

# IPmux-16

## TDM Pseudowire Access Gateway



### TDM circuit emulation over packet-switched networks

- Robust TDM emulation over packet networks
- Single or dual 10/100BaseT or 100BaseFx uplink to the network, with redundancy at the Ethernet link and module levels
- E1, T1, E3, T3 or channelized T3 TDM ports
- Compact, 1.5U-high, 19-inch rack mountable enclosure, two TDM service slots, two PSN slots and two power supply slots

**TDM** IP  
Driven®

IPmux®-16 provides a compact, simple to configure, easily scalable solution for transporting TDM E1/T1, E3/T3 or channelized T3 (CT3) services over IP and Ethernet-based networks.

IPmux-16 can be located at a central site or POP, aggregating TDMoIP traffic from multiple sources.

The primary benefit of IPmux-16 is transparent E1/T1 and E3/T3/CT3 connectivity over Layer 2/3 packet networks, both in carrier and enterprise environments.

The data streams of up to sixteen E1/T1 or up to two E3/T3, or up to two CT3 ports are converted into packets for transmission over the network. The addressing scheme of these packets is IP-based. The packets are transmitted via the Ethernet modules to the network. A remote TDMoIP gateway converts the IP packets back to TDM traffic

IPmux-16 is a standard IP device, supporting ICMP (ping), ARP, next hop and default gateway capabilities.

**RAD**

data communications

The Access Company

# IPmux-16

## TDM Pseudowire Access Gateway

The operation complies with the IETF TDMoIP protocol, working in conjunction with RAD's Gmux-2000, IPmux-1E, IPmux-11, IPmux-14, IPmux-8 and Megaplex ML-IP.

### PERFORMANCE

Minimal end-to-end processing delay is achieved, using high-performance buffering and forwarding techniques.

IP packet size is configurable. Greater packet length results in greater processing delay, yet a smaller bandwidth overhead.

An enhanced buffering mechanism compensates for packet delay variation (jitter) of up to 42 msec.

### QoS SUPPORT

VLAN tagging and priority labeling are implemented according to 802.1p&Q.

VLAN-based user traffic is separated by attaching a dedicated VLAN tag to every TDMoIP circuit, and a dedicated VLAN for managing the device.

Type of Service (ToS) of the outgoing IP frames is user-configurable. This allows an en-route Layer 3 router or switch, which supports ToS (or Diffserv), to give higher priority to the TDMoIP traffic for delay-sensitive applications.

Assigned, IANA-registered UDP socket number for TDMoIP simplifies flow classification through switches and routers.

### OPERATION MODES

Two TDM service types are offered:

- Unframed: Full E1/T1 or E3/T3 circuits are transparently extended across the network, regardless of framing structure. Channelized T3 supports up to 28 unframed T1 streams.
- Framed: IPmux 16 can be configured on a per-timeslot basis for fractional E1/T1 services over the packet network. CAS is supported.

Multibundling (grouping timeslots originating from a specific E1 or T1 port) can be performed for up to 31 bundles per E1 port and 24 bundles per T1 port for transport over the network. Both mesh and star topologies are supported.

1:1 bundle redundancy is used to back up TDMoIP traffic in case of a bundle connection or TDM interface failure.

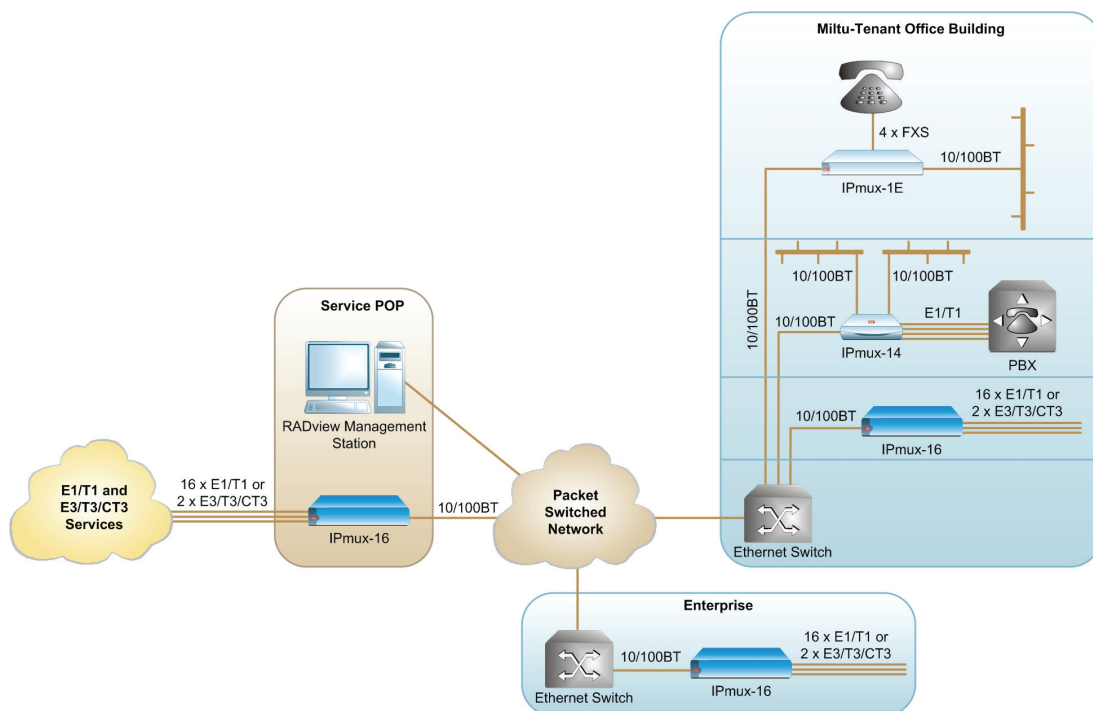


Figure 1. Extending E1/T1 or E3/T3-Based Services over a Packet Switched Network

## TIMING

IPmux 16 maintains synchronization between TDM devices by deploying advanced clock distribution mechanisms. The clocking options are:

- Internal: The IPmux 16 internal oscillator provides the master clock source for the TDM circuit.
- Loopback: The transmit clock is derived from the respective port's receive clock.
- Adaptive: The clock is recovered from the Ethernet network interface.
- External: An optional station clock port can be used to synchronize E1/T1 interfaces.

## ETHERNET MODULES

One or two 1- or 4-port Ethernet modules can be installed in the IPmux-16 chassis, providing links to the packet network.

Each module supports the following combinations of the 10/100BaseT or 100BaseFx ports:

- 1-port Ethernet module, one network port per module
- 4-port Ethernet module, four ports per module (one network and three user ports).

The 4-port Ethernet modules use hot-swappable fiber optic SFP transceivers (up to two fiber optic ports per module).

The Ethernet modules re order packets that arrive from the network to ensure an uninterrupted TDM service.

IPmux-16 units equipped with two Ethernet modules provide Ethernet network link redundancy.

4-port Ethernet modules support switching, rate limiting and VLAN stacking.

## E1 AND T1 MODULES

Each E1 or T1 module features either four or eight E1 or T1 interfaces for connecting IPmux 16 to any standard E1 or T1 device.

Integral LTU/CSU can be enabled for line protection and long haul applications.

Alarm detection and insertion are supported together with error statistics. SES/UAS statistics, LOS/AIS physical layer alarms and local/remote loopback tests are all supported. Standard E1/T1 alarms are transmitted end to-end.

## CHANNELIZED T3 MODULES

A channelized T3 (CT3) module converts T3 service signals into 28 unframed T1 streams, and each T1 stream into IP frames that are sent via a Fast Ethernet network.

## E3 AND T3 MODULES

Each E3 or T3 module features a single, standard E3 or T3 interface.

Alarm detection and insertion are supported together with error statistics. SES/UAS statistics, LOS/AIS physical layer alarms and local/remote loopback tests are supported. Standard E3 or T3 alarms are transmitted end-to-end.

## POWER SUPPLY

Modular hot-swappable power supplies of the chassis support carrier environments.

## DIAGNOSTICS & MANAGEMENT

IPmux 16 supports local and remote loopback tests. End-to-end alarm generation and end-to-end AIS indication are also provided. If a local E1/T1 port receives AIS, it is reported to the remote port via the Ethernet/IP network. If a local Ethernet port is disconnected, an AIS indication is generated both in the local and remote devices.

SES and UAS statistics are collected in 15-minute intervals and are stored for 24 hours (96 intervals). E1/T1 physical layer alarms (LOS, AIS, LOF, LCV) are also supported.

A dry contact alarm port allows the device to send/receive alarms by opening/closing the contact between the connector pins.

An internal built-in test (BIT) is performed after power-up. The results of the test are displayed at the local terminal.

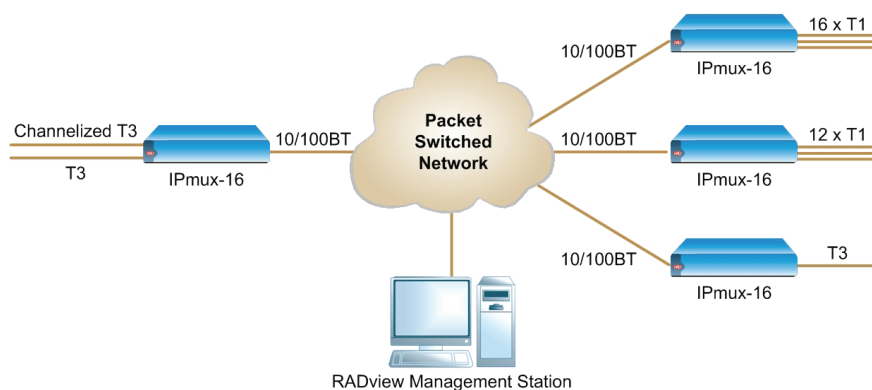


Figure 2. Extending T1 and T3 Circuits over IP/Ethernet

IPmux-16 monitors LAN and IP layer network condition statistics, such as packet loss and packet delay variation (jitter). The events are stored in log files and generate SNMP traps.

IPmux-16 can be configured and monitored:

- Locally, via an ASCII terminal
- Remotely, via Telnet or SNMP-based management software (RADview Service Center TDMoIP).

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 events 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.

Software can be downloaded locally, using XMODEM protocol, or remotely, using TFTP. After downloading a new version of software, IPmux-16 automatically saves

the previous version in non-volatile memory for backup purposes. Similarly, copies of the configuration file may be downloaded/uploaded to a remote workstation for backup and restore purposes.

## Specifications

### ETHERNET INTERFACE

#### Number of Ports

- 1-port Ethernet module: 1 per module (network)
- 4-port Ethernet module: 4 per module (1 network and 3 user ports)

#### Standards

IEEE 802.3, 802.3u, 802.1p&Q

#### Maximum Frame Size

1536 bytes

#### Data Rate

10 or 100 Mbps, full duplex

#### Number of Modules

Up to 2 per unit

#### Connector

RJ-45, 8-pin

#### Fiber Optic

1-port Ethernet modules:

- 1310 nm multimode laser: 2 km (1.2 mi)
- 1310 nm single mode laser: 15 km (9.3 mi)

4-port Ethernet modules:

- SFP-1: 1310 nm multimode LED, 2 km (1.2 miles)
- SFP-2: 1310 nm single mode laser, 15 km (9.3 miles)
- SFP-3: 1310 nm single mode laser, 40 km (24.8 miles)
- SFP-4: 1550 nm single mode laser, 80 km (49.7 miles)

**Note:** It is strongly recommended to order this device with **original RAD SFPs installed**. This will ensure that prior to shipping, RAD has performed comprehensive functional quality tests on the entire assembled unit, including the SFP devices. RAD cannot guarantee full compliance to product specifications for units using non-RAD SFPs. For detailed specifications of the SFP transceivers, see the SFP Transceivers data sheet.

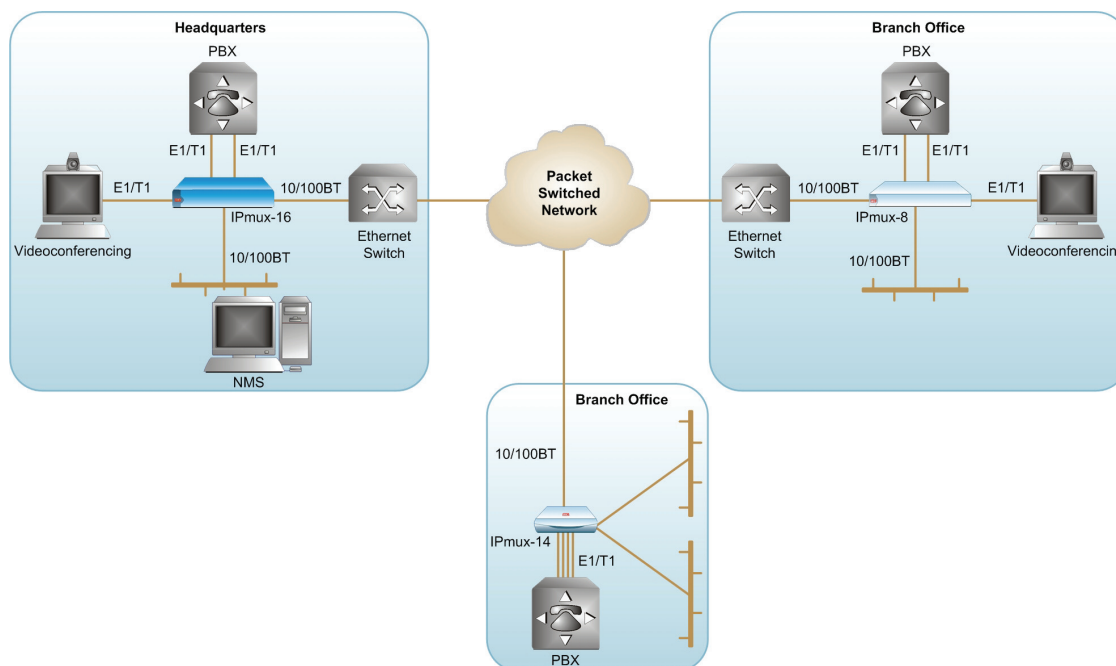


Figure 3. Enterprise Connectivity over Campus or Metro Area Networks

## IPmux-16

### TDM Pseudowire Access Gateway

#### ETHERNET MANAGEMENT INTERFACE

**Number of Ports**

1

**Standards**

IEEE 802.3, 802.34

**Data Rate**

10 Mbps full/half duplex

**Connector**

RJ-45, 8-pin

#### E1 INTERFACE

**Number of Ports**

4 or 8 ports per module, up to 2 modules per unit

**Standards**

ITU-T Rec. G.703, G.704, G.706, G.732, G.823

**Framing**

Unframed, CRC-4 MF, CAS MF

**Data Rate**

2.048 Mbps

**Line Code**

HDB3

**Receive Level**

0 to -32 dB with LTU

0 to -10 dB without LTU

**Transmit Level**

$\pm 3V \pm 10\%$ , balanced

$\pm 2.3V \pm 10\%$ , unbalanced

**Line Impedance**

120 $\Omega$ , balanced

75 $\Omega$ , unbalanced

**Jitter Performance**

Per ITU-T G.823

**Connector**

- RJ-45, 8-pin, balanced
- BNC, unbalanced (via adapter cable)

#### T1 INTERFACE

**Number of Ports**

4 or 8 ports per module, up to 2 modules per unit

**Standards**

AT&T TR-62411, ITU-T Rec. G.703/G.704, ANSI T1.403

**Data Rate**

1.544 Mbps

**Line Code**

AMI, B8ZS, B7ZS

**Framing**

Unframed, SF, ESF

**Receive Level**

0 to -30 dB

**Transmit Level**

$\pm 2.7V \pm 10\%$  at 0 to 655 ft with DSU

0 dB, -7.5 dB, -15 dB, -22.5 dB with CSU

**Line Impedance**

100 $\Omega$ , balanced

**Jitter Performance**

Per AT&T TR-62411

**Connector**

RJ-45, 8-pin

#### E3 INTERFACE

**Number of Ports**

1 per module, up to 2 modules per unit

**Data Rate**

34.368 Mbps

**Line Code**

HDB3

**Line Impedance**

75 $\Omega$ , unbalanced

**Standards**

Receive and transmit signal levels according to G.703

**Framing**

Unframed

**Jitter Performance**

Per G.823

**Connector**

BNC

#### T3 INTERFACE

**Number of Ports**

1 per module, up to 2 modules per unit

**Data Rate**

44.736 Mbps

**Line Code**

B3ZS

**Line Impedance**

75 $\Omega$ , unbalanced

**Standards**

Receive and transmit signal levels according to ANSI T1.102 and Bellcore TR-NWT-000499

**Framing**

Unframed

**Jitter Performance**

Per Bellcore TR-NWT-000499

**Connector**

BNC

#### CHANNELIZED T3 INTERFACE

**Number of Ports**

1 per module, up to 2 modules per unit

**Standards**

- Telcordia GR-253, GR-499
- ANSI T1.102, T1.404
- ITU-T G.703, G.755, G.824, G.151
- AT&T TR54014

**Data Rate**

44.736 Mbps

**Line Code**

AMI, B3ZS

**Line Impedance**

75 $\Omega$ , unbalanced

**Connector**

BNC

#### TERMINAL CONTROL INTERFACE

**Type**

RS-232/V.24 (DTE)

*Note: Cross-cable for terminal connection is supplied.*

**Data Rate**

9.6, 19.2, 38.4, 57.6, or 115.2 kbps,

**Connector**

9-pin, D-type, male

# IPmux-16

## TDM Pseudowire Access Gateway

### GENERAL

#### Chassis

Carrier-class, NEBS-compliant

#### Power

PSUs: Up to 2 redundant hot-swappable AC/AC, DC/DC or AC/DC power supplies

AC: 100 to 240 VAC, 50/60 Hz

DC: -40 to -72 VDC (-48 VDC nominal)

#### Power Consumption

75W max

#### Physical

Height: 760 mm (3.0 in)

Width: 432 mm (17 in)

Depth: 343 mm (13.5 in)

Weight: 5.9 kg (13 lb)

(depending on interface module combinations)

#### Environment

Operating temperature: 0 to 50°C (32 to 122°F)

Storage temperature: -20 to 70°C (32 to 110°F)

Humidity: Up to 90%, non-condensing

### Ordering

#### IPmux-16/#/€/\*

##### Legend

# Optional station clock port type:

**E1** 2.048 Mbps clock port

**T1** 1.544 Mbps clock port

€ Power supply type:

**AC** 100 to 240 VAC

**DC** -48 VDC

**AC/48** 100 to 240 VAC with

redundant -48 VDC

\* Power supply redundancy:

**R** Redundant identical power

supply

### INTERFACE MODULES

*Note: At least one TDM module (E1, T1, E3, T3 or CT3) and one Ethernet module must be ordered per IPmux-16 chassis.*

#### IPMUX-M/^/%

TDM module

##### Legend

^ TDM interface type:

**E1** Balanced E1 interface

**T1** Balanced T1 interface

**E1CX** Unbalanced E1 interface via adapter cable

**E3** E3 interface

**T3** T3 interface

**CT3** Channelized T3 interface

% Number of ports on E1 or T1 module

**4** Four ports

**8** Eight ports

#### IPMUX-M/ETH/~

1-port Ethernet module

##### Legend

~ Ethernet network port type:

**UTP** 10/100BaseT

**MM-LC** 100BaseFx interface, multimode fiber

**SM-LC** 100BaseFx interface, single mode fiber

#### IPMUX-M/4ETH/UTP

4-port Ethernet module with 4 copper ports

#### IPMUX-M/4ETH/@/3UTP

4-port Ethernet module with 1 SFP network fiber optic and 3 copper ports

#### IPMUX-M/4ETH/@/@/2UTP

4-port Ethernet module with 2 SFP fiber optic and 2 copper ports

@ SFP transceiver type:

**SFP-1** SFP-1 transceiver

**SFP-2** SFP-2 transceiver

**SFP-3** SFP-3 transceiver

**SFP-4** SFP-4 transceiver

**NULL** Empty SFP slot

### SUPPLIED ACCESSORIES

AC power cord for each ordered AC power supply

DC connection kit for each ordered DC power supply

#### CBL-RJ45/2BNC

RJ-45 to BNC adapter cable (if an unbalanced E1 interface is ordered)

#### CBL-DB9/DB9/NULL

Control port cross-cable

#### RM-27

Hardware kit for mounting one IPmux-16 unit into a 19" rack

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