Cisco Fourth-Generation T1/E1 Voice and WAN Network Interface Modules

These flexible interface cards support multiple integrated data, voice, and video applications, facilitating the migration from data-only as well as circuit-switched voice and video services to a packet voice and video solution.

Introduction

The Cisco® Fourth-Generation 1-, 2-, 4- and 8-PortT1/E1Multiflex Trunk Voice and WAN Network Interface Modules (NIMs) support data and voice applications on the Cisco 4451-X Integrated Services Routers (Figure 1). These cards combine WAN-interface-card (WIC), voice-interface-card (VIC), ISDN Primary Rate Interface (PRI), dial-access integration, and channelized-data (CE1T1) functions to provide unparalleled flexibility, versatility, and investment protection through their many uses. Customers who choose to integrate data and voice in multiple steps preserve their investment in a T1/E1 WAN interface.

Note: These NIMs are not supported with Cisco 2900 and 3900 Integrated Services Routers.

Figure 1. Cisco 4451-XT1/E1 NIMs

Table 1 lists the available cards and compares their features.

Table 1. Cisco T1/E1 NIM Types and Feature Comparison

Part Number	Number of Ports	Clear-channel data	MFT Packet Voice	Unstructured E1 (G.703) Support	Channelized Data
NIM-1MFT-T1/E1	1	Yes	Yes	No	No
NIM-2MFT-T1/E1	2	Yes	Yes	No	No
NIM-4MFT-T1/E1	4	Yes	Yes	No	No
NIM-8MFT-T1/E1	8	Yes	Yes	No	No
NIM-1CE1T1-PRI	1	Yes	Yes	Yes	Yes
NIM-2CE1T1-PRI	2	Yes	Yes	Yes	Yes
NIM-8CE1T1-PRI	8	Yes	Yes	Yes	Yes

You can insert the Cisco T1/E1 NIMs into the NIM slot on the supported Cisco4451-X Integrated Services Routers (ISRs). In addition to the features listed in Table 1, these modules support both T1 and E1, providing additional flexibility for supporting T1, fractional T1, E1, and fractional E1 for both voice and WAN applications simultaneously. All modules include the drop-and-insert multiplexing capability, which eliminates costly external third-party channel service units/data service units (CSUs/DSUs) and drop-and-insert multiplexers.

The fourth-generation Cisco T1/E1 NIMs add improvements over the Cisco Second- and Third-Generation T1/E1MultiflexVoice and WAN Interface Cards (MFT VWIC2s and VWIC3s, respectively). The fourth-generation T1/E1 modules enable each port to be clocked from an independent clock source for data applications. Voice applications can now be clocked independently from data applications, with all ports for voice applications clocked from a single source.

The T1/E1 modules contain an onboard Cisco Packet Voice Digital Signal Processor Module 4 (PVDM4) slot, which requires a fourth-generation PVDM4 module. A PVDM4 on the T1/E1 module is necessary for the voice features. The PVDM4 also provides for echo cancellation of up to 128-ms echo-tail length for demanding network conditions. Refer to Table 2for all configuration options offered with the modules.

These fourth-generation modules also provide increased port density per chassis compared to the Cisco Integrated Services Routers Generation 2 (ISRG2) platform.

Key Features

- Basic T1/E1 data: The multiflex trunk (MFT) versions act as WICs, supporting T1, fractional T1, E1, and fractional E1. To simplify remote management, these modules integrate a fully managed DSU/CSU for T1 deployments and a fully managed DSU for E1 deployments.
- E1/G.703 data: In addition to the basic T1/E1 data support, the CE1T1 versions also support structured G.703 with G.704 framing and unstructured E1 (G.703) applications.
- T1/E1 packet voice: All the modules support packet voice applications by providing T1, fractional T1, E1, and fractional E1 connections to private branch exchanges (PBXs) and central offices, thereby enabling new services and reducing voice and fax toll charges. An additional onboard PVDM4 is required. Also, each NIM has its own PVDM4, so each module can be connected to a different service provider with no single clock domain restriction.
- Mixed data and packet voice: All the modules can simultaneously support both data and voice, reducing the complexity and number of network components and facilitating a graceful migration to bandwidth-efficient packet voice.
- Mixed data and packet voice with drop and insert: You can deploy all the modules as T1/E1 drop-and-insert multiplexers with integrated DSUs/CSUs, reducing the complexity of the network and the cost of the central-office ports by efficiently combining time-division multiplexing (TDM) voice (PBX), IP voice, and data on the same trunks.
- ISDN Primary Rate Interface (PRI) for data use: The NIMs support Multilink Point-to-Point Protocol (MLPPP) and Multilink Frame Relay (FRF.16).

Applications

Packet Voice Solutions: PBX and Central-Office Connectivity

The modules supply PBX and public-switched-telephone-network (PSTN) connectivity for the Cisco 4451-X with the onboard NIM slots. The ISRs support H.323, Session Initiation Protocol (SIP), Media Gateway Control Protocol (MGCP), and Skinny Client Control Protocol (SCCP)-based voice over IP (VoIP).

Data Solutions: T1/E1 WIC with Integrated DSU/CSU

Simplify the branch-office connectivity by integrating the functions of a router, T1/E1, and fractional T1/E1 serial interface with a fully managed DSU/CSU. When used for data-only WAN connectivity, the modules support numerous functions, including Cisco IOS® Software Command-Line Interface (CLI)-initiated loopback control, similar to the popular Cisco 1-Port T1/Fractional T1 DSU/CSU WAN Interface Card (HWIC-1DSU-T1). Also included are the integrated DSU functions for E1 deployments and integrated CSU and DSU functions for T1 deployments, simplifying remote network management.

The MFT versions support a channelized capability where you can flexibly split the T1 or E1 service into one or two fractional channel groups. Thus a single physical port can provide connection to multiple sites.

Multiplexed Data and Voice Solutions: T1/E1 Drop-and-Insert Multiplexer with Integrated DSU/CSU

The Cisco fourth-generation T1/E1 modules simplify branch-office connectivity by consolidating the functions of a router, a fully managed drop-and-insert multiplexer, and a fully managed DSU/CSU into a single box. Typically a drop-and-insert multiplexer is used for channelized (that is, TDM) integration of data and voice onto a single T1, fractional T1, E1, or fractional E1 connection to the central office. Sharing a line can significantly reduce costs over those of two separate physical lines to the central office. Although the normal use is for data and voice sharing of a T1 or E1 service, you can also use the drop-and-insert capability for video and data, or data and data sharing of the service. More over, the integrated drop-and-insert capability enhances system availability by allowing the Cisco IOS Software to be reloaded while maintaining TDM switching.

Analog Cross-Connect Solution

You can cross-connect the TDM DS-0 channels with analog voice ports to create an analog cross-connect solution.

Table 2. Cisco T1/E1 Module Capacity Comparison

Configuration Description	MFT Modules NIM-1MFT-T1/E1, NIM-2MFT-T1/E1, NIM-4MFT-T1/E1, and NIM-8MFT-T1/E1	Channelized Modules NIM-1CE1T1-PRI, NIM-2CE1T1-PRI, and NIM-8CE1T1-PRI
Data Only		
Serial data (channel-group*)	2 per port	24 per port
E1 unframed G.703	Not supported	Supported
Voice Only		
Voice channel associated signaling (CAS) (ds0-group)**	24 per port (T1) 31 per port (E1) 1 per timeslot	24 per port (T1) 31 per port (E1) 1 per timeslot
Voice, Video and Data		
PRI (pri-group*)**	1 per port	1 per port
Drop and insert (tdm-group**)**	24 per port (T1) 31 per port (E1)	24 per port (T1) 31 per port (E1)

	1 per timeslot	1 per timeslot

* channel-group refers to bonding of one or more timeslots into a single (High-Level Data Link Control (HDLC)-framed serial connection for IP data traffic connectivity. This connection is used for HDLC, Frame Relay, and Multilink PPP (MLPPP) serial WAN connections.

** ds0-group refers to bonding of one or more timeslots into a single TDM voice connection using CAS such as ear and mouth (E&M), foreign exchange station (FXS), or foreign exchange office (FXO). This connection is used for TDM PBX or PSTN connections and typically is deployed only on T1.

*** pri-group refers to bonding of two or more timeslots into a single TDM connection using ISDN signaling. This connection is typically used for TDM PBX or PSTN voice and video connections on T1 and E1, and also for data WAN connections on E1. Each call on the PRI is individually indicated as being a voice, video, or data call with the ISDN bearer capability delivered with the call. Signaling is done on the D-channel, which is always channel 24 on a T1 and channel 31 on an E1.

**** tdm-group refers to cross-connecting one or more timeslots from one TDM interface to another. This connection is used to groom channels from different access points onto a combined T1 or E1 uplink. Because the router merely cross-connects and does not interpret or route the traffic from the ingress interface to the egress interface, the traffic type (voice, video, and data) is transparent to the router.

Cisco IOS-XE Software Release Requirements

The modules are supported on the Cisco 4451-X and require Cisco IOSXE Software Release 3.9.

Data applications require the IP Base technology package, which is included by default. Voice applications require a minimum of the UC technology package, which is optional.

Data Features

NIM data features follow:

- T1/E1 or fractional T1/E1 network interface
- n x 64 kbps or n x 56 kbps, non channelized data rates (T1: n = 1 to 24, E1: n = 1 to 31)
- Standards-based, including ANSI T1.403 and AT&T Publication 62411

Network Interfaces Specifications

Tables 3 and 4 give T1 and E1 network interface specifications, respectively.

Table 3. T1 Network Interface Specifications

T1 Network Interface	
Transmit bit rate	1.544 Mbps ±50 bps/32 ppm
Receive bit rate	1.544 Mbps ±50 bps/32 ppm
Line code	Alternate mark inversion (AMI) and binary 8-zero substitution (B8ZS)
Alternative mark inversion(AMI)ones density	Enforced for n x 56-kbps channels
Framing format	D4 (Super Frame [SF]) and Extended Super Frame (ESF)
Output level (line build-out [LBO])	0, -7.5 or -15 dB
Input level	+1 dB0 down to -24 dB0
Data-terminal-equipment (DTE) interface (WIC mode)	Fractional service
DTE interface (VIC mode)	G.704 or structured
Data-communications-equipment (DCE) interface	G.704 or structured

Table 4. E1 Network Interface Specifications

E1 Network Interface	
Transmit bit rate	2.048 Mbps ±100 bps/50 ppm
Receive bit rate	2.048 Mbps ±100 bps/50 ppm
Data rate	1.984 Mbps (framed mode) per E1 port
Clocking	Internal and loop (recovered from network)
E1 national bits	Fixed (nonconfigurable)
Encoding	High-density bipolar three (HDB3)
DTE interface (WIC mode)	Fractional service
DTE interface (VIC mode)	G.704 or structured
DCE interface	G.704 or structured

Table 5 gives the module specifications

Table 5. Module Specifications

Features	Specifications
Dimensions (H x W x D)	1.25 x 3.50 x 7.24 in. (3.18 x 8.89 x 18.39 cm)
Environmental	• Operating temperature: 0 to 50℃ (32 to 122℉) • Storage temperature: -20 to +65℃ (-4 to 148℉) • Relative humidity: 10 to 85% noncondensing operating; 5 to 95% noncondensing, nonoperating
T1 Compliance (partial list)	• TIA-968-A • CS-03 • Jate • ANSI T1.403
E1 Compliance (partial list)	• TBR4, TBR12, and TBR13 • ITU-T G.703, G.704, G.823, and I.431 • S016 (Australia)

Weight

All values are +/-0.01 lb (+/-5 g).

Product Number	Weight
NIM-1MFT-T1/E1	0.40 lb (181g)
NIM-2MFT-T1/E1	0.42 lb (191g)
NIM-4MFT-T1/E1	0.44 lb (200g)
NIM-8MFT-T1/E1	0.52 lb (236g)
NIM-1CE1T1-PRI	0.40 lb (181g)
NIM-2CE1T1-PRI	0.42 lb (191g)
NIM-8CE1T1-PRI	0.52 lb (236g)

Diagnostics

- ANSI T1.403 Annex B/V.54 loop-up/down code recognition, network loopback, user-initiated loopbacks, network payload loopback, local DTE loopback, and remote line (codes: V.54, loop up, and loop down)
- Bit-error-rate-testing (BERT) patterns: All 0's, all 1's, 1:2, 1:8, 3:24, QRW, QRSS, 63, 511, 2047, and V.54/T1.403 annex B bit patterns, and two user-programmable 24-bit patterns

- Alarm detection: Alarm indication signal (AIS), time-slot 16 AIS, remote alarm, far-end block error (FEBE), out of frame (OOF), cyclic-redundancy-check (CRC) multiframe OOF, signaling multiframe OOF, frame errors, CRC errors, loss of network signal (red alarm), loss of network frame, receive (blue alarm) (AIS) from network, receive (yellow) from network performance reports or error-counters CRC, errored seconds, burst errored seconds, severely errored seconds, Ft and Fs framing errors for SF framing, (FPS) framing errors for ESF framing, and 24-hour history stored in 15-minute increments
- Onboard processor for real-time facility-data-link (FDL) messaging, in-band code detection and insertion, alarm integration, and performance monitoring
- Full FDL support and FDL performance monitoring, according to configurable standard: ANSI T1.403 or AT&T TR 54016

DSU/CSU

- Selectable DSX-1 cable length in increments from 0 to 655 feet in DSU mode
- Selectable DS-1 CSU line build-out: 0, -7.5, and -15 dB

LEDs

- CD (data carrier detect): Indicates a received error on the telco link
- LP (loopback): Indicates that the interface is in loopback mode
- AL (alarm): Indicates an alarm condition

Table 6 gives the network management features and Table 7 gives regulatory compliance information about the NIMs.

Table 6. Network Management Features

Management Feature	
Telnet or console	Remote and local configuration, monitoring, and troubleshooting from Cisco IOS-XE Software CLI
Simple Network Management Protocol (SNMP)	• Router and DSU/CSU managed by single SNMP agent; router, DSU, and CSU appear as a single network entity to user • Standard MIB (MIB II) • Cisco Integrated DSU/CSU MIB • RFC 1406 T1 MIB, including Alarm Detection and Reporting
SNMP traps	Generated in response to alarms

Table 7. Regulatory Compliance

Safety	EMC Immunity	EMC Emissions	Network Equipment Building Standards (NEBS)
• UL 60950 • CAN/CSA C22.2 No. 60950 • IEC 60950-1 • EN 60950-1 • AS/NZS 60950	• EN55024 (CISPR24) • EN61000-4-2 • EN61000-4-3 • EN41000-4-4 • EN41000-4-5 • EN41000-4-6 • EN41000-4-8 • EN41000-4-11 • EN50082-1 • EN61000-6-2 • ITU-T K.21	• CFR 47 Part 15, Class A • ICES-003 Class A • EN55022 Class A • CISPR22 Class A • AS/NZS 3548 Class A • VCCI Class A • EN 300386 • EN61000-3-2 • EN61000-3-3	• GR-63 • GR-1089 Type 1, 3

Telecom Homologation

Homologation requirements vary by country and interface type. For specific country information, refer to the online approvals database at: http://tools.cisco.com/cse/prdapp/jsp/externalsearch.do?action=externalsearch&page=EXTERNAL_SEARCH&module=EXTERNAL_SEARCH.

Ordering Information

Help customers understand all the components or parts they need to purchase in order to install and use the product. This section also provides a direct link to the Cisco Ordering Tool and lists part numbers for customer convenience.

To place an order, visit the Cisco Ordering Home Page. To download software, visit the Cisco Software Center.

Table 8. Ordering Information

Product Name	Part Number
NIM-1MFT-T1/E1	1 port Multi-flex Trunk Voice/Clear-channel Data T1/E1 Module
NIM-2MFT-T1/E1	2 port Multi-flex Trunk Voice/Clear-channel Data T1/E1 Module
NIM-4MFT-T1/E1	4 port Multi-flex Trunk Voice/Clear-channel Data T1/E1 Module
NIM-8MFT-T1/E1	8 port Multi-flex Trunk Voice/Clear-channel Data T1/E1 Module
NIM-1CE1T1-PRI	1 port Multi-flex Trunk Voice/Channelized Data T1/E1 Module
NIM-2CE1T1-PRI	2 port Multi-flex Trunk Voice/Channelized Data T1/E1 Module
NIM-8CE1T1-PRI	8 port Multi-flex Trunk Voice/Channelized Data T1/E1 Module

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