

# IPmux-11

## TDMoIP® Gateway



**TDMoIP®**  
Driven

### FEATURES

- TDMoIP CPE (Customer Premises Equipment) for the small and medium-sized enterprise sites, offering TDM leased line extension over a packet switched network and controlled Ethernet access
- TDMoIP technology, implementing the emerging IETF, MPLS/FR Alliance, ITU-T and MEF standards for Pseudo-Wire Emulation Edge-to-Edge (PWE3):
  - E1/T1 communication over IP and Ethernet networks
  - Support for both framed (full or fractional) and unframed E1/T1
  - Minimal processing delay
  - Configurable jitter buffer to compensate for network packet delay variation
  - Dedicated external clock port
  - QoS support by labeling IP level priority Type of Service (ToS) and VLAN tagging/priority labeling according to IEEE 802.1p&Q
- Three Ethernet ports, two for user side and one for network access
- The user Ethernet ports offer:
  - Transparent Ethernet bridging
  - User data bandwidth and access control through rate limiting and VLAN filtering
  - VLAN classification through double VLAN tagging (stacking)
- 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 enclosure

### DESCRIPTION

- IPmux-11 is a TDMoIP gateway optimized for small and medium-sized enterprise sites. It offers Ethernet-based access, as well as extension of TDM-based legacy services over packet switched networks.

### ETHERNET CAPABILITIES

- IPmux-11's internal Layer-2 Ethernet switch supports three Ethernet ports. One port serves as a network interface and the other two serve for user Ethernet traffic.
- Each Ethernet port supports:
  - Configurable port-based rate limiting for bandwidth control
  - Configurable port-based VLAN membership for ingress traffic restriction
  - Configurable port-based VLAN tagging; a VLAN tag is added resulting in a double tagging (VLAN stacking) when an already tagged frame is switched.
- The device supports standard IP features, such as ICMP (ping), ARP, next hop and default gateway.

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## TDMoIP<sup>®</sup> Gateway

### TDMoIP PERFORMANCE

- IPmux-11 provides a legacy over Ethernet/IP solution supporting transmission of E1/T1 streams over IP and Ethernet-based networks. IPmux-11 converts the data stream from its user E1/T1 port into packets for transmission over the network. The addressing scheme of these packets is IP or MPLS. These packets are transmitted via the IPmux-11 Ethernet link port to the network. A remote IPmux converts the packets back to TDM traffic.
- High-performance buffering and forwarding techniques are used to achieve end-to-end processing delay as low as 3 msec.
- Packet size is configurable. A greater packet length results in greater processing delay, yet smaller bandwidth overhead is achieved.
- An enhanced buffering mechanism compensates for packet delay variation (jitter) of up to 300 msec in the network.
- Assigned, IANA-registered UDP socket number for TDMoIP simplifies flow classification through switches and routers.

### TDMoIP QoS SUPPORT

- IPmux-11 supports VLAN tagging and priority labeling according to 802.1p&Q. TDMoIP frames are assigned (tagged) a dedicated VLAN ID.
- The ToS or Diffserv of the outgoing TDMoIP frames are user-configurable. This allows the TDMoIP packets to be given a higher priority by the network switches and routers.

### 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 the IPmux-11 internal clock oscillator
  - **Loopback** – the transmit clock is derived from the E1/T1 port's receive clock
  - **Adaptive** – the clock is recovered from the Ethernet network interface
  - **External** – an external clock source to synchronize the device via its station clock port.

### ETHERNET INTERFACE

- IPmux-11 supports the following Ethernet ports:
  - One network port (UTP or fiber optic)
  - Two user ports (both UTP or UTP and fiber optic).
- The network and user ports provide autonegotiation, VLAN tagging and rate limiting.

### TDM INTERFACE

- One standard E1 or T1 port provides connectivity to any standard E1 or T1 device.
- E1 and T1 interfaces support the following:
  - Integral LTU/CSU for long haul applications
  - E1 balanced and unbalanced or T1 options
  - G.703 unframed and G.704 framed modes
  - CAS and CRC-4 bit generation (E1)
  - D4/SF and ESF framing (T1).

## APPLICATIONS

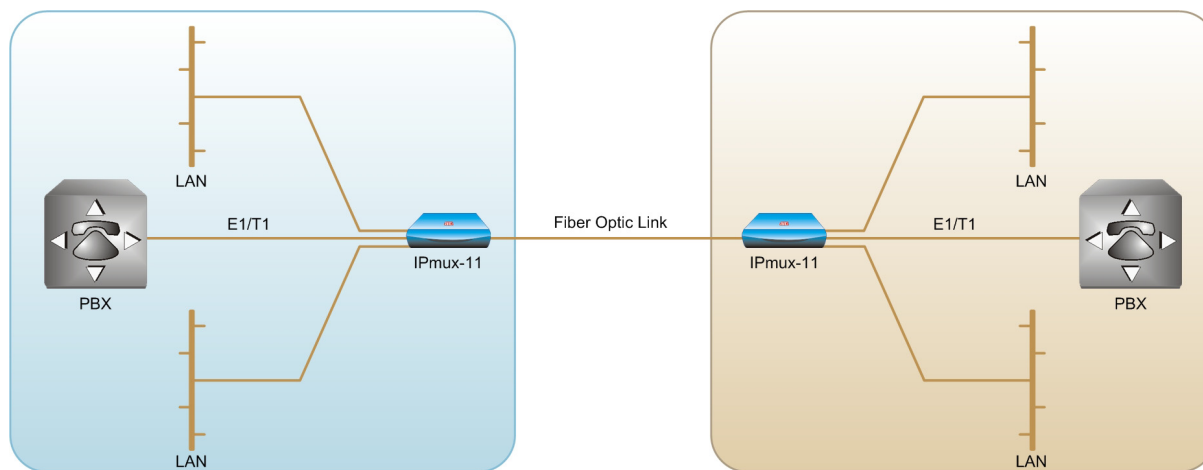


Figure 1. LAN and TDM Services over a Fiber Optic Ethernet Link

## DIAGNOSTICS

- IPmux-11 supports remote and local loopback testing.
- Alarm detection and insertion are supported together with error statistics. These include SES/UAS statistics, LOS/AIS physical layer alarms, and remote/local loopback test modes. Standard E1 or T1 alarms are transmitted end-to-end.
- The following physical layer alarms are supported: E1/T1 port LOS, AIS, LOF, LCV.
- IPmux-11 performs an internal built-in test (BIT) after power up. The results of the test are visible via the local terminal.
- IPmux-11 monitors LAN and IP layer network condition statistics, such as packet loss and packet delay variation (jitter). The events are stored in log files.
- Fault isolation, statistics and event logging are available.
- The minor and major alarms can be relayed to a remote alarm device via dedicated pins of the external clock RJ-45 connector.

## MANAGEMENT

- IPmux-11 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-11 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.

## SPECIFICATIONS

### E1 INTERFACE

- **Compliance**  
ITU-T Rec. G.703, G.704, G.706, G.732, G.823
- **Data Rate**  
2.048 Mbps
- **Line Code**  
HDB3
- **Framing**  
Unframed, CRC-4 MF, CAS MF
- **Signaling**  
CAS, CCS (transparent)
- **Line Impedance**
  - Balanced: 120Ω
  - Unbalanced: 75Ω
- **Signal Levels**  
Receive: 0 to -36 dB with LTU  
          0 to -10 dB without LTU  
Transmit balanced: ±3V ±10%  
Transmit unbalanced: ±2.37V ±10%
- **Jitter Performance**  
Per ITU-T G.823
- **Connector**
  - Balanced: RJ-45
  - Unbalanced: RJ-45 (RJ-45 to BNC adapter cable is supplied)

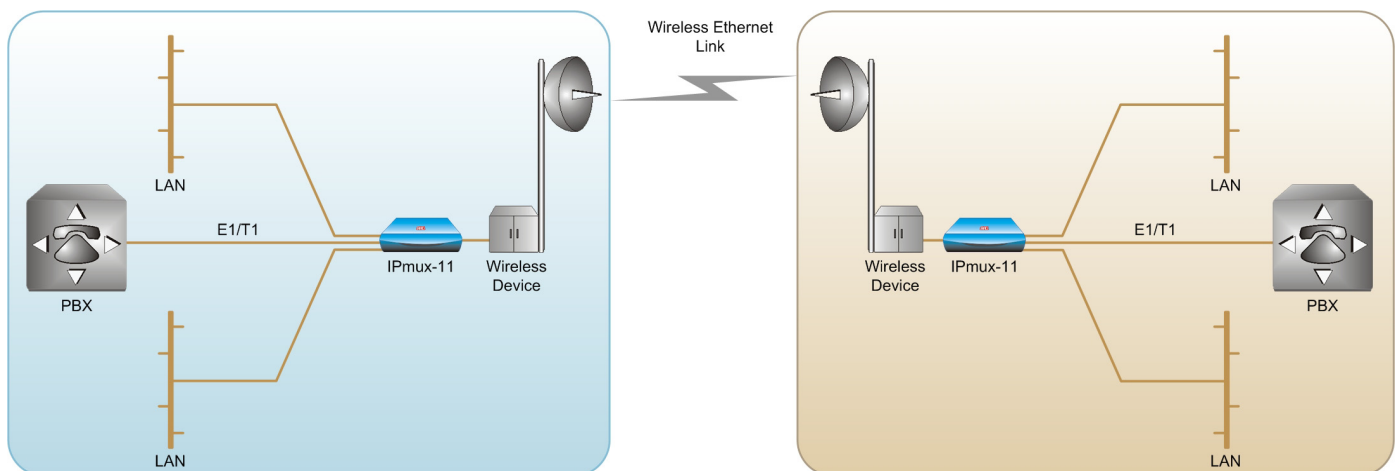


Figure 2. LAN and TDM Services over a Wireless Ethernet Link

### SPECIFICATIONS

#### E1 INTERFACE

- **Number of Ports**  
One
- **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: ±3V ±10%  
Transmit unbalanced: ±2.37V ±10%
- **Jitter Performance**  
Per ITU-T G.823
- **Connector**
  - Balanced: RJ-45
  - Unbalanced: RJ-45 (RJ-45 to BNC adapter cable is supplied)

#### T1 INTERFACE

- **Number of Ports**  
One
- **Compliance**  
ANSI T1.403, ITU-T Rec. G.703, G.704
- **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: ±3V ±20%; 0 dB, -7.5 dB, -15 dB, 22.5 dB (CSU), user-selectable  
±2.7V ±10%, 0 to 655 feet, (DSU), user-selectable
- **Jitter Performance**  
Per AT&T TR-62411, ITU-T G.824
- **Connector**  
RJ-45

#### ETHERNET INTERFACE

- **Compliance**  
IEEE 802.3, 802.3u, 802.1p&Q
- **Number of Ports**
  - Network: one, UTP or fiber
  - User: up to two, UTP only
- **Data Rate**
  - UTP: 10 Mbps or 100 Mbps, full or half duplex
  - Fiber: 100 Mbps full-duplex

Table 1. Fiber Optic Interface Characteristics

Wavelength [nm]	Fiber Type [μm]	Transmitter Type	Power		Receiver Sensitivity [dBm]	Loss		Budget [dBm]	Connector Type
			[dBm]			[dB/km]			
			Min	Max		Min	Max		
1310	62.5/125 multimode	LED	-19	-14	-32	1	4	10*	LC
1310	9/125 single mode	Laser	-15	-8	-34	0.5	0.8	13*	LC

\* Permitted fiber optic cable length differs according to fiber characteristics, splices, and connectors.

#### Optical Budget Calculation:

Optical Budget [dB] = |Receive Sensitivity| – |Optical Power| – 3 (Aging) – Connectors & Patch Panels Loss

#### Distance Calculation:

Min Distance = Optical Budget/Maximum Loss

Max Distance = Optical Budget/Minimum Loss

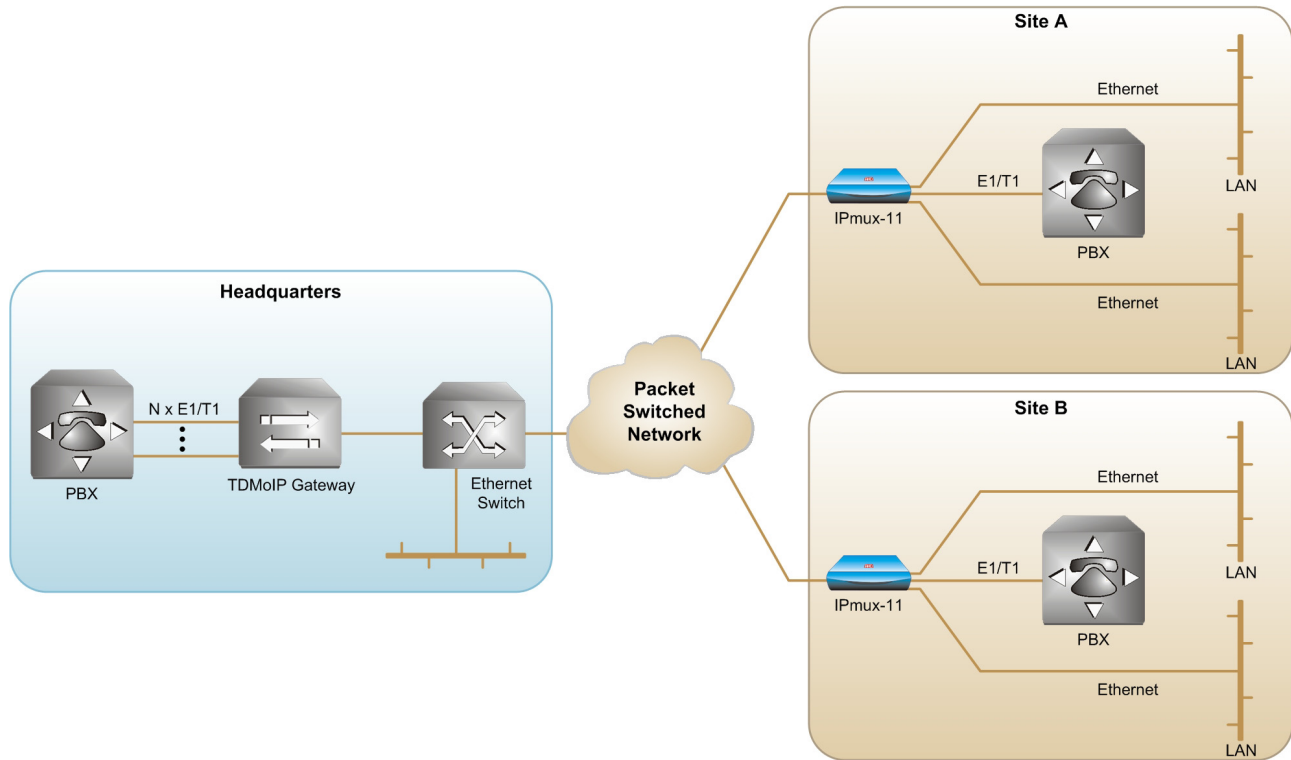


Figure 3. Corporate Multisite Communication over a Packet-Switched Network

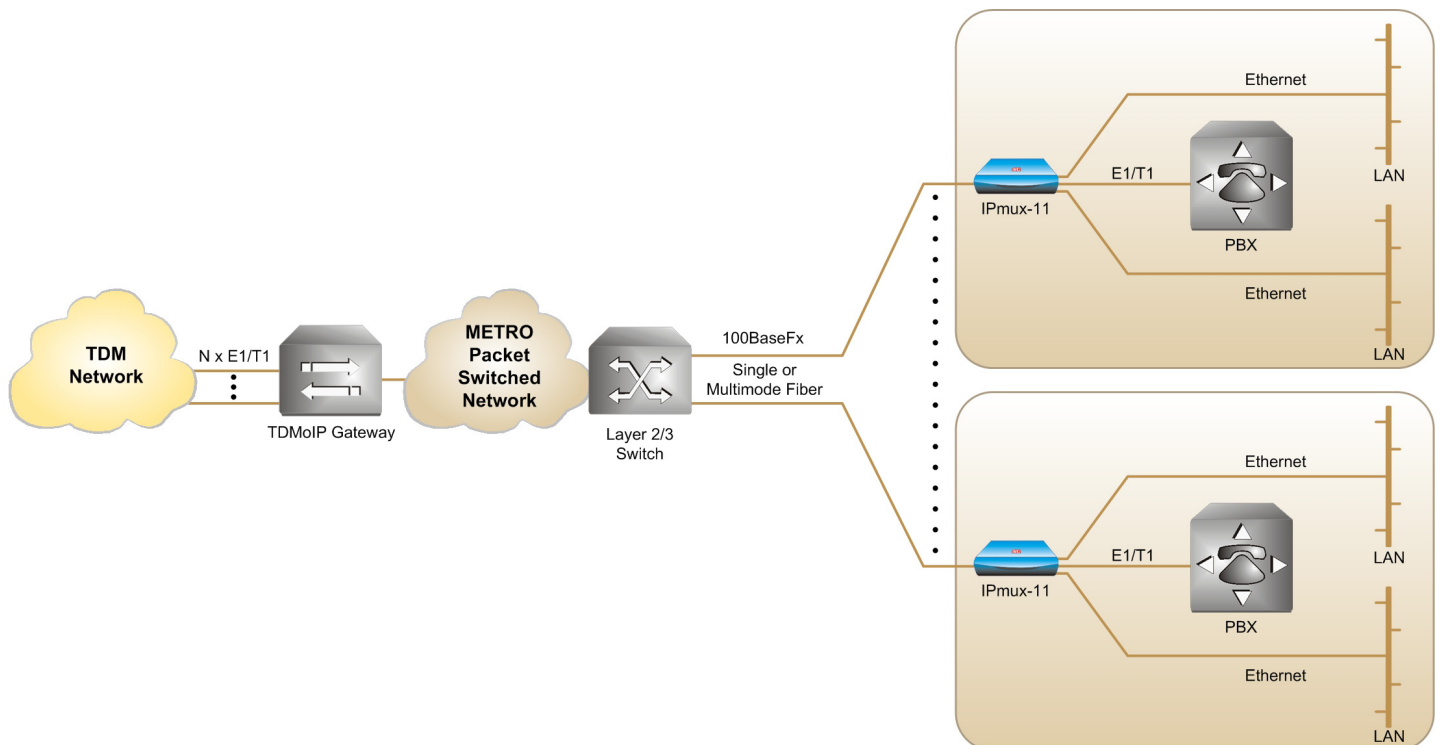


Figure 4. IPmux-11 Providing Ethernet in the First Mile

# IPmux-11

## TDMoIP<sup>®</sup> Gateway

### BUNDLES

- **Number of TDM Bytes**  
48–1440 TDM bytes per Ethernet frame
- **Destination IP Address**  
User-configurable
- **Jitter Buffer Size**  
Up to 300 msec

### MANAGEMENT PORT

- **Interface**  
V.24 (RS-232), DCE
- **Data Rate**  
9.6, 19.2, 38.4, 57.6, or 115.2 kbps
- **Connector**  
9-pin, D-type, female

### GENERAL

- **Timing**
  - Internal
  - External (E1 or T1, via dedicated port)
  - Loopback
  - Adaptive
- **Loopbacks**
  - E1/T1 local loopback
  - E1/T1 remote loopback
- **Statistics**
  - E1/T1 (per G.826 and RFC 2495)
  - Ethernet (per RFC 2819)
  - Receive buffer indication (overflow, underflow, sequence error)
- **Alarm Relay Port**  
Dry contact via pin 6, pin 7 and pin 8 of the EXT CLK RJ-45 connector.  
Operates as Normally Open and Normally Closed, using different pins.
- **Indicators**  
PWR (green) – Power  
ALM (red) – Alarm  
TST (red) – Test is in progress  
E1/T1 SYNC (green) – E1/T1 synchronization  
LINK/ACT (green) – Ethernet link/activity status
- **Power**  
AC/DC: 100–240 VAC or -40 to -72 VDC
- **Power Consumption**  
10W max

- **Physical**  
Height: 43.7 mm / 1.7 in  
Width: 240.0mm / 9.4 in  
Depth: 170.0mm / 6.7 in  
Weight 0.5 kg / 1.1 lb
- **Environment**  
Temperature: 0–50°C/32–122°F  
Humidity: Up to 90%, non-condensing

## ORDERING

**IPmux-11/\*/&/%**  
TDMoIP gateway

- \* Specify TDM interface type:  
**E1** for balanced E1 interface  
**E1CX** for unbalanced E1 interface (via supplied adapter cable)  
**T1** for T1 interface
- & Specify network Ethernet interface type:  
**UTP** for 10/100BaseT interface, RJ-45 connector  
**MM13LC** for multimode 1310 nm 100BaseFx interface, LC connector  
**SM13LC** for single mode 1310 nm 100BaseFx interface, LC connector
- % Specify **UTP** for 10/100BaseT user interface, RJ-45 connector

### RM-33

Hardware kit for mounting one IPmux-11 unit into a 19-inch rack

**RAD**

data communications

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