

# IPmux-1E

## TDM Pseudowire Access Gateway



### TDM circuit emulation over packet-switched networks

- Transporting E1, T1, ISDN and analog phone traffic over packet-switched networks
- Four FXS, FXO or E&M voice ports for standard analog telephones and key system connections
- Four standard S0 NT or TE interfaces for ISDN basic rate service
- Minimal processing delay (under 3 msec)
- Configurable jitter buffer to compensate for network packet delay

**TDM-IP  
Driven®**

IPmux® -1E provides legacy services over packet networks. The device converts the data stream from its user E1/T1, analog telephone or ISDN ports into packets for transmission over the network. The frame format of these packets is IP or Ethernet. These packets are transmitted via the IPmux-1E Ethernet network port to the PSN. A remote pseudowire device converts the packets back to the original user traffic format.

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.

**RAD**

data communications

The Access Company

## IPmux-1E

### TDM Pseudowire Access Gateway

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 or UTP 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 the packet-switched network.

#### PERFORMANCE

IPmux-1E achieves end-to-end processing delay as low as 3 msec, using high-performance buffering and forwarding techniques.

Configurable packet size allows to achieve proper balance between PSN throughput and delay.

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 pseudowire link.

#### QoS SUPPORT

VLAN tagging and priority labeling are supported according to 802.1p&Q. pseudowire frames are assigned (tagged) a dedicated VLAN ID.

VLAN membership allows:

- Management traffic to be 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 pseudowire packets. This allows the 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 rate of the traffic transmitted towards the packet-switched 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 units with E1 or T1 user interfaces via their station clock ports.

The external clock port serves for out-of-band synchronization.

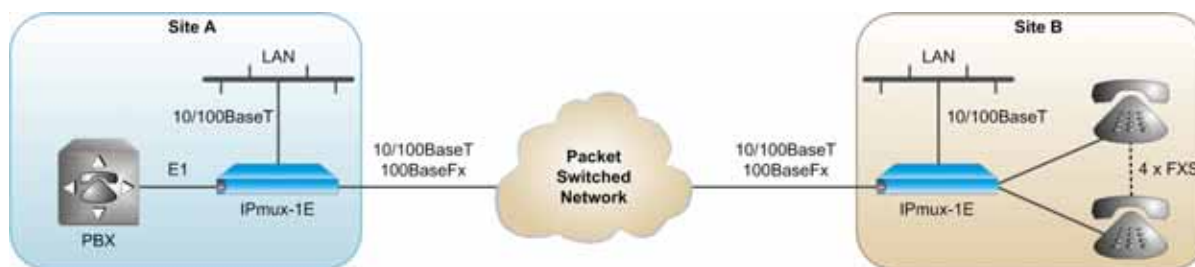


Figure 1. Voice and Data Integration over an Ethernet Link

### E1/T1 PORT

One E1 or T1 port provides connectivity to any standard E1 or T1 device.

E1 and T1 interfaces feature:

- 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 testing.

### ANALOG VOICE PORTS

Four FXS, FXO, or E&M ports provide connectivity to standard analog telephones and key systems.

An internal 16-msec echo canceller for the analog ports is available.

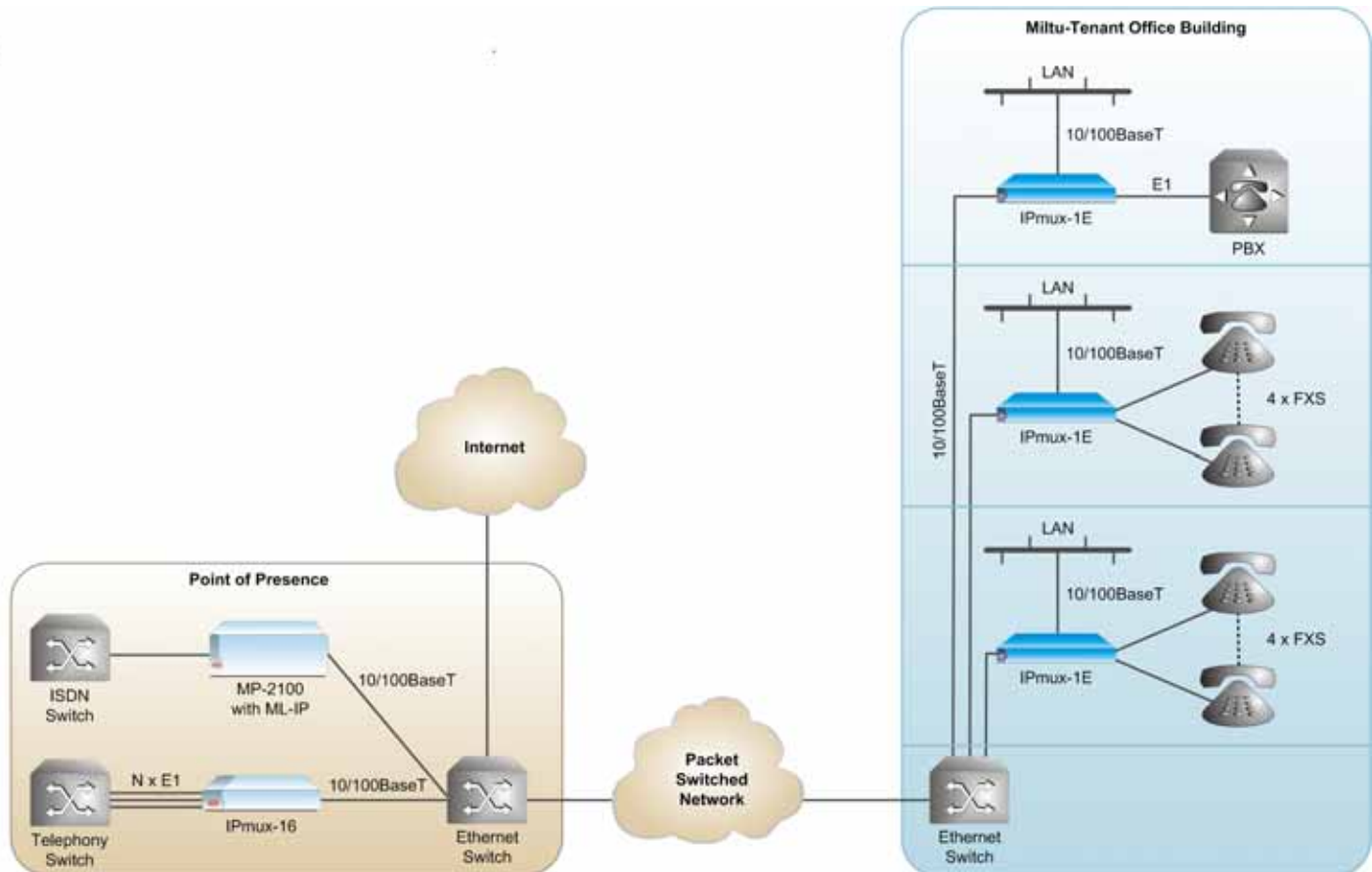


Figure 2. Integrated Ethernet-Based Voice and Data Access for Multi-Tenant Building

## 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.

Alarm generation and AIS indication are provided end-to-end. When a local E1 or T1 port receives AIS, it is passed to the remote port via the PSN. 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 is downloaded 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 purposes. Similarly, copies of the configuration file may be downloaded and uploaded to a remote workstation for backup and restore purposes.

The RADview Service Center TDMoIP package controls and monitors pseudowire 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.

## SPECIFICATIONS

### E1 INTERFACE

**Number of Ports**  
1

**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  $\pm$ 10%, balanced

2.37  $\pm$ 10%, unbalanced

**Connector**  
Balanced: RJ-45

Unbalanced: BNC (RJ-45 to BNC adapter cable is supplied)

**Line Impedance**  
120 $\Omega$ , balanced  
75 $\Omega$ , unbalanced

**Jitter Performance**  
Per ITU-T G.823

### T1 INTERFACE

**Number of Ports**  
1

**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  $\pm$ 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: LC

# IPmux-1E

## TDM Pseudowire Access Gateway

### ISDN SO INTERFACE

#### Number of Ports

4

#### 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, 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

RJ-11 (FXS, FXO)

RJ-45 (E&M)

### 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)

### Management

SNMPv1

Telnet

RADview Service Center TDMoIP (ordered separately)

ASCII terminal via V.24 (RS-232) DCE port

### Power

AC: 100–240 VAC

DC: -48 VDC (-40 to -60 VDC)

### 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 to 50°C (32 to 122°F)

Humidity: Up to 90%, non-condensing

Table 1. Fiber Optic Interface Characteristics

Interface Type	Wavelength [nm]	Optical Power [dBm]		Receive Sensitivity [dBm]	Optical Budget [dB]*	Loss [dB/km]	
		Min	Max			Min	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.

## IPmux-1E

### TDM Pseudowire Access Gateway

## Ordering

IPMUX-1E/AC/4BRI/UTP

IPMUX-1E/AC/4E&M/UTP

IPMUX-1E/AC/4E&M/UTP/UTP

IPMUX-1E/AC/4E&M-EC/UTP

### SPECIAL CONFIGURATIONS

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

#### Legend

# Power supply:

AC Single 100 to 240 VAC

DC Single -48 VDC

+ TDM interface:

4BRI 4 ISDN S0 interfaces

4FXS 4 analog FXS interfaces

4FXO 4 analog FXO interfaces

4E&M 4 analog E&M interfaces

4FXS-EC 4 analog FXS interfaces and echo canceller

4FXO-EC 4 analog FXO interfaces and echo canceller

4E&M-EC 4 analog E&M interfaces and echo canceller

E1-EC Balanced E1 interface and echo canceller

E1CX-EC Unbalanced E1 interface and echo canceller (RJ-45 to BNC adapter cable is supplied)

T1-EC Balanced T1 interface and echo canceller

& Ethernet interface:

UTP 10/100BaseT network port

MM-LC 100BaseFx network port, 850 nm, multimode, LC

SM-LC 100BaseFx network port, 1310 nm, single mode, LC

UTP/UTP 10/100BaseT network port and 10/100BaseT user port

MM-LC/UTP 100BaseFx network port, 850 nm, multimode, LC and 10/100BaseT user port

SM-LC/UTP 100BaseFx network port, 1310 nm, single mode, LC and 10/100BaseT user port

\* Station clock port (Default=none):

STC-E1 2.048 Mbps balanced, RJ-45

STC-E1CX 2.048 Mbps, unbalanced, mini BNC (mini BNC to BNC adapter cable is supplied)

STC-T1 1.544 Mbps balanced, RJ-45

*Note: Station clock port is available for the units with E1 or T1 TDM user ports only.*

### SUPPLIED ACCESSORIES

AC power cord

DC connection kit (with DC power supply only)

#### CBL-RJ45/2BNC/E1/X

Adapter cable (if unbalanced E1 interface is ordered)

#### CBL-MINIBNC-BNC

Mini BNC to 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

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