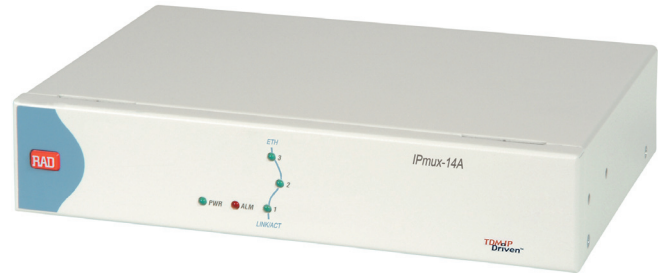


IPmux-14



TDM Pseudowire Access Gateway



**TDMoIP
Driven®**

FEATURES

- TDM pseudowire CPE/CLE, offering TDM circuit emulation over a packet-switched network (PSN) and controlled Ethernet access
- Built on TDMoIP technology, implementing the emerging IETF, MFA Forum, ITU-T and MEF standards for Pseudowire Emulation Edge-to-Edge (PWE3)
- E1/T1 or HDLC emulation over MPLS, IP and Ethernet networks
- Support for both framed (full or fractional) and unframed E1/T1
- Serial traffic emulation over packet networks
- ASIC-based architecture minimizes processing delay
- Multiple pseudowire connections without any performance degradation
- Configurable jitter buffer compensates for network packet delay variation
- Dedicated external clock port
- Ensures TDMoIP priority by QoS marking: ToS, VLAN priority or EXP bits
- Operates opposite other members of RAD's TDMoIP family of products (IPmux-1E, IPmux-11, IPmux-8/16, Gmux-2000, Megaplex ML-IP)
- One Ethernet network port; two Ethernet user ports, offering:
 - Transparent Ethernet bridging
 - User data bandwidth and access control through rate limiting and VLAN filtering
 - VLAN tagging and double tagging
- Two or four E1 or T1 TDM ports or one serial data port
- Independent clock recovery mechanism per TDM port
- Typical applications:
 - GSM/CDMA backhauling
 - E1/T1 (voice or data) or HDLC leased line replacement
 - PBX PSTN access
 - Multiservice TDM/Ethernet CLE/CPE
- Management via ASCII terminal, Telnet host, Web terminal or SNMP-based network management station
- Provisioning and monitoring of TDMoIP services using the RADview Service Center for TDMoIP applications
- Compact, 1U-high enclosures, plastic or metal

IPmux-14

TDM Pseudowire Access Gateway

DESCRIPTION

- IPmux-14 is a TDM pseudowire access gateway extending TDM-based services over packet switched networks. It also serves as an Ethernet-based access device.

TDMoIP PERFORMANCE

- IPmux-14 provides a legacy over PSN solution for transmitting E1/T1 streams over packet switched networks. The device converts the data stream from its user E1/T1 ports into packets for transmission over the network. The addressing scheme of these packets is IP or MPLS. These packets are transmitted via the IPmux-14 Ethernet network port to the PSN. A remote TDMoIP device converts the packets back to TDM traffic.

- High-performance ASIC-based buffering and forwarding techniques are used to achieve minimal end-to-end processing delay.
- Configurable packet size allows to achieve proper balance between PSN throughput and delay.
- A jitter buffer compensates for packet delay variation (jitter) of up to 200 msec in the network.
- Assigned, IANA-registered UDP port number for TDMoIP simplifies flow classification through switches and routers.

TDMoIP QoS

- IPmux-14 supports VLAN tagging and priority labeling according to 802.1p&Q. TDMoIP packets are assigned a dedicated VLAN ID and 802.1p bit.
- The ToS or Diffserv of the outgoing TDMoIP packets are user-configurable. This allows the TDMoIP packets to be given a higher priority in IP networks.
- EXP bits are used for QoS marking of the TDMoMPLS traffic in MPLS networks.

APPLICATIONS

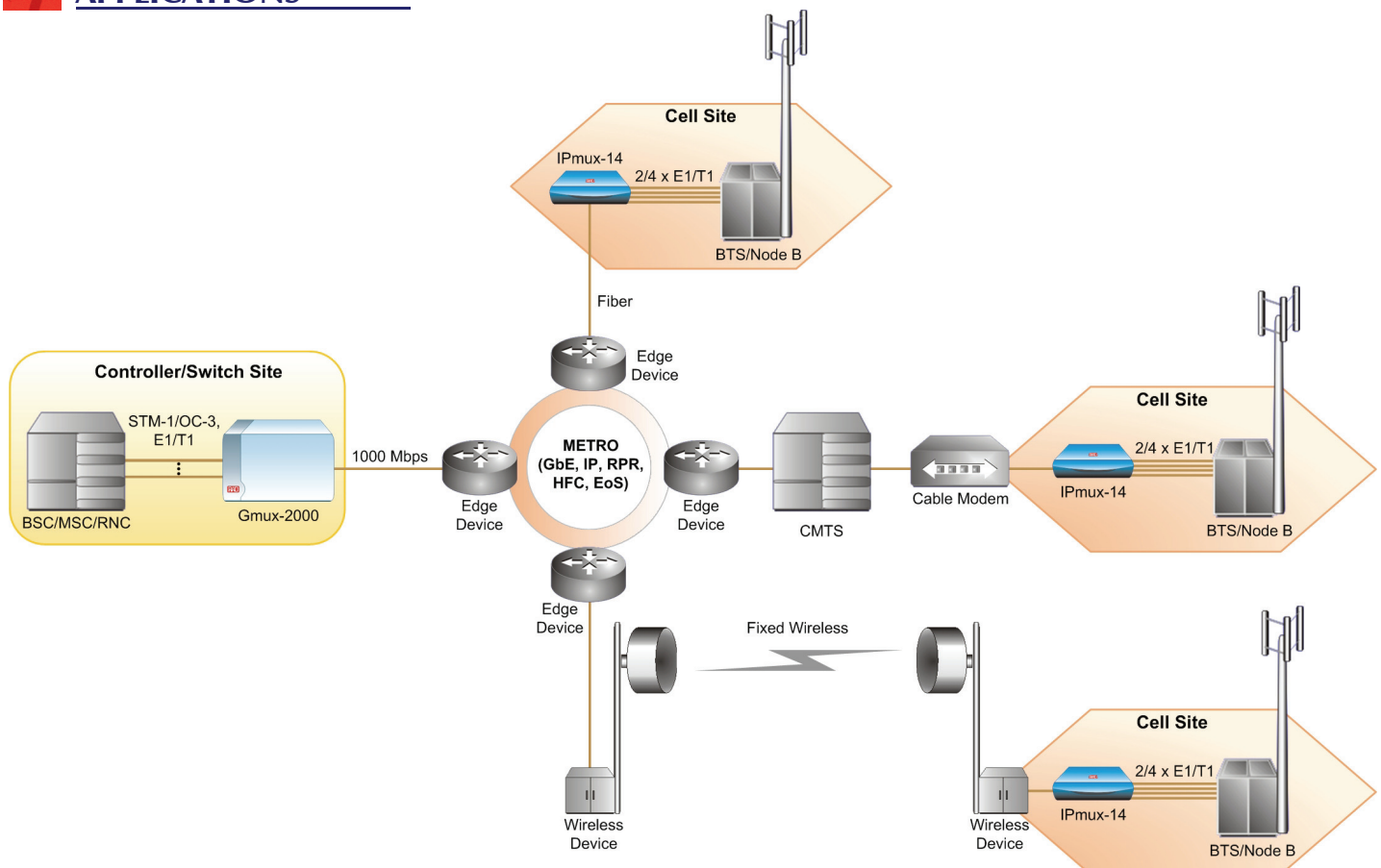


Figure 1. 2G/3G Cellular Backhaul over IP/Ethernet-Based Fiber Optic, Cable HFC and Wireless Links

TDM Pseudowire Access Gateway

TDMoIP TIMING

- Synchronization between TDM devices is maintained, by deploying advanced clock distribution mechanisms. The clocking options are:
 - **Internal** – the master clock source for the TDM circuit is provided by IPmux-14's internal clock oscillator
 - **Loopback** – the transmit clock is derived from the E1/T1 port's receive clock
 - **Adaptive** – the clock is recovered from the PSN
 - **External** – an external clock source to synchronize the device via its external clock port.

Note: External clock port in IPmux-14 units with serial data interface is not operational.

- System clock ensures single clock source for all TDM links. The system clock uses master and fallback timing sources for clock redundancy. IPmux-14 also provides system clock output via external clock connector.
- Advanced clock recovery mechanism complies with G.823 (clause 6) requirements, providing frequency accuracy of up to 16 ppb. This makes the unit suitable for timing-sensitive applications, such as cellular backhauling.

TDM INTERFACE

- Two or four E1 or T1 ports provide connectivity to any standard E1 or T1 device.
- E1 and T1 interfaces support the following:
 - Integral LTU/CSU for long haul applications
 - G.703 unframed and G.704 framed modes
 - CAS and CRC-4 bit generation (E1)
 - D4/SF and ESF framing (T1)
 - Robbed bit (T1).

SERIAL INTERFACE

- Data port is available for an N x 64 kbps serial connection to legacy equipment.
- Provided via 25-pin D-type connector, the serial port is software-configurable to support the following interfaces:
 - X.21
 - V.24/RS-232
 - RS-530/RS-422
 - V.35
 - V.36/RS-449.
- DCE/DTE port configuration is performed via adapter cables and IPmux-14 clock selection.

ETHERNET INTERFACE

- IPmux-14 provides the following Ethernet ports:
 - One network port (copper or fiber optic)
 - Two user ports (both copper or one copper + one fiber optic).
- The network and user ports feature autonegotiation, VLAN tagging and rate limiting.

ETHERNET CAPABILITIES

- IPmux-14's internal Layer-2 Ethernet switch provides three Ethernet ports. One port serves as a network interface and the other two serve for user Ethernet traffic.
- Each Ethernet port supports:
 - Port-based rate limiting for bandwidth control
 - Port-based VLAN membership for ingress traffic restriction
 - Port-based VLAN tagging
 - Double VLAN tagging (VLAN stacking)
 - Bridging and filtering.
- The device supports standard IP features, such as ICMP (ping), ARP, next hop and default gateway.

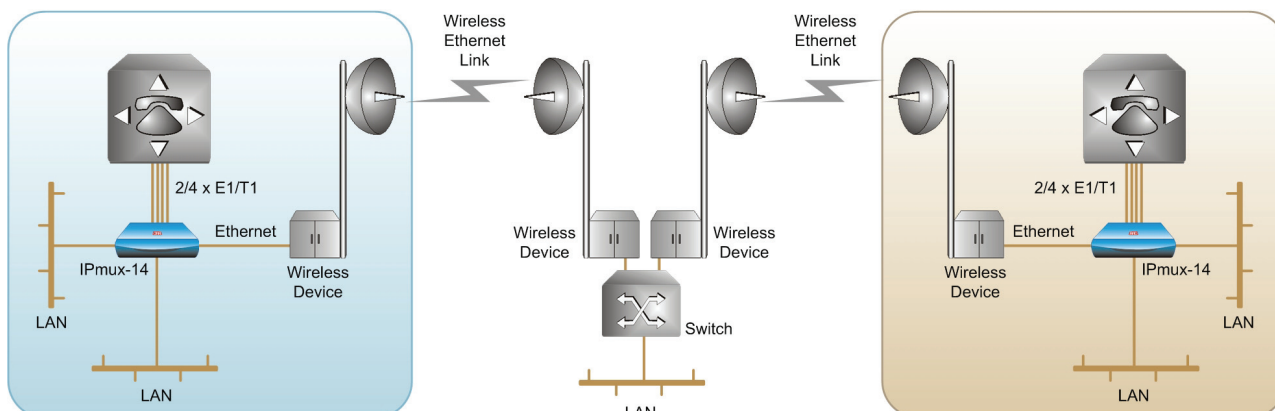


Figure 2. LAN and TDM Services over a Wireless Ethernet Link

IPmux-14

TDM Pseudowire Access Gateway

MANAGEMENT

- IPmux-14 can be configured and monitored locally via an ASCII terminal, or remotely via Telnet, Web browser or RADview.
- Management traffic can run over a dedicated VLAN.
- The RADview Service Center and Element Manager packages control and monitor TDM over IP (TDMoIP) devices and circuits. The Service Center's intuitive GUI, "point-and-click" functionality and easy-to-follow wizards increase the efficiency and accuracy of the service provisioning process.
- Software download is supported via the local terminal, using XMODEM, or remotely, using TFTP. After downloading a new software version, IPmux-14 automatically saves the previous version in non-volatile memory for backup purposes. Similarly, copies of the configuration file may be downloaded and uploaded to a remote workstation for backup and restore purposes.

DIAGNOSTICS

- External and internal loopbacks can be used to check TDM link connectivity.
- The following E1/T1 physical layer performance statistics are available: LOS, LOF, LCV, RAI, AIS, FEBE, BES, DM, ES, SES, UAS and LOMF.
- IPmux-14 performs an internal built-in test (BIT) after power-up. The results of the test are visible via the local terminal.
- LAN and IP layer network condition statistics, such as packet loss and packet delay variation (jitter) are monitored and stored by the device.
- Fault isolation, statistics and event logging are available.
- To enhance fault condition reporting capabilities, remote IPmux-14 transfers RDI, LOS and AIS conditions received from the remote E1/T1 device to the local E1/T1 device via the PSN.

ENVIRONMENT

- IPmux-14/H is an environmentally hardened version intended for the street-cabinet and cellular-tower installations.

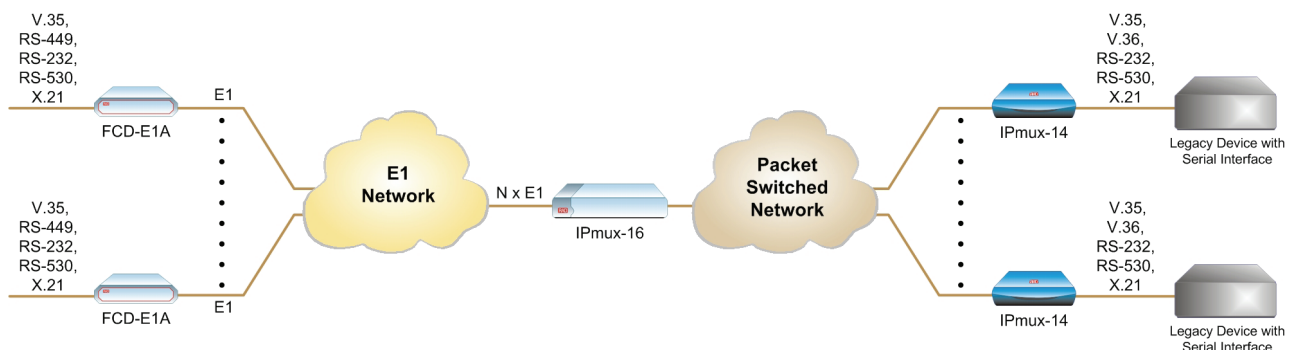


Figure 3. Gradual Migration from Serial Data Services to a Packet-Switched Network

TDM Pseudowire Access Gateway

SPECIFICATIONS

E1 INTERFACE

- **Number of Ports**
2 or 4
- **Compliance**
ITU-T Rec. G.703, G.704, G.706, G.732, G.823
- **Data Rate**
2.048 Mbps
- **Line Code**
HDB3
- **Framing**
Unframed, framed, multiframe; with or without CRC-4
- **Signaling**
CAS, CCS (transparent)
- **Line Impedance**
 - 120Ω, balanced
 - 75Ω, unbalanced

- **Signal Levels**
Receive: 0 to -36 dB with LTU (long haul)
0 to -10 dB without LTU (short haul)
Transmit balanced: $\pm 3V \pm 10\%$
Transmit unbalanced: $\pm 2.37V \pm 10\%$
- **Jitter and Wander Performance**
Per ITU-T G.823
- **Connector**
 - Balanced: RJ-45
 - Unbalanced: BNC (RJ-45 to BNC adapter cable is supplied)

T1 INTERFACE

- **Number of Ports**
2 or 4
- **Compliance**
ANSI T1.403, ITU-T Rec. G.703, G.704, G.824
- **Data Rate**
1.544 Mbps

- **Line Code**
B8ZS, B7ZS, AMI
- **Framing**
Unframed, SF, ESF
- **Signaling**
CAS (bit robbing), CCS (transparent)
- **Line Impedance**
100Ω, balanced
- **Signal Levels**
Receive: 0 to -36 dB
Transmit pulse amplitude: $\pm 3V \pm 20\%$; 0 dB, -7.5 dB, -15 dB (CSU), user-selectable
 $\pm 2.7V \pm 10\%$, 0 to 655 feet, (DSU), user-selectable
- **Jitter and Wander Performance**
Per AT&T TR-62411, ITU-T G.824 (for internal, loopback and external clock modes)
- **Connector**
RJ-45

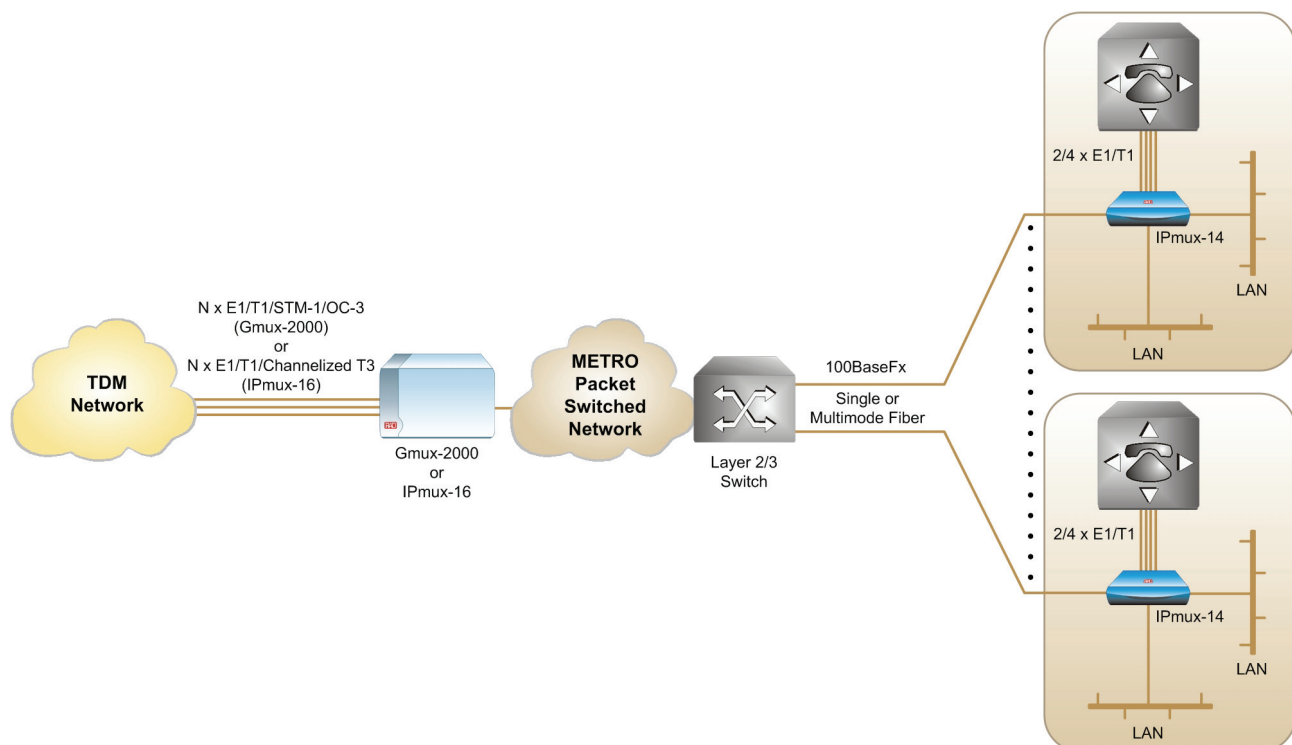


Figure 4. Providing Ethernet in the First Mile

IPmux-14

TDM Pseudowire Access Gateway

SERIAL INTERFACE

- **Number of Ports**
1
- **Interface Type**
X.21, V.24/RS-232, RS-530/RS-422, V.35, V.36/RS-449
- **Timing**
 - DCE – Rx and Tx clock is supplied by the data port
 - DTE – Rx and Tx clock is supplied by the equipment connected to the data port
- **Control Signals**
 - CTS – constantly ON or follows RTS, user-selectable
 - DCD – constantly ON, unless a fault in the PSN network is detected
- **Data Rate**
 $N \times 64$ kbps ($N = 1, 2, \dots 32$)
- **Connector**
25-pin, D-type, female

ETHERNET INTERFACE

- **Standard Compliance**
IEEE 802.3, 802.3u, 802.1p&Q
- **Number of Ports**
 - Network: 1 (copper or fiber)
 - User: up to 2 (copper only)
- **Data Rate**
 - UTP: 10 Mbps or 100 Mbps, full or half duplex
 - Fiber: 100 Mbps, full duplex
- **Typical Range**
 - 1310 nm LED: 2 km (1.2 mi)
 - 1310 nm laser: 15 km (9.3 mi)
 - 1550 nm laser: 80 km (49.7 mi)
- **Connector**
LC, SFF-based

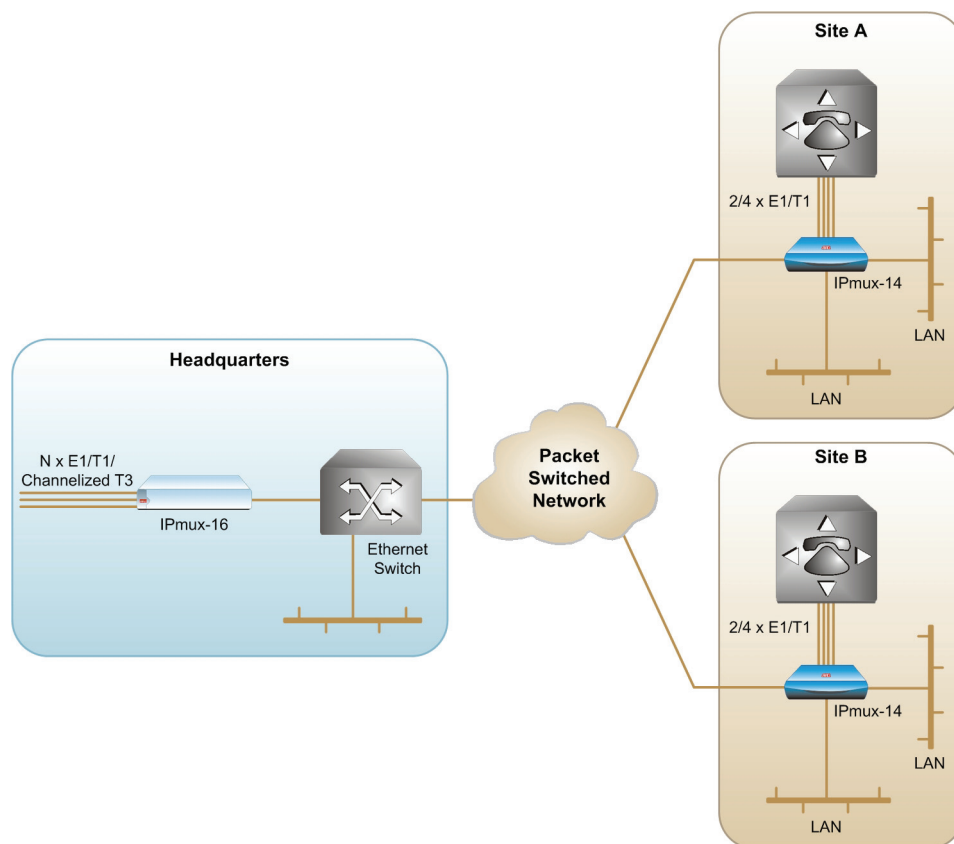


Figure 5. Corporate Multisite Communication over a Packet-Switched Network

TDM Pseudowire Access Gateway

PEUDOWIRE CONNECTIONS

- **Standard Compliance**
 - IETF: TDMoIP
 - ITU-T: Y.1413 (TDMoIP)
 - MFA: IA 4.0
- **Number of PW Connections**
64 (16 PWs per E1/T1 port)
- **Jitter Buffer Size**
 - 0.5–200 msec (unframed) with 0.1 msec granularity
 - 2.5–200 msec (framed) with 0.5 msec granularity

GENERAL

- **Timing**
 - Internal
 - External input or output via dedicated connector: E1/T1 or 2048/1544 kHz squarewave (RS-485 electrical levels)
 - Loopback
 - Adaptive

Note: External clock port in IPmux-14 units with serial data interface is not operational.

- **IPmux-14/A Adaptive Clock Characteristics**
 - Frequency accuracy: ± 16 ppb and G.823 synchronization interface requirements (clause 6), when locked to a PRC (stratum 1) or SSU (stratum 2) clock
 - Frequency accuracy in holdover: ± 16 ppb ± 1 ppb of aging per day
- **Management**
 - SNMPv1
 - Telnet
 - RADview Service Center TDMoIP (ordered separately)
 - ASCII terminal via V.24 (RS-232) DCE port
- **Diagnostics**
 - E1/T1 local loopback
 - E1/T1 remote loopback
 - Facility Type 1 (FAC1) inband loopback
 - CSU loopback as per Telecordia GR-54
- **Statistics**
 - E1/T1 (per G.826 and RFC 2495)
 - Ethernet (per RFC 2819)
 - Jitter buffer indication (overflow, underflow, sequence error)

- **Indicators**
PWR (green) – Power status
ALM (red/yellow) – Alarm status
E1/T1 SYNC (green/red) – E1/T1 synchronization status
LINK/ACT (green) – Ethernet link/activity status
EXT CLK (green/red) – External clock status
- **Power**
AC/DC: 100–240 VAC or –40/–60 VDC
DC: 24 VDC
- **Power Consumption**
12W max
- **Physical**
IPmux-14:
Height: 43 mm (1.7 in)
Width: 217 mm (8.5 in)
Depth: 170 mm (6.7 in)
Weight: 0.5 kg (1.1 lb)

IPmux-14/A, IPmux-14/H:
Height: 47 mm (1.8 in)
Width: 215 mm (8.4 in)
Depth: 147 mm (5.8 in)
Weight: 0.7 kg (1.5 lb)
- **Environment**
Temperature:
IPmux-14:
0 to 50°C (32 to 122°F)
IPmux-14/H: –30 to 65°C (–22 to 149°F)
Humidity: Up to 90%, non-condensing

- + Specify TDM interface type:
2E1 for 2 balanced E1 interfaces
2E1CX for 2 unbalanced E1 interfaces
2T1 for 2 balanced T1 interfaces
4E1 for 4 balanced E1 interfaces
4E1CX for 4 unbalanced E1 interfaces
4T1 for 4 balanced T1 interfaces
SER for a single serial data interface

Note: Unbalanced E1 interfaces are provided via RJ-45 to BNC adapter cables supplied with the product.

- & Specify the network Ethernet interface type:
UTP for 10/100BaseT interface, RJ-45 connector
MM13LC for multimode 1310 nm LED, LC connector
SM13LC for single mode 1310 nm laser, LC connector
SM15LC for single mode 1550 nm laser, LC connector
SM13LCH for single mode 1310 nm laser, LC connector (IPmux-14/H only)
SM13LHLCH for single mode 1310 nm long haul laser, LC connector (IPmux-14/H only)
SM15LCH for single mode 1550 nm laser, LC connector (IPmux-14/H only)
- % Specify **UTP** for the 10/100BaseT user Ethernet interface, RJ-45 connector

ORDERING

IPmux-14*/+/&/%
TDM pseudowire access gateway

IPmux-14/24*/+/&/%
TDM pseudowire access gateway with 24 VDC power supply

IPmux-14/H*/+/&/%
Environmentally hardened TDM pseudowire access gateway

- * Specify special timing mechanism type or leave blank for standard timing capabilities (default):
T for accurate clock recovery
A for highly accurate clock recovery

Note: Only standard timing capabilities are available for IPmux-14 with two E1/T1, serial data interfaces and 24 VDC power supply.

IPmux-14

TDM Pseudowire Access Gateway

SUPPLIED ACCESSORIES

Power cord

AC/DC adapter plug

DC connection kit (if a 24 VDC option has been ordered)

CBL-RJ45/2BNC/E1/X

RJ-45 to BNC adapter cable (if an unbalanced E1 interface has been ordered)

OPTIONAL ACCESSORIES

The following cables convert the IPmux-14 25-pin data port connector into the respective interface. Cable length is 2m (6 ft).

CBL-HS2/V/1/\$

Adapter cable for connecting a data port in DCE timing mode to V.35 equipment

CBL-HS2/V/2/\$

Adapter cable for connecting a data port in DTE1 timing mode to V.35 equipment

CBL-HS2/V/3/\$

Adapter cable for connecting a data port in DTE2 timing mode to V.35 equipment

CBL-HS2/R/1/\$

Adapter cable for connecting a data port in DCE timing mode to V.36/RS-449 equipment

CBL-HS2/R/2/\$

Adapter cable for connecting a data port in DTE1 timing mode to V.36/RS-449 equipment

CBL-HS2/R/3/\$

Adapter cable for connecting a data port in DTE2 timing mode to V.36/RS-449 equipment

CBL-HS2/X/1/\$

Adapter cable for connecting a data port in DCE timing mode to X.21 equipment

\$ Specify cable connector type:

F for female

M for male

CBL-DB9F-DB9M-STR

Control port cable

RM-33-2

Hardware kit for mounting one or two IPmux-14 units into a 19-inch rack

RM-35/@

Hardware kit for mounting one or two IPmux-14/A or IPmux-14/H units into a 19-inch rack

@ Specify rack mounting kit type:

P1 for mounting one unit

P2 for mounting two units

WM-35

Hardware kit for mounting one IPmux-14/A or IPmux-14/H unit on a wall



data communications

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