

# IPmux-24

## TDM Pseudowire Access Gateway



- Comprehensive support for pseudowire/circuit emulation standards including TDMoIP, CESoPSN, SAToP, CESoETH and HDLCoPSN
- Industry-leading adaptive clock recovery mechanism suitable for cellular backhaul over packet-based networks
- Carrier-class/environmentally hardened device
- Extensive OAM and performance monitoring capabilities
- Three auto-detecting Gigabit or Fast Ethernet SFP- or UTP-based ports, and one, two or four TDM service ports

IPmux-24 provides legacy services over packet networks. The device converts the data stream from its user E1/T1 ports into packets for transmission over the network. These packets are transmitted via the IPmux-24 Ethernet network port to the PSN. A remote pseudowire device converts the packets back to their original format.

### TDM PSEUDOWIRE

#### Pseudowire Functionality

The ASIC-based architecture provides a robust and high performance pseudowire solution with minimal processing delay. The unit employs various pseudowire encapsulation methods, including TDMoIP, CESoPSN, SAToP, CESoETH (MEF 8) and HDLCoPSN.

Proper balance between PSN throughput and delay is achieved via configurable packet size.

A jitter buffer compensates for packet delay variation (jitter) of up to 180 msec in the network.

#### Pseudowire Traffic Protection

Pseudowire traffic can be backed up at the pseudowire connection level. This allows setting a different path for the primary and secondary PW bundles. Both bundles can be routed to the same or different destinations and operate in the

1+1 and 1:1 modes.

In 1:1 redundancy with two remote devices the PW bundles in the remote units operate in "mate" mode. In this mode each device monitors traffic on a mate bundle and transfers data only when the other bundle is inactive.

#### OAM

The unit uses the end-to-end Ethernet OAM protocol for proactive connectivity monitoring, fault verification, and fault isolation, according to the IEEE 802.1ag and ITU-T Y.1731 requirements.

In addition, RAD's TDM PW OAM mechanism verifies connectivity, measures round trip delay and prevents pseudowire configuration mismatch.

#### BRIDGE

IPmux-24 features an internal bridge, operating in VLAN-aware and VLAN-unaware modes.

VLAN stacking is used for traffic separation between different users or services, by defining a service provider VLAN ID per customer or service. When VLAN stacking is used, a service provider VLAN tag is added to the user traffic and removed from network traffic. Both service provider VLAN ID and service provider VLAN priority can be defined.

### QUALITY OF SERVICE

IPmux-24 provides four priority queues for each port or pseudowire traffic flow. User traffic can be prioritized according to VLAN priority, DSCP, IP Precedence or per port.

Outgoing pseudowire packets are prioritized over Ethernet network by being assigned a dedicated VLAN ID (802.1q) and marked for priority using 802.1p bits. Over IP networks, the outgoing pseudowire packets are marked for priority using DSCP, ToS, or Diffserv bits and over MPLS networks, EXP bits are assigned to a specific MPLS tunnel.

### TIMING AND SYNCHRONIZATION

#### Simple Network Timing Protocol

IPmux-24 employs Simple Network Time Protocol (SNTP) for propagating and receiving time information on a network, according to SNTPv4 (RFC 4330) requirements. SNTP is used to configure data and time by learning the information from a single or multiple SNTP servers. The clock can be configured to a local time by defining UTC and DST offsets.



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## TDM Pseudowire Access Gateway

### Pseudowire Timing

End-to-end synchronization between circuits is maintained by deploying advanced clock recovery mechanisms.

Clock recovery conforms to G.823 and G.824 traffic interface using G.8261-defined scenarios.

Advanced clock recovery conforms to G.823 synchronization interface using G.8261-defined scenarios and achieves 16 ppb clock accuracy.

The system clock ensures a single clock source for all TDM links. The system clock uses master and fallback timing sources for clock redundancy. IPmux-24 also provides system clock input and output via an optional external clock port.

### MANAGEMENT AND SECURITY

IPmux-24 can be configured and monitored locally via an ASCII terminal, or remotely via Telnet/SSH, Web browser or RADview.

Management traffic can run over a dedicated VLAN.

The RADview Service Center and Element Manager packages control and monitor 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. IPmux-24 performs RADIUS client authentication. Using SSH and SSL encryption protocols allows secure communication over potentially insecure IP-based networks.

The Syslog protocol is used by IPmux-24 to generate and transport event notification messages over IP networks to the central Syslog server. The Syslog operation is compliant with the RFC 3164 requirements.

SNMPv3 support introduces a user-based security model, enhances authentication and encryption techniques, and ensures management traffic security.

### RESILIENCY

#### Ethernet Ring Topologies

A G.8032 Layer-2 Ethernet ring is used by IPmux-24 for traffic protection. This technology builds a logical ring, defined as a set of IEEE 802.1-compliant bridges, and protects against link and node failures. To achieve this, every node in the ring has two bridge ports connected to adjacent nodes.

The ring itself is constructed independently of the transport technology used at the server layer.

In addition, the unit employs Resilient Ethernet Ring technology to construct a self-healing Ethernet fiber ring topology (ring resiliency is similar to that of SDH/SONET networks). In case of link failure on any segment of the ring, the pseudowire traffic is rerouted within 50 ms. A single ring supports up to 16 nodes.

#### Ethernet Link Protection

The unit performs link aggregation (LAG) based on 802.3ad requirements.

Dual homing technology (1:1) allows IPmux-24 to be connected to two different upstream devices.

### MONITORING AND DIAGNOSTICS

Fault propagation initiates service port alarms, e.g. E1/T1 LOS, to reflect network fault conditions. Alarms detected at service ports are propagated to the remote pseudowire device via the packet network.

Diagnostic loopbacks can be activated inband.

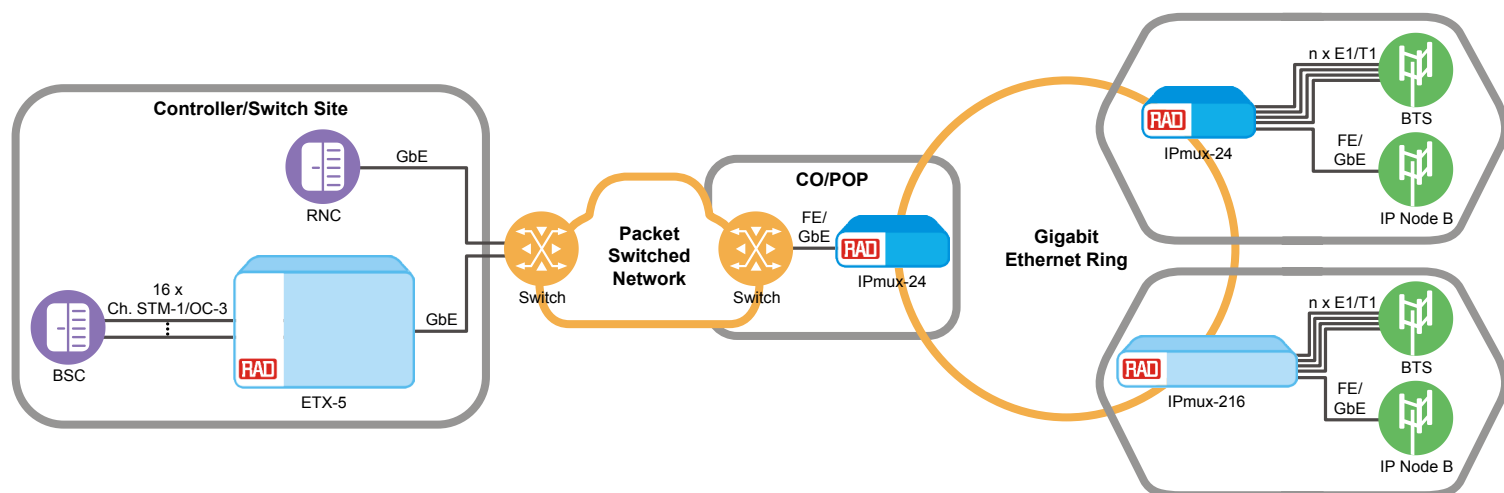


Figure 1. Delivering Ethernet and TDM Services over Fiber Ring in the First Mile

Ethernet and IP-layer network condition statistics, such as packet sequence errors (loss or misorder) and packet delay variation (jitter), are monitored and stored by the device.

The carrier-class version of IPmux-24 includes an alarm relay mechanism. The minor and major alarms are forwarded to a remote alarm device via dedicated pins of the external clock RJ-45 connector.

## Specifications

### E1 INTERFACE

**Number of Ports**

1, 2 or 4

**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**

120 $\Omega$ , balanced

75 $\Omega$ , unbalanced

**Signal Levels**

Receive:

0 to -36 dB with LTU (long haul)

0 to -10 dB without LTU (short haul)

Transmit balanced:  $\pm 3V \pm 10\%$

Transmit unbalanced:  $\pm 2.37V \pm 10\%$

**Jitter and Wander Performance**

Per AT&T TR-62411, ITU-T G.824 (for internal, loopback and external clock modes)

**Connector**

Balanced: RJ-45

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

### T1 INTERFACE

**Number of Ports**

1, 2 or 4

**Compliance**

ANSI T1.403, ITU-T Rec. G.703, G.704, G.824

**Data Rate**

1.544 Mbps

**Line Code**

B8ZS, B7ZS, AMI

**Framing**

Unframed, SF, ESF

**Signaling**

CAS (bit robbing), CCS (transparent)

**Line Impedance**

100 $\Omega$ , balanced

**Signal Levels**

Receive: 0 to -36 dB

Transmit pulse amplitude:

$\pm 3V \pm 20\%$ ; 0 dB, -7.5 dB, 15 dB (CSU), user-selectable

$\pm 2.7V \pm 10\%$ , 0 to 655 feet, (DSU), user-selectable

**Jitter and Wander Performance**

Per AT&T TR-62411, ITU-T G.824 (for internal, loopback and external clock modes)

**Connector**

RJ-45

# IPmux-24

## TDM Pseudowire Access Gateway

### ETHERNET INTERFACE

#### Compliance

IEEE 802.3, 802.3u, 802.1p&Q

#### Number of Ports

3, network or user

#### Port Combinations

3 fiber optic SFPs

2 fiber optic SFPs + 1 UTP

1 fiber optic SFP + 2 UTPs

#### 3 UTPs (Fast Ethernet unit only)

#### Type

SFP-based:

Gigabit Ethernet – 1000BaseSx,  
1000BaseLX10, 1000BaseBx10  
(metal enclosure only)

Fast Ethernet – 100BaseFx,  
100BaseLX10, 100BaseBx10

10/100/1000BaseT with SGMII

Built-in copper:

10/100BaseT

#### Fast and Gigabit Ethernet SPFs

For full details, see the SFP Transceivers data sheet at [www.rad.com](http://www.rad.com)

*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.*

#### Connector

LC

### PSEUDOWIRE

#### Compliance

IETF: RFC 4553 (SATOIP), RFC 5087  
(TDMoIP), RFC 5086 (CESoPSN),  
RFC 4618 (excluding clause 5.3 – PPP)

ITU-T: Y.1413

MFA: IA 4.1, IA 8.0.0

MEF: 8, 9, 14 (EPL-certified)

#### Number of PW Connections

64

#### Jitter Buffer Size

0.5–180 msec (unframed) with 0.1 msec granularity

2.5–180 msec (framed) with 0.5 msec granularity

#### IPmux-24/A Adaptive Clock

(Metal enclosure only)

Frequency accuracy:  $\pm 16$  ppb and G.823 synchronization interface requirements (clause 6), when locked to a PRC (stratum 1) or SSU (stratum 2) clock  
Frequency accuracy in holdover:  $\pm 16$  ppb  $\pm 1$  ppb of aging per day

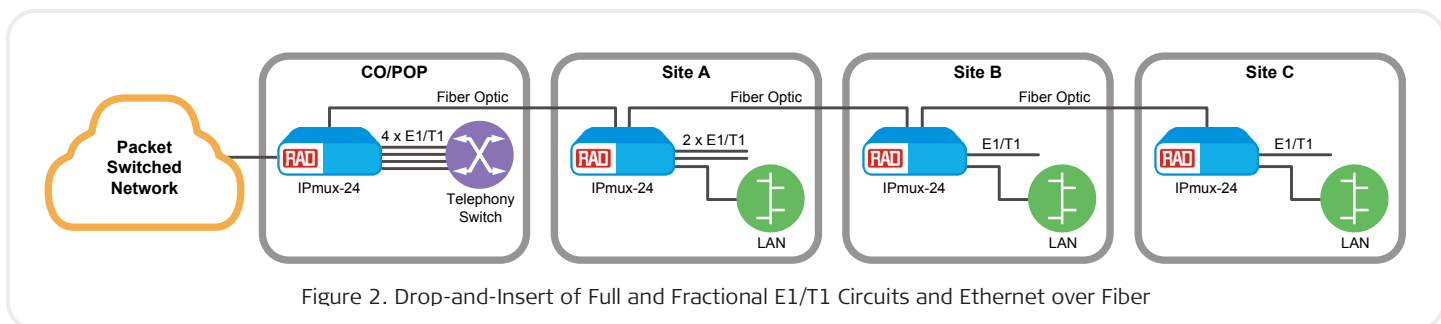


Figure 2. Drop-and-Insert of Full and Fractional E1/T1 Circuits and Ethernet over Fiber

## GENERAL

### Timing

Internal

Loopback

Adaptive

External input or output via optional dedicated RJ-45 port: E1/T1 or 2048/1544 kHz squarewave (RS-422 electrical levels)

### Management

SNMPv1, SNMPv3

Telnet

RADview Service Center TDMoIP (ordered separately)

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

### Diagnostics

E1/T1 local loopback

E1/T1 remote loopback

Facility Type 1 (FAC1) inband loopback

CSU loopback as per Telecordia GR-54

### Statistics

E1/T1 (per G.826 and RFC 2495)

Ethernet (per RFC 2819)

Jitter buffer indication (overflow, underflow, sequence error)

### Alarm Relay

*(Metal enclosure only)*

Via pin 6, pin 7 and pin 8 of the EXT. CLK connector (RJ-45), optional

### Indicators

PWR (green) - Power status

TST/ALM (red/yellow) - Test/alarm status

E1/T1 SYNC (green/red) - E1/T1 synchronization status

LINK/ACT (green) - Ethernet link/activity status

EXT. CLK (red/green) - External clock status

### Physical

Plastic enclosure:

Height: 43.7 mm (1.7 in)

Width: 217 mm (8.5 in)

Depth: 170 mm (6.7 in)

Weight: 0.5 kg (1.1 lb)

Metal enclosure:

Height: 47 mm (1.8 in)

Width: 215 mm (8.4 in)

Depth: 147 mm (5.8 in)

Weight: 0.7 kg (1.5 lb)

### Power

Plastic Enclosure:

AC: 100–240 VAC, 50/60 Hz

Metal Enclosure:

AC/DC: 100–240 VAC, 50/60 Hz or 48/60 VDC nominal (40 to 72 VDC)

DC: 24/48/60 VDC nominal (18 to 72 VDC)

### Power Consumption

12W max

### Environment

Temperature:

Plastic enclosure:

IPmux-24: 0 to 45°C (32 to 113°F)

Metal enclosure:

IPmux-24: 0 to 50°C (32 to 122°F)

IPmux-24/H: -30 to 65°C

(-22 to 149°F)

Humidity: Up to 90%, non-condensing

## IPmux-24

### TDM Pseudowire Access Gateway

## Ordering

#### RECOMMENDED CONFIGURATIONS

##### IPMUX-24/1E1/N/N/N

TDM pseudowire access gateway, 1 E1 port, 3 empty SFP GbE ports

##### IPMUX-24/1E1CX/N/N/N

TDM pseudowire access gateway, 1 unbalanced E1 port, 3 empty SFP GbE ports

##### IPMUX-24/1T1/N/N/UTP

TDM pseudowire access gateway, 1 T1 ports, 2 empty SFP GbE ports and 1 RJ45 FE port

##### IPMUX-24/4T1/N/N/UTP

TDM pseudowire access gateway, 4T1 ports, 2 empty SFP GbE ports and 1 RJ45 FE port

##### IPMUX-24/FE/1E1CX/UTP/UTP/UTP

TDM pseudowire access gateway, 1 unbalanced E1 port, 3 RJ45 FE ports

##### IPMUX-24/FE/2E1/UTP/UTP/UTP

TDM pseudowire access gateway, 2 E1 ports, 3 RJ45 FE ports

##### IPMUX-24/FE/2T1/UTP/UTP/UTP

TDM pseudowire access gateway, 2 T1 ports, 3 RJ45 FE ports

##### IPMUX-24/FE/4E1/UTP/UTP/UTP

TDM pseudowire access gateway, 4 E1 ports, 3 RJ45 FE ports

##### IPMUX-24/FE/4T1/UTP/UTP/UTP/PE

TDM pseudowire access gateway, 4 T1 ports, 3 RJ45 FE ports, plastic enclosure

##### IPMUX-24/FE/A/4T1/N/N/UTP

TDM pseudowire access gateway, advanced clock recovery, 4 T1 ports, 2 empty SFP FE ports , RJ45 FE port

##### IPMUX-24/FE/4T1/N/N/N/PE

TDM pseudowire access gateway, 4 T1 ports, 3 empty SFP FE ports, plastic

enclosure

#### SPECIAL CONFIGURATIONS

Please contact your local RAD partner for additional configuration options

#### SUPPLIED ACCESSORIES

AC power cord (when AC power supply is ordered)

DC connection kit (when DC power supply is ordered)

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

Adapter cable (if unbalanced E1 interface is ordered)

#### OPTIONAL ACCESSORIES

##### RM-35/@

Hardware kit for mounting one or two IPmux-24 units with metal enclosure into a 19-inch rack

##### RM-33-2

Hardware kit for mounting one or two IPmux-24 units with plastic enclosure in a 19-inch rack

##### CBL-DB9F-DB9M-STR

Control port cable

Table 1. GbE Interface Options

Network	Network/User	User
N	N	N
N	N	UTP
N	UTP	UTP
UTP	UTP	UTP
UTP	UTP	N
UTP	N	N

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