

## Cisco Catalyst 6500 Series 10 Gigabit Ethernet Modules

Cisco's premier modular multilayer switch, the Cisco® Catalyst® 6500 Series delivers secure, converged services from the access layer to the core, to the data center, to the WAN edge.

Figure 1. Cisco Catalyst 6500 Series CEF720 4-port 10 Gigabit Ethernet Module (WS-X6704-10GE) and installed XENPAKs



### PRODUCT OVERVIEW

As the leading switch in 10 Gigabit Ethernet deployments, the Cisco Catalyst 6500 Series delivers 10-Gbps performance and high port density for data centers and network cores. Building upon the award-winning Catalyst 6500 Series, these 10 Gigabit Ethernet modules enable service providers and enterprises to offer new Layer 2 through 7 services and network capabilities to increase revenue and user productivity without complete equipment upgrades.

Cisco Catalyst 6500 Series 10-Gigabit Ethernet modules provide a broad selection of features, including:

- Enable new bandwidth-intensive applications—Enable new applications, including storage networking, e-learning, computer hard drive data backup, imaging and 3D modeling, and grid computing with intensive bandwidth requirements.
- Smooth migration path from Gigabit EtherChannel® technology—Attractive price per port encourages Gigabit EtherChannel deployments to migrate to 10 Gigabit Ethernet.
- High 10 Gigabit Ethernet port density—High port density, up to 32 ports per system
- Enable Cisco Catalyst 6500 Series end-to-end solutions—Suitable for distribution, core, and data center traffic aggregation, or for inter-building, points of presence (POPs), WAN edge, and MAN connections.
- Superior traffic management—Supports eight transmit queues with one strict priority queue and multiple thresholds for traffic prioritization and policing.
- Choice of media and optics—Available in IEEE 802.3ae standard interfaces: 10GBASE-SR (26 m over 62.5-micron FDDI grade multimode fiber, 300 m over 50-micron 2000 MHz\*km multimode fiber) 10GBASE-LR (10 km over single-mode fiber),

10GBASE-ER (40 km over single-mode fiber), 10GBASE-LX4 (300 m over multimode fiber); and IEEE 802.3ak standard interfaces: 10GBASE-CX4 (15 m over copper infiniband cable); and DWDM optics (up to 32 wavelengths over one strand of single mode fiber; up to 80km); all available in XENPAK form factor for modularity and flexibility in deployment.

- **Operational consistency**—Supported on Cisco Catalyst 6500 6-, 9-, and 13-slot chassis running Cisco IOS® Software and Cisco Catalyst Operating System Software; interoperable with all other interfaces and services modules.
- **Maximum network uptime and resiliency**—Support Cisco enhanced Per-Virtual LAN (VLAN) Spanning Tree Plus (PVST+) protocol, IEEE 802.1w Rapid Spanning Tree Protocol (RSTP) and IEEE 802.1s Multiple Spanning Tree (MST) protocol, Per-VLAN Rapid Spanning Tree (PVRST) protocol, Hot Standby Router Protocol (HSRP), Virtual Router Redundancy Protocol (VRRP), Cisco EtherChannel technology, and IEEE 802.3ad link aggregation for fault-tolerant connectivity.
- **Extensive management tools**—Support CiscoWorks network management platform; Simple Network Management Protocol (SNMP) versions 1, 2, and 3; and four Remote Monitoring (RMON) groups (statistics, history, alarms, and events) as well as integrated multi-gigabit network analysis modules.

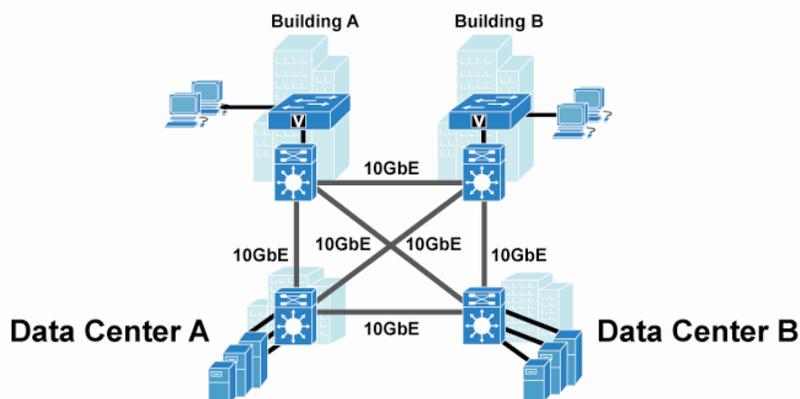
## APPLICATIONS

These 10 Gigabit Ethernet interface modules are suitable for distribution, core, and data center traffic aggregation, or for inter-building, points of presence (POPs), WAN edge, and MAN connections. Examples of these applications include data center campus connectivity applications, storage networking applications, and GRID computing applications.

### Data Center Campus Connectivity Applications

Productivity and business continuity are top concerns of companies today. Applications like e-learning and video broadcasting help improve corporate communications and information sharing anytime, anywhere. Daily desktop backups can be scheduled over the corporate network to ensure that critical information is not lost when computer hard drives fail. With improved video cameras and picture cameras, digital files are becoming larger and larger. Having a 10 Gigabit Ethernet data center connectivity prepares the network for e-learning, video broadcasting, and wide-scale desktop backups applications (Figure 2).

Figure 2. Applications: Data Center Campus Connectivity



## FEATURES AND BENEFITS

Cisco Catalyst 6500 Series switches provides 10 Gigabit Ethernet wire-speed switched connectivity over single-mode fiber, multimode fiber, and copper. The 4 port 10 Gigabit Ethernet interface module is CEF720 based and communicate using 40-Gbps connections to the integrated 720-Gbps switch fabric of the Supervisor Engine 720.

Cisco Catalyst 6500 Series 10 Gigabit Ethernet interfaces can be deployed in a wide variety of environments based on various features (Table 1).

Table 1. 4 port 10 Gigabit Ethernet Interface Module Features

Feature	WS-X6704-10GE 4 Port x 10 GE, CEF720 <sup>1</sup>
Primary application	High-performance enterprise cores and data centers, including Metro Ethernet networks, short haul transmission deployments. Add a distributed forwarding card (DFC) for high sustained performance enterprise or service provider networks.
Forwarding architecture and switch fabric connection	CEF720: Centralized supervisor engine-based forwarding (CEF) using a 40-Gbps connection to the Supervisor Engine 720's 720-Gbps switch fabric Optional full local forwarding (dCEF) distributed Cisco Express Forwarding engine using a field-upgradeable daughter card on interface module
Module performance maximum (mpps)	Centralized forwarding performance up to 30 mpps per system Fully non-blocking when using only two ports (2 and 4, 1 and 3, 1 and 4, or 2 and 3) Up to 98 percent non-blocking with all four ports active when using dCEF Distributed forwarding 48 mpps per slot for interface modules upgraded with DFCs; sustained system performance of up to 400 mpps per system
Ports, connector, and optics	4 ports SC (female) XENPAKs: XENPAK-10GB-SR XENPAK-10GB-LR XENPAK-10GB-ER XENPAK-10GB-LX4 XENPAK-10GB-CX4 DWDM-XENPAK-xx.xx , where xx.xx stands for the wavelength WDM-XENPAK-REC
Maximum port density and chassis	20 ports (13-slot) 32 ports (9-slot) 20 ports (6-slot) 12 ports (4-slot) 8 ports (3-slot)
Supervisor engines supported	Supervisor Engine 720
Performance upgrades and requirements	dCEF upgrade with Supervisor Engine 720: WS-F6700-DFC3BXL WS-F6700-DFC3B WS-F6700-DFC3A
Fabric connections	Dual 20-Gbps serial channel connections to the switch fabric of the Supervisor Engine 720
Slot requirements	Can occupy any slot in any Cisco Catalyst 6503-E, 6504-E, 6506, 6506-E, 6509, 6509-E or 6509-NEB-A chassis; can only occupy slots 9 through 13 in a Cisco Catalyst 6513 chassis
QoS queue selection criteria	CoS-queue
Scheduler	Deficit WRR
Transmit queue structure	1p7q8t (CoS to Queue)
Receive queue structure	1q8t (when using dCEF: 8q8t CoS to Queue)
Buffer size	16 MB

Jumbo frame support	up to 9216 bytes
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<sup>1</sup> For optimal performance, Cisco recommends equipping this module with a DFC.

Legend: 1p7q8t = one strict priority queue, seven WRR queues, and eight thresholds per WRR queue

### Superior Traffic Management and Queuing Characteristics

Cisco Catalyst 6500 Series 10 Gigabit Ethernet modules support multiple queues per port for quality of service. Each port supports Weighted Random Early Detection (WRED) for congestion avoidance within each queue, and Weighted Round Robin (WRR) for scheduling between queues and a strict priority queue for voice traffic. Additionally, multiple thresholds can be configured to manage differentiated levels of service. Ideal for handling mission-critical, bursting, or low-latency traffic such as enterprise resource planning (ERP) or voice applications, the CEF720-based WS-X6704-10GE enables scaling of network performance and intelligent services.

### Cisco EtherChannel Technology Increases Link Resiliency and Provides Scalable Bandwidth Aggregation

Cisco Catalyst 6500 Series modules can aggregate up to eight physical Fast Ethernet, Gigabit Ethernet, or 10 Gigabit Ethernet links into a single virtual link using the Cisco Port Aggregation Protocol (PAGP) or IEEE 802.3ad technology. This capability provides network managers a reliable high-speed solution for the campus network backbone.

Cisco Catalyst 6500 Series modules also support multi-module channeling technology, providing even greater resiliency by creating channels across ports on separate modules in the same chassis. As a result, connectivity is maintained even if one module (and corresponding ports) fails. This capability is ideal for deployments requiring scalable, flexible bandwidth within the network. Additional benefits of Cisco EtherChannel capabilities include automatic recovery and redistribution of loads across remaining links; easing management; and making the technology transparent to network applications.

### Cisco Catalyst 6500 SERIES 4-port 10 Gigabit Ethernet Interface Module, CEF720

Designed for distribution to core and data center interconnections in networks, the 4-port CEF720-based 10 Gigabit Ethernet interface modules deliver highly scalable high-performance 10 Gigabit Ethernet forwarding capabilities with optional fully distributed forwarding. The WS-X6704-10GE provides higher system port density at an affordable price, encouraging the migration from Gigabit EtherChannel deployments to 10 Gigabit Ethernet. These modules provide the following operational advantages:

- **Centralized forwarding architecture**—The supervisor's (Cisco Express Forwarding) engine performs all forwarding decisions; optional distributed forwarding is supported as an upgrade.
- **Forwarding performance**—Forwards up to 30 mpps per system (Cisco Express Forwarding) or when equipped with the optional dCEF daughter card for full local forwarding, can deliver up to 48 mpps sustained throughput per slot with sustained system throughput of up to 400 mpps.

**Note:** When two of four ports (ports 1 and 3, 2 and 4, 2 and 3, or 1 and 4) are used on this interface module, equipped with the distributed forwarding card, non-blocking performance is achieved. When all four ports are active, these ports are up to 98 percent non-blocking.

- **Distributed forwarding upgrade option**—Increases system throughput by allowing all forwarding decisions to be locally distributed to the DFC-equipped interface module; requires a WS-F6700-DFC3BXL or WS-F6700-DFC3B or WS-F6700-DFC3A and Cisco IOS native mode operation on the Supervisor Engine 720.
- **Fabric connection**—Connects through dual 20-Gbps serial-channel connections to fabric on the Supervisor Engine 720 (40 Gbps total per slot, for 80 Gbps total per slot full duplex).
- **Supervisor engine**—Requires the Supervisor Engine 720.
- **Slot and chassis requirements**—Can occupy any slot in Cisco Catalyst 6503-E, 6506, 6506-E, 6509, 6509-E or 6509-NEB-A chassis; requires slots 9 through 13 when used in the Catalyst 6513.
- **Optics**—Supports hot-pluggable XENPAK optical modules (see Table 2 for XENPAKs supported and Table 3 for cables available).

Table 2. XENPAKs for CEF720 4-port 10 Gigabit Ethernet Module

Product ID	Transceiver Type	Wavelength	IEEE Standard	Maximum Distance/Cable Type
XENPAK-10GB-SR	10GBASE-SR	850 nm Serial	802.3ae	26 m over 62.5-micron FDDI grade multimode fiber 33 m over 62.5-micron 200 MHz*km multimode fiber 66 m over 50-micron 400 MHz*km multimode fiber 82 m over 50-micron 500 MH*km multimode fiber 300 m over 50-micron 2000 MHz*km multimode fiber
XENPAK-10GB-LR	10GBASE-LR	1310 nm Serial	802.3ae	10 km over single multimode fiber
XENPAK-10GB-ER	10GBASE-ER	1550 nm Serial	802.3ae	40 km over single multimode fiber <sup>1</sup>
XENPAK-10GB-LX4	10GBASE-LX4	WWDM 1310 nm	802.3ae	300 m over 62.5-micron FDDI grade multimode fiber 240 m over 50-micron 400 MHz km multimode fiber 300 m over 50-micron 500 MHz km multimode fiber
XENPAK-10GB-CX4	10GBASE-CX4	Copper	802.3ak	15 m over 8 pair 100-Ohm infiniband cable
DWDM-XENPAK-xx.yy	DWDM	32 different wavelengths; C Band	100GHz ITU grid	32 wavelengths over single strand of single mode fiber; 80km <sup>2</sup>
WDM-XENPAK-REC	RX only WDM			RX only; no TX; 80km over single mode fiber

\* All XENPAKs have SC (female) connectors

1. According to the IEEE 802.3ae standard. Requires 5 dB 1550 nm fixed loss attenuator for <20 km; a 5 dB fixed loss attenuator is available as a spare, part number WS-X6K-5DB-ATT=. To calculate the exact distances that your module will support before installation, see Table 4 and Figure 6. The exact distance supported varies according to the number of splices and connectors in a single-mode fiber strand.

2. Any passive mux demux can be used with the DWDM XENPAKs. The ONS 15216 FlexLayer filters are one of the options.

Table 3. Cables for 10GBASE-CX4 XENPAK

Product ID	Product Description
CAB-INF-28G-1=	Cisco 1 m CX4 patch cable
CAB-INF-28G-5=	Cisco 5 m CX4 patch cable
CAB-INF-28G-10=	Cisco 10 m CX4 patch cable
CAB-INF-26G-15=	Cisco 15 m CX4 patch cable

## 10 Gigabit Ethernet Optics

Cisco Catalyst 6500 Series 10 Gigabit Ethernet modules use IEEE 802.3ae and 802.3ak standards-based 10 Gigabit Ethernet XENPAK optics (Table 4 and Figure 6).

### XENPAK Modules 4-port 10 Gigabit Interface Module

The WS-X6704-10GE supports industry XENPAK modular optics, providing both flexibility in station-to-station distances and investment protection for redeployment options. Each XENPAK supports a single 10 Gigabit Ethernet interface and can be mixed with other XENPAK optics on the same interface module for custom configurations. See Table 2 for XENPAKs supported on these modules.

Table 4. 10 Gigabit Ethernet Optical Specifications

Product ID	Transceiver Type	Wavelength	Transmit Power	Receive Power
XENPAK-GB-SR	10GBASE-SR	840 to 860 nm	Min: -7.3 dBm Max: -	Min: -9.9 dBm Max: -1.0 dBm
XENPAK-GB-LR	10GBASE-LR	1260 to 1355 nm	Min: -8.2 dBm Max: 0.5 dBm	Min: -14.4 dBm Max: 0.5 dBm
XENPAK-10GB-ER	10GBASE-ER	1530 to 1565 nm	Min: -4.7 dBm Max: 4 dBm	Min: -15.8 dBm Max: -1 dBm
XENPAK-10GB-LX4	10GBASE-LX4	Four lanes: 1269.0 to 1282.4 nm 1293.5 to 1306.9 nm 1318.0 to 1331.4 nm 1342.5 to 1355.9 nm	Min: - Max: -0.5 dBm per lane	Min: -14.4 dBm per lane <sup>1</sup> Max: -0.5 dBm per lane

<sup>1</sup>OMA sensitivity

## ORDERING INFORMATION

Table 5 lists the ordering information for Cisco Catalyst 6500 Series 10 Gigabit Ethernet interface modules.

Table 5. Product Numbers for Ordering

Product ID	Product Description
WS-X6704-10GE	Cisco Catalyst 6500 CEF720 4-port 10 Gigabit Ethernet Module, requires XENPAK
WS-F6700-DFC3BXL	Distributed Forwarding Card-3BXL Upgrade for WS-X67xx line cards using WS-SUP720-3BXL
WS-F6700-DFC3B	Distributed Forwarding Card-3B Upgrade for WS-X67xx line cards using WS-SUP720-3B
WS-F6700-DFC3A	Distributed Forwarding Card-3B Upgrade for WS-X67xx line cards using WS-SUP720
XENPAK-10GB-SR	1-port 10GBASE-SR XENPAK (multimode fiber)
XENPAK-10GB-LR	1-port 10GBASE-LR XENPAK (single-mode fiber)
XENPAK-10GB-ER	1-port 10GBASE-ER XENPAK (single-mode fiber)
XENPAK-10GB-LX4	1-port 10GBASE-LX4 XENPAK (multimode fiber)
XENPAK-10GB-CX4	1-port 10GBASE-CX4 XENPAK (copper infiniband cable)

CAB-INF-28G-1=	Cisco 1 m CX4 patch cable for XENPAK-10GB-CX4
CAB-INF-28G-5=	Cisco 5 m CX4 patch cable for XENPAK-10GB-CX4
CAB-INF-28G-10=	Cisco 10 m CX4 patch cable for XENPAK-10GB-CX4
CAB-INF-26G-15=	Cisco 15 m CX4 patch cable for XENPAK-10GB-CX4
DWDM-XENPAK-xx.yy	1 port DWDM XENPAK, where xx.yy ranges from 30.33 to 60.61 (single-mode fiber)
WDM-XENPAK-REC	1 port RX only XENPAK (single-mode fiber)

## SPECIFICATIONS

### Standard Protocols

- IEEE 802.1d, IEEE 802.1p, IEEE 802.1q, IEEE 802.1s, IEEE 802.1w, IEEE 802.3x, IEEE 802.3ad, IEEE 802.3ae, and IEEE 802.3ak

### Physical Specifications:

- Occupies one slot in the Cisco Catalyst 6500 Series chassis
- Dimensions (H x W x D): 1.2 x 14.4 x 16 in. (3.0 x 35.6 x 40.6 cm)

### Environmental Conditions

- Operating temperature: 32° to 104° F (0° to 40° C)
- Storage temperature: -40° to 167° F (-40° to 75° C)
- Relative humidity: 10 to 90 percent, non-condensing
- Operating altitude: -60 to 4000 m

### Regulatory Compliance

Cisco Catalyst 6500 Series 10 Gigabit Ethernet modules, when installed in a system, comply with the following EMI and safety standards:

- UL 1950
- CSA C22.2 No. 950
- EN 60950
- EN 60825-1
- IEC 60950
- IEC 60825-1
- TS 001
- CE marking
- AS/NZS 3260
- 21CFR1040
- FCC Part 15 (CFR 47) Class A
- VCCI Class A
- EN55022 Class A
- EN55024
- CISPR 22 Class A
- AS/NZS 3548
- ETS 300 386

**WS-X6K-5DB-ATT= Specifications**

- **Operational wavelength:** 1550 nm  $\pm$  25 nm
- **Attenuation:** 5 dB  $\pm$  1 dB
- **Return loss:** 50 dB (53 dB typical)
- **Connector:** SC
- **Dimensions:** (H x W x D): 9.0 x 12.8 x 37.0 mm
- **Operating temperature:** -20° to 70° C
- **Storage temperature:** -40° to 80° C

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**FOR MORE INFORMATION**

For more information about Cisco Catalyst 6500 Series switch, visit <http://www.cisco.com/en/US/products/hw/switches/ps708/index.html>.

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