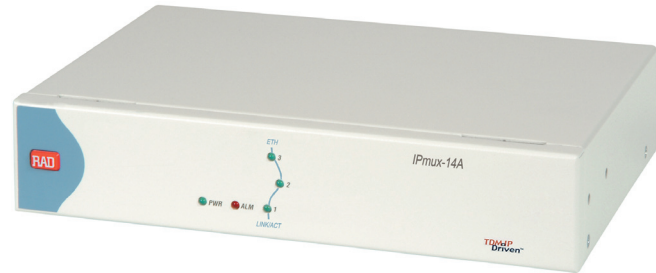


# IPmux-14

## 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

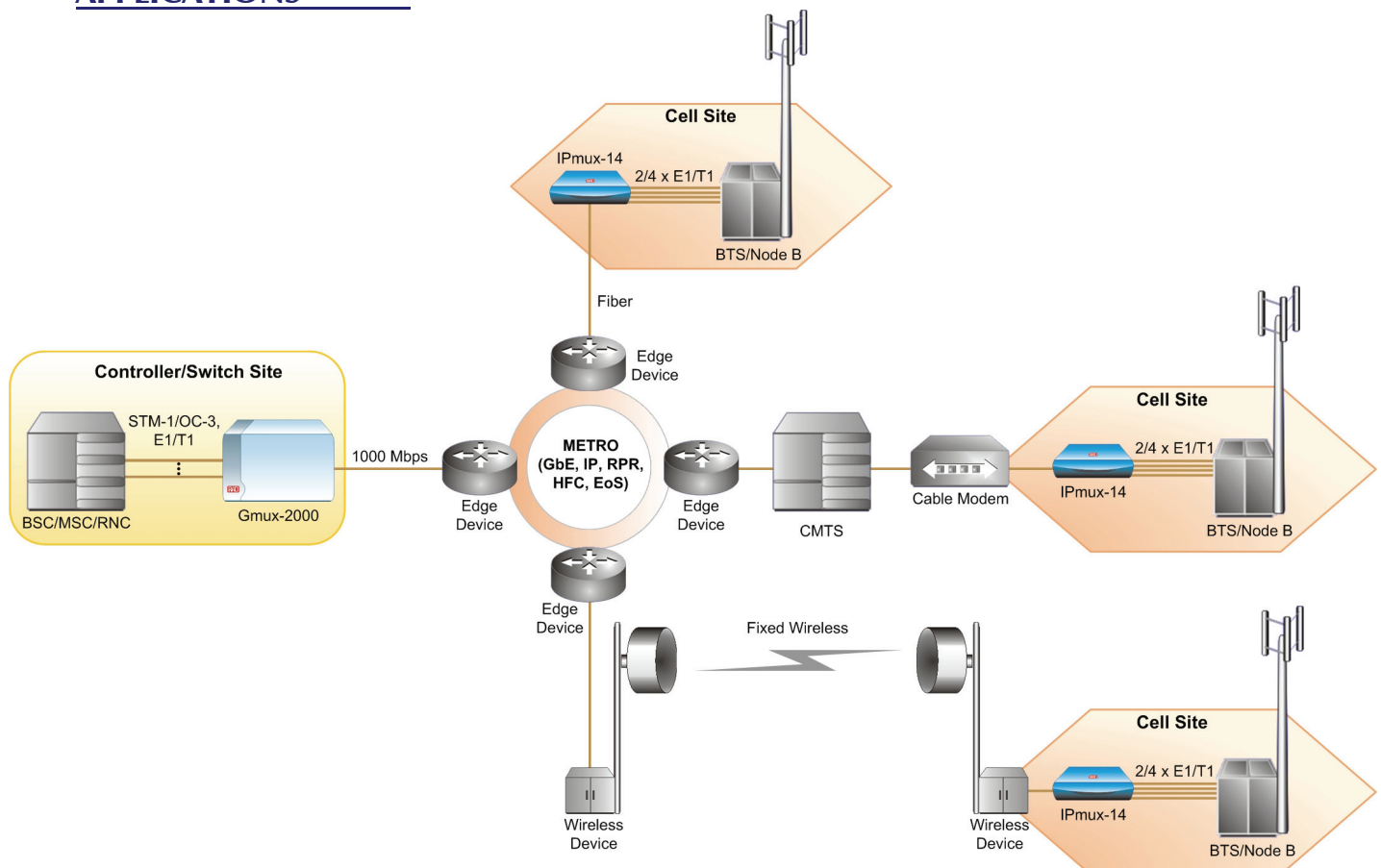


Figure 1. 2G/3G Cellular Backhaul over IP/Ethernet-Based Fiber Optic, Cable HFC and Wireless Links

## 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  $N \times 64$  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.

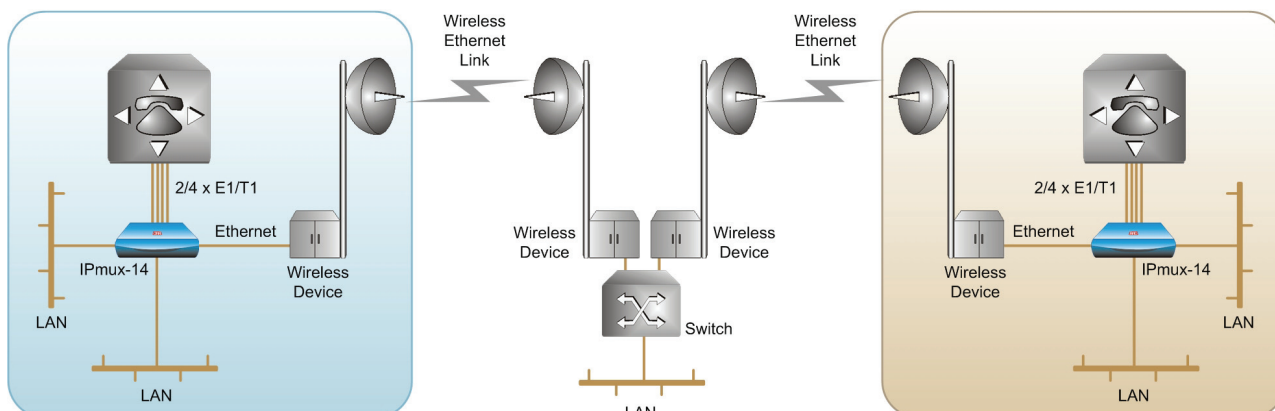


Figure 2. LAN and TDM Services over a Wireless Ethernet Link

# 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.

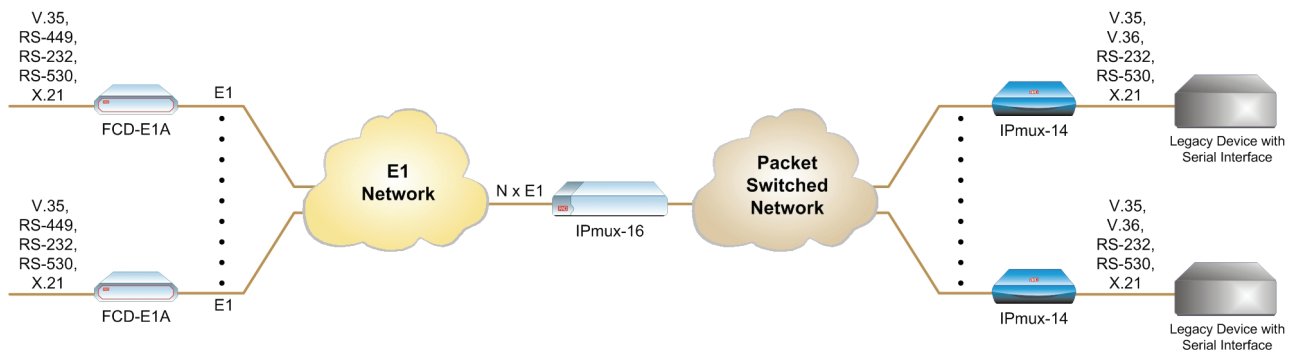


Figure 3. Gradual Migration from Serial Data Services to a Packet-Switched Network

## 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

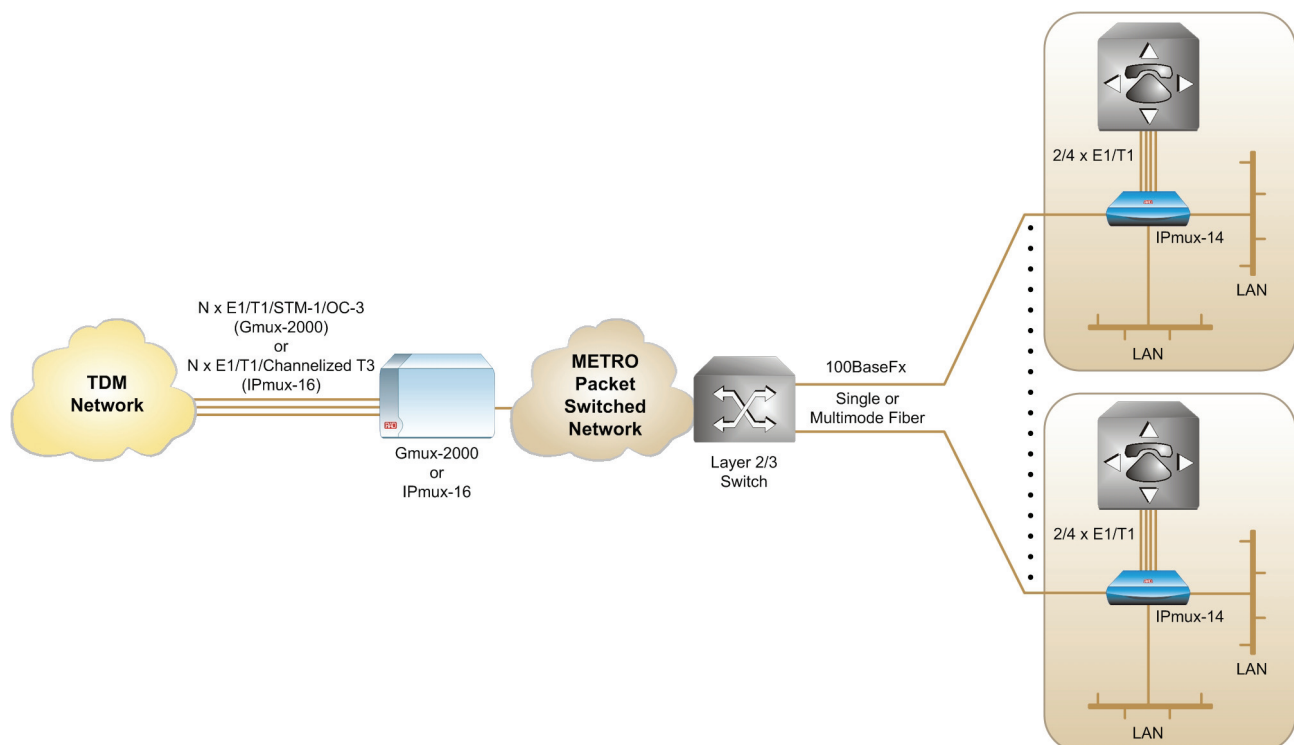


Figure 4. Providing Ethernet in the First Mile

# 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

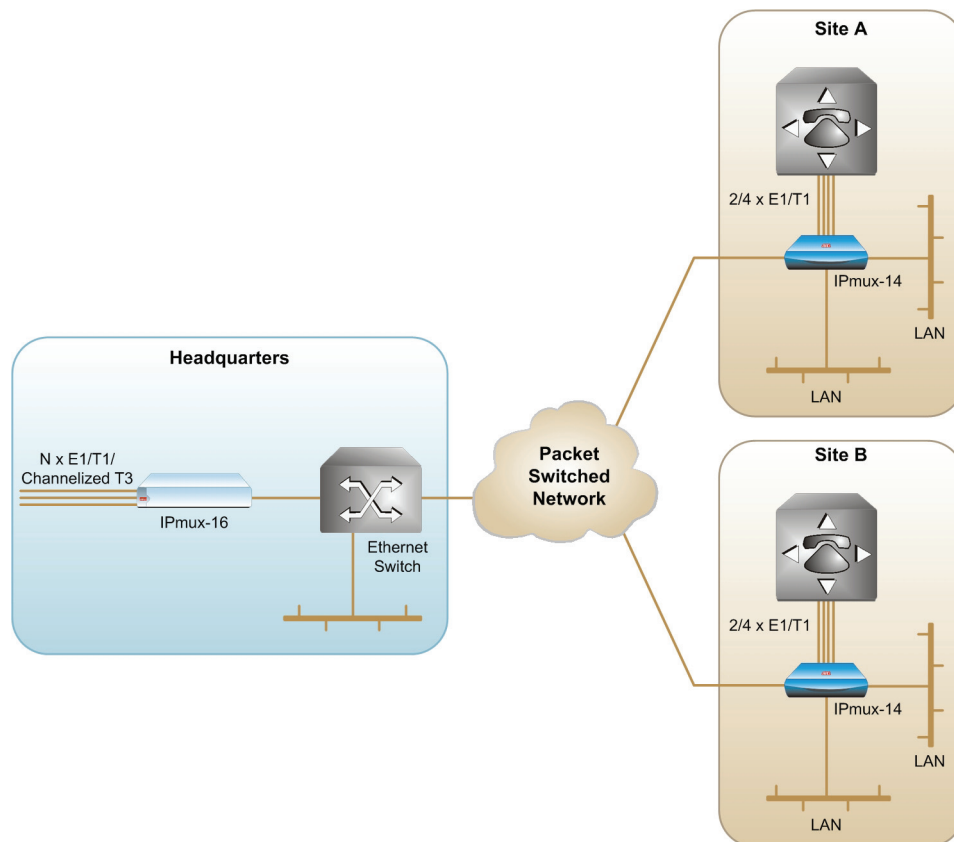


Figure 5. Corporate Multisite Communication over a Packet-Switched Network

## 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:  $\pm 16$  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:  $\pm 16$  ppb  $\pm 1$  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

