610-48P-I	48-port 1 GbE RJ45 PoE+, plus 8×1 GbE SFPP uplink ports (upgradable to 10 GbE). 4×40 GbE QSFP stacking ports. 1 power-supply-side intake, hot-swappable fan assembly and 1000 W power supply. Base software.
ICX6610-48P-PI	48-port 1 GbE RJ45 PoE+, plus 8×1 GbE SFPP uplink ports (upgradable to 10 GbE). 4×40 GbE QSFP stacking ports. 1 power-supply-side intake, hot-swappable fan assembly and 1000 W power supply. Premium software.

BROCADE ICX 6610 ORDERING INFORMATION (CONTINUED)

Accessories and Options	
ICX6610-PREM-LIC	Brocade ICX 6610 premium software license
ICX6610-ADV-LIC	Brocade ICX 6610 advanced software license
ICX6610-ADV-UPG-LIC	Brocade ICX 6610 premium to advanced software upgrade
ICX6610-10G-LIC-POD	License to upgrade 4 ports of 1 GbE SFPP uplink to 10 GbE
RPS15-E	Brocade ICX 6610/6650 non-PoE 250 W PSU, power-supply-side exhaust airflow
RPS15-I	Brocade ICX 6610/6650 non-PoE 250 W PSU, power-supply-side intake airflow
RPS16-E	1000 W power supply for Brocade ICX 6610 PoE models, power-supply-side exhaust airflow
RPS16-I	1000 W power supply for Brocade ICX 6610 PoE models, power-supply-side intake airflow
RPS16DC-E	510 W DC power supply for Brocade ICX 6610, power-supply-side exhaust airflow
RPS16DC-I	510 W DC power supply for Brocade ICX 6610, power-supply-side intake airflow
ICX6610-FAN-E	Power-supply-side exhaust airflow fan for the Brocade ICX 6610 (two fans required with two power supplies)
ICX6610-FAN-I	Power-supply-side intake airflow fan for the Brocade ICX 6610 (two fans required with two power supplies)
40G-QSFP-C-0101	40 GbE QSFP direct-attached copper cable, 1 m, one-pack
40G-QSFP-C-0501	40 GbE QSFP direct-attached copper cable, 5 m, one-pack
BR-NTWADV-IP-BASE	Brocade Network Advisor IP management software license for up to 50 devices; required for initial purchase of IP-only management; minimum of one year of support is required.

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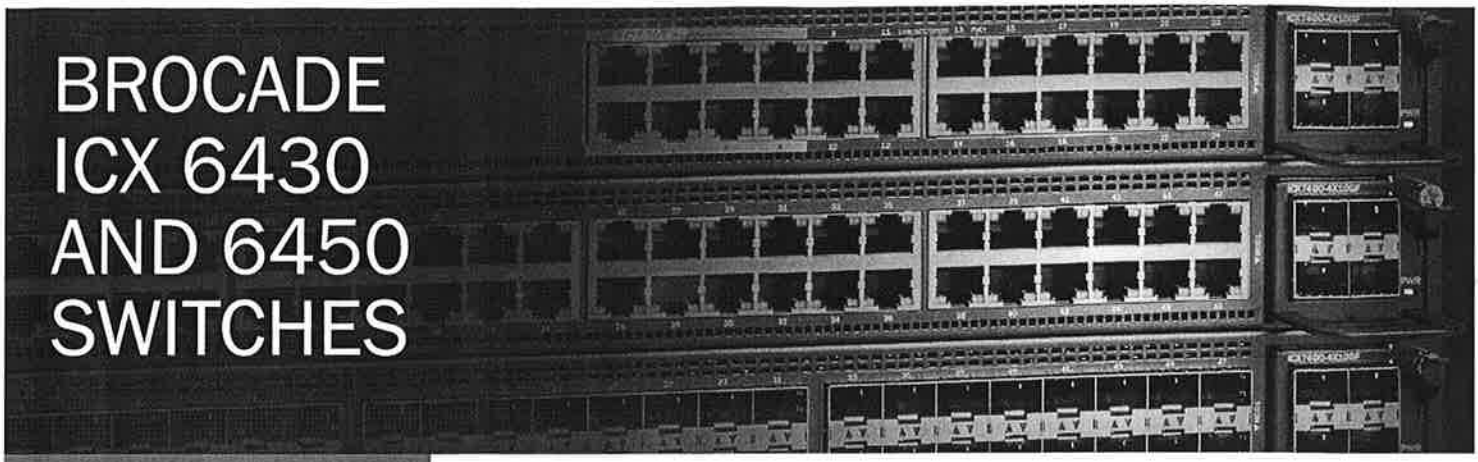
BROCADE

BROCADE ICX 6430 AND 6450 SWITCHES



ENTERPRISE LAN SWITCHING

Enterprise-Class Stackable Switching at an Entry-Level Price

HIGHLIGHTS

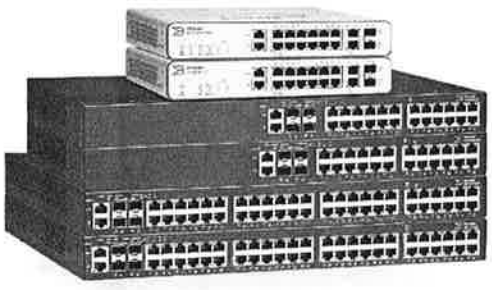
- Offers enterprise-class stackable switching at an entry-level price, allowing organizations to buy what they need now and easily scale as demand grows and new technologies emerge
- Delivers unprecedented feature/price value for enterprise applications, including Unified Communications (UC) and mobility, with 10 Gigabit Ethernet (GbE) and PoE/PoE+
- Provides unmatched availability for low-cost switching with redundant uplink/stacking ports, hitless stacking failover, and configurable power redundancy
- Simplifies network operations and protects investments with the Brocade HyperEdge Architecture, enabling consolidated network management and advanced services-sharing across heterogeneous switches
- Offers attractive 12-port, compact, and enterprise-class fanless switch models for deployments outside of the wiring closet
- Includes the Brocade Assurance Limited Lifetime Warranty and three years of technical support

Today's organizations expect their enterprise campus LANs to deliver more services to more users at a lower cost. These services include next-generation business applications as well as anytime, anywhere access for mobile devices. At the same time, campus LANs must be able to scale easily to meet future demands and efficiently evolve within dynamic business environments.

Brocade® ICX® 6430 and 6450 Switches provide enterprise-class stackable LAN switching solutions to meet the growing demands of campus networks. Designed for small to medium-size enterprises, branch offices, and distributed campuses, these intelligent, scalable edge switches deliver enterprise-class functionality at an affordable price—without compromising performance and reliability. The Brocade ICX 6430 and 6450 are available in 12-, 24-, and 48-port 10/100/1000 Mbps models and 1 Gigabit Ethernet (GbE) or 10 GbE dual-purpose uplink/stacking ports (see Figures 1 and 2)—with or without IEEE 802.3af Power over Ethernet (PoE) and 802.3at Power over Ethernet Plus (PoE+)—to support enterprise edge networking, wireless mobility, and IP communications.

BUILT FOR MAXIMUM COST-EFFICIENCY AND INVESTMENT PROTECTION

With Brocade ICX 6430 and 6450 Switches, organizations can buy only what they need today and easily scale user ports and services as their network requirements evolve. Brocade offers maximum investment protection through flexible software licensing options that bring advanced services and performance to lower-cost ports.



BROCADE

In particular, the Brocade HyperEdge® Architecture allows premium switch features and services to be shared with entry-level switches (Brocade ICX 6450 only). The Brocade ICX switches also are hardware-capable for easy software implementation (software available in a future release) of emerging security (IEEE 802.1AE MACsec) and energy savings (IEEE 802.3az EEE) standards, helping to protect today's investments while supporting tomorrow's needs.

Brocade ICX 6430 and 6450 Switches come with three years of technical support from the Brocade Technical Assistance Center and software maintenance updates. With these capabilities, organizations gain peace of mind while freeing up IT budget and resources to grow their businesses.

AUTOMATED DEPLOYMENT AND MANAGEMENT

Brocade ICX 6430 and 6450 Switches help simplify network deployment and management by enabling auto-discovery of new Brocade ICX switches within the stack. IT organizations can auto-configure switches using pre-set instructions on the network. To further simplify management, these stacked switches collectively utilize only a single IP address and offer transparent forwarding across the stack.

By embedding sFlow capabilities into the Brocade ICX 6450, Brocade delivers an "always-on" monitoring technology that operates with wire-speed performance. sFlow dramatically reduces implementation complexity compared to traditional network monitoring solutions that rely on mirrored ports, probes, and line-tap technologies.

HIGH AVAILABILITY AND RESILIENCY

Brocade Ethernet switch stacking technology helps IT organizations meet growing user demand by delivering high availability through real-time state synchronization across the stack and instantaneous hitless failover support. In addition, organizations can use hot-insertion and removal of stack members to avoid interrupting network service when adding or replacing a switch. High-performance Link Aggregation Groups (LAGs) increase 10 GbE uplink bandwidth and redundancy to the core, giving users uninterrupted high performance to support the most demanding applications. Brocade ICX 6430 and 6450 Switches also offer an external power supply for added resiliency and increased PoE/PoE+ port availability (see Figure 3).

STACKING TECHNOLOGY FOR THE MOST DEMANDING CAMPUS LAN ENVIRONMENTS

Brocade Ethernet switch stacking technology makes it possible to stack up to eight Brocade ICX 6450 Switches into a single logical switch (except the Brocade ICX 6450-C), providing simple and robust expandability for future growth at the network edge. This stacked switch has only a single IP address to simplify management and offers transparent forwarding across a pool of up to 384 1 GbE ports and 32 10 GbE ports. When new switches join the stack, they automatically inherit the stack's existing configuration file, enabling true plug-and-play network expansion. Flexible licensing of 1 GbE to 10 GbE ports for uplink and stacking allows organizations to optimize network performance based on specific requirements. Brocade stacking technology also delivers high availability, enabling instantaneous hitless failover to a standby stack controller if the master stack controller fails. In addition, organizations can use hot-insertion and removal of stack members to avoid interrupting network services.

For networks with lower bandwidth requirements, the Brocade ICX 6430 offers the same rugged stacking capability (except the Brocade ICX 6430-C) at a reduced price, providing a lower-density solution of up to 192 1 GbE access ports with 16 1 GbE uplink and stacking ports, and a maximum stack height of four switches.

Built to Power Next-Generation Edge Devices

The Brocade ICX 6430 and 6450 can deliver both PoE power and data across network connections, providing a single-cable solution for the latest edge devices (see Figure 4). Brocade ICX switches are compatible with industry-standard Voice over IP (VoIP) equipment as well as legacy IP phones. In addition, they support the PoE+ standard (IEEE 802.3at) to provide up to Class 4 (30 watts) power to each device. This high-powered solution simplifies wiring for next-generation edge devices, such as video conferencing and VoIP phones, surveillance cameras, and 802.11n wireless Access Points (APs). The PoE capability reduces the number of power receptacles and power adapters while increasing reliability and wiring flexibility. The Brocade ICX 6450 can provide PoE power to all ports and PoE+ (30 watts) to all ports when an external power supply is deployed.

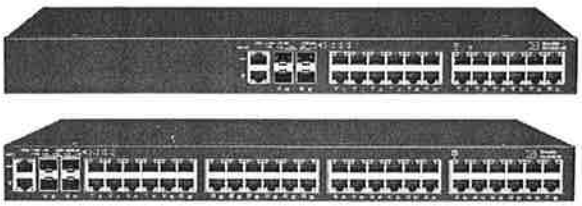


Figure 1.

Brocade ICX 6450 Switches support four dual-mode 1 GbE/10 GbE SFP/SFP+ ports for uplink and stacking, and up to 48 1 GbE RJ-45 ports. Brocade ICX 6430-24 and 6430-48 Switches support four 1 GbE SFP ports for uplink and stacking to provide a cost-optimized solution for lower-traffic networks.

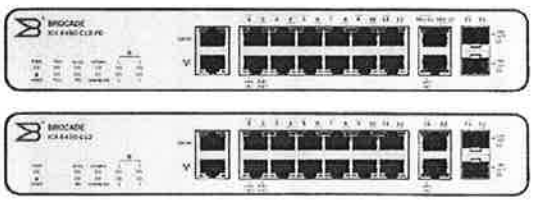


Figure 2.

The Brocade ICX 6430-C and 6450-C Compact Switches support two 1 GbE RJ-45 and two 1 GbE SFP ports for uplink and 12 1 GbE RJ-45 ports with four PoE/PoE+ capable ports in a compact and fanless design—ideal for deployment outside the wiring closet. The Brocade ICX 6450-C can be powered either from its internal power supply or with POE/PoE+ through its two RJ45 uplink ports, enabling the switch to be deployed in environments where no AC power outlet is present.

Plug-and-Play Operations for Powered Devices

Brocade ICX switches support the IEEE 802.1AB Link Layer Discovery Protocol (LLDP) and ANSI TIA 1057 Link Layer Discovery Protocol-Media Endpoint Discovery (LLDP-MED) standards that enable organizations to deploy interoperable multivendor solutions for Unified Communications (UC). Configuring IP endpoints such as VoIP phones can be a complex task, requiring manual and time-consuming configuration. LLDP and LLDP-MED provide a standard, open method for configuring, discovering, and managing network infrastructure.

The LLDP protocols also reduce operational costs by simplifying and automating network operations. For example, LLDP-MED provides an open protocol for configuring Quality of Service (QoS), security policies, Virtual LAN (VLAN) assignments, PoE power levels, and service priorities.

Compact Switch Solution for Deployment Outside the Wiring Closet

The Brocade ICX 6430-C/6450-C Compact Switch offers enterprise-class LAN switching capabilities, performance, reliability, security, and manageability in a small form factor with fanless operation for deployment outside the wiring closet. It is ideal for deployment in classrooms, retail locations, factories, small offices, workgroup, and space-constrained environments. The Brocade ICX 6430-C/6450-C is available in a 12-port 10/100/1000 Mbps model with IEEE 802.3af PoE and 802.3at PoE+ support on four ports plus four additional 1 GbE uplink ports. Additionally, the Brocade ICX 6450-C can be powered either from its internal AC power supply or with POE/PoE+ power, coming from one or both of its two RJ45 uplink ports, providing increased deployment flexibility by enabling the switch to be deployed in areas where no AC power outlet is present.

In the enterprise, the Brocade ICX 6430-C/6450-C Compact Switch can be used to extend the reach of the network outside the wiring closet, bringing connectivity to more users and supporting additional wireless AP deployment without running more wires. Additionally, the Brocade ICX 6450-C offers L3 routing and GRE support enabling secure and flexible deployment in remote areas. To simplify deployment in-situ, the Brocade ICX 6430-C/6450-C offer flexible mounting options, such as wall brackets and a magnetic mount kit.

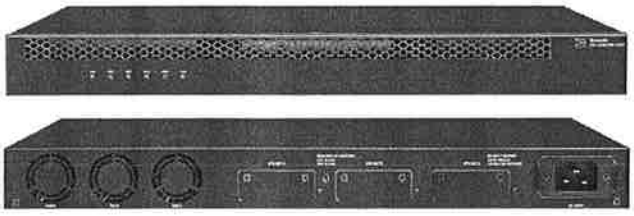


Figure 3.

The optional Brocade ICX 6400-EPS1500 is an external power supply source to provide additional power to the Brocade ICX switches (except the Brocade ICX 6430-C/6450-C and 6430-24). It also can be used for system power redundancy and increased PoE/PoE+ power budget to enable additional PoE/PoE+ ports. Each Brocade ICX 6400-EPS1500 can connect up to three Brocade ICX 6430 and 6450 Switches.

BROCADE HYPEREDGE ARCHITECTURE

The Brocade HyperEdge Architecture brings campus networks into the modern era to better support mobility, security, and application agility. This evolutionary architecture integrates innovative wired and wireless technologies to streamline application deployment, simplify network management, and reduce operating costs.

The HyperEdge Architecture enables organizations to build networks that are:

- **Agile:** By eliminating Spanning Tree Protocol (STP) between HyperEdge Domain switches through a flatter Layer 2 design, the HyperEdge Architecture increases link utilization and reduces application deployment complexity. The Distributed AP Forwarding functionality of Brocade wireless Access Points (APs) efficiently secures and directs mobile traffic at the network edge without tunneling data back to a central controller at the network core.
- **Automated:** By grouping premium and entry-level switches with intelligent wireless APs into a consolidated management domain, HyperEdge Domain switches eliminate the need to provision and manage devices individually—simplifying network deployment and management.
- **Cost-effective:** The HyperEdge Architecture enables the propagation of advanced features and services from premium switches to entry-level switches, allowing IT organizations to purchase only what they need today and add intelligent services as the business evolves. Further cost savings are achieved with Brocade wireless solutions using controller-less or controller-shared license deployment options.

Cost-Optimized Cooling Options

The Brocade ICX 6430 48-port and Brocade ICX 6450 24- and 48-port switches offer industry-standard side-to-back airflow with quiet fans at less than 40 dB (except the Brocade ICX 6450-48P). The Brocade ICX 6430-C/6450-C and 6430-24 Switches are available in a fanless configuration, helping to minimize sound and costs for deployments where users are present, such as classrooms and open office environments.

Basic Layer 3 Capabilities

Brocade ICX 6450/6450-C Switches offer an upgrade option to bring Layer 3 capabilities to the network edge, reducing complexity, and enhancing the reliability of enterprise networks.

Data Center ToR Server Connectivity

The Brocade ICX 6430 and 6450 are designed to fit in server racks by consuming only one rack unit. In data center environments where most servers are 1 GbE-capable, the Brocade ICX 6430 and 6450 provide a compact and cost-effective 1 GbE Top-of-Rack (ToR) switch by simply connecting the 1 GbE Network Interface Cards (NICs) in the servers to the Brocade ICX 6430 and 6450 1 GbE ports (see Figure 5). This configuration uses 10 GbE links (Brocade ICX 6450) or 1 GbE links (Brocade ICX 6430) to connect to Brocade ICX data center aggregation switches.

SIMPLIFIED, SECURE STANDARDS-BASED MANAGEMENT AND MONITORING

Brocade ICX 6430 and 6450 Switches provide simplified, standards-based management capabilities that help organizations reduce administrative time and effort while securing their networks.

sFlow-based "Always-On" Network Monitoring

sFlow is a standards-based network export protocol (RFC 3176) that addresses many of the challenges that network managers face today. By embedding sFlow into the Brocade ICX 6450/6450-C Switches, Brocade delivers an "always-on" technology that operates with wire-speed performance. sFlow dramatically reduces implementation costs compared to traditional network monitoring solutions that rely on mirrored ports, probes, and line-tap technologies. Moreover, sFlow gives organizations a full, enterprise-wide monitoring capability for every port in the network.

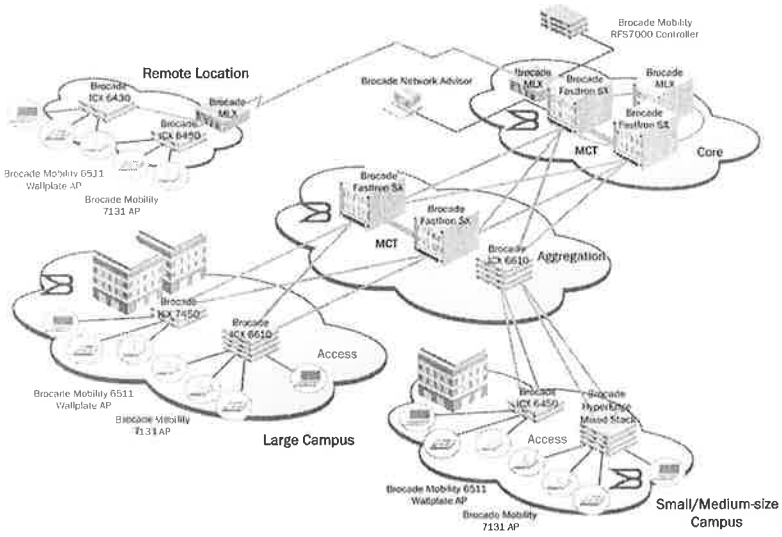


Figure 4.

Brocade ICX 6430 and 6450 Switches are suitable for a wide range of small to medium-size enterprises and branch office deployments at the network access layer.

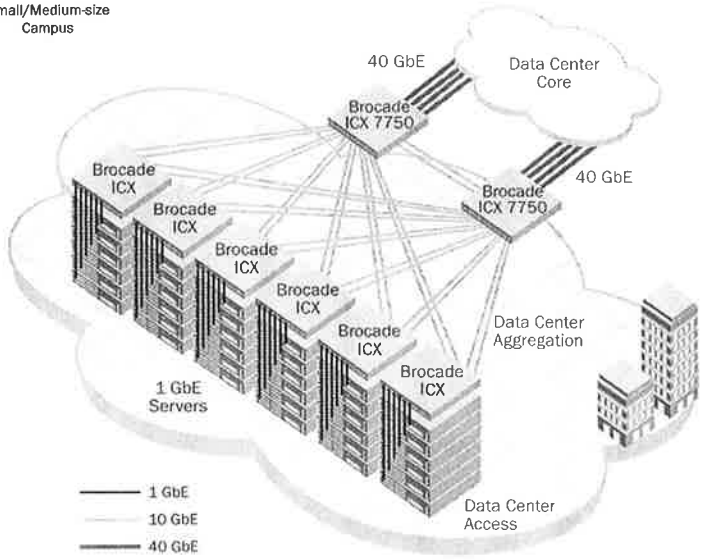


Figure 5.

Brocade ICX 6430 and 6450 Switches provide ToR access while Brocade ICX 7750 Switches provide data center aggregation.

Simplified Deployment with Auto-Configuration

Brocade ICX 6430 and 6450 Switches support auto-configuration, simplifying deployment with a truly plug-and-play experience. Organizations can use this feature to automate IP address and feature configuration without requiring a highly trained network engineer onsite. When the switches power up, they automatically receive an IP address and configuration from DHCP and Trivial File Transport Protocol (TFTP) servers. At this time, the switches can also automatically receive a software update to be at the same code revision as currently installed switches.

Open-Standards Management

Brocade ICX 6430 and 6450 Switches include an industry-standard Command Line Interface (CLI) and support Secure Shell (SSHv2), Secure Copy (SCP), and SNMPv3 to restrict and encrypt management communications to the system. In addition, support for Terminal Access Controller Access Control System (TACACS/TACACS+) and RADIUS authentication helps ensure secure operator access. Embedded Web management is also provided through a GUI-based device interface, and organizations can use Brocade Network Advisor to achieve full device and network management visibility.

Out-of-Band Management

Brocade ICX 6430 and 6450 Switches include a 10/100/1000 Mbps RJ-45 Ethernet port dedicated for out-of-band management, providing a remote path to manage the switches, regardless of the status or configuration of the data ports.

UNIFIED WIRED/WIRELESS NETWORK MANAGEMENT WITH BROCADE NETWORK ADVISOR

Managing enterprise campus networks continues to become more complex due to the growth in services that rely on wired and wireless networks. Services such as Internet, e-mail, video conferencing, real-time collaboration, and distance learning all have specific configuration and management requirements. At the same time, organizations face increasing demand to provide uninterrupted services for high-quality voice and Unified Communications (UC), wireless mobility, and multimedia applications.

To reduce complexity and the time spent managing these environments, the easy-to-use Brocade Network Advisor discovers, manages, and deploys configurations to groups of IP devices. By using Brocade Network Advisor, organizations can configure Virtual LANs (VLANs) within the network, manage wireless access points, and execute commands on specific IP devices or groups of IP devices. sFlow-based proactive monitoring is ideal for performing network-wide troubleshooting, generating traffic reports, and gaining visibility into network activity from the edge to the core. Brocade Network Advisor centralizes management of the entire family of Brocade wired products and Aruba wireless products.

WARRANTY

Brocade ICX 6430 and 6450 Switches are covered by the Brocade Assurance Limited Lifetime Warranty. For details, visit www.brocade.com/warranty.

BEST-IN-CLASS SUPPORT

Brocade ICX 6430 and 6450 Switches are supported by next-business-day advance replacement where available, as well as software defect repairs and maintenance updates. In an effort to further improve service levels and operational efficiency, Brocade includes three years of technical support for Brocade ICX 6430 and 6450 Switches, providing direct access to the Brocade Technical Assistance Center during normal 8×5 business hours.

BROCADE GLOBAL SERVICES

Brocade Global Services has the expertise to help organizations build scalable, efficient cloud infrastructures. Leveraging 15 years of expertise in storage, networking, and virtualization, Brocade Global Services delivers world-class professional services, technical support, network monitoring services, and education, enabling organizations to maximize their Brocade investments, accelerate new technology deployments, and optimize the performance of networking infrastructures.

AFFORDABLE ACQUISITION OPTIONS

Brocade Capital Solutions helps organizations easily address their IT requirements by offering flexible network acquisition and support alternatives. Organizations can select from purchase, lease, Brocade Network Subscription, and Brocade Subscription Plus options to align network acquisition with their unique capital requirements and risk profiles. To learn more, visit www.brocade.com/CapitalSolutions.

MAXIMIZING INVESTMENTS

To help optimize technology investments, Brocade and its partners offer complete solutions that include professional services, technical support, and education. For more information, contact a Brocade sales partner or visit www.brocade.com.

BROCADE ICX 6430/6450 FEATURE AND MODEL SPECIFICATIONS

	Brocade ICX 6430					Brocade ICX 6450				
	6430-C12	**6430-24**	**6430-24P**	**6430-48**	**6430-48P**	**6450-C12-PD**	**6450-24**	**6450-24P**	**6450-48**	**6450-48P**
10/100/1000 Mbps RJ-45 ports	12	24	24	48	48	12	24	24	48	48
10/100/1000 Mbps RJ-45 uplink ports	2					2				
1 GbE SFP ports (uplink/stacking)	2*	4	4	4	4	2*				
1/10 GbE SFP/SFP+ ports (uplink/stacking)							4 (Optional 2-port license)	4 (Optional 2-port license)	4 (Optional 2-port license)	4 (Optional 2-port license)
Stacking bandwidth (data rate, full duplex)		4 Gbps	4 Gbps	4 Gbps	4 Gbps		40 Gbps	40 Gbps	40 Gbps	40 Gbps
Units per stack		4	4	4	4		8	8	8	8
Long-distance stacking (maximum distance between two stacked switches)		100 m	100 m	100 m	100 m		100 m	100 m	100 m	100 m
Internal AC power supply rating	100 W	36 W	525 W	65 W	525 W	100 W	65 W	525 W	100 W	880 W
External power supply (redundant power and PoE power)			Optional 525 W	Optional 525 W	Optional 525 W		Optional 525 W	Optional 525 W	Optional 525 W	Optional 525 W x 2
PoE/PoE+ power budget (internal power supply)	68 W		390 W		390 W	68 W		390 W		780 W
PoE Class 3 ports (internal power supply)	4		24		24	4		24		48
PoE+ ports (internal power supply)	2		12		12	2		12		24
Max PoE Class 3 ports (with internal and external power supplies)	4		24		48	4		24		48
Max PoE+ ports (with internal and external power supplies)	2		24		24	2		24		48
PoE/PoE+ powered (Powered Device PD)						Yes				
Base software	Layer 2	Layer 2	Layer 2	Layer 2	Layer 2	Layer 3 with static routes	Layer 3 with static routes	Layer 3 with static routes	Layer 3 with static routes	Layer 3 with static routes
Layer 3 routing (RIP, OSPF)						Optional	Optional	Optional	Optional	Optional
Switching capacity (data rate, full duplex)	32 Gbps	56 Gbps	56 Gbps	104 Gbps	104 Gbps	32 Gbps	128 Gbps	128 Gbps	176 Gbps	176 Gbps
Forwarding capacity (data rate, full duplex)	24 Mpps	42 Mpps	42 Mpps	77 Mpps	77 Mpps	24 Mpps	96 Mpps	96 Mpps	132 Mpps	132 Mpps

** Stacking is not supported on the Brocade ICX 6430-C12/6450-C12-PD. 100Base-FX is supported on the Brocade ICX 6430-C12/6450-C12-PD.*

BROCADE ICX 6430/6450 SPECIFICATIONS

System Architecture	
Connector options	10/100/1000 Mbps ports: RJ-45 Brocade ICX 6430: 1 Gbps SFP ports for uplink/stacking: SX, LX, TX, LHA, LHB, direct-attached copper cable (Twinax) for stacking Brocade 6430-C/6450-C: 100 Mbps/1 Gbps SFP ports for uplink: FX, SX, LX, TX, LHA, LHB; 10/100/1000 Mbps RJ-45 ports for uplink Brocade ICX 6450: 1/10 Gbps SFP+ ports for uplink/stacking: USR, SR, LR, ER, LRM, direct-attached copper cable (Twinax) for stacking Out-of-band Ethernet management: 10/100/1000 Mbps RJ-45 Console management: RJ-45 serial External power connector: Redundant system power supply and extended PoE power supply (except the Brocade ICX 6430-24/6430-C12/6450-C12-PD)
Maximum MAC addresses	Brocade ICX 6430, 6430-C: 8,000 Brocade ICX 6450, 6450-C: 16,000
Maximum VLANs	Brocade ICX 6430-C: 1,024 Brocade ICX 6430, 6450, 6450-C: 4,096
Maximum STP (spanning trees)	Brocade ICX 6430, 6430-C: 32 Brocade ICX 6450, 6450-C: 253
Maximum routes (in hardware)	Brocade ICX 6450, 6450-C: 12,000 (IPv4) Brocade ICX 6450, 6450-C: 2,140 (IPv6)
Trunking	Brocade ICX 6430 Maximum ports per trunk: 8 Maximum trunk groups: 29 Brocade ICX 6430-C Maximum ports per trunk: 8 Maximum trunk groups: 16 Brocade ICX 6450, 6450-C Maximum ports per trunk: 8 Maximum trunk groups: 124
Priority queues	Brocade ICX 6430, 6430-C: 4 Brocade ICX 6450, 6450-C: 8
Maximum jumbo frame size	9,216 bytes
Layer 2 switching	• 802.1s Multiple Spanning Tree • 802.1X Authentication • Auto MDI/MDIX • BPDU Guard, Root Guard • Dual-Mode VLANs • MAC-based VLANs, Dynamic MAC-based VLAN activation • Dynamic VLAN Assignment • Dynamic Voice VLAN Assignment • Fast Port Span • GARP VLAN Registration Protocol • IGMP Snooping (v1/v2/v3) • IGMP Proxy for Static Groups • IGMP v2/v3 Fast Leave • IGMP Tracking • Inter-Packet Gap (IPG) adjustment • Link Fault Signaling (LFS) • MAC Address Locking, MAC Port Security • MAC-Layer Filtering, Filtering on source and destination MAC address
Layer 2 switching (continued)	• MAC Learning Disable • MLD Snooping (v1/v2) • Multi-device Authentication • Per-VLAN Spanning Tree (PVST/PVST+/PVRST) • Mirroring: Port-based, ACL-based, MAC Filter-based, and VLAN-based • Port Loop Detection • Private VLAN • Protected Link Groups • Protocol VLAN (802.1v), Subnet VLAN • Remote Fault Notification (RFN) • Single-instance Spanning Tree • Single-link LACP • Trunk Groups • Uni-Directional Link Detection (UDLD)
IPv6 support	• Host functionality management • Hardware support for IPv6 • IPv6 static routing (Brocade ICX 6450/6450-C only)
Base Layer 3 routing (Brocade ICX 6450/6450-C)	• IPv4 and IPv6 Static Routes • Port-based Access Control Lists • Host Routes • Virtual Interfaces, up to 255 virtual interfaces • Routed Interfaces • Route-only Support • IP helper • Routing Between Directly Connected Subnets • ECMP • Layer 3/Layer 4 ACLs
Premium Layer 3 routing (Brocade ICX 6450/6450-C)	• OSPF v2 • RIP v1/v2 • Virtual Route Redundancy Protocol (VRRP) • VRRP-E • GRE
SDN features	• Support for OpenFlow v1.0 and v1.3 (Openflow support for the Brocade ICX 6450 only available in a mixed stack configuration with a Brocade ICX 6610 stack controller) • OpenFlow support with true hybrid port mode • Operates seamlessly under the Brocade Vyatta® Controller
Metro features (except the Brocade ICX 6430-C/6450-C)	• Metro-Ring Protocol MRP (v1, v2) • Virtual Switch Redundancy Protocol (VSRP) • VLAN Stacking (Q-in-Q) • VRRP • Topology Groups

Quality of Service (QoS)	• ACL Mapping and Marking of ToS/DSCP • ACL Mapping and Marking of 802.1p • ACL Mapping to Priority Queue • ACL Mapping to ToS/DSCP • Classifying and Limiting Flows Based on TCP Flags • DHCP Relay (Brocade ICX 6450 only) • DiffServ Support • Honoring DSCP and 802.1p • MAC Address Mapping to Priority Queue • Priority Queue Management using Weighted Round Robin (WRR), • Strict Priority (SP), and a combination of WRR and SP
IEEE standards compliance	• 802.1AB LLDP/LLDP-MED • 802.1D-2004 MAC Bridging • 802.1p Mapping to Priority Queue • 802.1Q with Tagging • 802.1s Multiple Spanning Tree • 802.1w Rapid Spanning Tree (RSTP) • 802.1X Port-based Network Access Control • 802.3 10BASE-T • 802.3ab 1000BASE-T • 802.3ad Link Aggregation (Dynamic and Static) • 802.3ae 10 Gigabit Ethernet • 802.3af Power over Ethernet • 802.3at Power over Ethernet Plus • 802.3u 100BASE-TX • 802.3x Flow Control • 802.3z 1000BASE-SX/LX • 802.3 MAU MIB (RFC 2239) • 802.1AE- MACsec (HW-capable): Brocade ICX 6450/6450-C only • 802.3az-2010 - EEE (HW-capable)
RFC standards compliance	• For a complete list of RFCs supported by the Brocade FastIron® software platform, please visit www.brocade.com/FastIronOS.
Traffic management	• ACL-based inbound rate limiting and traffic policies • Broadcast, multicast, and unknown unicast rate limiting • Inbound rate limiting per port • Outbound rate limiting per port and per queue
High availability	• Redundant external power supply • Layer 3 VRRP protocol redundancy • Real-time state synchronization across the stack • Hitless failover from master to standby stack controller • Protected link groups • Hot insertion and removal of stacked units

Management	
Management and control	• Auto Configuration • Brocade HyperEdge technology (Brocade ICX 6450 only) • Configuration Logging • Digital Optical Monitoring (DOM) • Display Log Messages on Multiple Terminals • Embedded Web Management • Embedded DHCP Server • Industry-standard Command Line Interface (CLI) • Key-based activation of optional software features • Integration with HP OpenView for Sun Solaris, HP-UX, IBM AIX, and Windows • Brocade Network Advisor support • MIB Support for MRP, Port Security, MAC Authentication, MAC-based VLANs • Out-of-band Ethernet Management • RFC 783 TFTP • RFC 854 TELNET Client and Server • RFC 951 Bootp • RFC 1157 SNMPv1/v2c • RFC 1213 MIB-II • RFC 1493 Bridge MIB • RFC 1516 Repeater MIB • RFC 1573 SNMP MIB II • RFC 1643 Ethernet Interface MIB • RFC 1643 Ethernet MIB • RFC 1724 RIP v1/v2 MIB • RFC 1757 RMON MIB • RFC 2068 Embedded HTTP • RFC 2131 DHCP Relay (Brocade ICX 6450 only) • RFC 2570 SNMPv3 Intro to Framework • RFC 2571 Architecture for Describing SNMP Framework • RFC 2572 SNMP Message Processing and Dispatching • RFC 2573 SNMPv3 Applications • RFC 2574 SNMPv3 User-based Security Model • RFC 2575 SNMP View-based Access Control Model SNMP • RFC 2818 Embedded HTTPS • RFC 3176 sFlow (Brocade ICX 6450/6450-C only) • SNTP Simple Network Time Protocol • Multiple Syslog Servers
Embedded security	• 802.1X Accounting • MAC authentication • DHCP snooping • Dynamic ARP inspection • Bi-level Access Mode (Standard and EXEC Level) • EAP pass-through support • Packet filtering on TCP Flags • IEEE 802.1X username export in sFlow • Protection against Denial of Service (DoS) attacks

Secure management	• Authentication, Authorization, and Accounting (AAA) • Advanced Encryption Standard (AES) with SSHv2 • Bi-level Access Mode (Standard and EXEC Level) • RADIUS/TACACS/TACACS+ • Secure Copy (SCP) • Secure Shell (SSHv2) • Username/password • Web authentication

Physical Specifications

Dimensions	• Brocade ICX 6430-C12/6450-C12-PD models: 1.7 in. (H) × 10.6 in. (W) × 8.4 in. (D) 4.34 cm (H) × 26.92 cm (W) × 21.33 cm (D) • All 24-port models: 1.7 in. (H) × 17.44 in. (W) × 9.45 in. (D) 4.34 cm (H) × 44.3 cm (W) × 24 cm (D) • All 48-port models: 1.7 in. (H) × 17.44 in. (W) × 14.57 in. (D) 4.34 cm (H) × 44.3 cm (W) × 37 cm (D) • ICX6400-EPS1500: 1.7 in. (H) × 17.44 in. (W) × 14.57 in. (D) 4.34 cm (H) × 44.3 cm (W) × 37 cm (D)
Weight	• Brocade ICX 6430-C12: 4 lb (1.81 kg) • Brocade ICX 6430-24: 7.58 lb (3.44 kg) • Brocade ICX 6430-24P: 10.08 lb (4.57 kg) • Brocade ICX 6430-48: 11.09 lb (5.03 kg) • Brocade ICX 6430-48P: 13.8 lb (6.26 kg) • Brocade ICX 6450-C12-PD: 4.62 lb (2.09 kg) • Brocade ICX 6450-24: 7.39 lb (3.35 kg) • Brocade ICX 6450-24P: 10.03 lb (4.55 kg) • Brocade ICX 6450-48: 11.07 lb (5.02 kg) • Brocade ICX 6450-48P: 14.11 lb (6.4 kg) • Brocade ICX 6400-EPS1500: 14.85 lb (6.75 kg)

Environment

Temperature	• Operating temperature: 0°C to 55°C / 32°F to 131°F • Operating temperature for Brocade ICX 6430-C12: 0°C to 45°C / 32°F to 113°F • Storage temperature: -40°C to 70°C (-40°F to 158°F)
Humidity	• Operating relative humidity: 5% to 95%, non-condensing • Non-operating relative humidity: 0% to 95%, non-condensing
Storage altitude	• 10,000 ft (3,000 m) maximum
Acoustic (25°C)	• Brocade ICX 6430-C12: Fanless (ambient) • Brocade ICX 6430-24: Fanless (ambient) • Brocade ICX 6430-24P: 39.2 dBA • Brocade ICX 6430-48: 37.2 dBA • Brocade ICX 6430-48P: 39.3 dBA • Brocade ICX 6450-C12-PD: Fanless (ambient) • Brocade ICX 6450-24: 37.9 dBA • Brocade ICX 6450-24P: 39.2 dBA • Brocade ICX 6450-48: 37.2 dBA • Brocade ICX 6450-48P: 55.5 dBA • Brocade ICX 6400-EPS1500: 60.9 dBA
Vibration	• IEC 68-2-36, IEC 68-2-6
Shock and drop	• IEC 68-2-27 • IEC 68-2-32
MTBF (25°C, CL: 60%)	• Brocade ICX 6430-C12: 1,124,442 hours • Brocade ICX 6430-24: 1,229,732 hours • Brocade ICX 6430-24P: 505,469 hours • Brocade ICX 6430-48: 748,262 hours • Brocade ICX 6430-48P: 384,288 hours • Brocade ICX 6450-C12-PD: 868,732 hours • Brocade ICX 6450-24: 906,243 hours • Brocade ICX 6450-24P: 485,749 hours • Brocade ICX 6450-48: 756,081 hours • Brocade ICX 6450-48P: 397,590 hours • Brocade ICX 6400-EPS1500: 789,923 hours

Power	
Power supplies	• Integrated AC power supply for system and PoE power • External 1500 W AC power supply for redundant system power and extended PoE power
Power inlet (Max current rating at 100 V input)	• Brocade ICX 6430-C12: 1.8 Amp • Brocade ICX 6430-24: 0.9 Amp • Brocade ICX 6430-24P: 6 Amp • Brocade ICX 6430-48: 1.5 Amp • Brocade ICX 6430-48P: 6 Amp • Brocade ICX 6450-C12-PD: 1.8 Amp • Brocade ICX 6450-24: 1.5 Amp • Brocade ICX 6450-24P: 6 Amp • Brocade ICX 6450-48: 2 Amp • Brocade ICX 6450-48P: 10 Amp • Brocade ICX 6400-EPS1500: 16 Amp
Input voltage	• Universal 100 to 240 VAC
AC power cord current rating	• Brocade ICX 6430-C12/6450-C12-PD: 10 Amp, 100 to 240 V • Brocade ICX 6430 and 6450 switches: 13 Amp, 100 to 240 V • Brocade ICX 6400-EPS1500: 20 Amp, 100 to 240 V
DC power cord current rating	• Brocade ICX 6400-EPS1500: 5.6 Amp at 12 V rail; 6.85 Amp at 54 V rail • Brocade ICX 6400-EPS1500: 3 DC cables included; cable length: 3 feet
Input line frequency	• 50 to 60 Hz
Heat dissipation (no PoE load)	• Brocade ICX 6430-C12: 62 BTU/hr • Brocade ICX 6430-24: 67 BTU/hr • Brocade ICX 6430-24P: 104 BTU/hr • Brocade ICX 6430-48: 128 BTU/hr • Brocade ICX 6430-48P: 132 BTU/hr • Brocade ICX 6450-C12-PD: 68.3 BTU/hr • Brocade ICX 6450-24: 124 BTU/hr • Brocade ICX 6450-24P: 129 BTU/hr • Brocade ICX 6450-48: 186 BTU/hr • Brocade ICX 6450-48P: 192 BTU/hr

Regulatory Compliance and Safety Approvals	
Electromagnetic compatibility	• FCC Part 15, Subpart B, Class A • ICES-003: 2004 • VCCI—Technical Requirement (V-3/2011.04)/ Class A • EN 55022: 2006+A1: 2007 Class A • EN 61000-3-2: 2006+A1:2009+A2:2009 Class A • EN 61000-3-3: 2008 • EN 61000-6-1: 2007 • EN 61000-6-3: 2007 • EN 55024: 1998+A1:2001+A2:2003 • EN 300 386 (V1.4.1): 2008 • IEC 61000-4-2: 2008 ED. 2.0 • IEC 61000-4-3: 2006+A1:2007+A2:2010 ED. 3.2 • IEC 61000-4-4: 2004+A1:2010 ED. 2.0 • IEC 61000-4-5: 2005 ED. 2.0 • IEC 61000-4-6: 2008 ED. 3.0 • IEC 61000-4-8: 2009 ED. 2.0 • IEC 61000-4-11: 2004 ED. 2.0
Safety	• CAN/CSA-C22.2 NO. 60950-1-07; UL 60950-1 2nd Edition; IEC 60950-1 2nd Edition; EN 60950-1:2006 Safety of Information Technology Equipment; EN 60825-1 Safety of Laser Products—Part 1: Equipment Classification, Requirements and User's Guide; EN 60825-2 Safety of Laser Products—Part 2: Safety of Optical Fibre Communication Systems
Environmental regulatory compliance	• RoHS-compliant (6 of 6); WEEE-compliant

Measured Power Utilization

Models	Idle[1]	5% Throughput[2]	100% Throughput[3]
Brocade ICX 6430-C12	10 W	91 W	93 W
Brocade ICX 6430-24	7 W	19 W	20 W
Brocade ICX 6430-24P	9 W	391 W	396 W
Brocade ICX 6430-48	15 W	37 W	38 W
Brocade ICX 6430-48P	16 W	401 W	403 W
Brocade ICX 6450-C12-PD	11.3 W	94.3 W	94.6 W
Brocade ICX 6450-24	20 W	29 W	37 W
Brocade ICX 6450-24P	21 W	395 W	400 W
Brocade ICX 6450-48	30 W	51 W	55 W
Brocade ICX 6450-48P	31 W	771 W	776 W

[1] *All ports are disconnected with no PoE load.*

[2] *5 percent traffic load on all ports connected with maximum possible PoE loads (if equipped).*

[3] *100 percent traffic load on all ports connected with maximum possible PoE loads (if equipped).*

BROCADE ICX 6430/6450 ORDERING INFORMATION

Part Number	Description
ICX6430-C12	12-port 1 GbE compact switch (4 PoE+), 2×100 Mbps/1 GbE SFP and 2×100 Mbps/1 GbE copper uplinks, fanless
ICX6430-24	24-port 1 GbE switch, 4×1 GbE SFP uplink/stacking ports, fanless
ICX6430-24P	24-port 1 GbE switch PoE+ 390 W, 4×1 GbE SFP uplink/stacking ports
ICX6430-48	48-port 1 GbE switch, 4×1 GbE SFP uplink/stacking ports
ICX6430-48P	48-port 1 GbE switch PoE+ 390 W, 4×1 GbE SFP uplink/stacking ports
ICX6450-C12-PD	12-port 1 GbE compact switch (4 PoE+), 2×100 Mbps/1 GbE SFP and 2×100 Mbps/1 GbE copper uplinks, fanless, L3 static, PoE-powered, TAA
ICX6450-24	24-port 1 GbE switch, 2×1 GbE SFP+ (upgradable to 10 GbE) and 2×1 GbE/10 GbE SFP+ uplink/stacking ports
ICX6450-24-A	24-port 1 GbE switch, 2×1 GbE SFP+ (upgradable to 10 GbE) and 2×1 GbE/10 GbE SFP+ uplink/stacking ports, TAA
ICX6450-24P	24-port 1 GbE switch PoE+ 390 W, 2×1 GbE SFP+ (upgradable to 10 GbE) and 2×1 GbE/10 GbE SFP+ uplink/stacking ports
ICX6450-24P-A	24-port 1 GbE switch PoE+ 390 W, 2×1 GbE SFP+ (upgradable to 10 GbE) and 2×1 GbE/10 GbE SFP+ uplink/stacking ports, TAA
ICX6450-48	48-port 1 GbE switch, 2×1 GbE SFP+ (upgradable to 10 GbE) and 2×1 GbE/10 GbE SFP+ uplink/stacking ports
ICX6450-48-A	48-port 1 GbE switch, 2×1 GbE SFP+ (upgradable to 10 GbE) and 2×1 GbE/10 GbE SFP+ uplink/stacking ports, TAA
ICX6450-48P	48-port 1 GbE switch PoE+ 780 W, 2×1 GbE SFP+ (upgradable to 10 GbE) and 2×1 GbE/10 GbE SFP+ uplink/stacking ports
ICX6450-48P-A	48-port 1 GbE switch PoE+ 780 W, 2×1 GbE SFP+ (upgradable to 10 GbE) and 2×1 GbE/10 GbE SFP+ uplink/stacking ports, TAA
Accessories and Options	
ICX6450-PREM-LIC	Brocade ICX 6450/6450-C premium license (Layer 3 features)
ICX6450-2X10G-LIC-POD	Brocade ICX 6450 2×10 GbE capacity-based license; upgrade 1 GbE uplink/stacking ports to 1GbE/10 GbE
ICX6400-EPS1500	Brocade ICX 6430/6450 1500 W external power supply for RPS/EPS (connect up to three switches)
ICX6400-RMK	Brocade ICX 6400 two-post rack mount kit, spare
ICX6400-C12-RMK	Brocade ICX 6400-C compact switch 2-post rack mount kit
ICX6400-C12-MGNT	Brocade ICX 6400-C compact switch magnet mount kit
10G-SFPP-TWX-0101	Direct-attached SFP+ copper cable, 1 m, one-pack, stacking cable
10G-SFPP-TWX-0301	Direct-attached SFP+ copper cable, 3 m, one-pack, stacking cable
10G-SFPP-TWX-0501	Direct-attached SFP+ copper cable, 5 m, one-pack, stacking cable
1G-SFP-TWX-0101	Direct-attached 1 Gbps SFP copper cable, 1 m, stacking cable
1G-SFP-TWX-0501	Direct-attached 1 Gbps SFP copper cable, 5 m, stacking cable
10G-SFPP-USR	10GE USR SFP+ optic (LC), target range 100 m over MMF, one-pack
10G-SFPP-SR	10GBASE-SR, SFP+ optic (LC), target range 300 m over MMF
10G-SFPP-LR	10GBASE-LR, SFP+ optic (LC), for up to 10 km over SMF
10G-SFPP-ER	10GBASE-ER SFP+ optic (LC), for up to 40 km over SMF
10G-SFPP-LRM	10GBASE-LRM, 1310 nm SFP+ optic (LC), TAR
E1MG-TX	1000BASE-TX SFP copper, RJ-45 connector
E1MG-SX-OM	1000BASE-SX SFP optic, MMF, LC connector, optical monitoring-capable
E1MG-LX-OM	1000BASE-LX SFP optic, SMF, LC connector, optical monitoring-capable
E1MG-LHA-OM	1000BASE-LHA SFP optic, SMF, LC connector, optical monitoring-capable; 80 km
E1MG-LHB	1000BASE-LHB SFP optic, SMF, LC connector. 150 km maximum reach
E1MG-100FX-OM	100BASE-FX SFP optic MMF, LC connector, optical monitoring-capable (Brocade ICX 6400-C only)
BR-NTWADV-IP-BASE	Brocade Network Advisor IP management software license for up to 50 devices; required for initial purchase of IP only management; minimum of one year of support is required.

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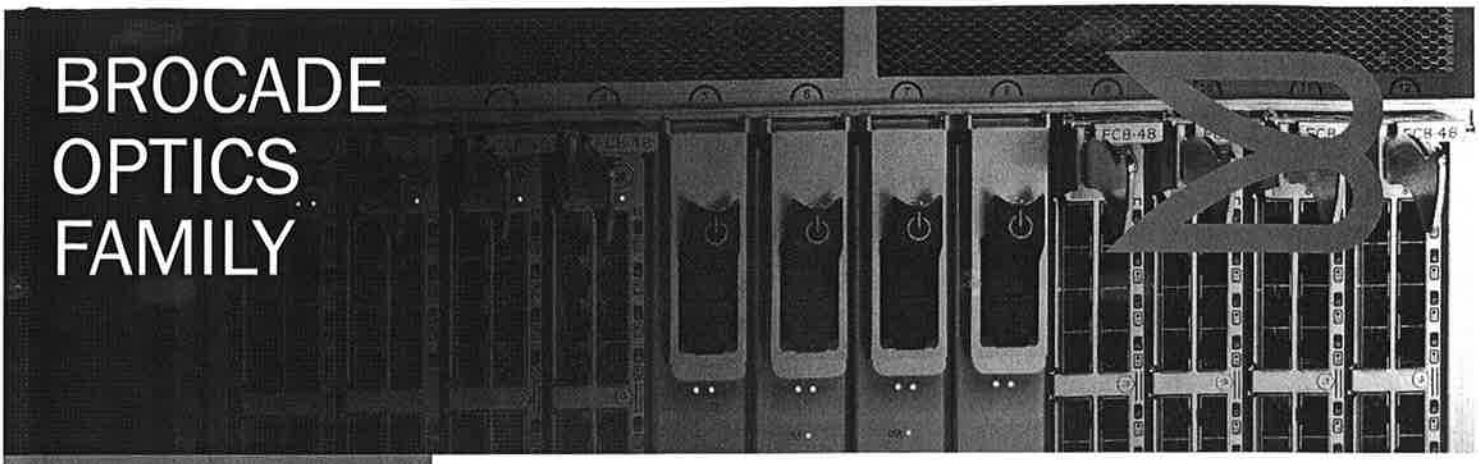
BROCADE

BROCADE OPTICS FAMILY



IP NETWORK

Highly Reliable, Brocade-Qualified Optics

HIGHLIGHTS

- Rigorously tested for performance and reliability by Brocade
- Hot-swappable flexibility in the field for greater ease and lower total cost of ownership
- Standards-based—802.3z, 802.3ah, 802.3u, 802.3ae, 802.3ak, and 802.3ba—and compliant as required
- Compliant with Requirements to Reduce Hazardous Substances (RoHS), meeting either RoHS 5 or RoHS 6 EU standards

Brocade offers a unique set of high-performance, reliable, and cost-effective optical transceivers that help enterprises and service providers meet the challenges of diverse network topologies. To ensure maximum quality, Brocade selects and tests the most reliable, highest-performing optical transceivers on the market, and then warrants their availability, capacity, and performance in Brocade® products.

Extensive performance and reliability testing reflects an ongoing commitment to quality. Brocade tests transceivers using the industry's most advanced tools and instruments to help ensure that they provide the right mix of functionality and performance when used in conjunction with Brocade products. The speed, capacity, reliability, and low cost of ownership that Brocade is known for is also provided in all optical components.

By using Brocade-qualified components, organizations can be assured that their warranty and service requirements will be met and that their Brocade products will continually provide the uptime, performance, and reliability required by today's leading enterprise service providers.

OPTICS FAMILY FEATURES

The Brocade optics family includes several offerings designed to meet the performance and scalability requirements of service provider and enterprise environments. The new 100 Gigabit Ethernet (GbE) CFP optics deliver even greater performance capacity to support cloud services for these environments.

100 MbE Optics

- 100 Megabit Ethernet (MbE) transceivers support link lengths from 2 km to 40 km
- Both SMF and MMF fiber types
- RoHS 5 and 6 compliant
- Enterprise switching and routing

1 GbE Optics

- 1 GbE transceivers support link lengths from 300 m to 100 km
- Both SMF and MMF fiber types
- Coarse Wavelength Division Multiplexing (CWDM) support for distances of 80 km to 100 km
- RoHS 5 and 6 compliant
- For core routers and security applications

10 GbE Optics

- 10 GbE transmissions support link lengths of 26 m to 80 km
- Protocol independent
- Less than one-third the power and size of MSA optic
- Hot swappable
- Digital Optical Monitoring (DOM) support
- RoHS 5 and 6 compliant
- Application delivery and acceleration
- High-Performance Computing (HPC) interconnects
- Service provider traffic management

POS Pluggable OC12, OC48, and OC192 XFP Optics

- Pluggable XFP optic
- Ranges from 500 m to 80 km

40 GbE QSFP+ Optics

- 40 GbE transmissions support link lengths up to 10 km
- Hot pluggable
- Industry-standard QSFP+
- Digital Optical Monitoring (DOM) support
- High-density 40 GbE connectivity options for data center, enterprise, and service provider applications

100 GbE CFP Optics

- 100 GbE transmissions support link lengths up to 40 km
- Hot pluggable
- Low voltage
- Industry-standard CFP
- Diagnostic features per CFP MSA for laser bias, temperature, supply voltage
- Carrier, service provider, and cloud services
- Enterprise campus core routing
- RoHS 6 compliant

PRODUCT SUPPORT FOR FAST ETHERNET

	Brocade ICX® Switches	FastIron® Series		FastIron X Series	BigIron® Series	NetIron® Series		
Fast Ethernet Optics	ICX 6610	LS/WS/ GS	FCX	SX	RX	XMR/MLX®	CES/CER/CER-RT	Brocade 6910
E1MG-100FX-OM	•[1]	•	•	•[2]	•	•	•	•
E1MG-100FX-IR-OM	•[1]	•	•	•[2]	Software v2.6.0	Software v3.9.0	•	•
E1MG-100FX-LR-OM	•[1]	•	•	•[2]	Software v2.6.0	Software v3.9.0	•	•

[1] Available only with Brocade ICX 6610-24F.

[2] Available only with SX-FI424HF and SX-FI-24HF.

PRODUCT SUPPORT FOR 1 GIGABIT ETHERNET

	Edgelron Series		Brocade ICX Switches			FastIron Series			FastIron X Series	BigIron Series	NetIron Series			ServerIron® Series	TurboIron®	Brocade VDX® Switches
1 GbE Fiber Optics	CF	G	ICX 6610	ICX 6430/ 6450	ICX 6650	LS/ GS	WS	FCX	SX	RX	XMR/ MLX	CES/ CER/ CER-RT	Brocade 6910	ADX®	24X	VDX 6710/ 6720/ 6730/ 8770
E1MG-SX-OM	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
E1MG-SX-OM-T													•			
E1MG-LX-OM	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
E1MG-LX-OM-T													•			
E1MG-LHA-OM	•	•	•	•		•	•	•	•[2]	•	•	•	•		•	
E1MG-LHA-OM-T													•			
E1MG-LHB	•	•	•	•		•	•		•[2]	•	•	•	•			
E1MG-BXD			•			•		•	•	•	•	•	•		•	
E1MG-BXU			•			•		•	•	•	•	•	•		•	
E1MG-CWDM80-XXXX		•	•			•	•		•	•	•	•	•			
E1MG-TX			•	•	•	•	•	•[3]	•	•	•	•[1]		•	•	
XBR-000190																•
1G-SFP-C-0x01				•												

[1] Qualified for 10/100/1000 Mbps speed.

[2] Not qualified on SX-FI-24HF.

[3] Only qualified on FCX-624S-F.

PRODUCT SUPPORT FOR 10 GIGABIT ETHERNET

	Brocade ICX Switches			FastIron Series		FastIron X Series	BigIron Series	NetIron Series		ServerIron Series	TurboIron	Brocade VDX Switches
10 GbE Fiber Optics	ICX 6610	ICX 6450	ICX 6650	LS	FCX	SX	RX	XMR/MLX	CER/CES/ CER-RT	ADX	24X	VDX 6710/ 6720/ 6730/ 8770
10G-XFP-SR, LR				•	•	•[1]	•[3]	•[3]	•	•		
10G-XFP-ER				•	•	•[1]	•[3]	•[3]	•			
10G-XFP-ZR				•	•	•[1]	•[3]	•[3]	•			
10G-XFP-ZRD				•	•	•[1]	•[3]	•[3]	•			
10G-XFP-1310-LRM					•							
10G-SFPP-USR	•	•	•		•	•[2]		•	•		•	•
10G-SFPP-SR, LR	•	•	•		•	•[2]	•	•[3]	•	•[4]	•	•
10G-SFPP-ER	•	•	• (8.0.01)		•[5]	•[2]	•	•[3]	•		•	•
10G-SFPP-ZR								•	•			
10G-SFPP-ZRD-T								•[6] (5.5)				
10G-SFPP-LRM	•	•			•[5]	•[2]			•	•[4]	•	
10G-SFPP-TWX-XXXX [7]	•	•	•		•	•[2]		•	•		•	•
10G-SFPP-AOC-XXXX								• (5.5a)	•			

[1] SX-FI42XGW module supports WAN mode.

[2] Available only with SX-FI-8XG, SX-FI-2XG, SX-FI-2XGMR-XL, and SX-FI-2XGMR-XL-PREM6 modules.

[3] The Brocade MLX and NetIron XMR modules (BR-MLX-10Gx8-X, BR-MLX-10Gx8-M, BR-MLX-10Gx4-X, BR-MLX-10Gx4-X-ML, NI-MLX-10Gx4, NI-MLX-10Gx2, NI-XMR-10Gx4, NI-XMR-10Gx2) and the Brocade BigIron RX 10 GbE modules support WAN mode.

[4] Available only with Brocade ADX 1000F.

[5] Available only with the FCX-2SFPP module.

[6] Available only with the Brocade MLXe 8×10 GbE and 24×10 GbE modules.

[7] XXXX= 0101 (1m), 0301 (3m), 0501 (5m)

PRODUCT SUPPORT FOR POS

	NetIron Series
POS Optics	XMR/MLX
OC12-SFP-MM	•
OC12-SFP-IR1	•
OC12-SFP-LR1	•
OC12-SFP-LR2	•
OC48-SFP-SR1	•
OC48-SFP-IR1	•
OC48-SFP-LR1	•
OC48-SFP-LR2	•
OC192-XFP-SR1	•
OC192-XFP-IR2	•
OC192-XFP-LR2	•

PRODUCT SUPPORT FOR 40 GIGABIT ETHERNET

	Brocade ICX Switches		Brocade VDX Switches	Brocade MLX Series
40 GbE Fiber Optics	ICX 6650	ICX 6610	VDX 8770	MLXe
40G-QSFP-SR4	•	•	•	•
40G-QSFP-SR4-INT	•			
40G-QSFP-LR4	•			•
40G-QSFP-4SFP-C-XXXX [7]	•			
40G-QSFP-QSFP-C-XXXX [7]	•			

PRODUCT SUPPORT FOR 100 GIGABIT ETHERNET

	Brocade MLX Series
100 GbE Fiber Optics	MLX/MLXe
100G-CFP- SR10	• (5.4)
100G-CFP-10X10-2KM-OM	• (5.2.00b)
100G-CFP-10X10-10KM-OM	• (5.2.00b)
100G-CFP-LR4-10KM	•
100G-CFP-ER4-40KM	• (5.4)

KEY STANDARDS AND FEATURES

	IEEE Standards	Domestic Safety Standards	International Safety Standards	Wavelength (nm)	Fiber Type	Maximum Cable Distance	Digital Optical Monitoring
Fast Ethernet							
E1MG-100FX-OM	802.3u	FDA 21CFR 1040.10 Class 1, CSA 60950-1-03/UL 60950-1	EN 60825-1, EN 60950-1	1310	MMF	2 km	Yes
E1MG-100FX-IR-OM	802.3			1310	SMF	15 km	Yes
E1MG-100FX-LR-OM	802.3			1310	SMF	40 km	Yes
1 GbE Fiber							
E1MG-SX-OM/ E1MG-SX-OM-T	802.3z	FDA 21CFR 1040.10 Class 1, CSA 60950-1-03/UL 60950-1	EN 60825-1, EN 60950-1	850	MMF	220 m to 550 m	Yes
E1MG-LX-OM/ E1MG-LX-OM-T	802.3z			1310	MMF/SMF	550 m to 10 km	Yes
E1MG-LHA-OM/ E1MG-LHA-OM-T	802.3z			1550	SMF	70 km	Yes
E1MG-LHB	802.3z			1550		150 km w/0.18 dB/km cable, 91 km w/standard 0.3 dB/km cable	No
E1MG-BXD	802.3ah			TX:1490, RX:1310		10 km	No
E1MG-BXU	802.3ah			TX:1310, RX:1490		10 km	No
E1MG-CWDM80-XXXX	802.3z			1470 to 1610		80 km	No
1000BASE-T Copper							
E1MG-TX, XBR-000190	802.3z	CSA 60950-1-03/UL	EN 60950-1	N/A	Cat5	100 m	N/A
1G-SFP-TWX-0x01	802.3z	Direct-attached SFP copper cables				1 m, 5 m	No
10 GbE Fiber							
10G-XFP-SR	802.3ae	FDA 21CFR 1040.10 Class 1, CSA 60950-1-03/UL 60950-1	EN 60825-1, EN 60950-1	850	MMF	26 m to 300 m	Yes
10G-XFP-LR	802.3ae			1310	SMF	10 km	
10G-XFP-ER	802.3ae			1550		40 km	
10G-XFP-ZR	802.3ae			1550		80 km	
10G-XFP-ZRD	802.3ae			1528.77 to 1561.42		80 km	
10G-XFP-1310-LRM	802.3aq			1310	MMF	220 m	
10G-SFPP-USR	N/A			850	MMF	100 m	
10G-SFPP-SR	802.3ae			850	MMF	26 m to 300 m	
10G-SFPP-LR	802.3ae			1310	SMF	10 km	
10G-SFPP-ER	802.3ae			1550	SMF	40 km	
10G-SFPP-ZR	802.3ae			1550	SMF	80 km	
10G-SFPP-ZRD-T	802.3-2005 Clause 52 standard			102 C-band tunable wavelengths from 1528 to 1568 (50 GHz apart)	SMF	80 km	
10G-SFPP-LRM	802.3ae			1310	MMF	220 m	
10GBASE Cable							
10G-SFPP-TWX-XXXX	802.3ae	Direct-attached SFP+ Twinax copper cables				1 m, 3 m, 5 m	No
10G-SFPP-AOC-XXXX	N/A	Direct-attached SFP+ active optical cables				7 m, 10 m	No

KEY STANDARDS AND FEATURES (CONTINUED)

40 GbE Fiber							
40G-QSFP-SR4	802.3ba	FDA 21CFR 1040.10 Class 1, CSA 60950-1-03/UL 60950-1	EN 60825-1, EN 60950-1	850	OM3 MMF OM4 MMF	100 m 150 m	Yes
40G-QSFP-SR4-INT (compatible with 10GBASE-SR)	802.3ba				OM3 MMF OM4 MMF	100 m 150 m	Yes
40G-QSFP-LR4	802.3ba			1264.5 to 1337.5	SMF	10 km	
40 GbE Copper							
40G-QSFP-4SFP-C-XXXX [7]	N/A	Direct-attached QSFP+ to 4 SFP+ active copper cables				1 m, 3 m, 5 m	No
40G-QSFP-QSFP-C-XXXX [7]	N/A	Direct-attached QSFP+ to QSFP+ active copper cables				1 m, 3 m, 5 m	No
100 GbE Fiber							
100G-CFP-SR10	802.3ba	FDA 21CFR 1040.10 Class 1, CSA 60950-1-03/UL 60950-1	EN 60825-1, EN 60950-1	850	OM3 MMF OM4 MMF	100 m 150 m	Yes
100G-CFP-LR4-10KM	802.3ba			1294.53 to 1310.19	SMF	10 km	Yes
100G-CFP-10x10-2KM-OM	10×10 MSA			1523 to 1595	SMF	2 km	Yes
100G-CFP-10x10-10KM-OM	10×10 MSA			1523 to 1595	SMF	10 km	Yes
100G-CFP-ER4-40KM	802.3ba			1294.53 to 1310.19	SMF	40 km	Yes

ORDERING INFORMATION

Part Number	Description
100 MbE SFP Transceivers	
E1MG-100FX-OM	100BASE-FX SFP optic MMF, LC connector, optical monitoring capable.
E1MG-100FX-IR-OM	100BASEFX-IR SFP optic for SMF with LC connector, optical monitoring capable. For distances up to 15 km.
E1MG-100FX-LR-OM	100BASEFX-LR SFP optic for SMF with LC connector, optical monitoring capable. For distances up to 40 km.
1 GbE Optics	
E1MG-BXD	1000BASE-BXD SFP optic, SMF, 1490 nm, LC connector. This optic can be connected only to an E1MG-BXU at the far end.
E1MG-BXU	1000BASE-BXU SFP optic, SMF, 1310 nm, LC connector. This optic can be connected only to an E1MG-BXD at the far end.
E1MG-CWDM80-XXXX	CWDM SFP optic, 80 km, 1470 to 1610 (total of eight wavelengths supplied by eight optics, each 20 nm apart in wavelength), LC connector.
E1MG-LHA-OM	1000BASE-LHA SFP optic SMF, LC connector, optical monitoring capable. For distances up to 70 km.
E1MG-LHA-OM-T	1000BASE-LHA SFP optic, MMF, LC connector, optical monitoring capable (70 km), industrial temperature.
E1MG-LHB	1000BASE-LHB SFP optic, SMF, LC connector, 150 km maximum reach.
E1MG-LX-OM	1000BASE-LX SFP optic SMF, LC connector, optical monitoring capable. For distances up to 10 km.
E1MG-LX-OM-T	1000BASE-LX SFP optic, SMF, LC connector, optical monitoring capable, industrial temperature.
E1MG-SX-OM	1000BASE-SX SFP optic, MMF, LC connector, optical monitoring capable.
E1MG-SX-OM-T	1000BASE-SX SFP optic, MMF, LC connector, optical monitoring capable, industrial temperature.
E1MG-TX, XBR-000190	1000BASE-T SFP copper, RJ-45 connector.
1G-SFP-C-0x01	1 GbE direct-attached SFP copper cable, 1 m or 5 m (where x=1 for 1 m; x=5 for 5 m).

10 GbE XFP	
10G-XFP-SR	850 nm serial pluggable XFP optic (LC), target range 300 m over MMF.
10G-XFP-LR	1310 nm serial pluggable XFP optic (LC) for up to 10 km over SMF.
10G-XFP-ER	1550 nm serial pluggable XFP optic (LC) for up to 40 km over SMF.
10G-XFP-ZR	1550 nm serial pluggable XFP optic (LC) for up to 80 km over SMF.
10G-XFP-ZRD-XXXX-AA	10GBASE-ZR DWDM, XFP optic, 80 km, 1528.77 to 1561.42 (total of 41 wavelengths supplied by 41 optics, each 100 GHz apart in frequency).
10G-XFP-1310-LRM	10GBASE-LRM, XFP optic, 1310 nm serial pluggable optic (LC) for use on OM1/OM2/OM3 MMF up to 220 m.
10 GbE SFP+	
10G-SFPP-USR	10 GbE Ultra-Short Reach (USR), SFP+ optic (LC), target range 100 m over MMF.
10G-SFPP-LR	10GBASE-LR, SFP+ optic (LC), for up to 10 km over SMF.
10G-SFPP-ER	10GBASE-ER, SFP+ optic (LC), for up to 40 km over SMF.
10G-SFPP-ZR	10GBASE-ZR, SFP+ optic (LC), for up to 80 km over SMF.
10G-SFPP-ZRD-T	10 GbE tunable DWDM SFP+ optic (LC), for up to 80 km over SMF.
10G-SFPP-LRM	10GBASE-LRM, SFP+ optic (LC), 220 m over OM1/OM2/OM3 MMF.
10G-SFPP-TWX-XXXX [7]	10 GbE SFP+ direct-attached copper cable, 1 m, 3 m, or 5 m.
10G-SFPP-AOC-XXXX	10 GbE SFP+ direct-attached active optical cable, 7 m or 10 m.
OC12-POS-SFP	
OC12-SFP-MM	POS OC-12 (STM-4) pluggable SFP optic (LC connector). Range up to 500 m over MMF.
OC12-SFP-IR1	POS OC-12 (STM-4) SR-1/IR-1 pluggable SFP optic (LC connector). Range up to 15 km over SMF. No attenuator needed for SR-1 applications.
OC12-SFP-LR1	POS OC-12 (STM-4) LR-1 pluggable SFP optic (LC connector). Range up to 40 km over SMF.
OC12-SFP-LR2	POS OC-12 (STM-4) LR-2 pluggable SFP optic (LC connector). Range up to 80 km over SMF.
OC48-POS-SFP 2.5 Gbps	
OC48-SFP-SR1	POS OC-48 (STM-16) SR-1 pluggable SFP optic (LC connector). Range up to 2 km over SMF.
OC48-SFP-IR1	POS OC-48 (STM-16) LR-1 pluggable SPF optic (LC connector). Range up to 15 km over SMF.
OC48-SFP-LR1	POS OC-48 (STM-16) LR-2 pluggable SFP optic (LC connector). Range up to 40 km over SMF.
OC48-SFP-LR2	POS OC-48 (STM-16) LR-2 pluggable SFP optic (LC connector). Range up to 80 km over SMF.
OC192-POS-XFP	
OC192-XFP-SR1 POS	OC-192 (STM-64) SR-1 pluggable XFP optic (LC connector). Range up to 2 km over SMF.
OC192-XFP-IR2	POS OC-192 (STM-64) IR-2 pluggable XFP optic (LC connector). Range up to 40 km over SMF.
OC192-XFP-LR2	POS OC-192 (STM-64) LR-2 pluggable XFP optic (LC connector). Range up to 80 km over SMF.
40 GbE QSFP+	
40G-QSFP-SR4	40GBASE-SR4 QSFP+ optic (MTP 1×8 or 1×12), 100 m over MMF (not compliant with 10GBASE-SR4 modules per IEEE 802.ae standard).
40G-QSFP-SR4-INT	40GBASE-SR4 QSFP+ optic (MTP 1×8 or 1×12), 100 m over MMF (10GBASE-SR compatible, breakout-capable).
40G-QSFP-LR4	40GBASE-LR4 QSFP+ optic (LC), for up to 10 km over SMF.
40G-QSFP-4SFP-C-XXXX [7]	4×10 GbE direct-attached QSFP+ to four SFP+ copper breakout cable, 1 m, 3 m, or 5 m.
40G-QSFP-QSFP-C-XXXX [7]	4×10 GbE direct-attached QSFP+ to QSFP+ copper cable, 1 m, 3 m, or 5 m.

ORDERING INFORMATION (CONTINUED)

100 GbE CFP	
100G-CFP-SR10	100 GbE CFP optic (MPO24), SR10, for distances up to 100 m over MMF
100G-CFP-LR4-10KM	100 GbE CFP optic (SC), LR4, for distances up to 10 km over SMF.
100G-CFP-10x10-2KM-OM	100 GbE CFP optic (LC), 10×10, for distances up to 2 km over SMF.
100G-CFP-10x10-10KM-OM	100 GbE CFP optic (LC), 10×10, for distances up to 10 km over SMF.
100G-CFP-ER4-40KM	100 GbE CFP optic (LC), ER4, for distances up to 40 km over SMF.

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Brocade Global Services has the expertise to help organizations build scalable, efficient cloud infrastructures. Leveraging 15 years of expertise in storage, networking, and virtualization, Brocade Global Services delivers world-class professional services, technical support, network monitoring services, and education, enabling organizations to maximize their Brocade investments, accelerate new technology deployments, and optimize the performance of networking infrastructures.

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BROCADE

Data Sheet

Cisco Aironet 1600 Series Access Point

Industrial Design

- Sleek design with internal antennas, ideal for office environments
- Extended operating temperature, ideal for factories, warehouses, and other indoor industrial environments
- Versatile RF coverage with optional external antennas
- UL 2043 plenum-rated for above-ceiling installation options or suspended from drop ceilings

Easy Installation and Power Efficient

- 802.11n performance with existing PoE switches
- Sleek design blends into a variety of indoor environments

Easy-to-Install Multipurpose Mounting Bracket

- Designed for easy replacement of existing access points
- Locks for theft protection

Deployment Options

- Controller-based or standalone deployment options

Secure Connections

- Supports rogue access point detection and denial-of service attacks
- Management frame protection detects malicious users and alerts network administrators

Cisco ClientLink 2.0 Beamforming

- Faster mobile client connections
- Support for all client types without any client requirements or dependencies
- More efficient use of mobile device batteries

Cisco CleanAir Express* Spectrum Intelligence

- Identifies, classifies and provides automatic remedial actions for different types of interference
- Locates and visualizes sources of interference

Cisco VideoStream Technology

- Efficient multicast-to-unicast conversion
- Video call admission control to prevent oversubscription
- Queue prioritization to help ensure best user experience for corporate videos

The new Cisco Aironet® 1600 Series Access Point is an enterprise-class, entry-level, 802.11n-based access point designed to address the wireless connectivity needs of small and medium-sized enterprise networks.

The Aironet 1600 Series delivers great performance at an attractive price for customers while providing advanced functionality such as CleanAir Express* for better cover through spectrum intelligence and Clientlink 2.0 for entry level networks that have a mixed client base. In addition to these features, the Aironet 1600 series includes 802.11n-based 3x3 multiple-input multiple-output (MIMO) technology with two spatial streams, making it ideal for small and medium-sized enterprises.

The Aironet 1600 Series also provides at least six times the throughput of existing 802.11a/g networks. As part of the Cisco® Aironet Wireless portfolio, the Cisco Aironet 1600 Series access point provides low total cost of ownership and investment protection by integrating seamlessly with the existing network. With an entry-level path to 802.11n migration, the Aironet 1600 Series can add capacity to the network for future growth for expanding applications and bandwidth.

Designed with rapidly evolving mobility needs in mind, the Cisco Aironet 1600 Series Access Point addresses the bring-your-own-device (BYOD) trend by providing advanced functionality at the right price point.

* Available via future release.

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RF Excellence

Building on the Cisco Aironet heritage of RF excellence, the Cisco Aironet 1600 Series delivers secure and reliable wireless connections. Enterprise-class chipsets and optimized radios deliver a robust mobility experience with:

- 802.11n with 3x3 multiple-input multiple-output (MIMO) technology with two spatial streams, which sustains 300-Mbps rates over a greater range for more capacity and reliability than competing access points
- Radio resource management (RRM): Automated self-healing optimizes the unpredictability of RF to reduce dead spots and help ensure high-availability client connections
- CleanAir Express: Effectively detects RF interference and provides basic spectrum analysis capability while simplifying ongoing operations
- Cisco ClientLink 2.0 technology: Improves downlink performance to all mobile devices including 802.11n while improving battery life on mobile devices such as smartphones and tablets
- Cisco BandSelect technology: Improves 5-GHz client connections in mixed-client environments

  Cisco VideoStream technology: Uses multicast to improve rich-media applications
- Building on the Cisco All of these features help ensure the best possible end-user experience on the wireless network. Cisco also offers the industry's broadest selection of 802.11n antennas delivering optimal coverage for a variety of deployment scenarios

Scalability

The Cisco Aironet 1600 Series is a component of the Cisco Unified Wireless Network, which can scale to up to 18,000 access points with full Layer 3 mobility across central or remote locations on the enterprise campus, in branch offices, and at remote sites. The Cisco Unified Wireless Network is the industry's most flexible, resilient, and scalable architecture delivering secure access to mobility services and applications, and offering the lowest total cost of ownership and investment protection by integrating seamlessly with the existing wired network

Cisco Network Assistant

For quick and easy setup of your access points, Cisco Network Assistant provides a centralized network view with a user-friendly GUI that simplifies configuration, management and troubleshooting. Using Cisco Network Assistant you can easily discover and initialize your network of stand-alone access points.

Cisco Network Assistant is available free, and can be downloaded here: http://www.cisco.com/go/cna.

Product Specifications

Table 1 lists the product specifications for Cisco Aironet 1600 Series Access Points.

Table 1. Product Specifications for Cisco Aironet 1600 Series Access Points

Item	Specification
Part Numbers	**The Cisco Aironet 1600i Access Point: Indoor environments, with internal antennas** • AIR-CAP1602I-x-K9 Dual-band controller-based 802.11a/g/n • AIR-CAP1602I-xK910 Eco-pack (dual-band controller-based 802.11a/g/n) 10 quantity access points • AIR-SAP1602I-x-K9 Dual-band stand-alone 802.11a/g/n • AIR-SAP1602I-xK9-5 Eco-pack (dual-band stand-alone 802.11a/g/n) 5 quantity access points **The Cisco Aironet 1600e Access Point: Indoor, challenging environments, with external antennas** • AIR-CAP1602E-x-K9 Dual-band controller-based 802.11a/g/n • AIR-CAP1602E-xK910 Eco-pack (dual-band 802.11a/g/n) 10 quantity access points • AIR-SAP1602E-x-K9 Dual-band stand-alone 802.11a/g/n • AIR-SAP1602E-xK9-5 Eco-pack (dual-band stand-alone 802.11a/g/n) 5 quantity access points

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Item	Specification
	Cisco SMARTnet® Service for the Cisco Aironet 1600 Series Access Point with internal and external antennas • CON-SNT-C1602I*x* - SMARTnet 8x5xNBD 1600i access point (dual-band 802.11 a/g/n, Controller-based), (e.g. CON-SNT-C1602IE for AP1600 internal antenna for E Domain, Controller based) • CON-SNT-C1602E*x* - SMARTnet 8x5xNBD 1600e access point (dual-band 802.11 a/g/n, Controller-based), (e.g. CON-SNT-C1602EA for AP1600 external antenna for A Domain, Controller based) • CON-SNT-S1602I*x* - SMARTnet 8x5xNBD 1600i access point (dual-band 802.11 a/g/n, Stand-alone), (e.g. CON-SNT-S1602IE for AP1600 internal antenna for E Domain, stand-alone) • CON-SNT-S1602E*x* - SMARTnet 8x5xNBD 1600e access point (dual-band 802.11 a/g/n, Stand-alone), (e.g. CON-SNT-S1602EA for AP1600 external antenna for A Domain, Stand-alone) **Cisco Wireless LAN Services** • AS-WLAN-CNSLT Cisco Wireless LAN Network Planning and Design Service • AS-WLAN-CNSLT Cisco Wireless LAN 802.11n Migration Service • AS-WLAN-CNSLT Cisco Wireless LAN Performance and Security Assessment Service **Regulatory domains: (x = regulatory domain)** Customers are responsible for verifying approval for use in their individual countries. To verify approval and to identify the regulatory domain that corresponds to a particular country, please visit: http://www.cisco.com/go/aironet/compliance. Not all regulatory domains have been approved. As they are approved, the part numbers will be available on the Global Price List.
Software	• Cisco Unified Wireless Network Software (available in Q4CY12) • Cisco IOS® Software Release (available in Q4CY12)
802.11n	• 3 x 3 multiple-input multiple-output (MIMO) with two spatial streams • Maximal ratio combining (MRC) • 20- and 40-MHz channels • PHY data rates up to 300 Mbps • Packet aggregation: A-MPDU (Tx/Rx), A-MSDU (Tx/Rx) • 802.11 dynamic frequency selection (DFS) (Bin 5) • Cyclic shift diversity (CSD) support
Data Rates Supported	**802.11a: 6, 9, 12, 18, 24, 36, 48, and 54 Mbps** **802.11g: 1, 2, 5.5, 6, 9, 11, 12, 18, 24, 36, 48, and 54 Mbps** **802.11n data rates (2.4 GHz[1] and 5 GHz):**

MCS Index[2]	GI[3] = 800ns		GI = 400ns	
	20-MHz Rate (Mbps)	**40-MHz Rate (Mbps)**	**20-MHz Rate (Mbps)**	**40-MHz Rate (Mbps)**
0	**6.5**	13.5	7.2	15
1	13	27	14.4	30
2	19.5	40.5	21.7	45
3	26	54	28.9	60
4	39	81	43.3	90
5	52	108	57.8	120
6	58.5	121.5	65	135
7	65	135	72.2	150
8	13	27	14.4	30
9	26	54	28.9	60
10	39	81	43.3	90
11	52	108	57.8	120
12	78	162	86.7	180
13	104	216	115.6	240

[1] 2.4 GHz: 2 GHz does not support 40 MHz.

[2] MCS Index: The Modulation and Coding Scheme (MCS) index determines the number of spatial streams, the modulation, the coding rate, and data rate values.

[3] GI: A Guard Interval (GI) between symbols helps receivers overcome the effects of multipath delays.

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Item	Specification				
	14	117	243	130	270
	15	130	270	144.4	300

Frequency Band and 20-MHz Operating Channels

A Regulatory Domain:
- 2.412 to 2.462 GHz; 11 channels
- 5.180 to 5.320 GHz; 8 channels
- 5.500 to 5.700 GHz; 8 channels (excludes 5.600 to 5.640 GHz)
- 5.745 to 5.825 GHz; 5 channels

C Regulatory Domain:
- 2.412 to 2.472 GHz; 13 channels
- 5.745 to 5.825 GHz; 5 channels

E Regulatory Domain:
- 2.412 to 2.472 GHz; 13 channels
- 5.180 to 5.320 GHz; 8 channels
- 5.500 to 5.700 GHz; 8 channels (excludes 5.600 to 5.640 GHz)

I Regulatory Domain:
- 2.412 to 2.472 GHz; 13 channels
- 5.180 to 5.320 GHz; 8 channels

K Regulatory Domain:
- 2.412 to 2.472 GHz; 13 channels
- 5.180 to 5.320 GHz; 8 channels
- 5.500 to 5.620 GHz; 7 channels
- 5.745 to 5.805 GHz; 4 channels

N Regulatory Domain:
- 2.412 to 2.462 GHz; 11 channels
- 5.180 to 5.320 GHz; 8 channels
- 5.745 to 5.825 GHz; 5 channels

Q Regulatory Domain:
- 2.412 to 2.472 GHz; 13 channels
- 5.180 to 5.320 GHz; 8 channels
- 5.500 to 5.700 GHz; 11 channels

R Regulatory Domain:
- 2.412 to 2.472 GHz; 13 channels
- 5.180 to 5.320 GHz; 8 channels
- 5.660 to 5.700 GHz; 3 channels
- 5.745 to 5.805 GHz; 4 channels

S Regulatory Domain:
- 2.412 to 2.472 GHz; 13 channels
- 5.180 to 5.320 GHz; 8 channels
- 5.500 to 5.700 GHz; 11 channels
- 5.745 to 5.825 GHz; 5 channels

T Regulatory Domain:
- 2.412 to 2.462 GHz; 11 channels
- 5.280 to 5.320 GHz; 3 channels
- 5.500 to 5.700 GHz; 8 channels (excludes 5.600 to 5.640 GHz)
- 5.745 to 5.825 GHz; 5 channels

Z Regulatory Domain:
- 2.412 to 2.462 GHz; 11 channels
- 5.180 to 5.320 GHz; 8 channels
- 5.500 to 5.700 GHz; 8 channels (excludes 5.600 to 5.640 GHz)
- 5.745 to 5.825 GHz; 5 channels

Note: This varies by regulatory domain. Refer to the product documentation for specific details for each regulatory domain.

Maximum Number of Nonoverlapping Channels

2.4 GHz
- 802.11b/g:
  - 20 MHz: 3
- 802.11n:
  - 20 MHz: 3

5 GHz
- 802.11a:
  - 20 MHz: 24
- 802.11n:
  - 20 MHz: 24
  - 40 MHz: 11

Note: This varies by regulatory domain. Refer to the product documentation for specific details for each regulatory domain.

Receive Sensitivity

2.4 GHz	2.4 GHz	5 GHz
802.11b	**802.11g**	**802.11a**
-101 dBm @ 1 Mb/s	-93 dBm @ 6 Mb/s	-92 dBm @ 6 Mb/s
-99 dBm @ 2 Mb/s	-93 dBm @ 9 Mb/s	-91 dBm @ 9 Mb/s
-92 dBm @ 5.5 Mb/s	-92 dBm @ 12 Mb/s	-91 dBm @ 12 Mb/s
-89 dBm @ 11 Mb/s	-90 dBm @ 18 Mb/s	-89 dBm @ 18 Mb/s
	-87 dBm @ 24 Mb/s	-86 dBm @ 24 Mb/s
	-85 dBm @ 36 Mb/s	-83 dBm @ 36 Mb/s
	-80 dBm @ 48 Mb/s	-79 dBm @ 48 Mb/s
	-79 dBm @ 54 Mb/s	-78 dBm @ 54 Mb/s

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Item	Specification		
	2.4 GHz	**5 GHz**	**5 GHz**
	802.11n (HT20)	**802.11n (HT20)**	**802.11n (HT40)**
	-93 dBm @ MCS0	-92 dBm @ MCS0	-88 dBm @ MCS0
	-91 dBm @ MCS1	-89 dBm @ MCS1	-87 dBm @ MCS1
	-89 dBm @ MCS2	-88 dBm @ MCS2	-85 dBm @ MCS2
	-86 dBm @ MCS3	-85 dBm @ MCS3	-82 dBm @ MCS3
	-83 dBm @ MCS4	-82 dBm @ MCS4	-79 dBm @ MCS4
	-78 dBm @ MCS5	-77 dBm @ MCS5	-74 dBm @ MCS5
	-77 dBm @ MCS6	-76 dBm @ MCS6	-73 dBm @ MCS6
	-76 dBm @ MCS7	-75 dBm @ MCS7	-72 dBm @ MCS7
	-93 dBm @ MCS8	-91 dBm @ MCS8	-88 dBm @ MCS8
	-90 dBm @ MCS9	-88 dBm @ MCS9	-86 dBm @ MCS9
	-88 dBm @ MCS10	-87 dBm @ MCS10	-84 dBm @ MCS10
	-85 dBm @ MCS11	-84 dBm @ MCS11	-81 dBm @ MCS11
	-81 dBm @ MCS12	-81 dBm @ MCS12	-78 dBm @ MCS12
	-77 dBm @ MCS13	-76 dBm @ MCS13	-73 dBm @ MCS13
	-76 dBm @ MCS14	-75 dBm @ MCS14	-72 dBm @ MCS14
	-74 dBm @ MCS15	-73 dBm @ MCS15	-70 dBm @ MCS15
Maximum Total Transmit Power	**2.4 GHz** • 802.11b ◦ 22 dBm (3 antennas enabled) • 802.11g ◦ 22 dBm (3 antennas enabled) • 802.11n (HT20) ◦ 22 dBm (3 antennas enabled)	**5 GHz** • 802.11a ◦ 22 dBm (3 antennas enabled) • 802.11n non-HT duplicate mode ◦ 22 dBm (3 antennas enabled) • 802.11n (HT20) ◦ 22 dBm (3 antennas enabled) • 802.11n (HT40) ◦ 22 dBm (3 antennas enabled)	

Note: The maximum power setting will vary by channel and according to individual country regulations. Refer to the product documentation for specific details.

Available Total Transmit Power Settings	**2.4 GHz**			**5 GHz**		
	Enabled antennas:			Enabled antennas:		
	1	2	3	1	2	3
	17 dBm	20 dBm	22 dBm	17 dBm	20 dBm	22 dBm
	14 dBm	17 dBm	19 dBm	14 dBm	17 dBm	19 dBm
	11 dBm	14 dBm	16 dBm	11 dBm	14 dBm	16 dBm
	8 dBm	11 dBm	13 dBm	8 dBm	11 dBm	13 dBm
	5 dBm	8 dBm	10 dBm	5 dBm	8 dBm	10 dBm
	2 dBm	5 dBm	7 dBm	2 dBm	5 dBm	7 dBm

Note: The maximum power setting will vary by channel and according to individual country regulations. Refer to the product documentation for specific details.

Integrated Antenna	• 2.4 GHz, gain 4.0 dBi, horizontal beamwidth 360° • 5 GHz, gain 4.0 dBi, horizontal beamwidth 360°
External Antenna (Sold Separately)	• Certified for use with antenna gains up to 6 dBi (2.4 GHz and 5 GHz) • Cisco offers the industry's broadest selection of 802.11n antennas delivering optimal coverage for a variety of deployment scenarios
Interfaces	• 10/100/1000BASE-T autosensing (RJ-45) • Management console port (RJ-45)
Indicators	• Status LED indicates boot loader status, association status, operating status, boot loader warnings, boot loader errors
Dimensions (W x L x H)	• Access point (without mounting bracket): 8.7 x 8.7 x 1.84 in. (22.1 x 22.1 x 4.7 cm)
Weight	• 1.9 lbs. (0.86 kg)

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Item	Specification
Environmental	**Cisco Aironet 1600i** • Nonoperating (storage) temperature: -22 to 158°F (-30 to 70°C) • Nonoperating (storage) Altitude Test -25°C, 15,000 ft. • Operating temperature: 32 to 104°F (0 to 40°C) • Operating humidity: 10 to 90% percent (noncondensing) • Operating Altitude Test -40°C, 9843 ft. **Cisco Aironet 1600e** • Nonoperating (storage) temperature: -22 to 158°F (-30 to 70°C) • Nonoperating (storage) Altitude Test - 25°C, 15,000 ft. • Operating temperature: -4 to 122°F (-20 to 50°C) • Operating humidity: 10 to 90 percent (noncondensing) • Operating Altitude Test -40°C, 9843 ft
System Memory	• 256 MB DRAM • 32 MB flash
Input Power Requirements	• AP1600: 44 to 57 VDC • Power Supply and Power Injector: 100 to 240 VAC; 50 to 60 Hz
Powering Options	• 802.3af Ethernet Switch • Cisco AP1600 Power Injectors (AIR-PWRINJ4=, AIR-PWRINJ5=) • Cisco AP1600 Local Power Supply (AIR-PWR-B=)
Power Draw	• AP1600: 12.95 W **Note:** When deployed using PoE, the power drawn from the power sourcing equipment will be higher by some amount dependent on the length of the interconnecting cable. This additional power may be as high as 2.45W, bringing the total system power draw (access point + cabling) to 15.4W.
Warranty	Limited Lifetime Hardware Warranty
Compliance	**Standards** • **Safety:** ◦ UL 60950-1 ◦ CAN/CSA-C22.2 No. 60950-1 ◦ UL 2043 ◦ IEC 60950-1 ◦ EN 60950-1 • **Radio approvals:** ◦ FCC Part 15.247, 15.407 ◦ RSS-210 (Canada) ◦ EN 300.328, EN 301.893 (Europe) ◦ ARIB-STD 33 (Japan) ◦ ARIB-STD 66 (Japan) ◦ ARIB-STD T71 (Japan) ◦ AS/NZS 4268.2003 (Australia and New Zealand) ◦ EMI and susceptibility (Class B) ◦ FCC Part 15.107 and 15.109 ◦ ICES-003 (Canada) ◦ VCCI (Japan) ◦ EN 301.489-1 and -17 (Europe) ◦ EN 60601-1-2 EMC requirements for the Medical Directive 93/42/EEC • **IEEE Standard:** ◦ IEEE 802.11a/b/g, IEEE 802.11n, IEEE 802.11h, IEEE 802.11d • **Security:** ◦ 802.11i, Wi-Fi Protected Access 2 (WPA2), WPA ◦ 802.1X ◦ Advanced Encryption Standards (AES), Temporal Key Integrity Protocol (TKIP) • **EAP Type(s):** ◦ Extensible Authentication Protocol-Transport Layer Security (EAP-TLS) ◦ EAP-Tunneled TLS (TTLS) or Microsoft Challenge Handshake Authentication Protocol Version 2 (MSCHAPv2) ◦ Protected EAP (PEAP) v0 or EAP-MSCHAPv2

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Item	Specification
	◦ Extensible Authentication Protocol-Flexible Authentication via Secure Tunneling (EAP-FAST) ◦ PEAPv1 or EAP-Generic Token Card (GTC) ◦ EAP-Subscriber Identity Module (SIM) • **Multimedia:** ◦ Wi-Fi Multimedia (WMM™) • **Other:** ◦ FCC Bulletin OET-65C ◦ RSS-102

Limited Lifetime Hardware Warranty

The Cisco Aironet 1600 Series Access Point comes with a Limited Lifetime Warranty that provides full warranty coverage of the hardware for as long as the original end user continues to own or use the product. The warranty includes 10-day advance hardware replacement and ensures that software media is defect-free for 90 days. For more details, visit: http://www.cisco.com/go/warranty.

Cisco Wireless LAN Services

Realize the full business value of your technology investments faster with intelligent, customized services from Cisco and our partners. Backed by deep networking expertise and a broad ecosystem of partners, Cisco Wireless LAN Services enable you to deploy a sound, scalable mobility network that enables rich media collaboration while improving the operational efficiency gained from a converged wired and wireless network infrastructure based on the Cisco Unified Wireless Network. Together with partners, we offer expert plan, build, and run services to accelerate your transition to advanced mobility services while continuously optimizing the performance, reliability, and security of that architecture after it is deployed. For more details, visit: http://www.cisco.com/go/wirelesslanservices.

For More Information

For more information about the Cisco Aironet 1600 Series, visit http://www.cisco.com/go/wireless or contact your local account representative.

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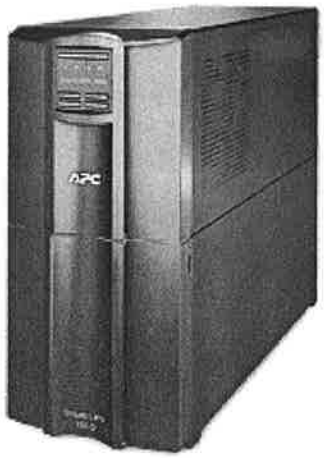
APC by Schneider Electric



APC Smart-UPS 3000VA LCD 120V
Part Number: SMT3000

SMT3000 Features

StruxureWare Central compatible	Enables centralized management via StruxureWare Central.
Predicitive failure notification	Provides early-warning fault analysis ensuring proactive component replacement.
Resettable circuit breakers	Enables a quick recovery from overload events.
Boost and Trim Automatic Voltage Regulation (AVR)	Eliminates voltage fluctuations as a source of AV signal degradation and component power-supply stress.
Serial connectivity	Use any Home Automation network to monitor and control the S20 through its RS-232 serial port. For information on how to communicate with the S20, see APC's Application Note #102. Crestron and AMX installers should visit their respective websites for information on how to integrate the S20 into those networks.
Green mode	Patent-pending operating mode that bypasses unused electrical components in good power conditions to achieve very high operating efficiency without sacrificing any protection.
Energy meter	Provides actual kilowatt hours of usage for energy conscious users.
Predictive replace battery date	Dynamically provides the month and year when battery replacement is recommended to aide in long term maintenance planning.
Intuitive LCD interface	Provides clear and accurate information in multiple languages with the ability to

	configure the UPS locally with easy to use navigation keys.
Single switched outlet group	Single outlet group that may be controlled separately from the UPS for discrete reboot of hung devices, sequenced on/off and non-critical load shedding.
Pure sine wave output on battery	Simulates utility power to provide the highest degree of compatibility for active PFC (power factor corrected) servers and sensitive electronics.
Disconnected battery notification	Warns when a battery is not available to provide backup power.
Adjustable voltage sensitivity	Provides the ability to adapt the UPS for optimal performance in specific power environments or generator applications.
Adjustable voltage-transfer points	Maximizes useful battery life by widening the input voltage window or tightening the output voltage regulation.
Audible alarms	Provides notification of changing utility power and UPS power conditions
Automatic restart of loads after UPS shutdown	Automatically starts up the connected equipment upon the return of utility power.
Automatic self-test	Periodic battery self-test ensures early detection of a battery that needs to be replaced.
Cold-start capable	Provides temporary battery power when the utility power is out.
Hot-swappable batteries	Ensures clean, uninterrupted power to protected equipment while batteries are being replaced
Network manageable	Provides remote power management of the UPS over the network.
Power conditioning	Protects connected loads from surges, spikes, lightning, and other power disturbances.
Battery failure notification	Provides early-warning fault analysis on batteries enabling timely preventive maintenance
Safety-agency approved	Ensures the product has been tested and approved to work safely with the connected service provider equipment and within the specified environment.
Serial connectivity	Provides management of the UPS via a serial port.
SmartSlot	Customize UPS capabilities with management cards.
Temperature-compensated battery charging	Prolongs battery life by regulating the charge voltage according to battery temperature.
USB connectivity	Provides management of the UPS via a USB port (not available on all models).
User-replaceable batteries	Increases availability by allowing a trained user to perform upgrades and replacements of the batteries reducing Mean Time to Repair (MTTR)
Boost and Trim Automatic Voltage Regulation (AVR)	Gives higher application availability by correcting low and high voltage conditions without using the battery (not available on all models).
Intelligent battery management	Maximizes battery performance, life, and reliability through intelligent, precision charging.

Smart-UPS Features & Benefits

Availability

Boost and Trim Automatic Voltage Regulation (AVR)	Gives higher application availability by correcting low and high voltage conditions without using the battery (not available on all models).
Intelligent battery management	Maximizes battery performance, life, and reliability through intelligent, precision charging.

Power conditioning	Protects connected loads from surges, spikes, lightning, and other power disturbances.
Temperature-compensated battery charging	Prolongs battery life by regulating the charge voltage according to battery temperature.
Automatic restart of loads after UPS shutdown	Automatically starts up the connected equipment upon the return of utility power.
Automatic self-test	Periodic battery self-test ensures early detection of a battery that needs to be replaced.
Disconnected battery notification	Warns when a battery is not available to provide backup power.

Manageability

Network manageable	Provides remote power management of the UPS over the network.
Audible alarms	Actively let you know if the unit is on battery, if the battery is low or if there is an overload condition.
LED status indicators	Quickly understand unit and power status with visual indicators.
Serial connectivity	Provides management of the UPS via a serial port.
USB connectivity	Provides management of the UPS via a USB port (not available on all models).
Disconnected battery notification	Warns when a battery is not available to provide backup power.

Serviceability

User-replaceable batteries	Increases availability by allowing a trained user to perform upgrades and replacements of the batteries reducing Mean Time to Repair (MTTR)
Hot-swappable batteries	Ensures clean, uninterrupted power to protected equipment while batteries are being replaced
Predictive failure notification	Provides early-warning fault analysis ensuring proactive component replacement.
Resettable circuit breakers	Enables a quick recovery from overload events.
Battery failure notification	Provides early-warning fault analysis on batteries enabling timely preventive maintenance

Adaptability

Adjustable voltage-transfer points	Maximizes useful battery life by widening the input voltage window or tightening the output voltage regulation.
Adjustable voltage sensitivity	Provides the ability to adapt the UPS for optimal performance in specific power environments or generator applications.

Safety

Safety-agency approved	Ensures the product has been tested and approved to work safely with the connected service provider equipment and within the specified environment.

Product Distribution

Canada, United States

*Except where noted, all prices are Estimated Resale Price (ERP) - Without Tax/VAT. Pricing in other locations and sites may vary.