



Resilient, cost-effective network connections

Service, protocol, and physical interface expansion capabilities for the Marconi ASX[®] and TNX[™] multiservice switches



The wide variety of Marconi Multiservice Broadband Network Modules enables easy and modular expansion for ASX[®] and TNX[™] multiservice switches. Marconi switches offer a broad range of physical interfaces, as well as advanced hardware features. With high connection capacity, priority queuing, cell buffering, and hierarchical traffic shaping, these modules are ideal for service providers that are looking for a strong multiservice offering.

The network modules are available in a range of interfaces, including 10/100 Ethernet, Gigabit Ethernet, T1/E1, DS-3/E3, Circuit Emulation (CEM), Frame Relay, and Asynchronous Transfer Mode (ATM). The modules' advanced hardware features preserve throughput and connection integrity, as well as manage traffic. Because of their modularity, the units help to protect your investment and offer a high degree of reuse. A new line of channelized DS-3 network modules — ATM/Inverse Multiplexing for ATM (IMA), Frame Relay, CEM — is also available for higher density applications.

In addition, superior software support, including intelligent traffic management, provides maximum revenue/service potential without costly overbuilding. Explicit service level agreements (SLAs) can be defined dynamically to offer voice, video, and data services over the same connection-oriented medium to virtually any level of granularity. This dynamic, flexible system enables full use of scarce “last-mile” bandwidth.

Key benefits

- Modular design for easy expansion to support future growth
- Tailored support of SLAs for maximum revenue
- Optimized traffic management for full utilization of network bandwidth and resources
- Maximum flexibility via service consolidation — i.e., Time Division Multiplexing (TDM), ATM, Ethernet, Transparent LAN Services (TLS), CEM, Frame Relay, Multiprotocol Label Switching (MPLS), etc.
- Best-in-class range of interface speeds and optical distances
- Advanced value-added features, such as IMA and intelligent traffic management, for maximum return on investment, particularly in last-mile or physically congested areas

Flexible, adaptable, feature-rich systems

The Marconi Multiservice Broadband Network Modules couple hardware flexibility and software intelligence to deliver a unique, award-winning combination for lower operating costs, high investment protection, and optimum value-added end-customer services. Our network modules have been in service for more than a decade at customer sites around the world. We've applied our expertise and experience to this solid, reliable product set to ensure maximum customer satisfaction.

The small, modular design of Marconi Multiservice Broadband Network Modules provides an ideal platform for flexible, long-range growth. As customer and network needs change, additional capacity can be incrementally added to switching units. This allows new functionality to be added to the existing infrastructure to meet the constantly changing demands of service delivery.

As an added benefit, software support for Internet Protocol (IP)/MPLS and ATM allows flexible implementation of protocols to meet network needs — without expensive hardware upgrades. And because the modules are standards-compliant, they can interoperate in existing infrastructures for maximum flexibility.

Ethernet modules provide connectivity to LANs or other Ethernet-based devices. ATM modules connect to ATM services and backbone transport services at speeds ranging from 25 Mbps to OC-48. Frame Relay services can be easily integrated with channelized DS-1/E1 1/0 Frame Relay (formerly known as FramePlus) modules; channelized DS-1/E1 1/0 CEM (formerly known as VoicePlus™) modules provide CEM service. And IMA modules offer a cost-effective means to aggregate bandwidth, increase capacity, and enhance resiliency.

Key advantages of the Marconi Multiservice Broadband Network Modules include:

- Per-virtual circuit (VC) Quality of Service (QoS) enforcement and measurements support SLA guarantees. Service can be tailored to any level.
- Per-VC buffer management isolates and protects individual circuits, enabling an effective combination of services without sacrificing service integrity.
- Hierarchical shaping of VCs and virtual paths (VPs) guarantees service at every transmission level — from the individual circuit through the overall network path.
- Adherence to the latest standards ensures interoperability with standards-based services and equipment.
- Compatibility across the series of Marconi ASX and TNX switches protects your investment and delivers a high degree of equipment reuse.
- Dynamic, hot-swappable configurations and non-service-disrupting upgrades ensure that our modules and switches can meet the demands of 99.999 percent uptime for production environments.

A variety of modular options

The Multiservice Broadband Network Modules are available in a wide variety of options, including Ethernet, Frame Relay, CEM, ATM, and IMA. Because Marconi ASX and TNX chassis offer multiple slots for these modules, different technologies can be mixed and matched to meet the demands of a multiservice environment.

Each network module incorporates unique value-added features for the particular technology domain that it services. A brief summary of the module options is presented in the table below.

Network modules options summary

Technology	Number of ports	Speed	Interface(s)
Ethernet	4	10/100 Mbps	Twisted pair (TP)
Gigabit Ethernet	1	1 Gbps	GBIC (SX or LX)
Frame Relay	4	DS-1/E1	TP
	3	chDS-3/1/0	BNC
CEM	6	DS-1/E1	TP
	3	chDS-3/1/0	BNC
	1	chOC-3c down to DS-1/0	Single mode, intermediate reach (SMIR) and multimode (MM) fiber
IMA	8	DS-1/E1	TP
	3	chDS-3/DS-1/E1	BNC
ATM	4	6 Mbps (J2)	TP
	6	25 Mbps	TP
	4 or 8	DS-1/E1	TP
	4	DS-3/E3	BNC
	3	chDS-3/1	BNC
	4	155 Mbps (OC-3c/STM-1)	TP; MM, SMIR, and single mode, long reach (SMLR) fiber; BNC
	1	622 Mbps (OC-12c/STM-4)	MM, SMIR, and SMLR fiber
	1	2,488 Mbps (OC-48c/STM-16)	Single mode short reach (SMSR) and SMLR fiber

Intelligent bandwidth management

The Multiservice Broadband Network Modules offer balanced hardware and software features to meet the most demanding network needs. Features such as per-VC queuing, smart buffering, user-programmable thresholds, traffic shaping, per-VC shaping and scheduling, frame discard, and available bit rate (ABR) management combine to provide a rich feature set. These features ensure SLA guarantees can be met and managed economically.

Per-VC queuing

Per-VC queuing enables the Multiservice Broadband Network Modules to support SLAs. It also allows the switches to manage buffer and bandwidth capacities on a per-connection, per-QoS basis. This prevents overactive traffic sources from impacting the service levels provided to other connections and users.

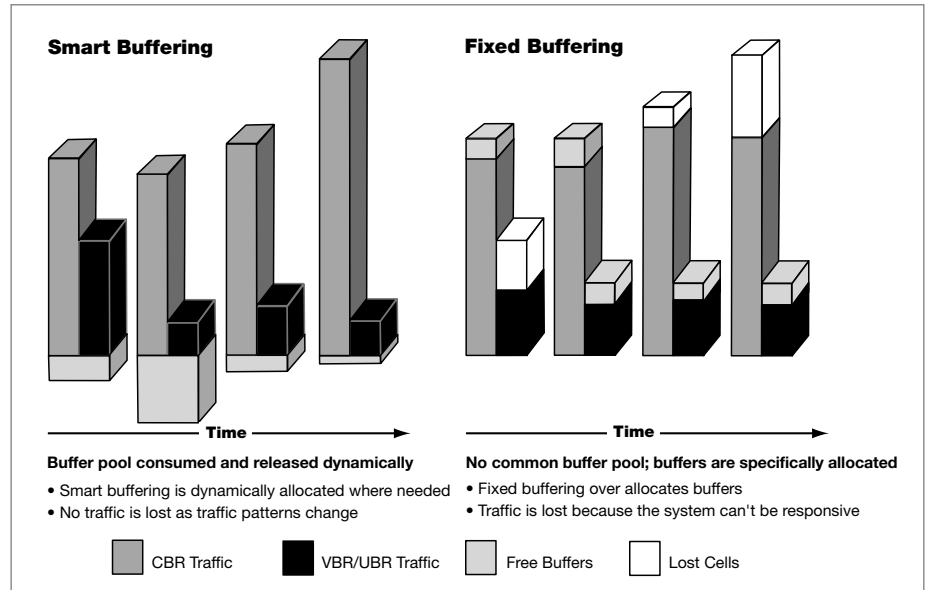
Smart buffering

Smart buffering techniques are integral to the network modules. These techniques maximize the effectiveness of the per-module output buffers by dynamically allocating buffers between connections.

When compared to statically managed buffers, Marconi smart buffers can achieve a 200 to 300 percent increase in buffer efficiency. Key advantages of the smart buffering techniques are:

- Buffers are allocated on an as-needed basis.
- QoS for constant bit rate (CBR) and variable bit rate (VBR) connections is assured.
- Traffic bursts from unspecified bit rate (UBR) and ABR traffic can be accommodated.
- User-programmable thresholds protect the integrity of CBR traffic, always ensuring that adequate resources are available for critical traffic streams.

Compared to other buffering techniques, smart buffering provides better service guarantees and less traffic loss. The graphs above illustrate the benefits of smart buffering over fixed buffering for the same traffic pattern.



Smart buffering vs. fixed buffering for the same traffic pattern

User-programmable thresholds

The Multiservice Broadband Network Modules are configurable with per-port, per-VC, and per-QoS parameters, including cell loss priority and frame discard thresholds. Network operators can adjust individual ports or VCs within ports for optimum resource utilization. Minimum per-QoS queue sizes ensure that all traffic types receive fair access to network resources. This fair access permits service levels to be set with certainty for even the most demanding situations.

Per-VC shaping and scheduling

The current generation of Multiservice Broadband Network Modules supports hierarchical per-VP and per-VC shaping and scheduling. These features enable a shaped VC to exist with a shaped VP. This ensures that each VP and VC adheres to its specific service contract. The hierarchical shaping capability is especially important when connecting to public ATM services, where policing can result in lost traffic.

Bandwidth groups

VCs on the Multiservice Broadband Network Modules can be combined into bandwidth groups for easy management and control. Explicit service contracts can be set on the group as a whole. As a result, the network manager can manage and control the group without the need to address each individual connecting within the group. Within the same physical path, each rate group is protected from the others, which ensures the service integrity of each rate group.

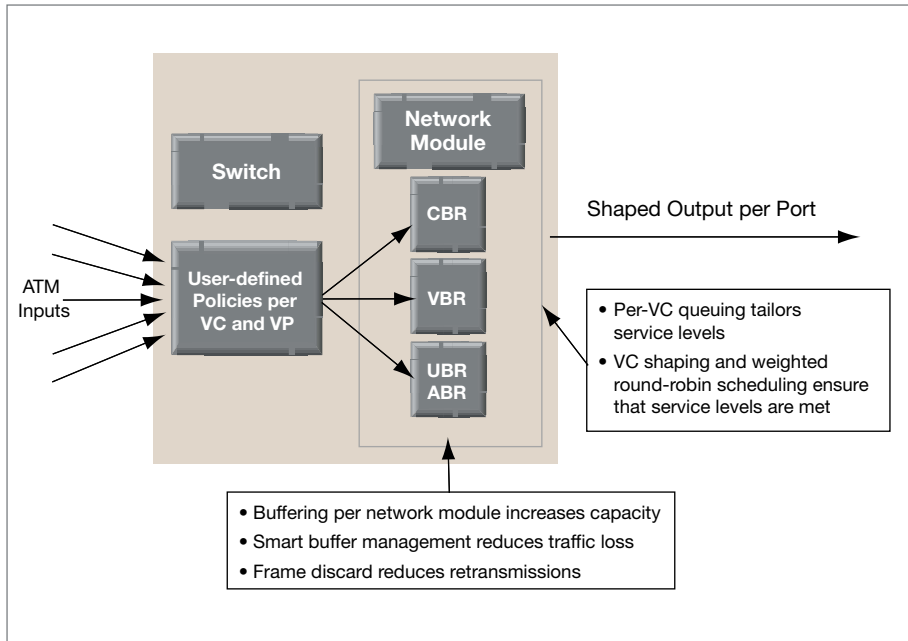
As bandwidth needs grow or change, the overall group can be changed in character to meet service level demands. This ability to aggregate and control simplifies network management without sacrificing service level integrity.

Frame discard

Marconi Multiservice Broadband Network Modules do not utilize random cell drops. Random cell drops will cause upper-network-level protocols to request packet retransmission. Because packets are comprised of multiple cells, this can tremendously increase overall network loading at a time when the network is least capable of sustaining a heightened traffic flow.

Instead, the network modules utilize frame discard, which improves data throughput by intelligently discarding all of the cells from selected ATM Adaptation Layer Type 5 (AAL-5) packets. Rather than dropping random cells from multiple packets, intelligent discard techniques significantly reduce the amount of traffic retransmissions, especially in congested situations. This ensures that bandwidth is preserved when it is most needed.

Testing has shown that smart discarding can dramatically reduce the number of packets that must be retransmitted, as well as increase the number of successfully transmitted packets on congested ports.



Advanced traffic management features guarantee service levels and reduce traffic loss

Channelized DS-1/E1 1/0 CEM network module

The channelized DS-1/E1 1/0 CEM network module delivers robust CEM services for the seamless migration of TDM equipment into common multiservice ATM infrastructures.

The module enables network operators to consolidate overlay voice, video conferencing, video distribution, and data networks onto a common scalable backbone. Features such as idle call suppression are available to increase bandwidth availability when lines are "on hook."

This integrated bandwidth management can result in substantial network savings via reduced lease-line charges, a decreased need for network support, fewer administrative costs, and reduced overall network complexity.

Explicit-rate ABR

Current-generation Multiservice Broadband Network Modules also support the explicit-rate ABR (ER-ABR) service category, per ATM Forum traffic management standards.

With ER-ABR, the network modules can detect congestion and address the issue by specifying rates at which the traffic source must operate to avoid congestion. This enables ATM traffic sources to tailor traffic for optimum bandwidth throughput. ER-ABR is especially critical for heavily utilized inter-switch or server-to-switch links.

The IMA advantage

IMA permits multiple physical ATM links to be combined into a single logical link. These links are composed of traditional T1/E1 links. Multiple links using small amounts of bandwidth can be economically aggregated using this technology, thus decreasing overall physical line needs. Or, where it is not possible to provide a complete OC-3 or DS-3/E3 service, multiple smaller lines can be aggregated to offer greater overall bandwidth.

An additional benefit of IMA is that failures on individual lines are transparent to the overall IMA group. Individual physical lines can fail and rejoin the group with no disruption in service, enabling true 24x7 service levels. This fault-tolerant behavior is ideal when redundancy is required to ensure service availability. IMA functionality is supported on discrete DS-1/E1 and channelized DS-3/1 network modules.

A growing family

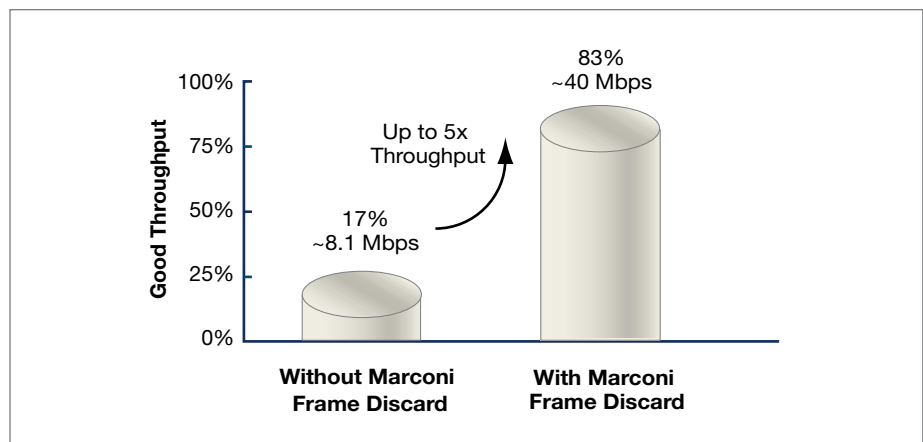
The Marconi family of Multiservice Broadband Network Modules is now in its fifth generation of technology. Over the years, it has continued to grow with interface technology enhancements (Frame Relay, T1/E1, Ethernet, etc.), as well as on-board processing enhancements.

The result is a mature, well-engineered family of products that continues to be advanced via both hardware and software improvements.

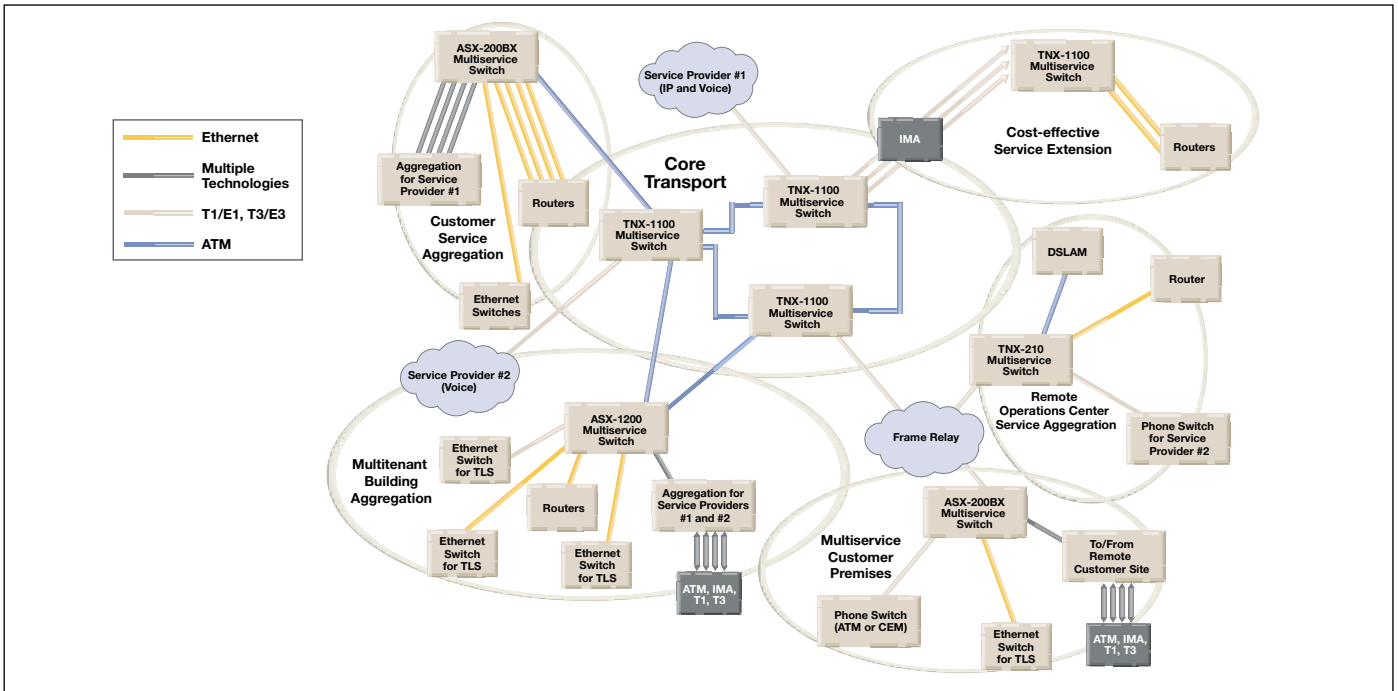
Channelized DS-1/E1 1/0 Frame Relay network module

The channelized DS-1/E1 1/0 Frame Relay network module delivers comprehensive, high-performance service and network interworking. It enables the seamless migration of Frame Relay or ATM frame-based user-to-network interface (FUNI) services into a common multiservice ATM infrastructure.

The ability to provide robust frame-to-cell interworking in a single platform can result in substantial network savings via lower network costs.



Frame discard improves throughput, with a dramatic increase on congested links



Multiservice network configuration

A unique feature of the channelized DS-1/E1 1/0 Frame Relay module is its ability to map Frame Relay to ATM. This enables providers to offer SLAs for Frame Relay service — an additional opportunity for enhancing both service and revenues.

Ethernet multiservice broadband network module

Marconi offers 10/100 autonegotiating Ethernet and Gigabit Ethernet interfaces for the ASX/TNX product lines. These modules support mapping of ATM permanent virtual circuits (PVCs) and smart PVCs (SPVCs) to Ethernet for transparent Ethernet LAN to WAN transport.

These modules extend Marconi's leadership in QoS engineering because they permit the mapping of IEEE 802.1p priority to QoS for CBR, VBR (both real-time and non-real-time) and UBR over ATM networks.

And the addition of IEEE 802.Q virtual LAN (VLAN) support makes the modules ideal for isolating traffic among networks to offer additional security and broadcast control.

Seamless Ethernet LAN and WAN integration enhances capabilities for providing TLS, which decreases end-user routing expenses while increasing the ability to offer guaranteed levels of service previously unattainable by other technologies.

Channelized network modules

For applications requiring a high density of low speed connections, Marconi offers channelized DS-3 network modules.

Customers looking for high-density DS-1 ATM with IMA support can use the three-port channelized DS-3 module with support for IMA versions 1.0 and 1.1. This network module is perfect for ATM/IMA User-Network Interface (UNI) service delivery as well as digital subscriber line access multiplexer (DSLAM) aggregation.

High-density Frame Relay applications can be supported with the three-port channelized DS-3 3/1/0 network module. This network module supports clear channel DS-3, or channelized DS-3/1/0 with support for structured and unstructured DS-1s. For enhanced applications, Multilink Frame Relay (FRF.16) and Access Rate Enforcement are supported.

Supporting a large number of TDM services over an ATM infrastructure can be accomplished with the three-port channelized DS-3 3/1/0 CEM network module. Supporting channelized DS-3 to unstructured or structured DS-1 (DS-0 level), this network module provides a robust feature set for the adaptation of TDM services across a highly efficient ATM network.

Investment protection

All Series E and a select number of Series D network modules can be used in ASX-4000 and ASX-4000M chassis via the Network Module Carrier Card (NMC), thus providing investment protection via reuse of technology, operations, and training. Please refer to the ASX-4000 and ASX-4000M data sheets for a complete list of network modules supported via the NMC.

World-class performance

Marconi Multiservice Broadband Network Modules set new standards in traffic management. They enable network operators to deploy scalable, high-capacity multiservice networks that efficiently utilize bandwidth while supporting fair, deterministic service to hundreds of thousands of end users and applications worldwide.

With tens of thousands of modules deployed in thousands of switches around the world, Marconi continues to provide robust solutions with unparalleled return on investment in customer network infrastructures.

Key features

- Hierarchical per-VP/VC shaping and scheduling
- Complete line of WAN and LAN interfaces
- 10/100 Ethernet to ATM and MPLS interworking
- Support for a variety of media
- Per-VC traffic management
- Per-VC QoS queuing
- Frame discard
- Cell and packet statistics
- Up to 32K connections per network module
- ER-ABR
- Smart buffers up to 128K cells
- Eight queues
- T1/E1 (Nx64 Kbps) CEM
- T1/E1 frame-to-cell interworking
- Hot-swap capabilities
- Standards-based operation (e.g., IMA 1.0/1.1; FRF.1.1, FRF.2.1, FRF.3, FRF.5, FRF.8, FRF.16)
- Synchronous Optical Network (SONET)/ Synchronous Digital Hierarchy (SDH) automatic protection switching (APS)/multiplex section protection (MSP) for OC-3c modules

Data summary

Description [minimum ForeThought requirement [§]]	Order number(s)	Port capacity	Data rate	Media	Maximum line length	Connector	Compliance
1.5 Mbps DS-1 (T1) ATM module (Series D) [5.0.0]*	NM-4/DS1D	4 DS-1	1.544 Mbps	UTP	655 ft (199.64 m)	RJ-48c	ATM Forum af-phy-0016.000; ANSI/Telcordia DSX-1, T1.102, T1.107, T1.408, TR-TSY-000009; ITU-T G.703, G.704, G.804
2 Mbps E1 multiservice module (Series D) [5.0.0]*	NM-4/DS-E1D	4 E1	2.048 Mbps	UTP	655 ft (199.64 m)	RJ-48c	ATM Forum af-phy-64.000; ITU-T G.703, G.704, G.804, I.432
N x 1.544 Mbps universal DS-1 IMA module (Series D) [6.1.0]**	NMIMA-8/DS1D	8 DS-1 ATM/IMA	N x 1.544 Mbps	UTP	0–200 m (0–656.17 ft) in 40-m (131.23-ft) increments	RJ-48c	ATM Forum af-phy-0016.00, af-phy-0086.000; ITU-T G.703, G.704, G.804, I.361, I.432; ANSI T1.102, T1.107; IMA 1.0, IMA 1.1
N x 2.048 Mbps universal E1 IMA module (Series D) [6.1.0]**	NMIMA-8/E1D	8 E1 ATM/IMA	N x 2.048 Mbps	UTP	0–200 m (0–656.17 ft) in 40-m (131.23-ft) increments	RJ-48c	ATM Forum af-phy-64.000, af-phy-0086.000; ITU-T G.703, G.704, G.804, I.361, I.432; IMA 1.0, IMA 1.1
6 Mbps J2 ATM module (Series C) [4.1.1]	NM-4/J2C	4 J2	6.312 Mbps	Coax	1,300 ft (396.24 m)	BNC	ATM Forum af-phy-0029.000; NTT Technical Reference of Cell Relay Interface v1; ITU-T G.703, G.704, G.804
25.6 Mbps UTP25 ATM module (Series C) [4.1.1]	NM-6/25UTPEC	(6) 25 Mbps UTP	25.6 Mbps	Category 3, 4, or 5 UTP	100 m (328.08 ft)	RJ-45	ATM Forum af-phy-0040.000; ITU-T I.432
45 Mbps DS-3 ATM module (Series E) [6.2.0]**	NM-4/DS3E	4 DS-3	44.736 Mbps	Coax	450 ft (137.16 m)	BNC	ATM Forum af-phy-0054.000; ANSI/Telcordia T1.102, T1.107, TR-TSY-000009
34 Mbps E3 ATM module (Series E) [6.2.0]	NM-4/E3E	4 E3	34.368 Mbps	Coax	450 ft (137.16 m)	BNC	ATM Forum af-phy-0034.000; ITU-T G.703, G.751, G.804, G.832
155 Mbps UTP ATM module (Series E) [6.2.0]	NM-4/155UTPE	4 SONET/SDH	155.52 Mbps	Category 5 UTP	100 m (328.08 ft)	RJ-45	ATM Forum STS-3c UNI v3.1; ITU-T I.432; ANSI T1E1.2/93-020, T1S1/92-185
155 Mbps OC-3c/STM-1 module (Series E) [6.2.0]	NM-4/155MMSCE (SC), NM-4/155MMSTE (ST)	4 SONET/SDH	155.52 Mbps	MMF; 62.5/125 µm, 50/125 µm; 1310 nm	2 km (1.24 mi)	SC or ST	ATM Forum STS-3c MMF ATM module UNI v3.1; ITU-T I.432; ANSI T1E1.2/93-020, T1S1/92-185; Telcordia GR-253-CORE
155 Mbps OC-3c/STM-1 SMF ATM module (Series E) [6.2.0]	NM-4/155SMIRE (IR), NM-4/155SMLRE (LR)	4 SONET/SDH	155.52 Mbps	SMF; 10/125 µm; 1310 nm (IR), 1550 nm (LR)	IR: 15 km (9.32 mi); LR: 60 km (37.27 mi); premium G.957 fiber: 80 km (49.68 mi)	SC	ATM Forum STS-3c UNI v3.1; ITU-T I.432; ANSI T1E1.2/93-020, T1S1/92-185; Telcordia GR-253-CORE
155 Mbps OC-3c/STM-1 mixed-mode fiber ATM module (Series E) [6.2.0]	NM-4/155IR3MME (IR), NM-4/155LR3MME (LR)	3 OC-3c/STM-1 MMF, 1 OC-3c/STM-1 SMF	155.52 Mbps	3 MMF, 1 SMF; 1310 nm (MMF), 1310 nm (IR), 1550 nm (LR)	MMF: 2 km (1.24 mi), Series C/D; IR: 15 km (9.32 mi); LR: 60 km (32.27 mi)	SC	ATM Forum STS-3c UNI v3.1; ITU-T I.432; ANSI T1E1.2/93-020; T1S1/92-185; Telcordia GR-253-CORE
155 Mbps STM-1e ATM module (Series E) [6.2.0]	NM-4/155STM1EE	4 OC-3c STM-1e	155.52 Mbps	Coax	450 ft (137.16 m); RG-6u type: 500 m (1,640.42 ft)	BNC	ATM Forum STS-3c UNI v3.1; ITU-T I.432, G.703; ANSI T1E1.2/93-020, T1S1/92-185
622 Mbps OC-12c/STM-4c ATM module (Series E) [6.2.0]	NM-1/622MMSCE	1 SONET/SDH	622.08 Mbps	MMF; 62.5/125 µm, 50/125 µm; 1270–1380 nm	500 m (1,640.42 ft)	SC	ATM Forum STS-12c UNI v3.1, MMF 95-0128-February 1995; ITU-T I.432; ANSI T1E1.2/93-020, T1S1/92-185; Telcordia GR-253-CORE
622 Mbps OC-12c/STM-4c SMF ATM module (Series E) [6.2.0]	NM-1/622SMIRE (IR), NM-1/622SMLRE (LR)	1 SONET/SDH	622.08 Mbps	SMF; 10/125 µm; 1310 nm (IR), 1550 nm (LR)	IR: 15 km (9.32 mi); LR: 60 km (32.27 mi); premium fiber: 80 km (49.68 mi)	SC	ATM Forum af-phy-0046.000; I.432; ANSI T1E1.2/93-020, ITU-T T1S1/92-185; Telcordia GR-253-CORE
2,488 Mbps OC-48c/STM-16c SMF ATM module and switch fabric [6.1.0]	NM-1/2488MSR (SR), NM-1/2488SMLR (LR)	1 SONET/SDH	2,488.32 Mbps	SMF; 10/125 µm; 1266–1360 nm (SR), 1280–1355 nm (LR)	SR: 2 km (1.24 mi); LR: 40 km (24.84 mi)	SC	ITU-T I.432, G.707, G.783; ANSI T1.105-1995, T1.646-1995; Telcordia GR-253-CORE
Channelized DS-1/E1 1/0 CEM module [4.1.1] [‡]	NMCE-6/DS1A (T1), NMCE-6/E1A (E1)	6 DS-1 or E1	DS-1: 1.544 Mbps; E1: 2.048 Mbps	UTP	200 m (656.17 ft)	RJ-48c	ITU-T I.432, G.703, G.704, G.707, G.783, G.823, G.824; ANSI T1.105-1995, T1.646-1995; Telcordia GR-253-CORE; CES Interoperability v2.0 (ATM Forum/95-1504R1); ANSI/Telcordia T1/403

[§] "Minimum ForeThought requirement" refers to the first release supporting the specific module. Please note that the latest ForeThought version is required to ensure compliance with all specifications and features listed in this table.

* Cell delineation is line framing.

** Cell delineation is line framing or PLCP (optional).

[†] Different ATM connections can be prioritized before dropped upon IMA bandwidth changes. Each port can be independently software-configured as an IMA port or an ATM port.

[‡] Structured service is digital cross-connect (DCS) type service where Nx64 Kbps and Nx56 Kbps circuits are mapped to unique ATM VCs; N = 1 to 24 (DS-1)/31 (E1) contiguous or non-contiguous DS-0 channels per DS-1/E1 port. Unstructured service is full-bandwidth 1.544 Mbps (DS-1) and 2.048 Mbps (E1) clear channel service per port. Channel-associated signaling (CAS) and basic circuit signaling modes are supported with structured service. Idle channel suppression optimizes bandwidth efficiencies across the ATM backbone and on specific ATM trunks, dynamically detecting active (off-hook) and idle (on-hook) conditions in real time and reallocating link bandwidth to other resource-hungry applications during idle periods.

^{‡‡} Contiguous or non-contiguous channel assignment of 64 Kbps time slots. Channelized Frame Relay service is fractional Nx64 Kbps or M x (Nx64 Kbps) service, where N < 24 for DS-1 and N < 3 for E1 ports. Unchannelized Frame Relay service is full-line-rate DS-1 (1.536 Mbps) or E1 (1.984 Mbps). Structured FUNI channel service is fractional Nx64 Kbps or M x (Nx64 Kbps), where N < 24 for DS-1 and N < 31 for E1 ports; up to full-line-rate DS-1 (1.536 Mbps) or E1 (1.984 Mbps).

Data summary (continued)

Description [minimum ForeThought requirement [§]]	Order number(s)	Port capacity	Data rate	Media	Maximum line length	Connector	Compliance
Channelized DS-1/E1 1/0 Frame Relay-to-ATM interworking module [4.1.1] ^{¶¶}	NMFR-4/DS1A (T1), NMFR-4/E1A (E1)	4 DS-1 or E1	DS-1: 1.544 Mbps; E1: 2.048 Mbps	UTP	200 m (656.17 ft)	RJ-48c (120-ohm RJ-48c to 75-ohm E1 adapter available)	Frame Relay Forum FRF.1.1, FRF.2.1, FRF.3, FRF.5, FRF.8; ATM Forum af-phy-0016.000.af-phy-0064.000.af-saa 0088.000, B-ICI; ANSI T1.403, T1.606, T1.606a, T1.617, T1.618, T1.633; ITU-T G.703, G.704, G.706, G.709, G.732, G.733, G.823, G.824, I.233.1, I.363.5, I.365, I.370, I.555, I.610, Q.933; IETF RFC 1483, RFC 1490; CES Interoperability v2.0 (ATM Forum/95-1504R1); ANSI/Telcordia T1/403
10/100 Ethernet network module [7.0.1]	NM-4/ETH-TXB	4 10/100 Ethernet; 8,192 MAC addresses per port	10/100 Mbps autonegotiating, FDX or HDX	UTP	100 m (328.08 ft)	RJ-45	IETF RFC 1483, RFC 1757, RFC 1066 (MIB-I), RFC 1213 (MIB-II), RFC 1643 (IEEE 802.3 Layer Management MIB), RFC 2037 (Entity MIB), RFC 1493 (Bridge MIB); IEEE 802.3x, IEEE 802.1D-1998 (802.1p) Packet Priority, IEEE 802.1Q VLANs
Channelized DS-3/DS-1/E1 ATM/IMA module [8.3.0]	NMIMA-3/DS3	3 DS-3; 84 DS-1; 63 E1	44.736 Mbps; 1.544 Mbps; 2.048 Mbps	Coax	450 ft (137.16 m)	BNC	AF-PHY-0016.00, ITU-T G.703, ANSI T1.403, ITU-T G.824, ITU-T G.775, ITU-T G.751, ITU-T G.752, ITU-T G.755, GR-499-CORE-1995, ANSI T1.105.03b 1997, ANSI T1.102-1993 IMA v1.0, IMA v1.1
Channelized DS-3 3/1/0 Frame Relay module [8.2.0]	NMFR-3/DS3	3 DS-3; 84 DS-1; 2,016 DS-0	44.736 Mbps; 1.544 Mbps; 56/64 Kbps	Coax	450 ft (137.16 m)	BNC	FRF.1.2: (UNI), FRF.2.1: (NNI), FRF.3.2: Multiprotocol Encapsulation Implementation Agreement (MEI), FRF.5: FR/ATM Network Interworking Implementation, FRF.6, FR Service Customer Network Management Implementation Agreement (MIB), FRF.8.1: FR/ATM PVC Service Interworking Implementation Agreement, FRF.14, Physical Layer Interface Implementation Agreement, FRF.16, Multi-link FR UNI/NNI Implementation Agreement, ATM Forum af-bici-0013.003 B-ICI specification, v2.0, ANSI T1.403.02-1999, ANSI T1.403-1999, ANSI T1.404-1994, T1.606, ANSI T1.617 Annex D, ANSI T1.618-1991 (R1997), ITU-T G.703, ITU-T G.704, ITU-T G.706, ITU-T G.704, ITU-T G.824, ITU-T G.826, ITU-T I.122, ITU-T I.233.1, ITU-T I.363.5, ITU-T I.365.1, ITU-T I.370, ITU-T I.372, ITU-T I.555, ITU-T Q.922, ITU-T Q.933 Annex A, GR-499-CORE
Channelized DS-3 3/1/0 CEM module [8.2.0]	NMCE-3/DS-3	3 DS-3; 84 DS-1; 2,016 DS-0	44.736 Mbps; 1.544 Mbps; 56/64 Kbps	Coax	450 ft (137.16 m)	BNC	ATM Forum Circuit Emulation Service Interoperability Specification v2.0 (af-vtoa-0078.00), ANSI/Bellcore T1.102, T1.107, T1.231, T1.404, ITU-T G.775, GR-499-CORE, GR-1098-CORE, RFC 2494, RFC 2495, RFC 2496
Gigabit Ethernet network module [8.3.0]	NM-1/ETH-1000-GBIC-SX/LX	1 Gigabit Ethernet	1000 Mbps	GBIC (SX or LX)	SX: 500 m (1,640.42 ft); LX: 10 km (6.21 mi)	GBIC	IETF RFC 1483, RFC 1757, RFC 1066 (MIB-I), RFC 1213 (MIB-II), RFC 1643 (IEEE 802.3 Layer Management MIB), 802.3u, RFC 2037 (Entity MIB), RFC 1483 (Bridge MIB), IEEE 802.3x, IEEE 802.1D-1998, 802.1p, 802.1Q RFC2684

[§] "Minimum ForeThought requirement" refers to the first release supporting the specific module. Please note that the latest ForeThought version is required to ensure compliance with all specifications and features listed in this table.

* Cell delineation is line framing.

** Cell delineation is line framing or PLCP (optional).

† Different ATM connections can be prioritized before dropped upon IMA bandwidth changes. Each port can be independently software-configured as an IMA port or an ATM port.

[¶] Structured service is digital cross-connect (DCS) type service where Nx64 Kbps and Nx56 Kbps circuits are mapped to unique ATM VCs; N = 1 to 24 (DS-1)/31 (E1) contiguous or non-contiguous DS-0 channels per DS-1/E1 port. Unstructured service is full-bandwidth 1.544 Mbps (DS-1) and 2.048 Mbps (E1) clear channel service per port. Channel-associated signaling (CAS) and basic circuit signaling modes are supported with structured service. Idle channel suppression optimizes bandwidth efficiencies across the ATM backbone and on specific ATM trunks, dynamically detecting active (off-hook) and idle (on-hook) conditions in real time and reallocating link bandwidth to other resource-hungry applications during idle periods.

^{¶¶} Contiguous or non-contiguous channel assignment of 64 Kbps time slots. Channelized Frame Relay service is fractional Nx64 Kbps or M x (N x 64 Kbps) service, where N < 24 for DS-1 and N < 3 for E1 ports. Unchannelized Frame Relay service is full-line-rate DS-1 (1.536 Mbps) or E1 (1.984 Mbps). Structured FUNI channel service is fractional Nx64 Kbps or M x (N x 64 Kbps), where N < 24 for DS-1 and N < 31 for E1 ports; up to full-line-rate DS-1 (1.536 Mbps) or E1 (1.984 Mbps).

Data summary (continued)

Description [minimum ForeThought requirement [§]]	Framing	Line encoding	Impedance or optical power	Unicast/multicast connection capacity	Output buffer	Clock accuracy	Statistics/alerts	Loopbacks
1.5 Mbps DS-1 (T1) ATM module (Series D) [5.0.0]*	Extended Superframe (ESF)	B8ZS	100 ohms, nominal	10,240/512	32,768 cells	±32 ppm	Line code violations (LCV), framing bit errors (FER), cells received (RxCells), cells transmitted (TxCells), signal/clock detection, alarm indication signal (AIS), header check sequence (HCS), errors, CRC-6 bit errorevents (BEE), out of frame (OOF) events	Transmit and receive
2 Mbps E1 multiservice module (Series D) [5.0.0]*	G.704 CRC-4 multiframe	HDB3	120 ohms, nominal	10,240/512	32,768 cells	±32 ppm	LCV, FER, RxCells, TxCells, signal/clock detection, AIS, HCS errors, far end block errors (FEBE), CRC error events	Transmit and receive
N x 1.544 Mbps universal DS-1 IMA module (Series D) [6.1.0]*†	ESF	AMI or B8ZS	100 ohms, nominal	10,240/512	32,768 cells	±25 ppm	LCV, FER, RxCells, TxCells, signal/clock detection, AIS, HCS errors, CRC-6 BEE, OOF events, ICP violation count (IV-IMA), severely errored seconds IMA (SES-IMA), SES-IMA far end (SES-IMA-FE), unavailable seconds IMA (UAS-IMA), UAS-IMA far end (UAS-IMA-FE)	Transmit and receive
N x 2.048 Mbps universal E1 IMA module (Series D) [6.1.0]*†	G.704 CRC-4 multiframe	HDB3	120 ohms, nominal	10,240/512	32,768 cells	±25 ppm	LCV, FER, RxCells, TxCells, signal/clock detection, AIS, HCS errors, CRC-6 BEE, OOF events, IV-IMA, SES-IMA, SES-IMA-FE, UAS-IMA, UAS-IMA-FE	Transmit and receive
6 Mbps J2 ATM module (Series C) [4.1.1]*	Per ITU-T G.704	B8ZS	75 ohms, nominal	11,264/1,024	13,312 cells	±30 ppm	LCV, FER, RxCells, TxCells, signal/clock detection, AIS, HCS errors, CRC error events	Transmit and receive
25.6 Mbps UTP25 ATM module (Series C) [4.1.1]*	—	4B/5B w/ NRZI	100 ohms, nominal	11,264/1,024	2,560 cells	±100 ppm	RxCells, TxCells, HCS errors, symbol error counter, loss of signal (LOS)	Receive
45 Mbps DS-3 ATM module (Series E) [6.2.0]*	C-bit parity or clear channel impedance	B3ZS	75 ohms, nominal	32,000/7,000	128,000 cells	±20 ppm	LCV, FER, RxCells, TxCells, signal/clock detection, AIS, HCS errors, P-bit and C-bit errors	Transmit and receive
34 Mbps E3 ATM module (Series E) [6.2.0]*	Per ITU-T G.751 or G.832	HDB3	75 ohms, nominal	32,000/7,000	128,000 cells	±20 ppm	LCV, FER, RxCells, TxCells, signal/clock detection, AIS, HCS errors, P-bit and C-bit errors, code violations, bit errors, parity errors	Transmit and receive
155 Mbps UTP ATM module (Series E) [6.2.0]**	STS-3c/STM-1	NRZ	—	32,000/7,000	128,000 cells	±20 ppm	AIS, HCS errors, LOS, loss of frame (LOF), loss of pointer (LOP), FEBE, far end receive failure (FERF), yellow alarm, bit interleaved parity (BIP) errors	Transmit and receive
155 Mbps OC-3c/STM-1 MMF ATM module (Series E) [6.2.0]***	STS-3c/STM-1	NRZ	-14 to -20 dBm Tx power, -14 to -30 dBm Rx sensitivity, 0 to 10 dB path attenuation	32,000/7,000	128,000 cells	±20 ppm	AIS, HCS errors, LOS, LOF, LOP, FEBE, FERF, yellow alarm, BIP errors	Transmit and receive
155 Mbps OC-3c/STM-1 SMF ATM module (Series E) [6.2.0]*	STS-3c/STM-1	NRZ	IR: 8 to -15 dBm Tx power, 8 to -31 dBm Rx sensitivity, 0 to 16 dB path attenuation; LR: 0 to -5 dBm Tx power, 7 to -31 dBm Rx sensitivity, 7 to 26 dB path attenuation	32,000/7,000	128,000 cells	±20 ppm	AIS, HCS errors, LOS, LOF, LOP, FEBE, FERF, yellow alarm, BIP errors	Transmit and receive
155 Mbps OC-3c/STM-1 mixed-mode fiber ATM module (Series E) [6.2.0]*	STS-3c/STM-1	NRZ	-14 to -20 dBm Tx power, -14 to -30 dBm Rx sensitivity, 0 to 10 dB path attenuation	32,000/7,000	128,000 cells	±20 ppm	AIS, HCS errors, LOS, LOF, LOP, FEBE, FERF, yellow alarm, BIP errors	Transmit and receive
155 Mbps STM-1e ATM module (Series E) [6.2.0]*	STM-1	CMI	75 ohms, nominal	32,000/7,000	128,000 cells	±20 ppm	AIS, HCS errors, LOS, LOF, LOP, FEBE, FERF, yellow alarm, BIP errors	Transmit and receive
622 Mbps OC-12c/STM-4c MMF ATM module (Series E) [6.2.0]*	STS-12c/STM-4c	NRZ	-14 to -20 dBm Tx power, -14 to -30 dBm Rx sensitivity, 0 to 10 dB path attenuation	32,000/7,000	128,000 cells	±20 ppm	AIS, HCS errors, LOS, LOF, LOP, FEBE, FERF, yellow alarm, BIP errors	Transmit and receive
622 Mbps OC-12c/STM-4c SMF ATM module (Series E) [6.2.0]*	STS-12c/STM-4c	NRZ	IR: -8 to -15 dBm Tx power, -7 to -29 dBm Rx sensitivity, 0 to 14 dB path attenuation; LR: 2 to -3 dBm Tx power, -7 to -29 dBm Rx sensitivity, 9 to 26 dB path attenuation	32,000/7,000	128,000 cells	±20 ppm	AIS, HCS errors, LOS, LOF, LOP, FEBE, FERF, yellow alarm, BIP errors	Transmit and receive
2,488 Mbps OC-48c/STM-16c SMF ATM module and switch fabric [6.1.0]	STS-48c/STM-16c	NRZ	SR: 3 to -10 dBm Tx power, 3 to -18 dBm Rx sensitivity, 0 to 10 dB path attenuation; LR: 3 to 2 dBm Tx power, 9 to -27 dBm Rx sensitivity, 10 to 24 dB path attenuation	32,000/8,192	32,768 cells	±20 ppm	RxCells, TxCells, AIS, HCS errors, LOS, LOF, LOP, FEBE, FERF, yellow alarm, BIP errors (line BIP-24, section BIP-8, path BIP-8)	Line and equipment
Channelized DS-1/E1 1/0 CEM module [4.1.1]****†	DS-1: ESF and Superframe (SF); E1: G.704	DS-1: AMI or B8ZS; E1: HDB3 (G.703)	DS-1: 100 ohms; E1: 120 ohms	N/A	N/A	On-board crystal = Stratum 4 source (±25 ppm)	Errored seconds (ES), SES, severely errored framing seconds (SEF), UAS, controlled slip seconds (CSS), path coding violations (PCV), line errored seconds (LES), bursty errored seconds (BES), degraded minutes (DM), LCV, AIS, LOF, LOS, loss of multiframe (LOMF)	Per port line/payload

[§] "Minimum ForeThought requirement" refers to the first release supporting the specific module. Please note that the latest ForeThought version is required to ensure compliance with all specifications and features listed in this table.

* Timing is primary and secondary 8 kHz reference from internal (default) or network.

** Timing is primary and secondary 8 kHz reference from internal (default) or network (Series LC).

*** Timing is internal or recovered.

**** Timing is primary and secondary 8 kHz reference from internal (default) or network port, or on-card crystal. Synchronous clocking, structured and unstructured services.

† Each IMA group (1–8) can transmit with a common Tx clock (CTC) or an independent Tx clock (ITC). Network module has a link differential delay of up to 200 ms.

‡ Transport of common channel signaling (CCS) between TDM intelligent signaling end devices across the ATM network.

Data summary (continued)

Description [minimum ForeThought requirement [§]]	Framing	Line encoding	Impedance or optical power	Unicast/multicast connection capacity	Output buffer	Clock accuracy	Statistics/alerts	Loopbacks
Channelized DS-1/E1 1/0 Frame Relay-to-ATM internetworking module [4.1.1]* ^Y	DS-1: ESF and SF; E1: G.704	DS-1: AMI or B8ZS; E1: HDB3	DS-1: 100 ohms; E1: 120 ohms	N/A	N/A	On-board crystal = Stratum 4 source (±25 ppm)	ES, SES, SEF, UAS, CSS, PCV, LES, BES, DM, LCV, CRC errors, common part indication (CPI) errors, length errors, oversized PDU errors and timeouts	Local line, remote line, diagnostic
10/100 Ethernet network module [7.0.1]	—	—	—	—	—	—	SNMP traps, link loss, link down, warm/cold start, align errors, FCS errors, collision errors, deferred transmits, carrier sense errors, frames too long, errors, number frames in/out, port utilization in real time, internal MAC AAL-5 PDU statistics, Mini-RMON (statistics, history, alarms, event groups)	—
Channelized DS-3/DS-1/E1 ATM/IMA module [8.3.0]	DS-3: Standard M13 framing format or C-bit parity framing format DS-1: ESF or SF	DS-3: B3ZS	75 ohms, nominal	32,000/7,000	128,000 cells	On-board crystal = Stratum 4 source (± 25 ppm)	LOF, LOS, AIS, OOF, RDI, LCV, ES, CRC bit errors, framing bit errors, frame slips, SEF	Local line, remote line, remote payload, diagnostic
Channelized DS-3 3/1/0 Frame Relay module [8.2.0]	DS-3: Standard M23 framing format or C-bit framing format. DS-1 ESF, SF (D4), and unframed	DS-3: B3ZS	75 ohms, nominal	N/A	N/A	On-board crystal = Stratum 4 source (± 25 ppm)	DS-1: AIS, RAI (yellow), LOF DS-3: AIS (red), RAI (yellow), LOS, LOF ES, SES, SEF, UAS, CSS, PCV, LES, LCV, CRC errors, CPI errors, length errors, oversized PDU errors, timeouts, DS-3 (framed mode), C-bit code violations (CCV), C-bit errored seconds (CES), C-bit severely errored seconds (CSEF)	Local line, remote line (far end action code, FEAC/facility data link, FDL), remote initiated FEAC/FDL, diagnostic
Channelized DS-3 3/1/0 CEM module [8.2.0]	Structured service Digital cross-connect emulation: 1) at DS-0 level, Nx64 Kbps and Nx56 Kbps circuits are mapped to unique ATM VCs; N = 1 to 24 contiguous or non-contiguous DS-0 channels per DS-1; 2) at DS-1 level, 28 DS-1 circuits per DS-3 port; 3) combination of NxDS-0 and DS-1 levels, any combination up to DS-3 port capacity Unstructured service Full bandwidth 1.544 Mbps (DS-1s) or 44.736 Mbps (DS-3) clear channel services per DS-3 port	DS-3: B3ZS	75 ohms, nominal	NA	NA	±20 ppm	Header errors, lost cells, buffer underflows, buffer overflows, CSS, PCV, LES, degraded minutes (DM), LCV, cell loss status, AIS, LOS, RDI Near-end and far-end versions of ES, SES, SEF, UAS	DS-3: Line, payload, diagnostic, FEAC, remote initiated DS-1: Line, payload (24 DS-0 bundle), diagnostics, FDL, remote initiated DS-0: Payload
Gigabit Ethernet network module [8.3.0]	Ethernet	—	—	—	—	—	SNMP traps, link loss, link down, warm/cold start, align errors, FCS errors, collision errors, deferred transmits, carrier sense errors, frames too long, internal MAC errors, number frames in/out, port utilization in real time, AAL-5 PDU statistics, Mini-RMON (statistics, history, alarms, events groups)	—

[§] "Minimum ForeThought requirement" refers to the first release supporting the specific module. Please note that the latest ForeThought version is required to ensure compliance with all specifications and features listed in this table.

* Timing is primary and secondary 8 kHz reference from internal (default) or network.

** Timing is primary and secondary 8 kHz reference from internal (default) or network (Series LC).

*** Timing is internal or recovered.

**** Timing is primary and secondary 8 kHz reference from internal (default) or network port, or on-card crystal. Synchronous clocking, structured and unstructured services.

† Each IMA group (1–8) can transmit with a common Tx clock (CTC) or an independent Tx clock (ITC). Network module has a link differential delay of up to 200 ms.

^Y Transport of common channel signaling (CCS) between TDM intelligent signaling end devices across the ATM network.

Ordering steps

1. Network modules are added to existing switch chassis to increase interface capabilities. Be sure that a slot is available in the switch chassis to accept the desired module(s).
2. Verify the current version of ForeThought software that is in use on the switch.
3. Select the network module(s) (below), verifying that the ForeThought software version from the Step 2 meets the minimum version requirements for the module.
4. If selecting the NM-1/2488 network module, order a minimum of one SCP (minimum 266 MHz) to power the module/fabric; order two SCPs if SCP redundancy is required in this module/fabric.*
5. Order additional replacement or support services from the Services ordering information (see next page) for each network module ordered. Marconi's standard one-year warranty provides return-to-factory (RTF) replacement within 10 business days. A wide portfolio of optional advisory and replacement services is available.
6. Order network module cables as needed. (Network modules and appropriate cables are listed on the following page.) Note that cables are for a single port. A four-port network module may require from zero to four cables, depending on specific configuration needs, etc.

Network modules ordering information

Multiservice LAN and WAN modules

	Minimum ForeThought requirement	Description
NM-6/25UTPEC	4.1.1	6-port 25.6 Mbps UTP module, RJ-45
NM-4/DS1D	5.0.0	4-port 1.5 Mbps DS-1 module, RJ-48c
NMIMA-8/DS1D	6.1.0	8-port universal DS-1 IMA module, RJ-48c
NM-4/E1D	5.0.0	4-port 2 Mbps E1 module, RJ-48c
NMIMA-8/E1D	6.1.0	8-port universal E1 IMA module, RJ-48c
NM-4/J2C	4.1.1	4-port 6 Mbps J2 module, BNC
NM-4/DS3E	6.2.0	4-port 45 Mbps DS-3 module, BNC
NM-4/E3E	6.2.0	4-port 34 Mbps E3 module, BNC
NM-4/155UTPE	6.2.0	4-port 155 Mbps STS-3c/STM-1 module, RJ-45
NM-4/155MMSCE	6.2.0	4-port 155 Mbps OC-3c/STM-1 module, MMF, SC
NM-4/155MMSTE	6.2.0	4-port 155 Mbps OC-3c/STM-1 module, MMF, ST
NM-4/155SMIRE	6.2.0	4-port 155 Mbps OC-3c/STM-1 module, SMF, intermediate reach, SC
NM-4/155SMLRE	6.2.0	4-port 155 Mbps OC-3c/STM-1 module, SMF, long reach, SC
NM-4/155STM1EE	6.2.0	4-port 155 Mbps OC-3c/STM-1e module, BNC
NM-1/622MMSCE	6.2.0	1-port 622 Mbps OC-12c/STM-4c module, MMF, SC
NM-1/622SMIRE	6.2.0	1-port 622 Mbps OC-12c/STM-4c module, SMF, intermediate reach, SC
NM-1/622SMLRE	6.2.0	1-port 622 Mbps OC-12c/STM-4c module, SMF, long reach
NM-1/2488SMSR*	6.1.0	1-port 2,488 Mbps OC-48c/STM-16c module, SMF, short reach, SC
NM-1/2488SMLR*	6.1.0	1-port 2,488 Mbps OC-48c/STM-16c module, SMF, long reach, SC
NMIMA-3/DS3	8.3.0	3-port channelized DS-3/DS-1/E1 ATM/IMA module, BNC; ForeThought 8.3.1 is required for E1 mapping

Mixed-mode modules

NM-4/155LR3MME	6.2.0	4-port 155 Mbps OC-3c/STM-1 mixed-mode module; 3 MMF, SC; 1 SMF, long reach, SC
NM-4/155IR3MME	6.2.0	4-port 155 Mbps OC-3c/STM-1 mixed-mode module; 3 MMF, SC; 1 SMF, intermediate reach, SC

CEM modules

NMCE-6/DS1A	4.1.1	6-port 1.544 Mbps DS-1 CEM module, RJ-48c
NMCE-6/E1A	4.1.1	6-port 2.048 Mbps E1 CEM module, RJ-48c
NMCE-3/DS3	8.2.0	3-port channelized DS-3/1/0 CEM module, BNC
NMCE-1/155MME	8.3.1	1-port channelized OC-3 CEM module, MMF, LC
NMCE-1/155SMIRE	8.3.1	1-port channelized OC-3 CEM module; SMF, intermediate reach; LC

Frame Relay-to-ATM internetworking modules

NMFR-4/DS1A	4.1.1	4-port 1.544 Mbps Frame Relay module, RJ-48c
NMFR-4/E1A	4.1.1	4-port 2.048 Mbps Frame Relay module, RJ-48c
NMFR-3/DS3	8.2.0	3-port channelized DS-3/1/0 Frame Relay module, BNC

10/100 Ethernet modules

NM-4/ETH-TXB	7.0.1	4-port 10/100 Mbps 100Base-TX module, RJ-45
NM-1/ETH-1000-GBIC-SX/LX	8.3.0	1-port Gigabit Ethernet module, GBIC

* Module occupies an entire fabric slot and fits into either an existing empty fabric slot or replaces the existing fabric. Only one interface (OC-48) is supported. No other network modules are installed in this fabric. However, one SCP is required for processing in this fabric; two SCPs are required if SCP redundancy is desired. The NM-1/2488 modules are supported only by the TNX-1100 and ASX-1200.

Cables ordering information

Network module(s)	Cable order number	Cable description
NMCE-6/DS1A, NMFR-4/DS1A	V35-T1-FT1-KIT V35-T1-FT1-C-KIT	T1/FT1-to-V.35 converter T1/FT1-to-V.35 converter; includes DB-60 pigtail for interconnection with Cisco routers
NMCE-6/E1A, NMFR-4/E1A	V35-E1-FE1-KIT V35-E1-FE1-C-KIT	E1/FE1-to-V.35 converter E1/FE1-to-V.35 converter; includes DB-60 pigtail for interconnection with Cisco routers
NMFR-4/E1A	RJ48C-75BNC	E-1 interface adapter, 120-ohm RJ-48c to 75-ohm BNC



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