

Cisco Catalyst 6500 Series Ethernet and Fast Ethernet Switching Modules

The Cisco Catalyst® 6500 Series offers a full line of Ethernet and Fast Ethernet switching modules that deliver advanced features, high performance, excellent scalability, and superior manageability. With support for user-upgradeable inline power, these modules enable the Catalyst 6500 Series to bring data, voice, and video integration onto a single platform for fully integrated communications in the access, distribution, and core layers of the network.

The Cisco Catalyst 6500 Series Ethernet and Fast Ethernet switching modules offer unparalleled physical interface flexibility, and support wire-speed, switched connectivity for unshielded twisted-pair (UTP), shielded twisted-pair (STP), and fiber-optic cable. Up to 12 48-port 10/100 modules can be added to a Cisco Catalyst 6500 Series platform representing industry-leading performance and scalability for the customers.

The Inline Power 10/100BASE-T Ethernet switching module enables the Cisco Catalyst® 6500 Series to be the industry's first platform to support new Fast Ethernet features necessary for campus network data/voice convergence.

48-port 10/100 Ethernet modules can be field-upgradeable to support Cisco Inline Power to provide a seamless data/voice converged solution, and are designed to support future upgrade to IEEE 802.3af inline power standard for maximum investment protection.

Figure 1
 48-port 10/100 Fast Ethernet Modules, upgradeable to Inline Power, RJ-45 and RJ-2

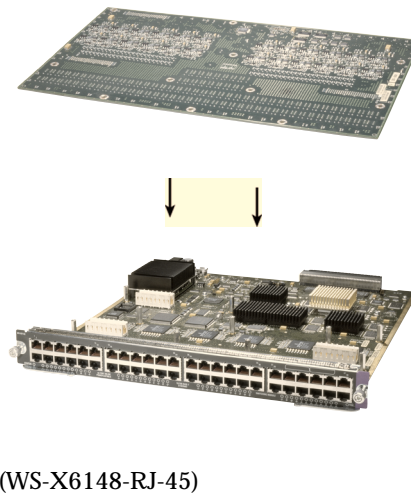
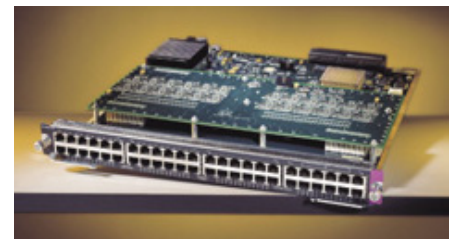


Figure 2
 Inline Power 10/100 Fast Ethernet Modules, RJ-45 and RJ-21



(WS-X6348-RJ45V)



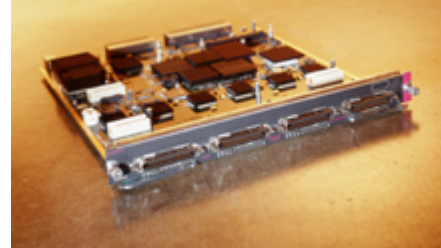
(WS-X6348-RJ21V and WS-X6148-RJ21V)



Figure 3
Fabric-Enabled 10/100 Fast Ethernet Modules, RJ-45 and RJ-21



(WS-X6548-RJ-45)



(WS-X6548-RJ-21)

Figure 4
Fabric-Enabled 100FX Fast Ethernet Module, Multimode Fiber, MT-RJ



(WS-X6524-100FX-MM)

Table 1 Key Feature Characteristics Matrix

Product Number	Interface	Backplane Connection	Forwarding	Inline Power	Queues per Port	Primary Applications
WS-X6148-RJ-45	10/100, RJ-45	32 Gbps Bus	Centralized	Upgradeable to Cisco Inline Power and IEEE 802.3af standard	2 transmit, 1 receive	Wiring Closet
WS-X6148-RJ-21	10/100, RJ-21	32 Gbps Bus	Centralized	Upgradeable to Cisco Inline Power and IEEE 802.3af standard	2 transmit, 1 receive	Wiring Closet
WS-X6148-RJ45V	10/100, RJ-45	32 Gbps Bus	Centralized	Yes	2 transmit, 1 receive	Wiring Closet
WS-X6348-RJ45V	10/100, RJ-45	32 Gbps Bus	Centralized	Yes	2 transmit, 1 receive	Wiring Closet
WS-X6148-RJ21V	10/100, RJ-21	32 Gbps Bus	Centralized	Yes	2 transmit, 1 receive	Wiring Closet
WS-X6348-RJ21V	10/100, RJ-21	32 Gbps Bus	Centralized	Yes	2 transmit, 1 receive	Wiring Closet



Table 1 Key Feature Characteristics Matrix

Product Number	Interface	Backplane Connection	Forwarding	Inline Power	Queues per Port	Primary Applications
WS-X6548-RJ-45	10/100, RJ-45	Switch Fabric and Bus	Centralized; support for (dCEF) with optional daughter card	No	4 transmit, 2 receive; including one strict priority queue in each direction	Distribution and Core, Server Farm and Data Center
WS-X6548-RJ-21	10/100, RJ-21	Switch Fabric and Bus	Centralized; support for (dCEF) with optional daughter card	No	4 transmit, 2 receive; including one strict priority queue in each direction	Distribution and Core, Server Farm and Data Center
WS-X6324-100FX-MM	100FX, mm, MT-RJ	32 Gbps Bus	Centralized	No	2 transmit, 1 receive	Access, Distribution and Core, Server Farm and Data Center
WS-X6324-100FX-SM	100FX, sm, MT-RJ	32 Gbps Bus	Centralized	No	2 transmit, 1 receive	Distribution and Core
WS-X6524-100FX-MM	100FX, mm, MT-RJ	Switch Fabric and Bus	Centralized; support for (dCEF) with optional daughter card	No	4 transmit, 2 receive; including one strict priority queue in each direction	Distribution and Core, Server Farm and Data Center
WS-X6024-10FL-MT	10FL, mm, MT-RJ	32 Gbps Bus	Centralized	No	2 transmit, 1 receive	Wiring Closet

Inline Power 10/100 Ethernet Switching Modules

Cisco is using the Cisco Catalyst 6500 Series to lead its customers to campus convergence. The first product features to be introduced are Fast Ethernet enhancements delivered by the 48-port Inline Power 10/100BASE-T Ethernet switching module. These modules introduce the following features for campus multiservice networking:

- Inline power
- Phone discovery
- Auxiliary virtual LANs (VLANs)



Inline Power

Inline Power is 48-volt DC power provided over standard Category 5 unshielded twisted-pair (UTP) cable up to 100 meters. Instead of requiring wall power, terminal devices such as IP telephones or wireless access points can utilize power provided from the Cisco Catalyst 6500 Series switches. Inline power is also used by other powered devices such as wireless access points and will include other devices as this technology evolves. This capability gives the network administrator centralized power control, which translates into greater network availability. By deploying Cisco Catalyst 6500 Series switches with uninterruptible power supply (UPS) systems in secured wiring closets, network administrators can ensure that building power outages will not affect network telephony connections.

Inline power is also used by other powered devices such as wireless access point and will have further uses as this technology evolves.

The inline power feature will work over customers' existing Category 5 UTP installations. The Cisco Catalyst inline power implementation passes the required domestic and international safety regulations and compliance measures. These modules are fully compliant with the 802.3 standard when no inline power is supplied. The 802.3 standard does not include specifications for providing power over Ethernet; this omission will be amended by the 802.3af task force currently under way in the Institute of Electrical and Electronics Engineers (IEEE). Cisco is committed to standards-based operation and will support the IEEE in its efforts to add Ethernet power specifications to the 802.3 Ethernet standard. The 48-port 10/100 Ethernet modules (WS-X6148-RJ-45 and WS-X6148-RJ-21) are designed to fully support future upgrade to the IEEE 802.3af inline power standard for maximum investment protection.

Phone Discovery

The Cisco phone discovery feature eases the network management burden by automating the inline power feature. With phone discovery, the Cisco Catalyst switch automatically detects the presence of an IP phone and supplies inline power. This means that network administrators can maintain centralized control without the need to manually enable each port to supply inline power. The phone discovery mechanism is intelligent enough to differentiate between an IP phone and a network interface card (NIC), and will not supply inline power to an NIC or other device not designed to use inline power. Therefore, network administrators can depend upon automatic and centralized control of inline power that is safe to deploy and maintain.

Auxiliary VLAN

Another feature that demonstrates the advanced Cisco IP telephony leadership is the unique auxiliary VLAN feature. This feature provides automatic VLAN configuration for IP telephones. This feature overcomes the complexity of overlaying a voice topology onto a data network. Network administrators can easily segment phones into separate logical networks, even though the data and voice infrastructure is physically the same.

The auxiliary VLAN places the phones into their own VLANs without any end-user intervention. Furthermore, these VLAN assignments can be seamlessly maintained, even if the phone is moved to a new location. The user simply plugs the phone into the switch, and the switch will provide the phone with the necessary VLAN information. By placing phones into their own VLANs, network administrators gain the advantages of network segmentation and control. Furthermore, network administrators can preserve their existing IP topology for the data end stations. IP phones can be easily assigned to different IP subnets using standards-based Dynamic Host Configuration Protocol (DHCP) operation. With the phones in their own IP subnets and VLANs, network administrators can more easily identify and troubleshoot network problems.



Additionally, network administrators can create and enforce quality of service (QoS) or security policies. With the auxiliary VLAN feature, Cisco enables network administrators to gain all the advantages of physical infrastructure while maintaining separate logical topologies for voice and data terminals. This creates the most effective way to manage a multiservice network.

The auxiliary VLAN feature uses 802.1Q as the standards-based VLAN tagging mechanism between the switch and phone. On the link between phone and switch, voice packets going to and from the phone are tagged with VLAN information. Packets going to and from the data end station remain untagged in the default configuration. Since the configuration between switch and phone is fully automated, the network administrator receives the benefits of VLANs without configuration complexity.

Switch Fabric-Enabled Modules for the Cisco Catalyst 6500 Series

The Cisco Catalyst 6500 series is scalable to 256 Gbps of switching bandwidth using a cross-bar switching fabric architecture. New fabric-enabled Fast Ethernet modules (10/100 or 100FX) support the 256-Gbps platform, delivering a new level of system performance for Fast Ethernet switching. Up to 528 fabric-enabled 10/100 Fast Ethernet ports or 264 fabric-enabled 100FX ports can be supported in a single Cisco Catalyst 6500 Series 13-slot chassis.

Designed to support the Cisco Catalyst 6500 256-Gbps platform, these new modules (48-port 10/100 and 24-port 100FX) enable Enterprise and Service Provider customers to scale their networks to meet their growing demands. With connections to both the switch fabric and the bus, these modules offer a new level of unparalleled network redundancy. They are ideally suited for the distribution and core layers for high performance 10/100 Ethernet aggregation, and for data center or web hosting applications. In a system with Supervisor Engine 2, these modules support Cisco Express Forwarding (CEF) and can be easily field-upgraded in the field to provide distributed forwarding with the addition of the Distributed Forwarding daughter card, providing maximum system performance and scalability.

High Performance and Scalability to Support the Largest Multiservice Networks

The Fast Ethernet switching modules for the Cisco Catalyst 6500 Series support up to 48 ports per module (10/100 with RJ-45 or RJ-21 interfaces). With 12 available slots in the Cisco Catalyst 6513 (WS-C6513), the platform can handle up to 576 Fast Ethernet 10/100 ports to support the largest Fast Ethernet multiservice networks.

To support the new demand for phone power provided with the inline power feature, Cisco has developed a new 4000-watt power supply for the Cisco Catalyst 6500 Series. This power supply has been designed to work in Cisco Catalyst 6500 Series chassis that will be loaded with inline power modules and IP phones. For fault tolerance, two power supplies can be deployed in a single chassis to guard against the failure of a single power supply. The maximum number of IP phones that can be powered centrally by a Cisco Catalyst 6500 Series switch will ultimately depend on the type and model of IP phone deployed. The power management feature of the Cisco Catalyst 6500 Series switch will monitor the overall system power budget as IP phones are added to the network and alert the network administrator as power thresholds are reached.



Flexibility for Converged Networks

The Cisco Catalyst 6500 Series Fast Ethernet switching modules offer several advanced features that make it easier to migrate to or implement Converged network. All of the 10/100 Fast Ethernet switching modules, for example, support autosensing and autonegotiation to determine the speed and duplex mode of an attached device. Inline power 10/100 modules provide the infrastructure for voice/data/video convergence. Fast Ethernet switch module customers have the flexibility to select modules with RJ-45, RJ-21, or fiber MT-RJ interfaces. Customers can use category 3 through category 5 UTP cable or STP cable or multimode fiber (62.5/125 micron) or single-mode fiber. All Fast Ethernet switching modules are hot swappable without interruption of the Cisco Catalyst 6500 Series switch.

The Cisco Catalyst 6500 Series of switches maintains up to 128K active Media Access Control (MAC) addresses in the bridge lookup table. The standard 802.1d spanning-tree algorithm is supported on a VLAN basis for fault-tolerant connectivity.

Increased Link Resiliency and Bandwidth Aggregation

The Cisco Catalyst 6500 Series Fast Ethernet modules fully support Cisco Fast EtherChannel[®] technology, giving network managers a reliable high-speed solution for the campus network backbone. Fast EtherChannel provides flexible, incremental bandwidth aggregation in multiple 200 Mbps increments, up to 1.6 Gbps per Fast EtherChannel link. Customers can take advantage of the multimodule channeling feature that combines ports from the same module or from different modules into a Fast EtherChannel link. This is ideal for customers requiring scalable, flexible bandwidth within the network. Customers also benefit from Fast EtherChannel automatic recovery and redistribution of loads across remaining links; ease of management; and technology that is transparent to network applications.

Advanced Manageability for Maximum Availability

The Cisco Catalyst 6500 Series offers advanced network management features to make it easy to manage fast-growing networks. Each module has extensive interface-level statistics including four remote monitoring (RMON) groups, alarms, events, history, and statistics. Additional RMON groups (all nine groups) may be monitored using the integrated Cisco Catalyst 6500 Series network analysis module (NAM) or switch probes. For in-depth network analysis, the Enhanced Switched Port Analyzer (Enhanced SPAN) feature enables network managers to redirect traffic from each switched port to a specific virtual LAN (VLAN), allowing them to add, move, and easily change group access to network resources from centralized locations using CiscoWorks network management software. Support for local, out-of-band management is delivered through a terminal or modem attached to the console/aux interface and remote in-band management is available via Simple Network Management Protocol (SNMP).

Hot-Swapping Modules

The Cisco Catalyst 6500 Series enables you to remove and replace Ethernet and Fast Ethernet switching modules without powering down the switch. This feature is known as hot swapping. When a 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 modules in the Cisco Catalyst 6500 Series switches enables maximum system uptime in addition to configuration flexibility.

Superior Traffic Management

The Cisco Catalyst 6500 Series Ethernet and Fast Ethernet modules support multiple priority queues for QoS. Each port supports Weighted Random Early Detection (WRED) for congestion avoidance with queues, and Weighted Round Robin (WRR) for scheduling between queues. Additionally, multiple thresholds can be configured to manage differentiated levels of service.

With very deep packet buffers and a strict priority queue in each direction, the fabric-enabled Fast Ethernet module scales the network in performance as well as intelligent services, and is ideal for handling mission-critical, bursty, or low latency traffic such as enterprise resource planning (ERP) or voice applications.

General Features for All Ethernet and Fast Ethernet Modules

The Ethernet and Fast Ethernet modules for the Cisco Catalyst 6500 Series includes:

- 48 ports, 10/100BASE-TX per module (RJ-45 or RJ-21)—supports up to 576 10/100 Fast Ethernet ports per switch
- 48-port 10/100 modules (WS-X6148-RJ-45, WS-X6148-RJ-21) are field upgradeable to provide inline voice power for a seamless voice/data solution
- 24 ports 100BASE-FX (multimode fiber or single-mode fiber, MT-RJ connector) or 10BASE-FL per module (multimode fiber MT-RJ connector)—supports up to 288 100BASE-FX or 10BASE-FL ports per switch
- Support for IEEE 802.3u autonegotiation process that allows the switch to negotiate speed (10 or 100 Mbps) or duplex mode (half or full duplex) with an attached device
- Capacity of up to 12 Fast Ethernet modules per platform—each module requires one slot, can be “mixed and matched” with other switching modules, and can be hot swapped or added as needed without interrupting the Cisco Catalyst 6500 Series switch
- Superior traffic management with large per-interface buffers and multiple priority queues
- Support for multiple active MAC addresses (up to 128K) on a switching port and can be dynamically allocated to any port
- Spanning-tree algorithm on logical VLANs for fault-tolerant connectivity—these modules can support up to 4096 VLANs, as well as Cisco’s enhanced Per-VLAN Spanning Tree (PVST+), Multi-Instance Shared Spanning Tree Protocol (MISTP), IEEE 802.1w Rapid Spanning Tree Protocol (RSTP), and IEEE 802.1s Multiple Spanning Tree (MST)
- Extensive management tools using Simple Network Management Protocol (SNMP) versions 1, 2, and 3 for support with network management platforms such as CiscoWorks
- Four RMON groups: statistics, history, alarms, and events are supported in all Cisco Catalyst 6500 Series Ethernet and Fast Ethernet switching modules



Inline Power Module Features

In addition to supporting the general features listed above, the inline power modules also support the following features:

- 48 ports, 10/100BASE-TX per module (WS-X6148-RJ-45, WS-X6148-RJ-21) is Inline-Power-Ready; it is field-upgradeable to support Cisco Inline Power or future upgrade to IEEE 802.3af inline power standard
- 48 ports, 10/100BASE-TX per module (WS-X6148-RJ45V, WS-X6348-RJ45V, WS-X6148-RJ21V, or WS-X6348-RJ21V)—supports up to 576 10/100 inline power ports per switch
- Inline power—48-volt DC power is provided over standard Category 5 UTP cable up to 100 meters
- Phone discovery—The Cisco Catalyst 6500 Series switch automatically detects the presence of an IP phone and supplies inline power
- Auxiliary VLAN via 802.1Q—The Cisco Catalyst 6500 Series switch automatically segments phones and data endpoints into separate logical networks

Switch Fabric-Enabled Module Features

In addition to supporting the general features listed above, the switch fabric-enabled modules also support the following features:

- Fabric-enabled, 48-port 10/100 modules (WS-X6548-RJ-45 and WS-X6548-RJ-21) and 24-port 100FX module (WS-X6524-100FX-MM) are field-upgradeable to support Distributed Cisco Express Forwarding (dCEF) for maximum scalability
- Connection to the bus as well as to the switch fabric for maximum resiliency
- Superior traffic management with very large per-interface buffers and multiple priority queues, including a strict priority queue in each direction

Ordering Information

Product Number	Description
WS-X6548-RJ-45	48-port, fabric-enabled 10/100 RJ-45 Module for the Cisco Catalyst 6500 Series Switches; field-upgradeable to support distributed forwarding with the addition of the Distributed Forwarding daughter card (WS-F6K-DFC=)
WS-X6548-RJ-21	48-port, fabric-enabled 10/100 RJ-21 Module for the Cisco Catalyst 6500 Series Switches; field-upgradeable to support distributed forwarding with the addition of the Distributed Forwarding daughter card (WS-F6K-DFC=)
WS-F6K-DFC=	Distributed Forwarding daughter card
WS-X6148-RJ-45	48-port 10/100 RJ-45 Module for the Cisco Catalyst 6000 Series and 6500 Series Switches; field-upgradeable to support Cisco Inline Power via voice daughter card (WS-F6K-VPWR=), and future upgrade to support IEEE 802.3af inline power standard
WS-X6148-RJ45V	48-port 10/100 RJ-45 Cisco Inline Power Module for the Cisco Catalyst 6000 Series and 6500 Series Switches
WS-X6348-RJ45	48-port 10/100 RJ-45 Module for the Cisco Catalyst 6000 Series and 6500 Series Switches; field-upgradeable to provide Cisco Inline Power via voice daughter card (WS-F6K-VPWR=)
WS-X6348-RJ45V	48-port 10/100 RJ-45 Cisco Inline Power Module for the Cisco Catalyst 6000 Series and 6500 Series Switches



Product Number	Description
WS-X6148-RJ-21	48-port 10/100 RJ-21 Module for the Cisco Catalyst 6000 Series and 6500 Series Switches; field-upgradeable to support Cisco Inline Power via voice daughter card (WS-F6K-VPWR=), and future upgrade to support IEEE 802.3af inline power standard
WS-X6148-RJ21V	48-port 10/100 Telco RJ-21 Cisco Inline Power Module for the Cisco Catalyst 6000 Series and 6500 Series Switches
WS-X6348-RJ21V	48-port 10/100 Telco RJ-21 Cisco Inline Power Module for the Cisco Catalyst 6000 Series and 6500 Series Switches
WS-F6K-VPWR=	Voice Daughter Card to support Cisco Inline Power for the Catalyst 6000 Series and 6500 Series Switches
WS-X6324-100FX-MM	24-port 100FX Module for the Cisco Catalyst 6000 Series and 6500 Series Switches, multimode fiber, MT-RJ
WS-X6324-100FX-SM	24-port, 100FX Module for the Cisco Catalyst 6000 Series switches, single-mode fiber, MT-RJ, with enhanced QoS
WS-X6524-100FX-MM	24-port, fabric-enabled 100FX Module for the Cisco Catalyst 6500 Series Switches; field-upgradeable to support distributed forwarding with the addition of the Distributed Forwarding daughter card (WS-F6K-DFC=)
WS-X6024-10FL-MT	24-port 10FL Module for the Cisco Catalyst 6000 Series and 6500 Series Switches, multimode fiber, MT-RJ

Specifications

Standard Network Protocols

- Ethernet: IEEE 802.3, 10BASE-T
- Fast Ethernet IEEE 802.3u, 100BASE-TX, and 100BASE-FX

Physical Specification

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

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

- UL 1950
- CSA-C22.2 No. 950
- EN 60950
- IEC 950



- AS/NZS 3260
- IEC 825
- EN 60825
- 21CFR1040

EMC Compliance

- FCC Part 15 (CFR 47) Class A
- VCCI Class A with UTP, Class B with STP
- EN55022 Class A with UTP, Class B with STP
- CISPR 22 Class A with UTP, Class B with STP
- CE marking
- AS/NZS 3548 Class A with UTP, Class B with STP

Frame Processing

- Transparent bridging (802.1d)

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
- CISCO-UDLD-MIB
- CISCO-ENTITY-FRU-CONTROL-MIB
- CISCO-COPS-CLIENT-MIB
- ENTITY-MIB (RFC 2037)
- HC-RMON
- RFC1213-MIB (MIB-II)
- SMON-MIB

Inline Power Specifications:

- Output power per port: 48-volt DC power
- Pin assignment: 1, 2, 3, 6

Maximum Station-to-Station Cabling Distance

- 10/100BASE-TX and 100BASE-TX Fast Ethernet: category 5 UTP: 328 ft. (100 m), 100-ohm STP: 328 ft. (100 m) half or full duplex
- 100BASE-FX Fast Ethernet: 62.5/125-micron multimode fiber: 400-m half duplex, 2-km half or full duplex
- 100BASE-FX Fast Ethernet: 8/125-micron single-mode fiber: 10-km half or full duplex
- 10BASE-FL Ethernet: 62.5/125-micron multimode fiber: 2-km half or full duplex
- Max power: off (max power condition not reached); on (max power condition reached—no more phones will receive inline power from this module)

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)
- 10/100BASE-TX and 100BASE-TX: RJ-45 (female)
- 100BASE-FX: MT-RJ (female, multimode)
- 100BASE-FX-MT-RJ (female, single mode)
- 10BASE-FL: MT-RJ (female, multimode)

Service and Support

Cisco AVVID (Architecture for Voice, Video and Integrated Data) support solutions are designed for one purpose—to ensure customer success by delivering a suite of proactive services. The award-winning Cisco internetworking service and support offerings provide presales network audit planning, design consulting, network implementation, operational support, and network optimization. Cisco interactive knowledge-transfer solutions enhance customer success by leveraging Cisco expertise and experience. By including service and support when purchasing Cisco AVVID products, customers can confidently deploy Cisco AVVID networks utilizing Cisco expertise, experience, and resources.



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