

# IPmux-1, IPmux-1E

TDMoIP® Gateways



TDMoIP®  
Driven

## FEATURES

- TDMoIP® gateways enabling E1/T1, ISDN, and analog phone communication over asynchronous IP and Ethernet networks
- Framed (full or fractional) and unframed E1/T1 user traffic
- FXS/E&M/FXO voice ports for standard analog telephones and key system connections
- Standard S0 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 enclosures

# IPmux-1, IPmux-1E

## TDMoIP® Gateways

### DESCRIPTION

- IPmux-1, IPmux-1E provide a legacy over Ethernet/IP solution supporting E1/T1, ISDN BRI, and FXS/FXO/E&M services over IP and Ethernet-based networks. IPmux-1 and IPmux-1E convert 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-1 and IPmux-1E Ethernet port to the network. A second IPmux at the other location converts the IP packets back to TDM traffic.
- IPmux-1 and IPmux-1E feature a powerful internal Layer-2 Ethernet switch, which enables addition of a user Ethernet port with rate limiting and port-based VLAN tagging capabilities.
- IPmux-1 and IPmux-1E support 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 via an IP network.

### PERFORMANCE

- IPmux-1 and IPmux-1E achieve 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 packet delay variation (jitter) in the network of up to 300 msec.
- When a large end-to-end delay exists over the TDMoIP® link, an echo may develop. IPmux-1E can be ordered with an internal echo canceller.

### 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

- IPmux-1 and IPmux-1E maintain synchronization between TDM devices, by deploying advanced clock distribution mechanisms. The clocking options are:
  - **Internal** – the master clock source for the TDM circuit is provided by the IPmux-1 and 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.

### APPLICATIONS

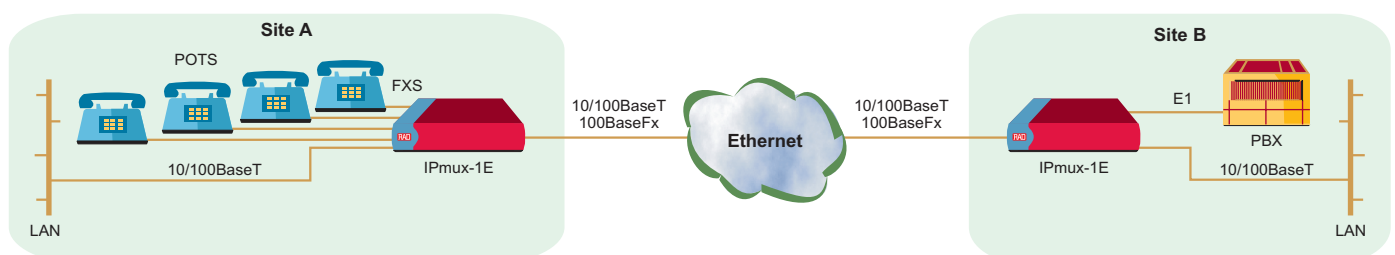


Figure 1. Voice and Data Integration over an Ethernet Link

## ETHERNET PORTS

- IPmux-1 and IPmux-1E offer a single Ethernet network port with UTP or fiber optic interface:
  - **UTP option** – standard 10/100BaseT half/full duplex port with auto-negotiation support. If auto-negotiation is disabled, the configuration can be:
    - 100BaseT, full duplex
    - 100BaseT, half-duplex
    - 10BaseT, full duplex
    - 10BaseT, half-duplex.
  - **Fiber optic option** – standard 100BaseFx full duplex port (see Table 1).
- An additional 10/100BaseT port for connecting the user LAN is optional.

## E1 OR T1 PORT

- One standard E1 or T1 port provides connectivity to any standard E1 or T1 device.
- Integral LTU/CSU can be enabled for line protection and long haul applications.
- E1 balanced, unbalanced or T1 interface options are available.
- Alarm detection and insertion are supported together with error statistics. These include SES/UAS statistics, LOS/AIS physical layer alarms and local/remote loopbacks. Standard E1 or T1 alarms are supported end-to-end.
- Two types of E1/T1 service are available:
  - **Unframed** – full E1/T1 circuits are extended transparently across the IP network, regardless of framing structure.
  - **Framed** – full or fractional E1/T1 services with CAS and CRC-4 support over IP networks.

## ISDN BRI S0 PORTS (IPMUX-1E ONLY)

- 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.

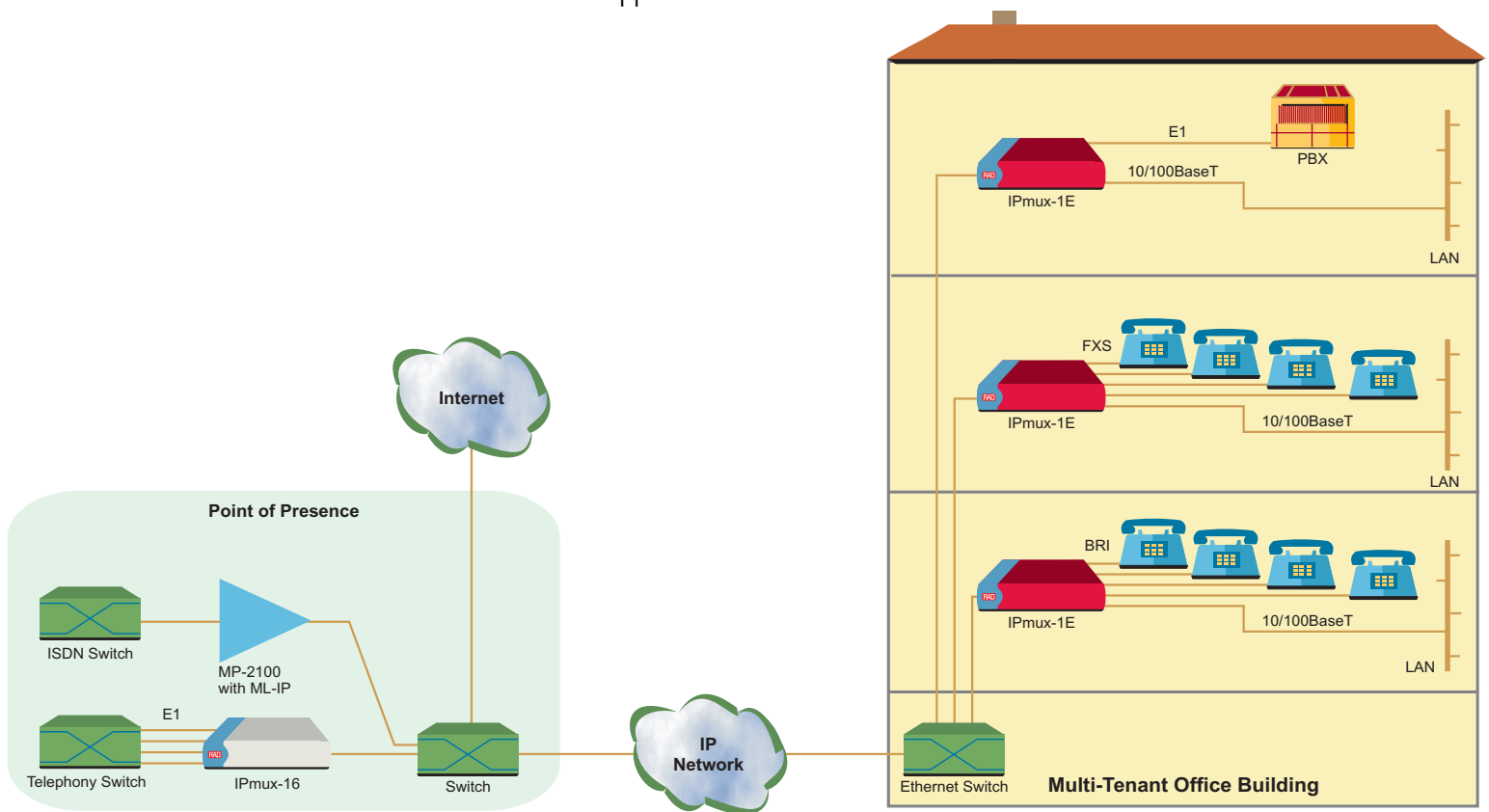


Figure 2. Ethernet-Based Voice and Data Integrated Access Multi-Tenant Environment

# IPmux-1, IPmux-1E

## TDMoIP® Gateways

### ANALOG PORTS (IPMUX-1E ONLY)

- IPmux-1E offers four FXS, FXO, or E&M analog ports.
- An internal 16 msec echo canceller can be optionally ordered.

### EXTERNAL CLOCK PORT

- External clock port provides out-of-band synchronization.

### DIAGNOSTICS & MANAGEMENT

- IPmux-1 and IPmux-1E support remote and local loop testing.
- IPmux-1 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.

- Physical layer alarms support:
  - IPmux-1: E1/T1 port LOS, AIS, LOF, LCV
  - IPmux-1E: ISDN S0 LOF and FXS/FXO/E&M port status.
- IPmux-1 and IPmux-1E perform an internal built-in test (BIT) after power up. The results of the test are visible via the local terminal.
- IPmux-1 and IPmux-1E monitor LAN and IP layer network condition statistics such as packet loss and packet delay variation (jitter). The events are stored in log files.

- Software download is supported via the local terminal, using XMODEM, or remotely, using TFTP. After downloading a new software version, IPmux-1 and IPmux-1E automatically save 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.
- IPmux-1 and IPmux-1E can be configured and monitored locally via an ASCII terminal, or remotely via Telnet or RADview.

### MANAGEMENT APPLICATIONS

- 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.
- Fault isolation, statistics and event gathering are available.

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:

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



### 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**  
Balanced:  $\pm 3V \pm 10\%$   
Unbalanced:  $\pm 2.37V \pm 10\%$
- **Connector**  
Balanced: RJ-45  
Unbalanced: RJ-45 (RJ-45 to BNC adapter cable is supplied)
- **Line Impedance**  
Balanced:  $120\Omega$   
Unbalanced:  $75\Omega$
- **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**  
 $\pm 2.75V \pm 10\%$  at 0 to 655 ft with DSU  
0 dB, -7.5 dB, -15 dB, -22.5 dB with CSU
- **Connector**  
RJ-45
- **Line Impedance**  
 $100\Omega$ , 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**  
 $100\Omega \pm 5\%$
- **Connector**  
RJ-45

#### ANALOG INTERFACES

- **Type**  
FXS, FXO, and E&M interfaces
- **Modulation Method**  
PCM (per ITU-T G.711 and AT&T PUB-43801),  $\mu$ -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 E1/T1 receive line)
  - Adaptive (regenerated from Ethernet link)PCM:
  - Internal (from internal oscillator)
  - Loopback (derived from Channel 1 for IPmux-1E with ISDN/TE, FXS, FXO and E&M interfaces)
  - Adaptive (regenerated from Ethernet link)
- **Power**  
AC: 100 to 240 VAC, 50/60 Hz  
DC:
  - IPmux-1: -36 to -72 VDC (-48 VDC nominal)
  - IPmux-1E: -48 VDC only
- **Power Consumption**  
IPmux-1: 4W or 10W (with Ethernet switch)  
IPmux-1E: 25W or 32W (with Ethernet switch)
- **Physical**  
IPmux-1:  
Height: 43 mm / 1.7 in  
Width: 215 mm / 8.4 in  
Depth: 246 mm / 9.7 in  
Weight: 1.2 kg / 2.7 lb  
IPmux-1E:  
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-1, IPmux-1E

## TDMoIP<sup>®</sup> Gateways

### ORDERING

**IPmux-1/#/+/&/\***

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

TDMoIP<sup>®</sup> gateways

# Specify power supply:

**AC** for 100 to 240 VAC

**DC** for -48 VDC

+ Specify TDM user port for IPmux-1:

**E1** for balanced E1 interface, RJ-45

**T1** for balanced T1 interface, RJ-45

**E1CX** for unbalanced E1 interface, RJ-45 (RJ-45 to BNC adapter cable is supplied)

Specify TDM user port for IPmux-1E:

**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:

**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 (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

#### RM-35

Hardware kit for mounting one or two IPmux-1 units into a 19-inch rack

#### RM-34

Hardware kit for mounting one IPmux-1E unit into a 19-inch rack, supplied with the unit

**RAD**

data communications

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