Cisco 4-Port, 8-Port, and 8-Port with PoE/PoE+ Gigabit Ethernet LAN Switch Network Interface Modules

Product Overview

The 4- and 8-port Cisco® Gigabit Ethernet LAN Switch Network Interface Modules (NIMs) can reduce your company's total cost of ownership (TCO) by integrating Gigabit Ethernet switch ports within Cisco 4000 Series Integrated Services Routers (ISRs). These low-density Gigabit Ethernet switches offer small to medium-sized businesses and enterprise branch offices a combination of switching and routing integrated into a single device (Figure 1).

Integration of these switches with Cisco IOS-XE Software allows network administrators to manage a single device using Cisco management tools or the router command-line interface (CLI) for LAN and WAN management needs. This approach reduces network complexity, lowers maintenance contract costs, and lessens staff training needs. It also simplifies software qualification efforts and delivers a consistent user experience at branch offices. Additionally, these low-density Gigabit Ethernet switching modules enable Cisco's industry-leading power initiatives, including per-port Power over Ethernet (PoE) and Power over Ethernet Plus (PoE+) power monitoring, which enhances the ability of the branch office to scale to higher performance requirements and still meet environmental initiatives for IT teams to operate a power-efficient network.

The 4- and 8-port Gigabit Ethernet LAN Switch NIMs provide line-rate Layer 2 switching across onboard Gigabit Ethernet ports. The 4-port NIM has four 10/100/1000 switched Gigabit Ethernet ports. The 8-port NIM has eight 10/100/1000 switched Gigabit Ethernet ports, with a PoE/PoE+ version capable of powering all eight ports. The NIMs furthermore enable direct module-to-module communication through the use of the multigigabit fabric (MGF).

The new features for the Gigabit Ethernet LAN Switch NIMs include four quality-of-service (QoS) queues per port, Shaped Deficit Weighted Round Robin (SDWRR), dynamic secure port, intra chassis cascading, up to 30W of PoE/PoE+ per port, and PoE per-port monitoring and policing.

Figure 1. 4-Port, 8-Port, and 8-Port PoE/PoE+ Cisco Gigabit Ethernet LAN Switch Network Interface Modules

Secure Network Connectivity for Data, Voice, and Video

When inserted in a Cisco 4000 Series ISR, the Gigabit Ethernet LAN Switch NIMs provide a fully integrated, highly secure networking and converged IP communications solution. From a single platform with an integrated switch, you can connect IP phones, wireless access points, and IP-based video cameras to your network and power them using IEEE 802.3af (PoE) and 802.3at (PoE+). With the optional integration of Cisco Unified Communications Manager Express, the router can also provide call processing for the phones. As users attempt network access, the NIMs can use IEEE 802.1X to validate the credentials of the end device and place the user in the appropriate VLAN.

Features and Benefits

The Gigabit Ethernet LAN Switch NIMs provide increased performance levels, enhanced per-port security, and ease of configuration. In addition, with intermodule cascading capabilities, they allow for port expandability over time.

Table 1 lists some important business benefits of deploying an integrated switching solution.

Table 1. Business Benefits

Customer Needs	How Addressed by Cisco NIMs
Total Cost of Ownership	
• Scaled network infrastructure across multiple sites • Decreased costs of operating multiple devices at the branch office • Optimized IT resources	• An integrated switch solution lowers operating costs, simplifies troubleshooting, and enables businesses to scale. • One vendor also means one support center, eliminating blaming among vendors, thereby reducing troubleshooting time. • Cisco Smart Net Total Care™ support covers both ISRs and Cisco EtherSwitch® devices.
Ease of Management	
• Reduced network complexity and simplified branch-office router management • Single administration and configuration of LAN and WAN policies	• Integrated switches allow simplified configuration and management. • CiscoWorks LAN Management Solution (LMS), Remote Monitoring (RMON1 and RMON2), and standards-based MIBs support provides configuration as well as detailed reporting and troubleshooting capabilities. • Simple Network Management Protocol Versions 1, 2, and 3 (SNMPv1, v2, and v3) offer comprehensive in-band management, and a CLI management console provides detailed out-of-band management. • The management interface uses standard SNMP or Secure Sockets Layer (SSL) to integrate Cisco and third-party management systems.
Green IT	
• Single power supply for Cisco EtherSwitch device and router	• These switches provide two to eight times lower power consumption than standalone switches. • Because no additional rack space or power supply is needed, there is less to rack, stack, and cool.

Power over Ethernet

Although PoE has been employed for more than a decade, the technology is still evolving. New and innovative applications continue to raise power requirements. The Cisco Gigabit Ethernet LAN Switch NIMs take advantage of the increased power capabilities of the Cisco 4000 Series ISRs. Table 9 provides information about total PoE (802.3af) and PoE+ (802.3at) power output per platform. Depending on the ISR platform type, total available power offered to PoE devices by the NIMs ranges from 120W to 500W.

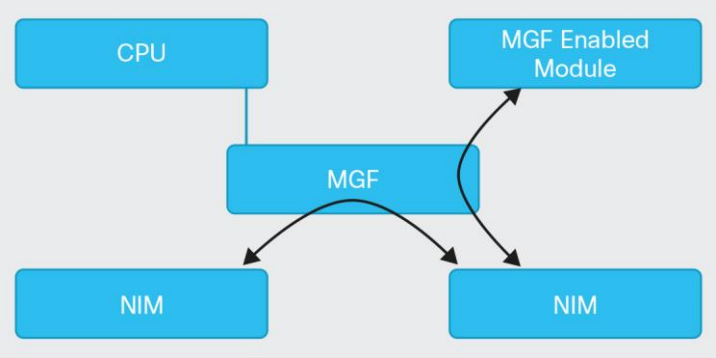
Additional PoE features include the following:

- Per-port power consumption control allows you to specify a maximum power setting on an individual port.
- Per-port PoE power sensing measures the actual power being drawn, enabling more intelligent control of powered devices.
- The Cisco PoE MIBs provide proactive visibility into power usage and allow you to set different power-level thresholds.
- Cisco Discovery Protocol Version 2 allows the NIMs to negotiate a more granular power setting than the IEEE classification provides when connecting to Cisco devices such as IP phones or access points.

Multigigabit Fabric

The LAN switch NIMs have a gigabit connection to the MGF and transparently integrate into the system. Connecting over the MGF enables the NIM to directly communicate with other MGF-enabled modules in the system without involving the router's forwarding architecture (Figure 2). Throughput for direct module-to-module traffic using the MGF will thereby not be limited by the platform's performance license levels. Layer 2 switching of packets is thus done at the full Gigabit Ethernet line rate, either local to each LAN switch NIM or when transferring the MGF with multiple MGF-enabled modules installed in the system; module-to-module MGF traffic throughput is limited to 1 Gbps.

Figure 2. Direct Module-to-Module Connection Without Involving CPU



Applications

Small and Medium-Sized Branch Offices

The Cisco Gigabit Ethernet LAN Switch NIMs in a small to medium-sized enterprise branch-office data deployment scenario provide the flexibility of integrated routing and switching functions in one device. This scenario allows the deployment of high-speed connections between individual network resources such as client desktops, servers, IP phones, wireless access points, and video devices from a single device and at the same time allows for WAN connectivity at Layer 3 through the router.

When deployed in a unified communications environment, the 4- or 8-port NIMs transparently interoperate with analog or digital time-division multiplexing (TDM) voice gateway modules and Cisco Unified Communications Manager Express IP Telephony, Cisco Survivable Remote Site Telephony (SRST), or Cisco Unified Border Element solutions.

The 8-port NIM with optional PoE/PoE+ provides power and phone discovery for IP phones. In addition, the NIMs support separate VLAN configuration for IP phones. The auxiliary VLAN feature allows network administrators to segment phones into separate logical networks, even though the data and voice infrastructures are physically the same. The phone discovery feature allows the 4-port and 8-port NIMs to automatically detect the presence of an IP phone; the 8-port NIM with PoE/PoE+ will supply power to it.

Features and Benefits

Table 2 provides an overview of the architecture, features, and benefits of the 4-port and 8-port Cisco Gigabit Ethernet LAN Switch NIMs, Table 3 lists other features of the new NIMs, and Table 4 lists the maximum number of VLANs supported per platform.

Table 2. Architecture, Features, and Benefits

Feature	Benefit
4 or 8 10/100/1000BASE-TX ports	• The switches offer line-rate forwarding for Layer 2 traffic on each port.
Autosensing, autonegotiation, and Automatic Media-Dependent Interface Crossed Over (Auto-MDIX)	• Autosensing allows the switch to detect the speed of the attached device and automatically configure the port for 10-, 100-, or 1000-Mbps operation. • Autonegotiation allows the switch to automatically select half- or full-duplex transmission mode to optimize bandwidth on all the ports of the NIM. • Auto-MDIX allows the switch to automatically detect cable type (straight-through vs. crossover) between an attached device and the switch port.
Integrated switching	• Integrated switching provides fewer points of management for remote and small branch offices.
Intrachassis stacking or cascading	• Grouping LAN switch NIMs together is called cascading. The NIMs are capable of cascading on all Cisco 4000 Series ISRs using the internal MGF. • Cascading of multiple LAN switch NIMs over the MGF allows multiple NIMs to behave as a single switch. • Layer 2 switching of packets can be internal to each LAN switch NIM, or they can go through the MGF when multiple LAN switch NIMs in the system are acting as a unified switch. The router CPU is not involved in this operation.
IEEE 802.1P QoS (Traffic Prioritization)	• This feature supports QoS based on the IEEE 802.1P class of service (CoS) and port-based prioritization, allowing the switch to change the CoS settings of tagged packets on a per-port basis. • Each port has four QoS queues. Strict priority is enforced by default. The routers support SDWRR with configurable weight on each queue.
802.1Q Trunking	• This feature provides an industry wide VLAN tagging standard, allowing for trunks also to be set up to third-party devices.
802.1D Spanning Tree Protocol	• This industry-standard link layer network protocol helps ensure a loop-free topology between Layer 2 devices regardless of vendor. IEEE 802.1D Spanning Tree Protocol is turned off by default.
Voice VLAN (VVLAN)	• VVLANs enable Cisco IP phones to place voice and data in their own separate VLANs. The NIM switch port is manually configured as a trunk port to support voice and data VLANs on the same port. The switch then uses Cisco Discovery Protocol to dynamically configure the Cisco IP phones.
IEEE 802.1X authentication	• Support for 802.1X port-based authentication, single/multiple host mode, guest VLAN, MAC Authentication Bypass (MAB), restricted VLAN, critical VLAN, and dynamic VLAN.
PoE+ (option)	• Cisco Gigabit Ethernet technology with the appropriate PoE+ module and internal power supply can power Cisco IP phones and wireless access points. Support is provided for both IEEE 802.3af (PoE) and IEEE802.3at (POE+).
IP Multicast management support	• The routers provide Internet Group Management Protocol (IGMP) Snooping in hardware for management support.
SNMP management	• SNMP allows management of the MIB through a MIB browser.
Cisco IOS® Software CLI	• This feature provides configuration through the Cisco IOS Software CLI and provides a common user interface for all the router functions.

Feature	Benefit
CiscoWorks support	• CiscoWorks network management software enables management on a per-port and per-switch basis, providing a common management interface for Cisco routers, switches, and hubs. • SNMPv1, v2, and v3 (noncryptographic) and Telnet interface support delivers comprehensive in-band management, and a CLI management console provides detailed out-of-band management. • Cisco Discovery Protocol Versions 1 and 2 enable a CiscoWorks network management station to automatically discover the switch in a network topology. • Support is provided by the CiscoWorks LAN Management Solution.
Cisco Discovery Protocol Versions 1 and 2	• This protocol enables a CiscoWorks network management station to automatically discover the switch in a network topology.
Cisco VLAN Trunking Protocol (VTP; client, server, and transparent modes)	• Cisco VTP supports dynamic VLAN configuration across Cisco switches.
Cisco Configuration Professional -based configuration and device management	• This feature simplifies initial configuration of a switch through a web-based GUI, eliminating the need for more complex terminal emulation programs and CLI knowledge. • Cisco Discovery Protocol reduces the cost of deployment by helping less-skilled personnel set up switches quickly and simply.
Status-indicator LEDs	• Two LEDs per port provide visual indication of the switch-port status and PoE status.

Table 3. New Features

Feature	LAN Switch NIM	New Feature
10/100/1000BASE-TX	✓	✓
IEEE 02.1Q Trunking	✓	
IEEE 802.1D Spanning Tree	✓	
Static and dynamic MAC address learning	✓	
IEEE 802.1X port-based and multiple supplicant	✓	
PoE (15.4W)	✓	
PoE+ (30W)	✓	✓
IEEE 802.1u (guest VLAN)	✓	
IEEE 802.1s Multiple Spanning Tree (MST)	✓	
IEEE 802.1w Rapid Spanning Tree Protocol (RSTP)	✓	
IGMP Snooping	✓	
Auxiliary VLANS	✓	
Maximum number of VLANs supported	60	✓
Maximum number of VLAN IDs	4094	
SDWRR and fixed scheduling	✓	✓
4 QoS queues per port	✓	✓
IEEE 802.1p for 802.1q tagged packets	✓	
Port-based priority for untagged packets	✓	
Priority override	✓	
Switched Port Analyzer (SPAN)	✓	
SPAN across multiple NIMs	Not supported	Not supported
Number of Spanning Tree Protocol instances	1 per VLAN (60 maximum)	
Per-port storm control	Not supported	
MAC notification	✓	
Dynamic secure port	Not supported	
Secure port filtering (port security)	Not supported	
Intrachassis cascading (no external link between NIM cards)	✓	✓
Private VLAN edge (protected port)	✓	✓

Feature	LAN Switch NIM	New Feature
Protected port (across multiple NIMs)	✓	✓
Bridge protocol data unit (BPDU) guard	✓	
PortFast	✓	
Jumbo Frames	✓	
VTP (client, server, and transparent modes)	✓	
Per-VLAN Spanning Tree (PVST)	✓	
Per-port power monitoring and policing	✓	✓
Hot Standby Router Protocol (HSRP), Virtual Router Redundancy Protocol (VRRP), and Gateway Load Balancing Protocol (GLBP) on VLAN interfaces	✓	✓
MGF integration	✓	
CiscoWorks LAN Management Solution (LMS)	✓	
RMON support	✓	
Auto-MDIX	✓	
Cisco EtherChannel technology	Not supported	

Table 4. Maximum Number of VLANs Supported per Platform

Platform	Maximum Number of VLANs
Cisco 4321 ISR	60
Cisco 4331 ISR	60
Cisco 4351 ISR	60
Cisco 4431 ISR	60
Cisco 4451 ISR	60

Table 5 lists the PoE power-supply options for the Cisco 4000 Series routers.

Table 5. Cisco 4000 Series ISRs PoE Power-Supply Product Numbers

Product Number	Description
PWR-4320-POE-AC=	Cisco 4321 PoE Power Supply
PWR-4330-POE-AC=	Cisco 4331 PoE Power Supply
PWR-4450-POE-AC=	Cisco 4351 PoE Power Supply
PWR-4430-POE-AC=	Cisco 4431 PoE Power Supply
PWR-4430-POE-AC/2=	Cisco 4431 PoE Power Supply (Redundant)
PWR-4450-POE-AC=	Cisco 4451 PoE Power Supply
PWR-4450-POE-AC/2=	Cisco 4451 PoE Power Supply (Redundant)

Platform Support

Table 6 lists the platforms that support the new 4-port and 8-port Cisco Gigabit Ethernet LAN Switch NIMs.

Table 6. Platform Maximum Support for the 4- and 8-port Cisco Gigabit Ethernet LAN Switch NIMs

	Cisco 4321	Cisco 4331	Cisco 4351	Cisco 4431	Cisco 4451
4-port non-PoE	2	2	3	3	3
8-port non-PoE	2	2	3	3	3
8-port PoE	2	2	3	3	3
Maximum number of non-PoE ports	16	16	24	24	24
Maximum number of PoE ports at 30W in normal mode	3	8	16	8	16
Maximum number of ports running at 30W in boost mode	NA	NA	NA	16	33

Summary and Conclusion

As companies strive to lower the costs of operation and at the same time increase productivity of their workforce by using network applications, higher-speed integrated branch-office solutions are required.

The Cisco Gigabit Ethernet LAN Switch NIMs enable a high level of performance as well as POE+ capabilities. Other benefits are advanced Layer 2 switching features for data and IP communications, easy expandability, and simplified branch-office router management.

Specifications

Table 7 gives the technical specifications of the 4-port and 8-port NIMs.

Table 7. Technical Specifications for the 4- Port (NIM-ES2-4) and 8-Port (NIM-ES2-8 and NIM-ES2-8-P) Cisco Gigabit Ethernet LAN Switch NIMs

Parameter	Specification
Form factor	• NIM-ES2-4: Single-wide NIM form factor • NIM-ES2-8: Single-wide NIM form factor • NIM-ES2-8-P: Single-wide NIM form factor
Dimensions (H x W x D)	• NIM-ES2-4: 0.8 x 3.1 x 4.8 in. (2.1 x 7.9 x 12.2 cm) • NIM-ES2-8: 0.8 x 6.2 x 4.8 in. (2.1 x 18.8 x 12.2 cm) • NIM-ES2-8-P: 0.8 x 6.2 x 4.8 in. (2.1 x 18.8 x 12.2 cm)
Weight	• NIM-ES2-4: 79g (0.17 lb) • NIM-ES2-8: 108g (0.24 lb) • NIM-ES2-8-P: 149g (0.33 lb)
Standards	
IEEE protocols	• Gigabit Ethernet: IEEE 802.3 and 10BASE-T • Gigabit Ethernet: IEEE 802.3u, 100BASE-TX, and 1000BASE-TX • IEEE 802.1d Spanning Tree Protocol • IEEE 802.1p CoS for Traffic Prioritization • IEEE 802.1q VLAN • IEEE 802.1X Security • IEEE 802.3x Full Duplex • IEEE 802.3af Power over Gigabit Ethernet Standard

Parameter	Specification
RFC	RFC 2284, PPP Extensible Authentication Protocol (EAP)
MIBs	• RFC 1213 • IF MIB • RFC 2037 ENTITY MIB • CISCO-CDP-MIB • CISCO-IMAGE-MIB • CISCO-FLASH-MIB • OLD-CISCO-CHASSIS-MIB • CISCO-VTP-MIB • CISCO-HSRP-MIB • OLD-CISCO-TS-MIB • CISCO-ENTITY-ASSET-MIB • CISCO-ENTITY-FRU-CONTROL-MIB • BRIDGE MIB (RFC 1493) • CISCO-VLAN-MEMBERSHIP-MIB • CISCO-VLAN-IFINDEX-RELATIONSHIP-MIB • RMON1-MIB • PIM-MIB • CISCO-STP-EXTENSIONS-MIB • OSPF MIB (RFC 1253) • IPMROUTE-MIB • CISCO-MEMORY-POOL-MIB • ETHER-LIKE-MIB (RFC 1643) • CISCO-ENTITY-FRU-CONTROL-MIB.my • CISCO-RTTMON-MIB • CISCO-PROCESS-MIB • CISCO-COPS-CLIENT-MIB
	To obtain lists of supported MIBs by platform and Cisco IOS Software release, and to download MIB modules, go to the Cisco MIB website on Cisco.com at: http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml.
Manageability	• SNMP and Telnet interface support delivers comprehensive in-band management, and a CLI management console provides detailed out-of-band management. • An embedded RMON software agent supports four RMON groups (history, statistics, alarms, and events) for enhanced traffic management, monitoring, and analysis. • A SPAN port can mirror traffic from one or many ports to another port for monitoring all eight RMON groups with an RMON probe or network analyzer. • Trivial File Transfer Protocol (TFTP) reduces the cost of administering software upgrades by downloading from a centralized location. • Two LEDs per port provide convenient visual indication of the port link and PoE status. • Crash information support enables a switch to generate a crash file for improved troubleshooting. • Show-interface capabilities provide information about the configuration capabilities of any interface.
Connectors and cabling	• 10BASE-T ports: RJ-45 connectors, two-pair Category 3, 4, or 5 unshielded twisted pair (UTP) cabling • 100BASE-TX ports: RJ-45 connectors; two-pair Category 5 UTP cabling • 1000BASE-TX ports: RJ-45 connectors; two-pair Category 5e and Category 6 UTP cabling
LED indicators	• Link status LED: One LED per port for indicating link status • PoE LED: One LED per port system for PoE status indication
Power Requirements	
Internal power supply	Optional PoE system power supply available for all Cisco 4000 Series routers
Internal redundant power supply	For the Cisco 4431 and 4451 routers only
DC power support	• DC system power input available on the Cisco 4351, 4431, and 4451 routers • PoE option not available with DC system power input
Software support	Minimum Cisco IOS-XE Software Release 3.15 for Cisco 4000 Series routers: IP Base License of the Universal image
Environmental	
Operating temperature	32° to 104°F (0° to 40°C)
Operating humidity	10 to 90 percent, noncondensing
Nonoperating temperature	-4° to 149°F (-20° to 65°C)
Operating altitude	15,000 ft (4,570m)
Regulatory compliance, safety, and EMC	When installed in a Cisco 4000 Series router, the Cisco Gigabit Ethernet LAN Switch NIM meets the standards (regulatory compliance, safety, and EMC) of the router itself. Refer to the data sheets for the Cisco 4000 Series routers for more details.

Cisco 4000 Series Router Modes of Operation

Table 8 describes the modes of operation for the Cisco 4000 Series routers, and Table 9 gives the power output of the routers.

Table 8. Modes of Operation

Mode	Description
Normal	One PoE power supply
Redundant	Two PoE internal power supplies (Cisco 4431 and 4451) for 3 PoE NIMs

Table 9. Power Output

	Cisco 4451	Cisco 4431	Cisco 4351	Cisco 4331	Cisco 4321
Normal PoE with single PoE power supply (watts)	500	250	500	250	110
Maximum number of ports running at 15.4W in normal mode	32	16	32	16	7
Maximum number of ports running at 20W in normal mode	25	12	25	12	5
Maximum power with dual PoE supplies in boost mode (watts)	1000	500	NA	NA	NA
Maximum number of ports running at 15.4W in boost mode	64	32			
Maximum number of ports running at 20W in boost mode	50	25			

Ordering Information

To place an order, visit the Cisco Ordering Home Page and refer to Table 10.

For more information about the Cisco 4000 Series routers, visit: http://www.cisco.com/c/en/us/products/routers/4000-series-integrated-services-routers-isr/index.html.

Table 10. Ordering Information

Product Number	Product Description
NIM-ES2-4=	4-port Layer 2 Gigabit Ethernet LAN Switch NIM
NIM-ES2-8=	8-port Layer 2 Gigabit Ethernet LAN Switch NIM
NIM-ES2-8-P=	8-port PoE/PoE+ Layer 2 Gigabit Ethernet LAN Switch NIM

Cisco IOS Software Support

The Cisco Gigabit Ethernet LAN Switch NIMs are supported in IP Base and later images. No Cisco IOS Software technology or feature licenses are required. Table 11 provides the minimum Cisco IOS Software requirements.

Table 11. Minimum Cisco IOS Software Release

Integrated Services Router	Minimum Cisco IOS Software Release
Cisco 4000 Series	IOS-XE 3.15.0: IP Base License of the Universal Image

Service and Support

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Cisco Smart Net Total Care technical support is available on a one-time or annual contract basis. Support options range from help-desk assistance to proactive, onsite consultation.

All support contracts include:

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- Full access rights to Cisco.com technical libraries for technical assistance, electronic commerce, and product information
- Access to the industry's largest dedicated technical support staff 24 hours a day

For more information about Cisco Services, refer to Cisco Technical Support Services or Cisco Advanced Services.

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For More Information

For more information about the Cisco Integrated Services Routers, visit http://cisco.com/en/US/prod/routers/networking_solutions_products_genericcontent0900aecd806cab99.html or contact your local Cisco account representative.

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