

# IPmux-1E

## TDMoIP Gateway



**TDMoIP**  
Driven®

### FEATURES

- TDMoIP gateway enabling E1/T1, ISDN, and analog phone communication over asynchronous IP and Ethernet networks
- Framed (full or fractional) and unframed E1/T1 user traffic
- Four FXS/E&M/FXO voice ports for standard analog telephones and key system connections
- Four standard SO NT or TE interfaces for ISDN basic rate service
- QoS includes:
  - Labeling IP level priority Type of Service (ToS)
  - VLAN tagging and priority labeling according to IEEE 802.1p&Q
- Optional Ethernet user port offering:
  - Transparent LAN bridging
  - User data bandwidth and access control through rate limiting and VLAN filtering
- Ethernet network port with either copper UTP or fiber optic interfaces
- Minimal processing delay (under 3 msec)
- Configurable jitter buffer to compensate for network packet delay
- Manageable via ASCII terminals, Telnet hosts or RADview-Service Center, RAD's Java-based network management system
- Compact, 1U-high enclosure

# IPmux-1E

## TDMoIP Gateway

### DESCRIPTION

- IPmux-1E is a TDMoIP gateway for transporting E1/T1, ISDN BRI, and FXS/FXO/E&M services over IP and Ethernet-based networks. IPmux-1E converts the data stream from the user ports to packets for transmission over the packet-switched network. The addressing scheme of these packets is IP. These packets are transmitted via the IPmux-1E Ethernet port to the network. A remote TDMoIP gateway converts the IP packets back to TDM traffic.
- A powerful internal Layer-2 Ethernet switch provides a user Ethernet port with rate limiting and port-based VLAN tagging capabilities.
- The device supports standard IP features, such as ICMP (ping), ARP, next hop and default gateway capabilities.
- *Figure 1* shows a point-to-point application extending analog phone service to a remote PBX, and providing LAN-to-LAN communication over a shared fiber optic, UTP or coaxial cable.
- *Figure 2* shows a multi-tenant office building where a variety of legacy TDM services (ISDN, E1/T1, and analog phones) are provided by IPmux-1E units connected to IPmux-16 and Megaplex-2100 with ML-IP via an IP network.

### PERFORMANCE

- IPmux-1E achieves end-to-end processing delay as low as 3 msec, using high-performance buffering and forwarding techniques.
- IP 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 network packet delay variation (jitter) of up to 300 msec.
- An optional internal echo canceller improves voice quality when a large end-to-end delay exists on the TDMoIP link.

### QoS SUPPORT

- VLAN tagging and priority labeling are supported according to 802.1p&Q. TDMoIP frames are assigned (tagged) a dedicated VLAN ID.
- VLAN membership allows:
  - Management traffic to run over a dedicated VLAN
  - User data traffic to be filtered according to a set of up to 15 VLANs.

- The user can configure the ToS or Diffserv of the outgoing TDMoIP packets. This allows the TDMoIP packets to be given a higher priority by network switches and routers.
- Assigned, IANA-registered UDP socket number for TDMoIP simplifies flow classification through switches and routers.
- Rate limiting can be applied on the Ethernet user port to control the maximum traffic rate transmitted towards the IP/Ethernet network.

### TIMING

- Synchronization between TDM devices is maintained by using advanced clock distribution mechanisms. The clocking options are:
  - **Internal** – the master clock source for the TDM circuit is provided by the IPmux-1E internal clock oscillator
  - **Loopback** – the transmit clock is derived from the E1/T1 port receive clock
  - **Adaptive** – the clock is recovered from the Ethernet network interface
  - **External** – an external clock source is used to synchronize the device via its station clock port.
- The external clock port provides out-of-band synchronization.

### APPLICATIONS

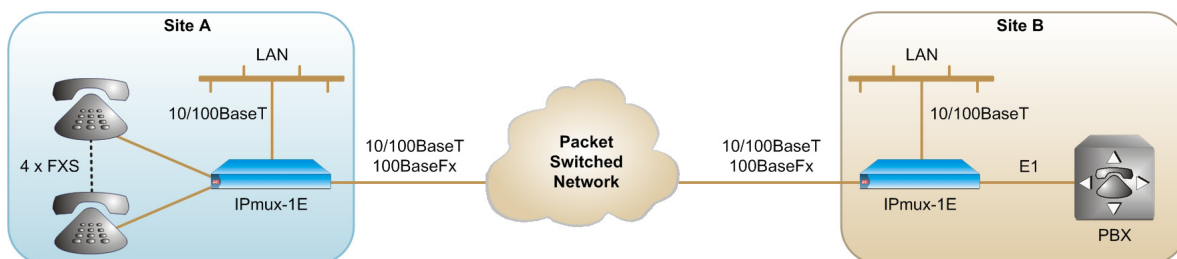


Figure 1. Voice and Data Integration over an Ethernet Link

## ETHERNET PORTS

- IPmux-1E supports the following Ethernet ports:
  - One network port (copper or fiber optic)
  - One user port (copper)

## E1 OR T1 PORT

- One standard E1 or T1 port for connectivity to any standard E1 or T1 device.
- E1 and T1 interfaces support the following:
  - Integral LTU/CSU for line protection and long haul applications
  - G.703 unframed and G.704 framed modes
  - CAS
  - CRC-4 bit generation (E1).
- An internal 16-msec echo canceller for the E1 and T1 ports is available.

## ISDN BRI S0 PORTS

- Four standard ISDN basic rate S0 ports provide connectivity to any Network Termination (NT) or Terminal Equipment (TE) ISDN device.
- The phantom feeding function enables IPmux-1E to power the remote user equipment (NT mode).
- Each S0 port supports remote and local digital loopback test modes.

## ANALOG PORTS

- IPmux-1E offers four FXS, FXO, or E&M analog ports.
- An internal 16-msec echo canceller for the analog ports is available.

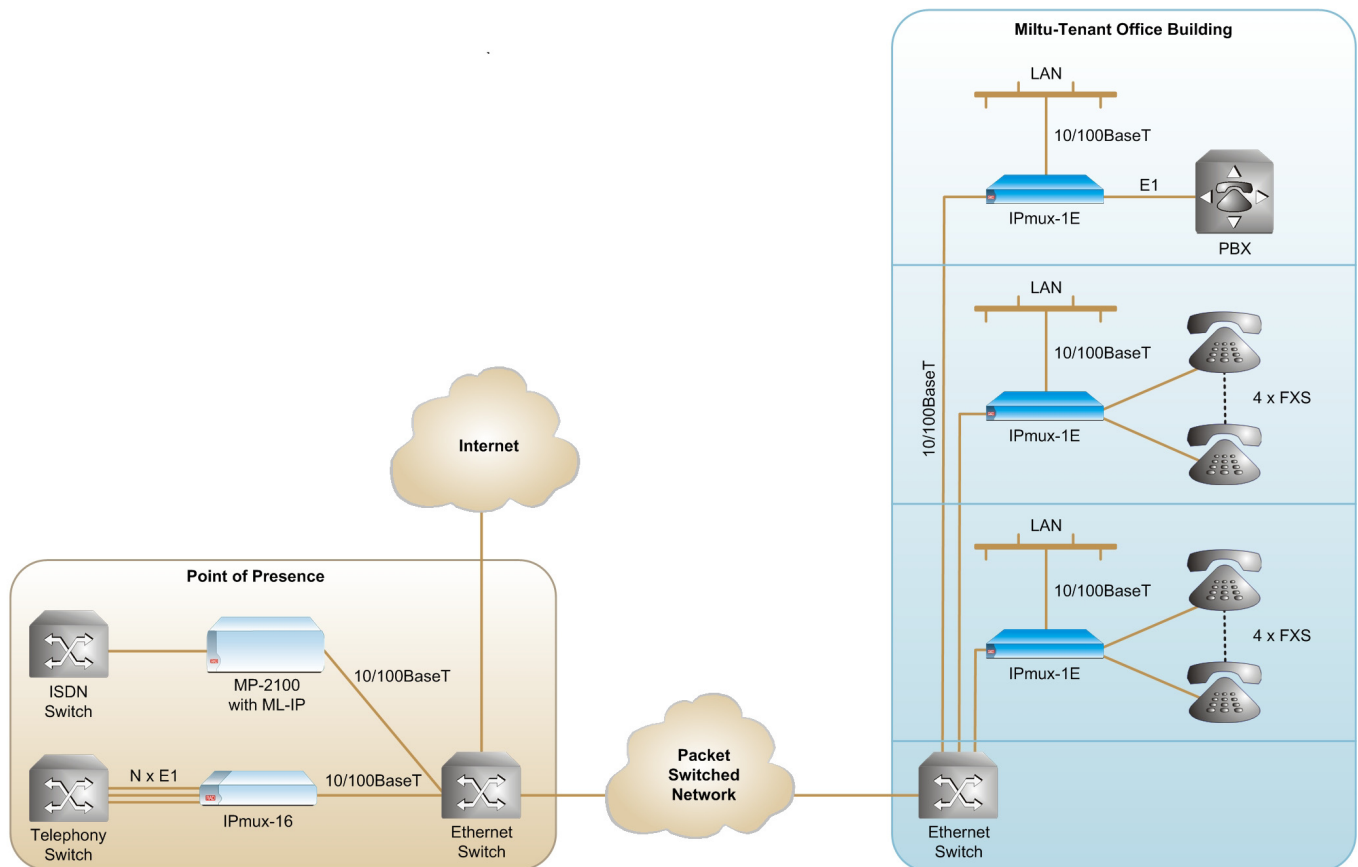


Figure 2. Integrated Ethernet-Based Voice and Data Access for Multi-Tenant Building

### DIAGNOSTICS

- External and internal loopbacks can be used to check the TDM links connectivity.
- The following physical layer alarms are supported:
  - E1/T1 LOS, AIS, LOF, LCV
  - ISDN S0 LOF
  - FXS/FXO/E&M port status.
- IPmux-1E provides end-to-end alarm generation and end-to-end AIS indication. When a local E1 or T1 port receives AIS, it is passed to the remote port via the Ethernet/IP network. If a local Ethernet port is not connected, AIS indication is generated both in the local and the remote devices.

- An internal built-in test (BIT) is performed after power-up. The results of the test are visible via the local terminal.
- IPmux-1E monitors LAN and IP layer network condition statistics, such as packet loss and packet delay variation (jitter). The events are stored in log files.

### MANAGEMENT

- Configuration and monitoring are performed locally via an ASCII terminal, or remotely via Telnet, or RADview.
- Software download is supported via the local terminal, using XMODEM, or remotely, using TFTP. After downloading a new software version, IPmux-1E automatically saves the previous version in non-volatile memory for backup. Similarly, copies of the configuration file can be downloaded and uploaded to a remote workstation for backup and restore purposes.

- RADview Service Center TDMoIP network management application provides TDMoIP service and manages the TDMoIP devices via a user-friendly graphical interface that allows monitoring and configuring multiple IPmux devices. Fault isolation, statistics and event gathering are available. The intuitive GUI, "point-and-click" functionality and easy-to-follow wizards increase the efficiency and accuracy of the service provisioning process.

**Table 1. Fiber Optic Interface Characteristics**

Interface Type	Wavelength [nm]	Optical Power		Receive Sensitivity [dBm]	Optical Budget [dB]*	Loss	
		Min [dBm]	Max			Min [dB/km]	Max
Multimode	1310	-19	-14	-32	10*	1	4
Single mode	1310	-15	-8	-32	14*	0.5	0.8

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

### Optical Budget Calculation:

$$\text{Optical Budget [dB]} = |\text{Receive Sensitivity}| - |\text{Optical Power}| - 3 \text{ (Aging)} - \text{Connectors \& Patch Panels Loss}$$

### Distance Calculation:

$$\text{Min Distance} = \text{Optical Budget/Maximum Loss}$$

$$\text{Max Distance} = \text{Optical Budget/Minimum Loss}$$

### SPECIFICATIONS

#### E1 INTERFACE

- **Standards**  
ITU-T Rec. G.703, G.704, G.706, G.732, G.823
- **Framing**
  - Unframed
  - CRC-4 with or without MF
  - CAS with or without MF
- **Data Rate**  
2.048 Mbps
- **Line Code**  
HDB3
- **Receive Level**  
0 to -28 dB with LTU  
0 to -9 dB without LTU
- **Transmit Level**  
±3V ±10%, balanced  
±2.37V ±10%, unbalanced:
- **Connector**
  - Balanced: RJ-45
  - Unbalanced: RJ-45 (RJ-45 to BNC adapter cable is supplied)
- **Line Impedance**  
120Ω, balanced  
75Ω, unbalanced
- **Jitter Performance**  
Per ITU-T G.823

#### T1 INTERFACE

- **Standards**  
AT&T TR-62411; ITU-T Rec. G.703, G.704; ANSI T1.403, G.824
- **Data Rate**  
1.544 Mbps
- **Line Code**  
AMI, B8ZS, B7ZS
- **Framing**  
Unframed, SF, ESF
- **Receive Level**  
0 dB to -30 dB
- **Transmit Level**  
±2.75V ±10% at 0 to 655 ft with DSU  
0 dB, -7.5 dB, -15 dB, -22.5 dB with CSU
- **Connector**  
RJ-45
- **Line Impedance**  
100Ω, balanced
- **Jitter Performance**  
Per AT&T TR-62411, ITU-T G.824

#### ETHERNET INTERFACE

- **UTP**
  - Standards: IEEE 802.3, 802.3u, 802.1p&Q
  - Data Rate: 10 or 100 Mbps, half/full-duplex
  - Range: up to 100m (328 ft) on UTP Cat.5 cable
  - Connector: RJ-45
- **Fiber Optic (network port only)**
  - Characteristics: see *Table 1*
  - Connector: SC or LC

#### CONTROL INTERFACE

- **Interface**  
RS-232/V.24 (DCE)
- **Data Rate**  
9.6, 19.2, 38.4 or 57.6 kbps
- **Connector**  
DB-9, female

#### ISDN S0 INTERFACE

- **Compliance**  
ETS 300012, I.430, NTT, 5ESS, DMS-100, NI1
- **Bit Rate**  
192 kbps
- **Line Coding**  
Pseudo-ternary
- **Line Termination**  
100Ω ±5%
- **Connector**  
RJ-45

#### ANALOG INTERFACES

- **Type**  
FXS, FXO, and E&M
- **Modulation Method**  
PCM (per ITU-T G.711 and AT&T PUB-43801), μ-Law or A-Law
- **Interface**  
Loop start for direct connection to a 2-wire telephone
- **Diagnostics**
  - Remote analog loopback
  - 1-kHz tone injection
  - Activity status
- **Connectors**
  - FXS and FXO: RJ-11
  - E&M: RJ-45

#### GENERAL

- **Timing**  
E1/T1:
  - Internal (from internal oscillator)
  - External (E1 or T1, via dedicated port)
  - Loopback (derived from the E1/T1 receive line)
  - Adaptive (regenerated from Ethernet link)PCM:
  - Internal (from internal oscillator)
  - Loopback (derived from Channel 1 for the unit with ISDN/TE, FXS, FXO and E&M interfaces)
  - Adaptive (regenerated from the Ethernet link)
- **Power**  
AC: 100 to 240 VAC, 50/60 Hz  
DC: -48 VDC only
- **Power Consumption**  
25W or 32W (with Ethernet switch)
- **Physical**  
Height: 44 mm (1.7 in)  
Width: 432 mm (17.0 in)  
Depth: 246 mm (9.7 in)  
Weight: 2.3 kg (5.1 lb)
- **Environment**  
Temperature: 0–50°C (32–122°F)  
Humidity: Up to 90%, non-condensing

# IPmux-1E

## TDMoIP Gateway

### ORDERING

**IPmux-1E/#/+/&/\***  
TDMoIP gateway

# Specify power supply:  
AC for 100 to 240 VAC  
DC for -48 VDC

+ Specify TDM user port type:  
**4BRI** for 4 ISDN S0 interfaces  
**4FXS** for 4 analog FXS interfaces  
**4FXO** for 4 analog FXO interfaces  
**4E&M** for 4 analog E&M interfaces  
**4FXS-EC** for 4 analog FXS interfaces and echo canceller  
**4FXO-EC** for 4 analog FXO interfaces and echo canceller  
**4E&M-EC** for 4 analog E&M interfaces and echo canceller  
**E1-EC** for balanced E1 interface and echo canceller  
**E1CX-EC** for unbalanced E1 interface, RJ-45 and echo canceller (RJ-45 to BNC adapter cable is supplied)  
**T1-EC** for balanced T1 interface, RJ-45 and echo canceller

& Specify Ethernet port type:  
**UTP** for 10/100BaseT network port, RJ-45  
**MM-SC** for 100BaseFx network port, 850 nm, multimode, SC  
**SM-SC** for 100BaseFx network port, 1310 nm, single mode, SC  
**UTP/UTP** for 10/100BaseT network port, RJ-45 and 10/100BaseT user port, RJ-45  
**MM-LC/UTP** for 100BaseFx network port, 850 nm, multimode, LC and 10/100BaseT user port, RJ-45  
**SM-LC/UTP** for 100BaseFx network port, 1310 nm, single mode, LC and 10/100BaseT user port, RJ-45

\* Specify station clock port type (optional, default is none):  
**STC-E1** for 2.048-Mbps balanced, RJ-45  
**STC-E1CX** for 2.048-Mbps, unbalanced, mini BNC (mini BNC to BNC adapter cable is supplied)  
**STC-T1** for 1.544-Mbps balanced, RJ-45

### SUPPLIED ACCESSORIES

Power cord

DC power supply connector kit (if a DC-powered unit is ordered)

**CBL-RJ45/2BNC/E1/X**  
adapter cable (if an unbalanced E1 interface is ordered)

**CBL-MINIBNC-BNC**  
adapter cable (if a station clock module with unbalanced E1 interface is ordered)

### RM-34

Hardware kit for mounting one IPmux-1E unit into a 19-inch rack

### OPTIONAL ACCESSORIES

**CBL-DB9F-DB9M-STR**  
Control port cable



data communications

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