

CATALYST 6000 FAMILY GIGABIT ETHERNET MODULES

Overview

The Catalyst® 6500 and 6000 Series meet the demands of today's most demanding and fast-growing enterprise and service-provider networks with high-performance gigabit ethernet switching modules. Available in 8- or 16-port versions, the Catalyst 6500 Series and 6000 Series Gigabit Ethernet switching modules are ideal for deployment in gigabit backbone and server-farm configurations or for aggregation of high-density 10/100-megabits per second (mbps) wiring closets. Up to eight gigabit ethernet modules can be added to a single nine-slot catalyst 6000 family, for a maximum of 130 gigabit ports per platform.

Product Description

Gigabit Ethernet Modules for the Catalyst 6000 Family

The Catalyst 6000 family, consisting of the Catalyst 6000 series and 6500 series, delivers a scalable, industry-leading Gigabit Ethernet solution for today's growing enterprise and service-provider networks. The Catalyst 6000 series delivers 32 Gigabits per second (Gbps) of backplane bandwidth, while the Catalyst 6500 series is scalable to 256 Gbps. The Catalyst 6000 family 8- and 16-port Gigabit Ethernet modules are IEEE standards compliant and support full-duplex operation. The Catalyst 6000 family provides industry leading port density of up to 194 Gigabit ports in a 13-slot chassis,

The 8-port modules (WS-X6408-GBIC, WS-X6408A-GBIC) can be configured with shortwave (SX), longwave/long-haul (LX/LH), and extended-range (ZX) gigabit interface converters (GBICs). All Gigabit Ethernet ports on these modules have SC-type connectors for multimode fiber (MMF) or single-mode fiber (SMF).

Designed for a wide range of Gigabit Ethernet applications, the 16-port Gigabit Ethernet modules are available in a variety of interfaces: small form factor MT-RJ connectors, SX, LX/LH, and ZX GBICs, and RJ-45 connectors for Category 5 copper cabling.

Figure 1 16-Port 10/100/1000 BASE-T Module (WS-X6516-GE-TX)



Figure 2 16-Port GBIC-based Gigabit Ethernet Module (WS-X6416-GBIC)

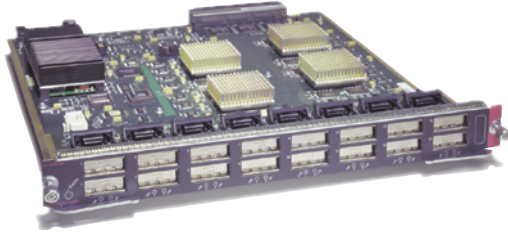


Figure 3 16-Port RJ-45 Gigabit Ethernet Module (WS-X6316-GE-TX)

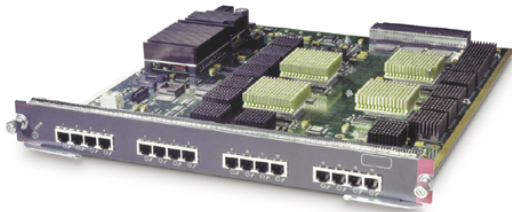
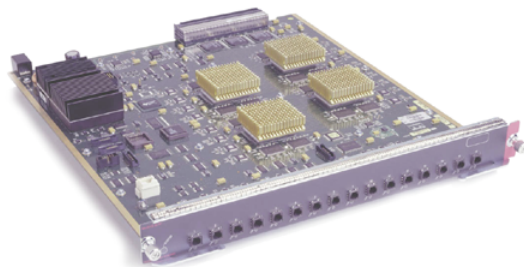


Figure 4 16-Port MT-RJ Gigabit Ethernet Module (WS-X6416-GE-MT)



Switch Fabric-Enabled Modules for the Catalyst 6500 Series

The Catalyst 6500 series is scalable to 256 Gbps of switching bandwidth using a cross-bar switching fabric architecture. New fabric-enabled Gigabit Ethernet modules support the 256-Gbps platform, delivering a new level of system performance for gigabit switching. Up to 176 fabric-enabled Gigabit Ethernet ports can be supported in a single 13-slot chassis.

Designed to meet the growing demand of gigabit switching applications in both the enterprise and service-provider networks, a wide range of 16-port fabric-enabled Gigabit Ethernet modules are available for the Catalyst 6500 series 256-Gbps platform. These fabric-enabled gigabit modules come with either a single or dual interfaces to the switching fabric with centralized or distributed forwarding capabilities, providing excellent scalability and performance. These fabric-enabled gigabit modules all support the GBIC interfaces (SX, LX/LH, and ZX), or Category 5 RJ-45 copper interfaces providing further flexibility in system design.

The Catalyst 6500 series 256-Gbps platform supports hardware-based Cisco Express Forwarding (CEF), as well as distributed CEF for maximum control-plane and forwarding performance. This is ideally suited for gigabit switching applications such as e-commerce, Web hosting, and content delivery in enterprise and service-provider networks. All fabric-enabled Gigabit Ethernet modules can support distributed forwarding. For those modules utilizing centralized forwarding, the distributed-forwarding capabilities can be added later via a daughter-card field upgrade, providing maximum system flexibility and scalability.



Figure 5 16-port Fabric-Enabled GBIC-based Gigabit Ethernet Module, Single Fabric Interface (WS-X6516-GBIC)

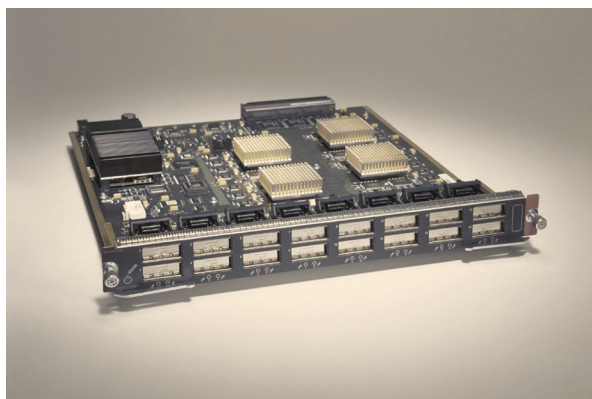


Figure 8 Eight-Port GBIC-based Gigabit Ethernet Module (WS-X6408-GBIC, WS-X6408A-GBIC)



Figure 6 Distributed Forwarding Daughter Card (WS-F6K-DFC)

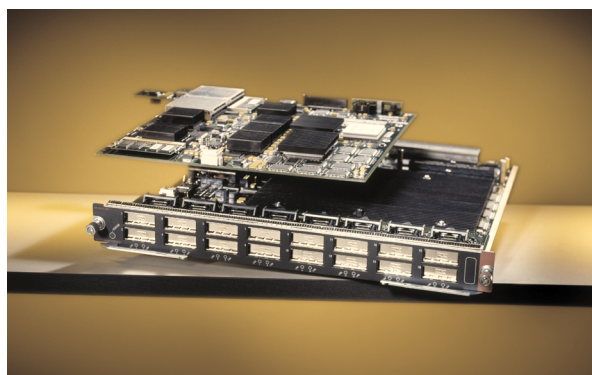


Figure 7 16-port Fabric-Enabled GBIC-based Gigabit Ethernet Module with Distributed Forwarding Dual Fabric Interfaces (WS-X6816-GBIC)

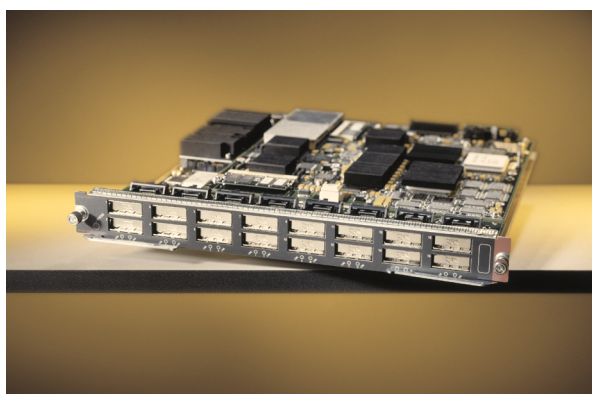




Table 1 Catalyst 6000 Family Gigabit Ethernet Module Offerings

Product Number	Backplane Connection	Forwarding	Number of Transmit Queues per Port	Number of Receive Queues per Port
WS-X6408-GBIC	Bus	Centralized	2	1
WS-X6408A-GBIC	Bus	Centralized	3	2
WS-X6416-GBIC	Bus	Centralized	3	2
WS-X6416-GE-MT	Bus	Centralized	3	2
WS-X6316-GE-TX	Bus	Centralized	3	2
WS-X6516-GBIC	Switch Fabric and Bus	Centralized: support for Distributed Forwarding (dCEF) with optional daughter card	3	2
WS-X6516-GE-TX	Switch Fabric and Bus	Centralized:support for Distributed Forwarding (dCEF) with optional daughter card	3	2
WS-X6816-GBIC	Switch Fabric (dual channel interfaces)	Distributed Forwarding(dCEF) with integrated distributed forwarding card.	3	2

Key Benefits

Scalable and High-Performance Gigabit Ethernet Connectivity

The Catalyst 6000 family scales to support up to 194 Gigabit Ethernet interfaces (eight 16-port Gigabit Ethernet modules, plus two Gigabit Ethernet ports on the supervisor) to provide industry-leading port density and scalability. For the high-performance 256-Gbps Catalyst 6500 series platform, support for up to 178 Gigabit Ethernet interfaces (fabric-enabled) is provided. Each 8- or 16-port Gigabit Ethernet module occupies a single Catalyst 6000 family slot with no slot dependency. Supporting an advanced crossbar switching fabric architecture, the Catalyst 6500 series scales to provide 256 Gbps of backplane bandwidth. With support for Forwarding Information Base (FIB)-based technology using the proven CEF architecture that also enables distributed forwarding (dCEF), the Catalyst 6500 series can further scale in performance switching up to 100+ Mpps while providing a comprehensive set of intelligent services such as advanced quality of service (QoS), high availability, and advanced security services.

Gigabit EtherChannel Technology for Future-Proof Backbones

Cisco Gigabit EtherChannel® technology is based on proven EtherChannel technology pioneered by Cisco with thousands of Fast EtherChannel ports deployed in production networks. Gigabit EtherChannel technology enables critical backbone trunks to be scaled to multiple gigabits of throughput as backbone traffic continues to grow. By combining eight Gigabit Ethernet links into one logical link, up to 16 Gbps of throughput is possible between devices. Port Aggregation Protocol (PAP) allows for dynamic creation of Gigabit Ethernet channels between devices. Customers can take advantage of the new multimodule channeling feature that combines ports from the same module or from different modules into a Gigabit EtherChannel link. Furthermore, Gigabit EtherChannel technology provides an unmatched level of resiliency. If one physical port on a Gigabit EtherChannel link goes down, all traffic on that port is automatically redirected and load balanced to the remaining ports. This redirection happens without operator intervention, assuring maximum backbone throughput and availability.

Modular Gigabit Interfaces Provide Choice and Upgrade Flexibility

The 8- and 16-port Gigabit Ethernet modules in the Catalyst 6000 family support GBIC modular technology to ensure customers have the maximum flexibility in configuring physical network interfaces in their Gigabit Ethernet network. GBICs enable the customer to intermix any combination of 802.3z-compliant 1000BASE-X interfaces on a port-by-port basis. GBICs are hot-swappable and provide easy selection or change of interfaces. Cisco is offering a 1000BASE-LX/LH interface that is fully compliant with the IEEE 802.3z 1000BASE-LX standard, but has the ability to go up to 10 km over single-mode fiber, 5 km further than garden-variety 1000BASE-LX interfaces. The 1000BASE-ZX standard has the ability to transmit traffic up to 100 km over dispersion-shifted fiber. Up to 12 1000BASE-ZX ports are supported in a Catalyst 6000 family switch.

Gigabit over Copper

The 16-port Gigabit Ethernet module with RJ-45 interfaces is IEEE 802.3ab standards compliant, allowing gigabit-speed transmission up to 100m over Category 5 unshielded twisted-pair (UTP) cables. With intelligent network services such as advanced QoS and Gigabit EtherChannel technology, this is ideally suited for applications such as server-farm aggregation, providing a highly reliable and cost-effective solution for high-speed server connectivity. The Fabric-enabled 16-port 10/100/1000 BASE-T Gigabit Ethernet module with autosensing enables seamless migration to Gigabit Ethernet from servers or workstations.

Gigabit Module Hot-Swapping for Maximum Uptime

Catalyst 6000 family switches support advanced technology, enabling removal and replacement of Gigabit Ethernet interface modules without powering down the switch. This feature is known as hot-swapping. When a Gigabit Ethernet module is removed or inserted while the switch is powered on and operating, the system:

- Determines whether there is sufficient power for the module
- Scans the backplane for configuration changes
- Initializes all newly inserted switching modules

- Places any previously configured interfaces on the switching module back to the state they were in when they were removed

The ability to hot-swap Gigabit Ethernet modules in the Catalyst 6000 family switches enables maximum system uptime in addition to the configuration flexibility many customers want and need.

Superior Traffic Management

The Catalyst 6000 family Gigabit Ethernet modules support multiple priority queues for QoS. Each Gigabit Ethernet port supports Weighted Random Early Detection (WRED) for congestion avoidance with queues, and Weighted Round Robin (WRR) for scheduling between queues. Multiple receive and transmit queues are dedicated per port, and they enable separate delivery paths for mission-critical traffic such as enterprise resource planning (ERP) or voice applications. Additionally, each queue supports multiple configurable thresholds to manage differentiated levels of service.

Advanced Manageability for Maximum Availability

The Catalyst 6000 family offers advanced network management features to make it easy to configure and monitor Gigabit Ethernet modules within the Catalyst system from the CiscoWorks enterprise management console. Each module has extensive interface-level statistics, including four Remote Monitoring (RMON) groups (groups 1, 2, 3, and 7 for statistics, history, alarms, and events, respectively). For in-depth network analysis, users can employ the Enhanced Switched Port Analyzer (Enhanced SPAN) feature to redirect traffic from each module to a specific virtual LAN (VLAN), allowing the user to add, move, and easily change group access to network resources from centralized locations using CiscoWorks.

The following table summarizes the various interfaces and distances supported by all of the Gigabit Ethernet modules in the Catalyst 6000 family:

Table 2 Interfaces and Distances Supported by Gigabit Ethernet Modules in the Catalyst 6000 Family

Module	No. of Ports	Interface/Fiber Core	62.5 um MM 160/500 MHz-km	275m	62.5 um MM 200/500 MHz-km	50 um MM 400/400 MHz-km	50 um MM 500/500 MHz-km	9/10 um Single Mode	Dispersion Shifted	Cat 5 UTP
WS-X6416-GE-MT	16	MT-RJ	220m	275m	500m	550m				
WS-X6408-GBIC	8	1000BASE-SX	220m	275m	500m	550m				
WS-X6408A-GBIC	8	1000BASE-SX	220m	275m	500m	550m				
WS-X6416-GBIC	16	1000BASE-SX	220m	275m	500m	550m				
WS-X6516-GBIC	16	1000BASE-SX	220m	275m	500m	550m				
WS-X6816-GBIC	16	1000BASE-SX	220m	275m	500m	550m				
WS-X6408-GBIC	8	1000BASE-LX/LH ¹	550m	550m	550m	550m		10 km		
WS-X6408A-GBIC	8	1000BASE-LX/LH	550m	550m	550m	550m		10 km		
WS-X6416-GBIC	16	1000BASE-LX/LH	550m	550m	550m	550m		10 km		
WS-X6516-GBIC	16	1000BASE-LX/LH	550m	550m	550m	550m		10 km		
WS-X6816-GBIC	16	1000BASE-LX/LH	550m	550m	550m	550m		10 km		
WS-X6408-GBIC	8	1000BASE-ZX						70 km	100 km	
WS-X6408A-GBIC	8	1000BASE-ZX						70 km	100 km	
WS-X6416-GBIC	16	1000BASE-ZX						70 km	100 km	
WS-X6516-GBIC	16	1000BASE-ZX						70 km	100 km	
WS-X6816-GBIC	16	1000BASE-ZX						70 km	100 km	
WS-X6316-GE-TX	16	RJ-45								100 m
WS-X5316-GE-TX	16	RJ-45								

1. Cisco 1000BASE-LX/LH interfaces fully comply with the IEEE 802.3z 1000BASE-LX standard. However, their higher optical quality allows them to reach 10 km over single-mode fiber versus the 5 km specified in the standard.

Features

- Supports up to 194 Gigabit Ethernet ports per Catalyst 6500 Series Switch for 32-Gbps systems; supports up to 178 Gigabit Ethernet ports per Catalyst 6500 series switch for 256-Gbps systems.
- The Gigabit Ethernet modules in the Catalyst 6500 Series are based on industry-standards IEEE 802.3z and IEEE 802.3ab, ensuring vendor interoperability and long-term investment protection.

- GBIC-based Gigabit Ethernet modules enable data transmission up to 100 km, supporting fiber-optic SC interfaces for both multimode and single-mode connectivity.
- Copper-based Gigabit Ethernet modules enable transmission at 10/100/1000 or 1000 Mbps speeds up to 100m over Category 5 cables.

- Supports up to twelve modules per platform--up to eleven modules for fabric-enabled modules because one slot is used by the switch fabric module itself
- Gigabit Ethernet modules require one slot; there is no slot dependency for any Gigabit Ethernet module except for the dual fabric channel interfaces Gigabit Ethernet module (WS-X6816-GVIC), which can be placed in slot 9 through 13 of the Catalyst 6513 chassis, or any slot of the Catalyst 6506 or Catalyst 6509 chassis
- Modules can be “mixed and matched” with other modules, and can be hotswapped or added as needed without resetting the Catalyst 6000 Family switch
- Support for dCEF for fabric-enabled Gigabit Ethernet modules, providing maximum control plane and forwarding performance.
- Support for auto-negotiation flow control.
- Accommodates different traffic patterns with superior traffic management with large per-interface buffers and multiple priority queues.
- Supports multiple active Media Access Control (MAC) addresses (up to 32,000) on a switching port and dynamically allocates to any port.
- Support for the spanning-tree algorithm on logical VLANs for fault-tolerant connectivity; these modules are capable of supporting up to 4000 VLANs between Catalyst 6000 family switching platforms and Cisco routers.
- Easily managed using Simple Network Management Protocol (SNMP) network management platforms such as CiscoWorks for Switched Internetworks.
- Support for four RMON groups: statistics, history, alarms, and events.

Ordering Information

WS-X6408-GBIC	8-port Gigabit Ethernet module for the Catalyst 6000 family switches; requires GBICs
WS-X6408A-GBIC	8-port Gigabit Ethernet module for the Catalyst 6000 family switches with enhanced QoS; requires GBICs
WS-X6416-GBIC	16-port Gigabit Ethernet module for the Catalyst 6000 family switches; requires GBICs
WS-X6416-GE-MT	16-port Gigabit Ethernet module for the Catalyst 6000 family switches; MT-RJ
WS-X6316-GE-TX	16-port Gigabit Ethernet module for the Catalyst 6000 family switches; RJ-45
WS-X6516-GE-TX	16-port 10/100/1000 Mbps Ethernet module for the Catalyst 6500 series switches with single fabric channel interface; upgradeable to support distributed forwarding via the addition of distributed forwarding daughter card (WS-F6K-DFC)
WS-X6516-GBIC	16-port fabric-enabled Gigabit Ethernet module for the Catalyst 6500 series switches with single fabric channel interface; requires GBICs; upgradeable to support distributed forwarding via the addition of the distributed forwarding daughter card (WS-F6K-DFC)
WS-F6K-DFC	Distributed forwarding daughter card
WS-X6816-GBIC	16-port fabric-enabled Gigabit Ethernet module for the Catalyst 6500 series switches with dual fabric channel interfaces and distributed forwarding; requires GBICs
WS-G5484	1000BASE-SX SX GBIC (multimode only)
WS-G5485	1000BASE-LX/LH LH GBIC (single mode or multimode)
WS-G5487	1000BASE-ZX ZX GBIC (single mode)

Specifications

Standard Protocols

- IEEE 802.3z, IEEE 802.3x, IEEE 802.3ab, IEEE 802.1Q, IEEE 802.1p

Physical Specification

- Occupies one slot in the Catalyst 6000 family platform
- 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%, noncondensing
- Operating altitude: -60 to 4000m
- Mean Time Between Failure (MTBF): seven years for system configuration

Safety Compliance

Catalyst 6000 family Gigabit Ethernet modules, when installed in a system, comply with the following compliance 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

EMC Compliance

Catalyst 6000 family Gigabit Ethernet modules, when installed in a system, comply with the following EMI standards:

- FCC Part 15 (CFR 47) Class A
- VCCI
- EN55022
- EN55024
- CISPR 22
- CE marking
- AS/NZS 3548

Network Management

- ETHERLIKE-MIB (RFC 1643)

- IF-MIB (RFC 1573)
- Bridge MIB (RFC 1493)
- CISCO-STACK-MIB
- CISCO-VTP-MIB
- CISCO-CDP-MIB
- RMON MIB (RFC 1757)
- CISCO-PAGP-MIB
- CISCO-STP-EXTENSIONS-MIB
- CISCO-VLAN-BRIDGE-MIB
- CISCO-VLAN-MEMBERSHIP-MIB
- ENTITY-MIB (RFC 2037)
- HC-RMON
- RFC1213-MIB (MIB-II)
- SMON-MIB

Maximum Station-to-Station Cabling Distance

- 1000BASE-SX: 62.5 um multimode fiber: up to 275m
- 1000BASE-SX: 50 um multimode fiber: up to 550m
- 1000BASE-LX: 62.5 um multimode fiber: up to 550m
- 1000BASE-LX: 50 um multimode fiber: up to 550m
- 1000BASE-LX: 9/10 um single mode fiber: up to 5 km
- 1000BASE-LH: 62.5 um multimode fiber: up to 550m
- 1000BASE-LH: 50 um multimode fiber: up to 550m
- 1000BASE-LH: 9/10 um single mode fiber: up to 10 km
- 1000BASE-ZX: 9/10 um single mode fiber: up to 70 km
- 1000BASE-ZX: disposition shifted fiber: up to 100 km
- 1000BASE-T: Category 5 cable: up to 100m
- 10/100/1000BASE-T: Category 5 cable: up to 100m

Indicators and Interfaces

- Status: green (operational)/red (faulty)/orange (module booting or running diagnostics)
- Link good: green (port active)/orange (disabled)/off (not active/connected)/blinking orange (failed diagnostic and disabled)
- 1000BASE-SX: GBIC (female, multimode)
- 1000BASE-LX/LH: GBIC (female, multimode)
- 1000BASE-LX/LH: GBIC (female, single mode)
- 1000BASE-ZX: GBIC (female, single mode)
- 1000BASE-ZX: GBIC (female, dispersion shifted)
- 1000BASE-SX: MT-RJ (female, multimode)
- 1000BASE-T: RJ-45
- 10/100/1000BASE-T: RJ-45



Corporate Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 526-4100

European Headquarters
Cisco Systems Europe
11, Rue Camille Desmoulins
92782 Issy Les Moulineaux
Cedex 9
France
www.cisco.com
Tel: 33 1 58 04 60 00
Fax: 33 1 58 04 61 00

Americas Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
www.cisco.com
Tel: 408 526-7660
Fax: 408 527-0883

Asia Pacific Headquarters
Cisco Systems Australia, Pty., Ltd
Level 17, 99 Walker Street
North Sydney
NSW 2059 Australia
www.cisco.com
Tel: +61 2 8448 7100
Fax: +61 2 9957 4350

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