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Gmux-2000

Hub-Site Pseudowire and Voice Trunking Gateway

Scalable, carrier-class, multiservice pseudowire gateway converging TDM services over PSNs

TDMoIP Driven®

- High capacity modular pseudowire gateway, transporting TDM traffic over packet-switched networks in a 6U, 19″ enclosure
- Built on pseudowire technology, implementing the IETF, MFA Forum and ITU-T standards for Pseudowire Emulation Edge-to-Edge (PWE3)
- Transport of up to seven fully populated STM-1 or OC-3 streams via dual-port modules, up to seven channelized T3 links, or up to 196 E1 or T1 streams received via seven 28-port external E1/T1 interface modules
- Central solution for Vmux voice trunking gateways, compressing up to 112 E1/T1 streams over E1, T1, STM-1, OC-3 or Gigabit Ethernet
- Full redundancy of the GbE/2 and STM-1/OC-3 links and modules, clocks, control and power supply modules; N+1 redundancy for voice compression and E1/T1 PW modules

Gmux-2000 is a modular pseudowire gateway that extends the TDM traffic (originating from legacy circuit-switched networks) over packet-switched networks (PSNs). This is achieved by converting TDM data streams coming from the TDM ports into packets transported over the PSN. Gmux-2000 features the following ports:

- TDM ports: Up to seven protected channelized SDH/SONET ports at the STM-1/OC-3 level (155.52 Mbps), or up to seven channelized T3 links, or up to 196 external PDH ports at the E1/T1 level

- PSN port: GbE/2 interface via SFPs.

Gmux-2000 capacity is 441 E1 streams (seven channelized STM-1 streams) for the SDH version, and 588 T1 streams (seven channelized OC-3 streams) for the SONET version. The E1 streams are transparently transported using a circuit emulation method, while supporting all the signaling protocols and payload types. Advanced packet handling capabilities, VLAN and ToS ensure the highest quality of service (QoS) that modern packet-switched networks can provide.

When equipped with VCA-E1/16 or VCA-T1/16 modules, Gmux-2000 delivers compressed voice traffic over STM-1/OC-3, E1/T1 and ETH links.

Packets sent over Metro-Ethernet networks use smaller overhead in comparison to the IP encapsulation. This is ideal for networks with bandwidth constraints.

In addition to the TDMoIP connection mode, Gmux-2000 provides CESoPSN, CESoETH, SAToP and HDLCoIP transmission. HDLC-based applications such as Frame Relay or PPP are supported in port mode.

Gmux-2000 is designed as a central solution for RAD's pseudowire products, operating with all members of the IPmux product line, Vmux and Megaplex ML-IP.

CHASSIS

The chassis accommodates up to seven I/O modules, two Gigabit Ethernet trunk modules, two control/clock modules, three power supply modules (AC or DC), one power inlet module (AC or DC) and a fan unit. The modules are hot swappable.

Gmux-2000 comes in a 6U-high chassis, mountable in a 19-inch ETSI or ANSI rack.

PSN INTERFACE MODULE

The Gigabit Ethernet module serves for packet network connection. The module is equipped with a pair of redundant replaceable SFP-based fiber optic or electrical interfaces or with a pair of UTP interfaces.

The GbE interface operation complies with IEEE 802.3, 802.1Q and 802.1p requirements.

Operating as a level-3/4 switch, the GbE/2 module routes the packets coming from the PSN to the I/O modules and the system modules connected to the packet bus. The routing is performed at wire speed, minimizing delays on the packet bus.

The GbE/2 module performs link aggregation as per 802.3ad. This enables the operator to use two Ethernet links as a single virtual interface for load sharing and link resilience.

When redundancy is enabled at the module level (dual homing), two ports of one module are active at any time, while the ports of the other module serve as backup. GbE/2 also performs link aggregation between ports of different modules.

When Gmux-2000 is equipped with VCA cards, GbE/2 modules can be used in VoIP applications.

The GbE/2 card also supports pseudowire applications which emulate PDH circuits over metro Ethernet networks in accordance with MEF 8.

SDH/SONET INTERFACE MODULE

Gmux-2000 uses STM1/OC3 modules for the SDH/SONET connection. Each module has two ports that can be ordered with electrical (75Ω coax), or various optical interfaces (850 nm or 1310 nm with laser and LED transmitters). The module complies with the applicable requirements of ITU-T Rec. G.957, G.958, I.432 and G.703.

The module operates as a terminal multiplexer and is usually connected to an STM-1/OC-3 add/drop multiplexer port for access to the SDH/SONET backbone.

The module provides 1+1 APS line redundancy for rapid restoration of service in case of line failure. Two modules operate in APS mode for HW redundancy.
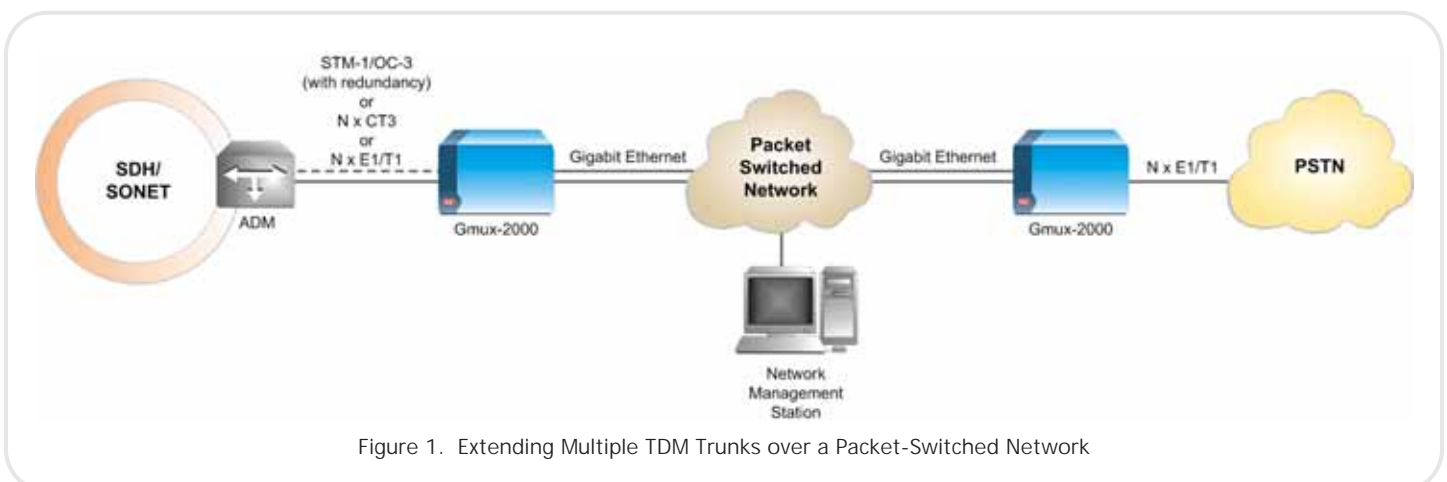

Figure 1. Extending Multiple TDM Trunks over a Packet-Switched Network

SDH/SONET CHANNELIZED INTERFACE MODULE

Channelized STM1 and OC3 modules also serve for SDH/SONET connection. In contrast to the regular STM-1 and OC-3 cards, the channelized modules provide full pseudowire emulation services and do not require pseudowire servers for the PSN connection. Total module capacity is 336 pseudowire connections.

The STM-1/OC-3 module provides 1+1 APS line redundancy (uni- and bidirectional) to ensure rapid restoration of service in case of line failure. Two STM-1/OC-3 modules operate in APS mode for hardware redundancy.

PW CIRCUIT EMULATION MODULES

Gmux-2000 uses the following PW Circuit Emulation (CE) modules, in accordance with the required external TDM interface:

- When external E1/T1 interfaces are required, 28-port external E1/T1 modules are used

- Channelized T3 interface is provided by CT3-PW/1 modules with a single cT3 port served by 28 internal T1 channels

- For SDH/SONET connection, dedicated PW server modules are used to bridge between the PSN interface module and the regular STM1/OC3 interface module.

VOICE COMPRESSION MODULES

VCA-E1/T1 modules are universal voice compression modules with E1/T1 voice ports used for voice trunking.

Each VCA-E1/12/16 or VCA-T1/12/16 module transmits up to 12 or 16 E1/T1 data streams over two E1/T1 links or aggregates them into an STM–1/OC-3 trunk or a GbE link.

Note: *For detailed information on the voice compression modules, see the VCA data sheet.*

When used without STM-1/OC-3 modules, Gmux-2000 accommodates seven VCA modules. Chassis with one or two STM-1/OC-3 modules accommodate six or five VCA-E1-T1/12 or VCA-E1-T1/16 modules, respectively.

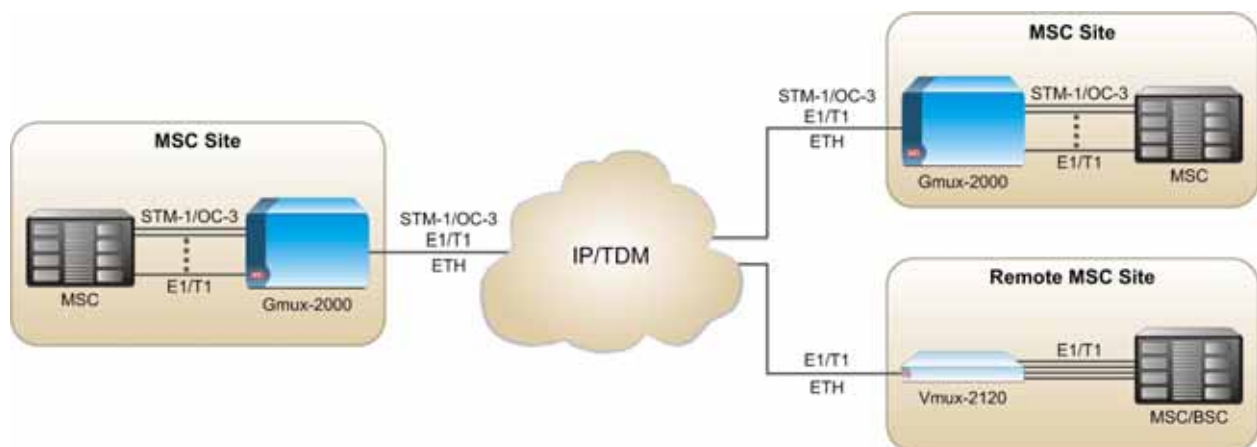The modules employ TDMoIP multiplexing and G.723.1 and G.729 Annex A voice compression algorithms.

Figure 2. VCA-E1/VCA-T1 in an Inter-MSC Application for Cellular Operator

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CONTROL MODULES

The control modules interface with the external SNMP-based network management stations, supervision terminals and Telnet hosts. Each control module has two out-of-band ports: a serial RS-232 synchronous port and a 10/100BaseT Ethernet port. Two control modules are used for hot standby system redundancy.

Control modules store the application software in flash memory. The software can be remotely updated through the management link.

The control modules collect operational history (alarms, configuration error messages, performance statistics, etc).

NPS-101

Gmux-2000 may work in conjunction with an NPS-101 device, which is a compact, high-density carrier class 1:N protection switching device. It protects the traffic carried by a group of N modules (PW and VCA) installed in Gmux-2000, by automatically switching to an additional backup module (also part of Gmux-2000), to replace any failed module. This way it enables continued service without capacity reduction.

NPS-101 leverages Gmux-2000 to a fully redundant system, including voice compression cards.

NPS-101 has a capacity of 14 protection switching modules and two backup modules, each capable of handling 14 E1 or T1 streams, resulting in a maximum traffic protection capacity of 196 streams.

PSEUDOWIRE QoS SUPPORT

Gmux-2000 performs VLAN tagging and priority labeling according to 802.1P&q. PW packets are assigned a dedicated VLAN ID and 802.1p bit.

The ToS or Diffserv of the outgoing PW packets are user-configurable, allowing the PW packets to be given a higher priority in IP networks.
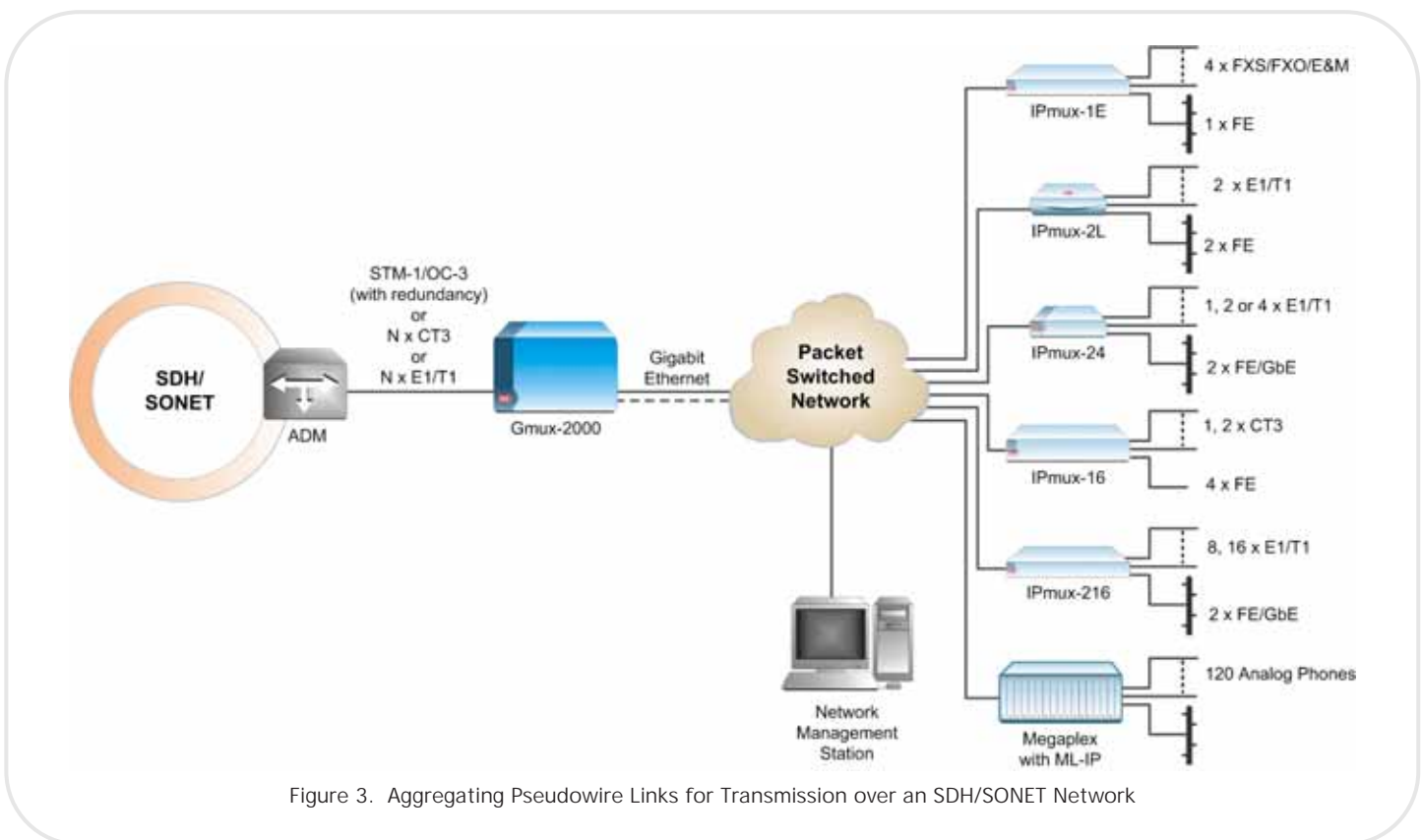

Figure 3. Aggregating Pseudowire Links for Transmission over an SDH/SONET Network

ETHERNET SERVICE OAM (802.1ag)

The gateway uses the end-to-end Ethernet layer OAM protocol for proactive connectivity monitoring, fault verification, and fault isolation, according to the IEEE 802.1ag and ITU-T Y.1731 requirements.

PSEUDOWIRE TRAFFIC PROTECTION

Pseudowire traffic can be backed up at the pseudowire connection level. This allows setting a different path for the primary and secondary PW bundles. Both bundles can be routed to the same or different destinations and operate in the 1+1 mode.

MANAGEMENT CAPABILITIES

The chassis can be managed using different ports and applications:

- Local out-of-band management via a terminal connected to the RS-232 port, using CLI
- Remote out-of-band management via the dedicated 10/100BaseT port
- Remote inband management via the GbE/2 interface. Remote management is performed using Telnet or RADview-SC/TDMoIP, RAD's SNMP-based NMS.

The following security protocols are provided by Gmux-2000 to ensure client-server communication privacy and correct user authentication:

- RADIUS (client authentication only)
- SSH for Secure Shell Telnet session
- SNMPv3.

For voice trunking applications when Gmux-2000 contains only voice compression modules and the voice traffic is directed only to TDM ports, no packet traffic is generated by the chassis. In this case, it is not necessary to equip Gmux-2000 with GbE/2 modules: VC-MGT inband management modules can be used. They provide FE management interfaces and no payload ports.

ALARM REPORTING

The chassis features a dry-contact connector for reporting alarms to external equipment. The connector also has an external alarm input for monitoring external sensors.

TIMING

Gmux-2000 features flexible clock management using external and internal timing signals coming from:

- External station clock source
- SDH/SONET clock (8 kHz)
- 2.048/1.544 MHz clock recovered from an external E1/T1 port, internal E1/T1 port, or a generated PW flow.

Each clock signal type is received on two different lines, one designated as main source and the other as fallback.

Two station clock ports are located on each control module. If a control module providing a system clock fails, Gmux-2000 switches to the second control module, without affecting system performance.
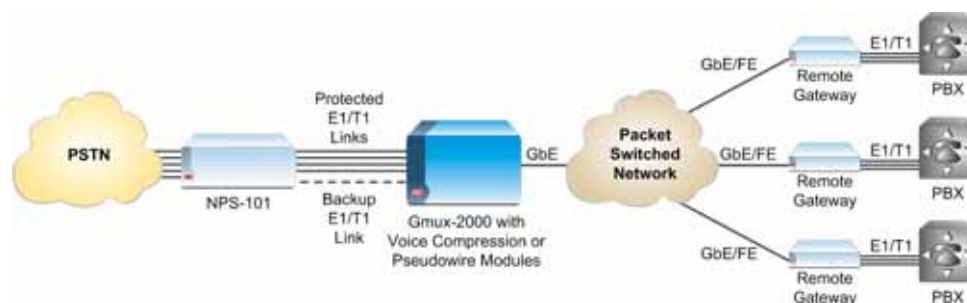

Figure 4. Gmux-2000 with 1:N Protection

SYSTEM REDUNDANCY

Gmux-2000's modular architecture provides redundancy at different levels without a single point of failure.

Service module redundancy is available for:

- Hot standby control modules to ensure continuity of the system control and timing functions
- Power supply modules with 2+1 redundancy
- Intelligent fan unit with eight independently controlled fans.

PSN and I/O module redundancy is supported by:

- PSN modules with 802.3ad-based link aggregation, dual homing and module redundancy modes
- Voice compression and pseudowire server modules with 1:N redundancy by adding a standby module to a group of N modules that carry the traffic
- STM-1/OC-3 modules with module redundancy or 1+1 line redundancy for 50 ms restoration of service in case of line faults.
- Voice compression and external E1/T1 PW modules with 1:N redundancy, provided by NPS-101 protection device.

Table 1. I/O Modules

| Module	Description
GbE/2	PSN module with two 1000BaseFx or 10/100/1000BaseT ports
E1-PW/28, T1-PW/28	Pseudowire emulation module with 28 E1 or T1 external interfaces
E1-PW-SRV/21, T1-PW-SRV/28	Pseudowire emulation server module with 21 E1 or 28 T1 interfaces. The modules operate in conjunction with STM1 and OC3 modules, respectively.
STM1, OC3	Dual-port STM-1 or OC-3 modules for direct connection to SDH or SONET cores. The modules operate in conjunction with E1-PW-SRV/21 and T1-PW-SRV/28 modules, respectively.
C.STM1, C.OC3	Dual-port channelized STM-1 or OC-3 modules for direct connection to SDH or SONET cores with TDM service emulation over PSN
CT3-PW/1	Pseudowire emulation module with channelized T3 interface
VCA-E1/12/16, VCA-T1/12/16	Universal voice compression modules with 12 or 16 E1/T1 voice ports for voice trunking
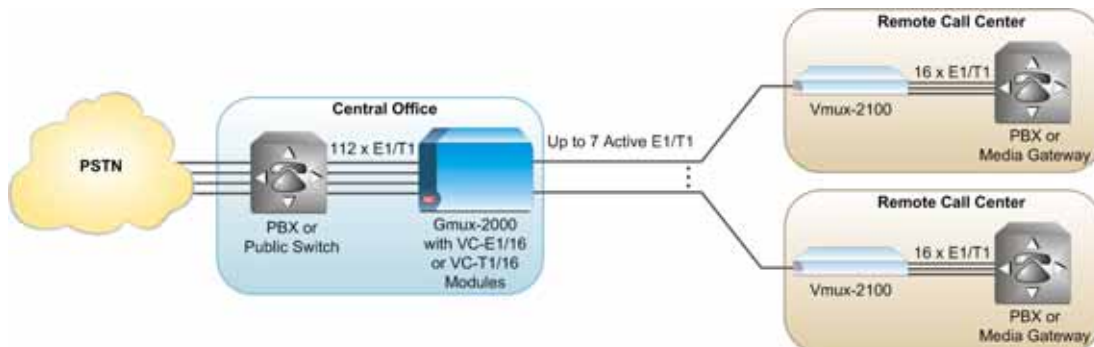
Figure 5. Compressing up to 112 E1s or T1s over up to 7 E1s or T1s

Specifications

TDM Interfaces
SDH (STM-1)/SONET (OC-3)
Channelized T3
PDH: E1/T1

PSN Interface
Two GbE ports (1.25 Gbps) via SFPs or UTP

PW Routing
Any E1/T1 stream from any PDH or
SDH/SONET interface to any IP destination

MANAGEMENT

Methods
Supervision terminal, directly or via
   modem link
Telnet/SSH
RADview-SC/TDMoIP, RADview-EMS (basic
shelf view), or other SNMP-based NMS

Interfaces
Serial ports on control modules
10/100BaseT ports on control modules
Inband via PSN interface ports

Serial Port
Type: RS-232 (V.24) asynchronous DCE
Data rate: 0.3–115.2 kbps
Connector: 9-pin, D-type, female

EXTERNAL ALARM INTERFACE

Alarm Outputs
Major and minor alarm indication by
floating change over dry contacts

Output Contact Ratings
Maximum 60 VDC/30 VAC across open
   contacts
Maximum 1 ADC through closed contacts
Maximum load switching capacity: 60W

External Alarm Input
One active-low input, RS-232 levels

POWER

Source
AC: 100 to 240 VAC, 50/60 Hz, via 3 inlets
DC: -48 VDC, via 2 inlets

Power Consumption (per power supply)
200W max

300W max for high-power AC PS modules

Number of Power Supply Modules
3

Redundancy
2+1

PHYSICAL

Number of Slots
1 power inlet slot
3 power supply slots
2 control slots
2 PSN slots
7 I/O slots
1 cooling fan tray slot

Dimensions
Height: 265 mm (10.4 in)
Width: 440 mm (17.3 in)
Depth: 210 mm (8.2 in)
Weight: 12 kg (26.4 lb), max

Environment
Operating temperature: 0–55°C (0–131°F)
Storage temperature: -20 to +70°C
   (0 to 150°F)
Humidity: Up to 90%, non-condensing

1 Power Inlet Module	1 PSN Module	Fan Unit
2 or 3 Power Supply Modules	1 STM-1 or OC-3 Module or 1–7 Channelized STM-1 or OC-3 Modules	
1 or 2 Control Modules	1–6 E1/T1 Server Modules or Voice Compression Modules (no need for servers if channelized STM-1/OC-3 modules are used)	

Channelized STM-1/OC-3 Service

1 Power Inlet Module	1 PSN Module	Fan Unit
2 or 3 Power Supply Modules	1–7 External E1/T1 Modules or Channelized T3 Modules or Voice Compression Modules	
1 or 2 Control Modules		

N × E1/T1 or N × Channelized T3 Service

Figure 6. Gmux-2000 Configurations

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Ordering

Standard Gmux-2000 systems are comprised of a chassis, service modules (control, power supply, etc), and interface modules (GbE, STM-1, OC-3, CT3, E1, T1). *Figure 6* illustrates minimal required combinations of the service and interface modules in the chassis. See separate module data sheets for interface module details and ordering information.

GMUX-2000/%/RM

Gmux-2000 chassis with 1 power inlet module, 2 or 3 power supplies, 1 fan unit

Legend

% Power supply/power inlet:

AC	AC power inlet and 2 AC power supply modules
48	DC power inlet and 2 DC power supply modules
ACR	AC power inlet and 3 AC power supply modules
48R	DC power inlet and 3 DC power supply modules
ACHP	AC power inlet and 2 high-power AC power supply modules
ACHPR	AC power inlet and 3 high-power AC power supply modules

RM Rack:

A	ANSI rack (19 inch)
E	ETSI rack (23 inch)

GMUX-M/@/#

Gmux-2000 service module

Legend

@ Service module:

PI	Power inlet module
PS	Power supply module
CL2	Control and timing module
CL2/A	Control and timing module with advanced clock recovery mechanism
CL-VMX	Control module for voice compression applications
FANS	Fan module

Note: *GMUX-M-GBE-N module is required for managing Gmux-2000 inband over a TDM link.*

Power inlet and power supply module:

AC	AC power inlet module and AC power supply module
48	DC power inlet module and DC power supply module

SUPPLIED ACCESSORIES

RM-2000
Hardware kit for mounting one Gmux-2000 chassis into a 19-inch rack (supplied with GMUX-2000/%/A option)

RM-2000E
Hardware kit for mounting one Gmux-2000 chassis into an ETSI rack (supplied with GMUX-2000/%/E option)

OPTIONAL ACCESSORIES

NPS-101/!/?

1:N external protection chassis for pseudowire and voice compression modules two PSU (AC/DC).

The ordering options include: backup modules and necessary cables

Legend

Interface:

!	**CT3**	1:N protection for Gmux-M-CT3 modules
	PW	1:N protection for Gmux-M-E1/T1-PW-28 modules
	VC12	1:N protection for 12 E1/T1 ports voice compression modules
	VC16	1:N protection for 16 E1/T1 ports voice compression modules
	VC2	1:N protection for voice compression modules with only the channelized E1/T1 main links in use

? Number of Gmux-2000 modules protected by NPS-101:

1	One protected working module (1:1)
2	Two protected working modules (1:2)
3	Three protected working modules (1:3)
4	Four protected working modules (1:4)
5	Five protected working modules (1:5)
6	Six protected working modules (1:6)

GMUX-P PANEL-28-PW/^

Patch panel for Gmux-M-E1/T1-PW-28 modules (including cables)

Legend

Interface:

^	**BAL**	Balanced RJ-45 patch panel
	UNBAL	Unbalanced BNC patch panel

The Access Company