

# IPmux-16L

## Hub-Site Pseudowire Access Gateway



Legacy over PSN  
solution for  
transmitting E1  
streams over packet  
switched networks

**TDMIP**  
Driven®

- Comprehensive compliance with pseudowire/circuit emulation standards including TDMoIP, CESoPSN, SAToP and HDLCoPSN
- Built on TDMoIP technology, implementing IETF, MFA Forum, ITU-T for Pseudowire Emulation Edge-to-Edge (PWE3)
- E1 emulation over MPLS, IP and Ethernet networks
- Framed (full or fractional) and unframed E1 traffic
- Three Gigabit, three Fast Ethernet and 8/16 TDM service ports

IPmux®-16L is a TDM pseudowire access gateway, extending TDM-based services over packet switched networks. It also serves as an Ethernet-based access device.

### PSEUDOWIRE PERFORMANCE

The unit provides a legacy over PSN solution by transmitting E1 streams over packet switched networks (PSNs). The device converts the data stream from its user E1 ports into packets for transmission over the network. The addressing scheme of these packets is IP, MPLS or MEF-8.

These packets are transmitted via the IPmux-16L Ethernet network port to the PSN. A remote pseudowire device converts the packets back to TDM traffic.

**RAD**

data communications  
The Access Company

# IPmux-16L

## Hub-Site Pseudowire Access Gateway

Preserves investment in legacy equipment when migrating to PSN

The hardware-based processing provides a robust and high performance pseudowire solution with minimal latency

The unit supports various legacy over packet transport types, including TDMoIP, CEsPSN, SAToP and HDLCoPSN.

High-performance hardware-powered buffering and forwarding techniques achieve minimal end-to-end processing delay. Configurable packet size balances PSN throughput and delay while a jitter buffer compensates for packet delay variation (jitter) of up to 200 msec in the network.

An assigned IANA-registered UDP port number for pseudowire simplifies flow classification through switches and routers.

### PSEUDOWIRE TIMING

Synchronization between TDM devices is maintained by deploying advanced clock distribution mechanisms. The clocking options are:

- Internal – The IPmux-16L internal clock oscillator provides the master clock source for the TDM circuit
- Loopback – The transmit clock is derived from the TDM port receive clock
- Adaptive – The clock is recovered from the PSN.

The system clock ensures a single clock source for all TDM links and uses master and fallback timing sources for clock redundancy. The system also supports different clock sources from different TDM links at the same time.

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.

### QoS

IPmux-16L performs VLAN tagging and priority labeling according to 802.1p&Q. Pseudowire packets could be assigned a dedicated VLAN ID and 802.1p bit.

The ToS or Diffserv of the outgoing pseudowire packets are user-configurable. This allows assigning pseudowire packets a higher priority in IP networks.

EXP bits are used for QoS marking of the TDMoMPLS traffic in MPLS networks.

### TDM INTERFACE

8 or 16 E1 ports provide connectivity to any standard E1 device.

E1 interfaces feature:

- Integral LTU for long haul applications
- G.703 unframed and G.704 framed modes
- CAS and CRC-4 bit generation (E1).

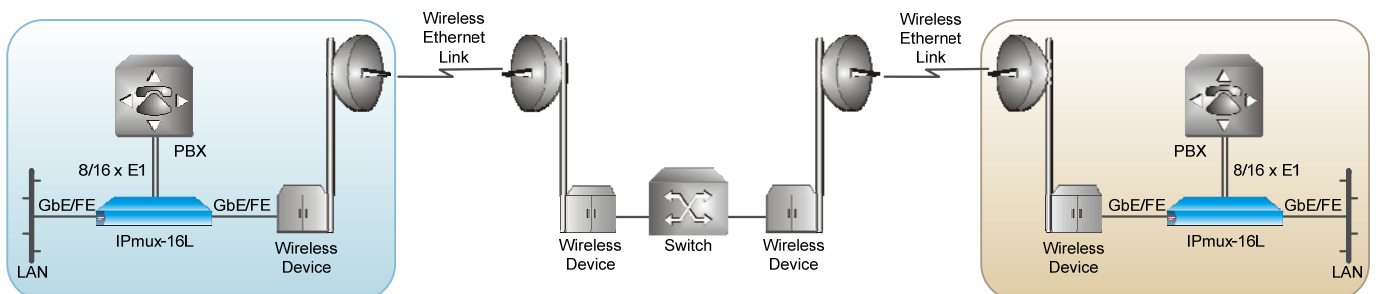


Figure 1. LAN and TDM Services over Wireless Link

## ETHERNET INTERFACE

IPmux-16L includes the following Ethernet ports:

- Three Gigabit Ethernet ports (SFP or UTP)
- Three Fast Ethernet ports (SFP or UTP).

All ports can be used for network or user connection. They support autonegotiation, VLAN tagging and rate limiting.

## ETHERNET CAPABILITIES

IPmux-16L features an internal bridge, operating in VLAN-aware and VLAN-unaware modes, supporting up to 4k VLANs.

Each Ethernet port features:

- Rate limiting for bandwidth control
- Four priority queues (strict or weighted) for handling traffic with different service demands. Traffic is classified according to IP Precedence, 802.1p, DSCP or port default priority.
- VLAN membership for ingress traffic restriction
- VLAN tagging
- Double VLAN tagging (VLAN stacking)
- Bridging and filtering.

The device supports standard IP features, such as ICMP (ping), ARP, next hop and default gateway.

Ingress and egress rate can be limited per user and network port. Rate limitation can be configured per packet type as well.

## ETHERNET RING

The unit employs an automatic protection switching protocol (G.8032) to construct a self-healing Ethernet fiber ring topology. In case of link failure on any segment of the ring, the Ethernet traffic is rerouted within 50 ms.

## MANAGEMENT

IPmux-16L can be configured and monitored locally via an ASCII terminal, or remotely via Telnet or Web browser.

Management traffic can run over a dedicated VLAN.

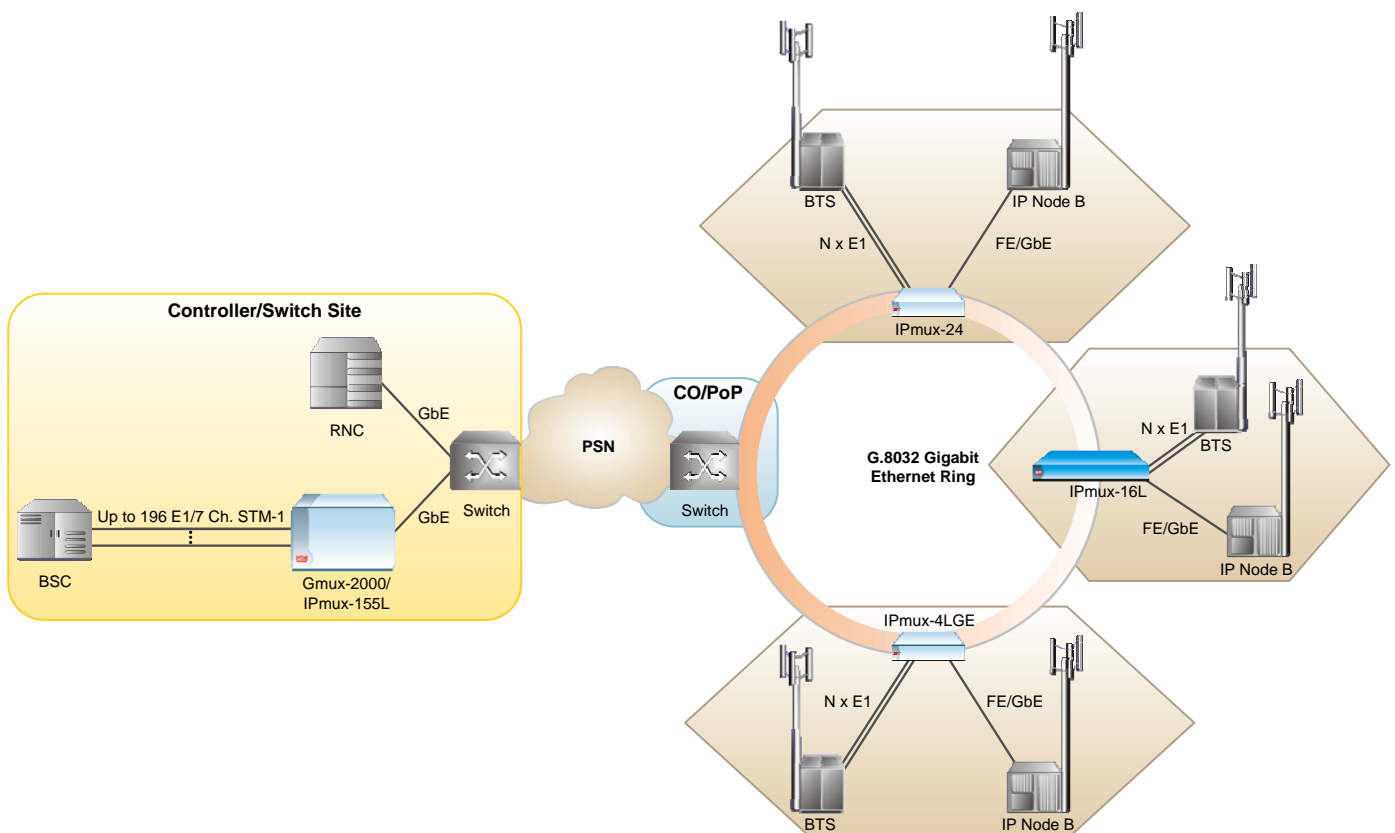


Figure 2. 2G/3G Mobile Backhaul over a Protected Fiber Ring

# IPmux-16L

## Hub-Site Pseudowire Access Gateway

Lowers Opex of TDM service by utilizing packet infrastructure

Software can be downloaded via a local terminal using XMODEM/YMODEM, or remotely, using TFTP. After downloading a new software version, IPmux-16L automatically saves the previous version in non-volatile memory for backup purposes. Also, copies of the configuration file may be downloaded and uploaded to a remote workstation for backup and restore purposes.

### DIAGNOSTICS

External and internal loopbacks check TDM link connectivity.

A built-in internal and external BERT utility is used to monitor the TDM link quality.

The following E1 physical layer performance statistics are available: LOS, LOF, LCV, RAI, AIS, FEBE, BES, DM, ES, SES, UAS and LOMF.

LAN and IP layer network condition statistics, such as packet loss and packet delay variation (jitter), are monitored and stored by the device.

Fault isolation, statistics and event logging are also available.

RAD's TDM PW OAM verifies connectivity and prevents pseudowire configuration mismatch.

## Specifications

### E1 INTERFACE

#### Number of Ports

8 or 16

#### Compliance

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

#### Data Rate

2.048 Mbps

#### Line Code

HDB3, AMI

#### Framing

Unframed, framed, multiframe; with or without CRC-4

#### Signaling

CAS, CCS (transparent)

#### Line Impedance

120Ω, balanced

#### Signal Levels

Receive:

0 to -36 dB with LTU (long haul)

0 to -10 dB without LTU (short haul)

Transmit balanced: ±3V ±10%

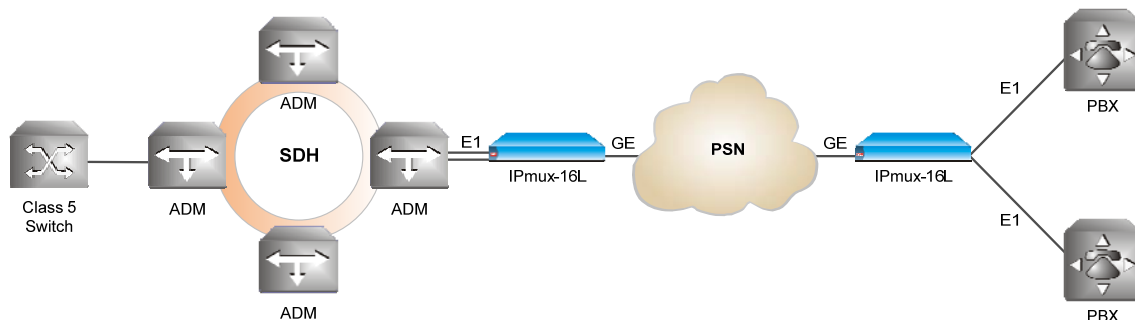


Figure 2. TDM Backhaul and Trunking over a PSN

**Jitter and Wander Performance**

Per ITU-T G.823

**Connector**

RJ-45, balanced

**ETHERNET INTERFACE****Number of Ports**

6 (network or user)

**Port Combination**

3 GbE (SFP or UTP) + 3 FE (SFP or UTP)

**Type**

Electrical: 10/100/1000BaseT

Fiber optic (SFP-based): 1000Base-SX, 1000Base-LX, 1000Base-Bx, 100Base-FX

**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 at [www.rad.com](http://www.rad.com).

**MAC Table Size**

8K

**Frame Size**

Up to 1632 bytes

**PSEUDOWIRE CONNECTIONS****Compliance**

IETF: RFC 4553 (SAToP), RFC 5087 (TDMoIP) and RFC 5086 (CESoPSN)

ITU-T: Y.1413

MFA: IA 4.1, IA 8.0.0

**Number of PW Connections**

256 (up to 16 PWs per E1)

**Jitter Buffer Size**

0.5–200 msec with 0.1 msec granularity (SAToP)

1.5–200 msec with 0.5 msec granularity (TDMoIP, CESoPSN)

**Adaptive Clock**

Frequency accuracy:  $\pm 16$  ppb or  $\pm 100$  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

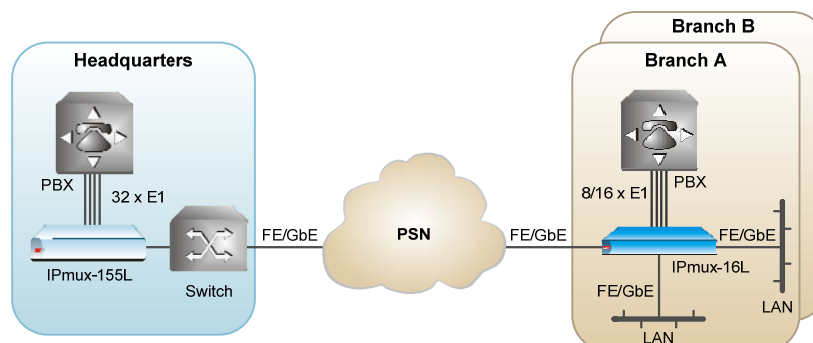


Figure 4. Corporate Multisite Communication over a PSN

Carrier-grade voice  
quality without  
compression, or  
silence suppression

### GENERAL

#### E1 Timing

Internal  
System  
Loopback  
Adaptive

#### System Timing

E1 loopback/ACR  
E1 adaptive clock recovery  
Internal

#### Adaptive Clock Characteristics

According to G.823 traffic interface

#### Management

SNMPv1v2c  
Telnet  
ASCII terminal via V.24 (RS-232) DCE port  
Web browser

#### Diagnostics

Loopbacks: E1 port local/remote  
BERT: E1 port internal/external  
VCT: Ethernet Virtual Cable Test

#### Statistics

E1 (per G.826 and RFC 2495)  
Ethernet (per RFC 2819)  
Jitter buffer indication (overflow,  
underflow, sequence error, max/min jitter  
buffer levels)

#### Alarm Relay

Via dedicated DB-9 female connector

#### Indicators

PWR (green) – Power status  
TST (yellow) – Test status  
ALM (red) – Alarm status  
LOC/REM (red/red) – E1 local/remote  
sync loss  
LINK/ACT (green/yellow) – Ethernet  
link/activity status on RJ-45 or SFP

#### Power

AC: 100–240 VAC  
DC: -48 VDC (-40 to -60 VDC)

#### Power Consumption

21W max







#### Physical

Height: 43 mm (1.7 in)  
Width: 440 mm (17.5 in)  
Depth: 240 mm (9.4 in)  
Weight: 3.6 kg (7.9 lb)

#### Environment

Temperature: 0° to 50°C (32° to 122°F)  
Humidity: Up to 90%, non-condensing

Table 1. IPmux Family Product Comparison

Feature	IPmux-2L (Ver. 2.0)	IPmux-4L (Ver. 1.0)	IPmux-4LGE (Ver. 2.0)	IPmux-16L (Ver. 1.0)	IPmux-24 (Ver. 3.5)	IPmux-216 (Ver. 3.5)
						
TDM service ports	1, 2 × E1	2, 4 × E1	4 × E1	8, 16 × E1	1, 2, 4 × E1/T1	8, 16 × E1/T1
Ethernet network ports	1 × FE	1 × FE	1 × GbE network, 2 × GbE network/user	3 × GbE network/user 3 × FE network/user	1 × GbE/FE network, 1 × GbE/FE network/user	1 × GbE/FE network 1 × GbE/FE network/user
Ethernet subscriber ports	2 × FE	2 × FE	4 × FE		1 × GbE/FE	1 × GbE/FE
Number of PWs	63	64	64	256	64	256
Multi-pseudowire	✓	✓	✓	✓	✓	✓
Advanced clock recovery	-	✓	✓	✓	✓	✓
Redundant power supply	-	-	-	-	-	✓
External clock port	-	-	-	-	Optional	✓
Serial data port	Optional	-	-	-	-	-
SSH, SSL, RADIUS	-	-	-	-	✓	✓
Network management system	RV-EMS	RV-EMS	RV-EMS	RV-EMS	RV-SC/TDMoIP, RV-EMS (basic shelf view)	RV-SC/TDMoIP, RV-EMS (basic shelf view)

## IPmux-16L

## Hub-Site Pseudowire Access Gateway

## Ordering

## STANDARD CONFIGURATIONS

IPMUX-16L/AC/16E1/3XGESFP/3FEUTP

IPMUX-16L/AC/16E1/3XGEUTP/3FEUTP

IPMUX-16L/AC/8E1/3XGESFP/3FEUTP

IPMUX-16L/AC/8E1/3XGEUTP/3FEUTP

## SPECIAL CONFIGURATIONS

IPMUX-16L/!/~/\$/+1/+2

! Power supply:

AC 100 to 240 VAC

48 -48 VDC

~ Timing (Default=Standard clock recovery):

A Hardware support for accurate clock recovery over packet

\$ TDM interface:

8E1 8 balanced E1 interfaces

16E1 16 balanced E1 interfaces

+1 Ethernet network/user port:

3XGESFP 3 GbE SFP ports

3XGEUTP 3 GbE UTP ports

+2 Ethernet network/user port:

3XFESFP 3 Fast Ethernet SFP ports

3XFEUTP 3 10/100BaseT UTP ports

**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, refer to the SFP Transceivers data sheet.

## SUPPLIED ACCESSORIES

Power cord

DC power connection kit

## RM-34

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

## OPTIONAL ACCESSORIES

## CBL-DB9F-DB9M-STR

Control cable

## International Headquarters

24 Raoul Wallenberg Street  
Tel Aviv 69719, Israel  
Tel. 972-3-6458181  
Fax 972-3-6498250, 6474436  
E-mail market@rad.com

## North America Headquarters

900 Corporate Drive  
Mahwah, NJ 07430, USA  
Tel. 201-5291100  
Toll free 1-800-4447234  
Fax 201-5295777  
E-mail market@rad.com

www.rad.com

Order this publication by Catalog No. 803957



data communications

The Access Company