# Cisco Multimode G.SHDSL Network Interface Module

The Cisco® 4000 Series Integrated Services Routers Network Interface Module (NIM) supports single-port Cisco Multimode Four-Pair G.SHDSL-based WAN connectivity using both 802.3ah Ethernet in the first mile (EFM) and ATM modes. This NIM is used in modular routers that are deployed in Small and Medium-sized Businesses (SMBs) and enterprise branch offices.

Product overview

Designed to deliver high-speed Ethernet services over Symmetrical High-speed DSL (SHDSL) access, the multimode G.SHDSL NIM (Figure 1) offers symmetric data rates over one to four pairs of copper wire and supports both EFM and ATM modes. To achieve higher bandwidths, bonding of multiple pairs (4-wire, m-pair, inverse multiplexing over EFM bonding) is supported.

Figure 1.   Cisco Multimode Four-Pair G.SHDSL NIM (NIM-4SHDSL-EA)
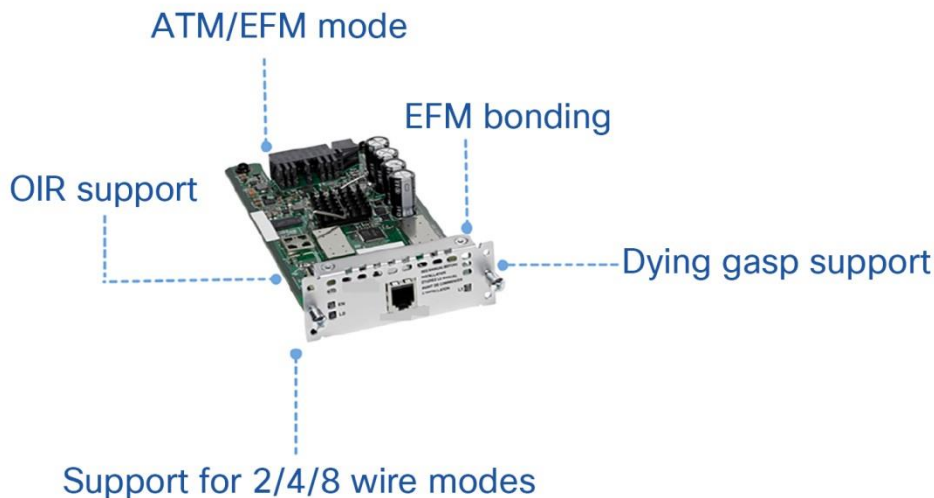
In EFM mode, the multimode G.SHDSL NIM allows bonding, as defined by IEEE 802.3ah, and is typically used in scenarios where individual links are aggregated using the 802.3ah loop aggregation. Depending on the number of wire pairs in service, the maximum data rate is 61.4 Mbps, with each line supporting up to 15 Mbps with 128-TCPAM. The NIM complies with the 2BASE-TL standard, which is based on the IEEE 802.3ah EFM standard. The 2BASE-TL standard uses the technology standard defined in ITU recommendation G.991.2 (G.SHDSL.).

In ATM mode, the multimode G.SHDSL NIM allows bonding of multiple pairs up to four pairs (8-wire) with increased bandwidth by using data interleaving and m-pair mode. In m-pair mode, the multimode four-pair G.SHDSL NIM offers data rates up to 5.7 Mbps per pair and up to 22.7 Mbps over four pairs. (See Table 2 for the data rates supported by the multimode four-pair G.SHDSL NIM (NIM-4SHDSL-EA) under different modes.)

The multimode four-pair G.SHDSL NIM cost-effectively allows service providers and enterprise customers to deliver Ethernet services to sites with no access to fiber by using bonded copper pairs with symmetrical bandwidth. These rates cover applications traditionally served by High-data-rate DSL (HDSL), Single-line DSL (SDSL), T1, E1, and services beyond E1.

The multimode four-pair G.SHDSL NIM, together with the ISR 4000 series router, provides businesses the necessary bandwidth for critical traffic such as voice and videoconferencing and enables customers to save money by integrating voice and data traffic on the same WAN link. Service providers can increase subscriber revenue by bundling services and offering differentiated service levels through Service-Level Agreements (SLAs).

Feature summary

- Complies with standard, based on ITU recommendation G.991.2
- Supports G.SHDSL Annexes A (U.S. signaling) and B (European signaling)
- Supports Annexes F and G
- Supports ATM or EFM modes (one mode at a time)
- Offers symmetrical WAN speeds up to 1 x 2304 kbps over single copper pair, up to 2 x 2304 kbps over two copper pairs, up to 3 x 2304 kbps over three copper pairs, and up to 4 x 2304 kbps over four copper pairs using ITU-T G.991.2 annexes A and B
- Offers symmetrical WAN speeds up to 1 x 5696 kbps over single copper pair, up to 2 x 5696 kbps over two copper pairs, up to 3 x 5696 kbps over three copper pairs, and up to 4 x 5696 kbps over four copper pairs using ITU-T G.991.2 annexes F and G
- Supports EFM bonding; supports bonding of up to four SHDSL pairs
- In ATM mode, supports maximum of eight Permanent Virtual Circuits (PVCs)
- Supports dying gasp and wetting current
- Supports point-to-point configuration
- Supports 802.1Q, QinQ (IEEE 802.1ad), trunk, and VLAN tagging
- Supports ATM Class-of-Service (CoS) and IP Quality-of-Service (QoS) features, 802.1P, and Differentiated Services Code Point (DSCP)
- Supports EFM (IEEE 802.3ah) Operation, Administration, and Maintenance (OA&M)
- Offers ability to configure multiple G.SHDSL EFM NIMs per ISR 4000 router
- Provides single RJ-45 connector system requirement

System requirements

- Multimode four-pair G.SHDSL NIMs are supported on all modular Cisco ISR 4000 series routers.
- Multimode four-pair G.SHDSL NIMs are supported in all Cisco IOS® Software feature sets.
- The ISR 4000 routers must be running Cisco IOS XE Software Release 16.8.1 or later.
- The system requires no additional flash or DRAM memory beyond the specified minimum for the previously mentioned Cisco IOS releases.
- The multimode four-pair G.SHDSL NIMs can be inserted into any NIM slot in any ISR 4000 router.

Cisco Integrated Services Routers with multimode G.SHDSL EFM NIM applications

Business-class DSL with backup WAN

Cisco ISR 4000 routers with the four-pair G.SHDSL EFM NIM provide a business-class DSL solution for WAN access along with the option of a backup WAN interface (asymmetric DSL [ADSL] and ADSL2+, very-high-data-rate DSL 2 [VDSL2], ISDN Basic Rate Interface [BRI], T1/E1, analog modem, cable modem, third- and fourth-generation [3G and 4G, respectively], etc.) for mission-critical applications. The bonding feature offered on the G.SHDSL EFM NIM allows service providers to bond two or more pairs of G.SHDSL links to offer differentiated bandwidth based on SLAs.

Business-class security

Cisco ISR 4000 routers with the multimode G.SHDSL EFM NIMs can be optimized for Internet security with Cisco IOS Firewall supporting stateful inspection firewall and intrusion prevention system features. These platforms can also be optimized for VPNs to allow for secure use of the Internet for communications with the same policies and levels of security and performance as a private network. VPNs provide security through encryption tunneling, and the Cisco routers support hardware-based Triple Data Encryption Standard (3DES) IP Security (IPsec), Advanced Encryption Standard (AES), and SSL VPN. Encryption features can be enabled on the routers with the Advanced Security or any later feature set of the Cisco IOS XE Software. Further, Cisco ISR 4000 Web Security with the Cisco Umbrella™ solution enables branch offices to intelligently redirect web traffic to the cloud to enforce granular security and control policy over dynamic content, protecting branch-office users from threats such as Trojan horses, back doors, rogue scanners, viruses, and worms.

Differentiated service offerings through IP

Using Cisco QoS features, including Class-Based Weighted Fair Queuing (CBWFQ), Low-Latency Queuing (LLQ), Weighted Random Early Detection (WRED), etc., the Cisco ISR 4000 routers with the G.SHDSL NIM help service providers and resellers offer services that can differentiate bandwidth based on a specific application or a specific user.

Metro Ethernet

Service providers could also run Layer 2 Ethernet services and provide transparent LAN services over a metro Ethernet infrastructure. Service providers can take advantage of ISR 4000 support for Xconnect over Multiprotocol Label Switching over Generic Routing Encapsulation (GRE) with Static Pseudowire Provisioning and L2PT on Layer 2 ports, Dot1Q tunnel mode support on Layer 2 ports, customizable L2PT tunneling MAC address etc., and provide these Layer 2 Ethernet services.

Converged platform for SMB and enterprise branch-office applications

The Cisco 4000 Series Integrated Services Routers with the multimode G.SHDSL EFM NIMs offer you a choice of converged platforms that offer best-in-class data, security, WAN access, and voice services in a single system. The ISR 4000 routers embed voice functions directly inside the router, enabling you to deploy voice services by installing Cisco 2800/3800 High-Density Packet Voice Digital Signal Processor modules and the Cisco Integrated Services Module for IP telephony conferencing, voice gateways, as well as Cisco Unity® Express voicemail and Automated Attendant. For call processing, you can enable the Cisco Unified Communications Manager Express solution as part of Cisco IOS XE Software and reconfigure the same software to support Survivable Remote Site Telephony (SRST) for centralized call processing with Unified Communications Manager.

Such an integrated solution rapidly enables service deployment, increases efficiency of network operations, and provides opportunities to protect, grow, and optimize your business.

Multimode G.SHDSL NIM features

Table 1 lists the features of the G.SHDSL NIM.

Table 1.   Multimode four-pair G.SHDSL NIM features

Features	Description
Annexes A and B	Yes
Annexes F and G	Yes
Support for 2-, 4-, and 8-wire modes	Yes
Support for M-pair bonding with Annex F and Annex G	Yes
EFM bonding	Yes
Connecter	RJ-45
Dying gasp	Yes
Wetting current	Yes
Line coding	4, 8, 16, 32, 64, 128
Rate adaption	Yes
Termination	Customer Premises Equipment (CPE)
Data rate	192 to 5696 kbps per pair Up to 15 Mbps per pair (Lantiq extension rates— supported if DSLAM supports it as well)
G.SHDSL chipset	Socrates-4e from Lantiq

Data rates supported with four-pair G.SHDSL EFM/ATM NIM

Table 2 gives data rates for the four-pair G.SHDSL NIM in the two modes (EFM and ATM).

Note: Actual data rates depend upon factors such as loop length, line conditions, DSLAM line card and chipset, and data rates provisioned by the service provider.

Table 2.　DSL group and data rates

DSL group with 1-pair
Annex A and B—192 to 2304 kbps
Annex F and G (32 TC-PAM)—768 to 5696 kbps
Annex F and G (16 TC-PAM)—2304 to 3840 kbps
Annex A to F, and B to G (32 TC-PAM)—768 to 5696 kbps
Annex A to F, and B to G (16 TC-PAM)—192 to 3840 kbps
Annex A to F, and B to G (32 TC-PAM)—768 to 5696 kbps
DSL group with 2-pair
Annex A and B— 384 to 4608 kbps
Annex F and G (32 TC-PAM)—1536 to 11,392 kbps
Annex F and G (16 TC-PAM)—4608 to 7680 kbps
Annex A to F, and B to G (32 TC-PAM)—1536 to 11,392 kbps
Annex A to F, and B to G (16 TC-PAM)—384 to 7680 kbps
DSL group with 3-pair
Annex A and B— 576 to 6912 kbps
Annex F and G (32 TC-PAM)— 2304 to 17,088 kbps
Annex F and G (16 TC-PAM)— 6912 to 11,520 kbps
Annex A to F, and B to G (32 TC-PAM)— 2304 to 17,088 kbps
Annex A to F, and B to G (16 TC-PAM)— 576 to 11,520 kbps
DSL group with 4-pair
Annex A and B— 768 to 9216 kbps
Annex F and G (32 TC-PAM)— 3072 to 22,784 kbps
Annex F and G (16 TC-PAM)— 9216 to 15,360 kbps
Annex A to F, and B to G (32 TC-PAM)— 3072 to 22,784 kbps
Annex A to F, and B to G (16 TC-PAM)— 768 to 15,360 kbps
EFM bonding with 4-pair
Annex F and G (128 TC-PAM)— 9248 to 61,216 kbps
Annex F and G (64 TC-PAM)—9216 to 50,944 kbps
Annex A to F, and B to G (128 TC-PAM)— 800 to 61,216 kbps
Annex A to F, and B to G (64 TC-PAM)— 768 to 50,944 kbps

Interoperability

The multimode G.SHDSL NIM is based on the Lantiq chipset, and it operates when connected to a Digital Subscriber Line Access Multiplexer (DSLAM). Table 3 lists the DSLAMs that have been tested and are supported for interoperability. This table will be updated as more DSLAMs, line cards, and firmware versions are tested and supported in the future. For more information and details about DSLAM and NIM interoperability, please refer to Cisco ISR4000 xDSL Interoperability.

Table 3.　DSLAM interoperability

#	Mode	DSLAM	DSLAM chassis	Controller card	Line card	Firmware
1	ATM	Alcatel ASAM 7300	7300	SANT-F	SMLT-A	LDP7AA46.030
					SMLT-C	LPR9AA46.029
2	ATM	Huawei MA5603	5603	SCUB	SHEB	1.4.13
3	ATM	Lucent Stringer			LIM-SL-72	9.7.4 e21
					LIM-SL-48	9.7.4 e21
4	ATM	ECI 480	480		STUC-16A	S3_8.10.16
					STUC-32A	S3_8.10.16

#	Mode	DSLAM	DSLAM chassis	Controller card	Line card	Firmware
5	ATM	Alcatel ISAM_7330_FTTN	7330	NANT-A	NSLT-A	1.4.1
					SMLT-J	1.2.42
6	EFM	Alcatel ISAM_7330_FTTN	7330	NANT-A	NSLT-A	1.4.1
7	EFM	Huawei_5603	5603	SCUB	SHEB	1.4.13
8	EFM	Huawei_5600	5600		SHEB	1.4.18
9	EFM	Hatteras HN4000	HN4000			7.1.2
10	EFM	Actelis ML698	ML 698			SW: 7.10/35

Platform support

Table 4 gives platform support details for the multimode G.SHDSL NIMs, and Table 5 shows the number of NIMs supported per router.

Table 4.   Supported ISR 4000 platforms

Platforms	Multimode Four-Pair G.SHDSL NIM
Platforms supported	ISR 4221, ISR 4321, ISR 4331, ISR 4351, ISR 4431, and ISR 4451
Onboard NIM slots on all platforms	Yes

Table 5.   Number of supported multimode G.SHDSL double-wide NIMs per ISR 4000 platform

Platform part numbers	Maximum number of NIMs
Cisco 4321 and 4331 ISR routers	2
Cisco 4351, 4431, and 4451 ISR routers	3

Software requirements

The single-port Cisco Multimode G.SHDSL NIM is supported on Cisco IOS XE Software Release 16.8.1 and later releases on Cisco 4321, 4331, 4351, 4431, and 4451 Integrated Services Routers.

The G.SHDSL features are supported with the IP Base technology package license for the Cisco 4300 and 4400 Series Integrated Services Routers.

Product number and ordering information

Table 6 gives product ordering information, and Table 7 gives product hardware specifications.

Table 6.   Product ordering information

Product Number	Description
NIM-4SHDSL-EA	4-pair G.SHDSL EFM/ATM NIM

Table 7.   Hardware specifications

Specification	Cisco Multimode Four-Pair G.SHDSL NIM
Chipset	Socrates-4e from Lantiq
Dimensions (H x W x D)	3.50 x 1.25 x 7.24 in. (8.89 x 3.18 x 18.39 cm)
Firmware version	IDC firmware version: V 1.7.2.6
Weight	0.40 lb (181g)

Specification	Cisco Multimode Four-Pair G.SHDSL NIM	
LEDs	EN/LP	Status of the system: Green: Operating system is running Amber: Indicates loopback mode
	EFM	Green: Indicates EFM mode
	ATM	Green: Indicates ATM mode
	L0, L1, L2, L3	Status of link: Green on: Link is active Off: Link is inactive or not configured Amber: Link alarm Blinking green: Link is training Amber and green blinking Simultaneously: Loopback mode EN/LP is also amber
Ports	RJ-45 connector	
Cable	RJ-45	
Network Equipment Building Standards (NEBS) compliance	No	

Safety, EMC, telecom, network homologation, power, and environmental requirements

When installed in a Cisco ISR 4000 router, the multimode four-pair G.SHDSL NIM (NIM-4SHDSL-EA) does not change the standards (safety, EMC, telecom, network homologation, power, environmental requirements, and regulatory approvals) of the router itself. Refer to the Cisco 4000 Series Integrated Services Routers platform-specific links for regulatory compliance, safety, EMC, and telecom standards at https://www.cisco.com/go/isr4000.

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