

IPmux-4LGE

TDM Pseudowire Gateway



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

TDM-IP
Driven®

- Comprehensive support for 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

IPmux-4LGE is a TDM pseudowire access gateway extending TDM-based services over packet switched networks.

PSEUDOWIRE PERFORMANCE

The units provide a legacy over PSN solution for 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 or MPLS.

These packets are transmitted via the IPmux-4LGE Ethernet network ports to the PSN. A remote pseudowire devices convert the packets back to TDM traffic.

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



IPmux-4LGE (GbE)

TDM Pseudowire Gateway

Preserves investment in legacy equipment in migration to PSN

High-performance ASIC-based 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.

CLOCKING

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

- Internal – The IPmux-4LGE internal clock oscillator provides the master clock source for the TDM circuit
- Loopback – The transmit clock is derived from the TDM or serial data port receive clock
- Adaptive – The clock is recovered from the PSN
- System – An external clock source synchronizes the device via one of its E1 ports to input or output a 2.048 Mbps clock reference.

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 multiple clock sources from different TDM links at the same time.

PSEUDOWIRE QoS

IPmux-4LGE supports VLAN tagging and priority labeling according to 802.1p&q. Pseudowire packets are 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.

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.

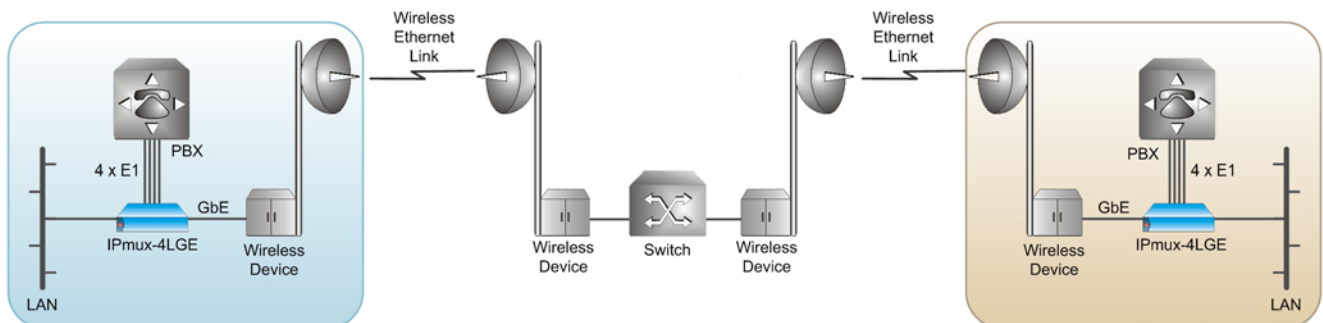


Figure 1. LAN and TDM Services over a Wireless Ethernet Link

TDM INTERFACE

Four 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).

ETHERNET INTERFACE

IPmux-4LGE is available with the following Ethernet port combinations:

- Fast Ethernet – Four (UTP)
- Gigabit Ethernet – One or three (SFP).

All interfaces serve as either network or user port, and support autonegotiation, VLAN tagging and rate limiting.

ETHERNET CAPABILITIES

Internal Ethernet bridge operates in VLAN-aware and VLAN-unaware modes, supporting up to 4094 VLANs.

Each bridge port features:

- Port-based rate limiting for bandwidth control
- Port-based VLAN membership for ingress traffic restriction
- Port-based 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.

QoS

Ethernet or pseudowire traffic is forwarded to one of the four priority queues. User Ethernet traffic can be prioritized according to VLAN priority, DSCP, IP Precedence or per port.

Ingress and egress rate can be limited per user and network port. Rate limitation is configured per packet type (broadcast, multicast or unknown unicast).

ETHERNET RING

A G.8032 Layer-2 Ethernet ring is used by IPmux-4LGE 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 it to adjacent nodes. The ring itself is constructed independently of the transport technology used at a server layer. Failures in the ring detected by using Ethernet OAM (Y.1731) continuity check (CC) messages between adjacent nodes.

For fiber optic interfaces, G.8032 ring protection provides sub-50 msec traffic switching.

Lowers Opex of TDM service by utilizing packet infrastructure

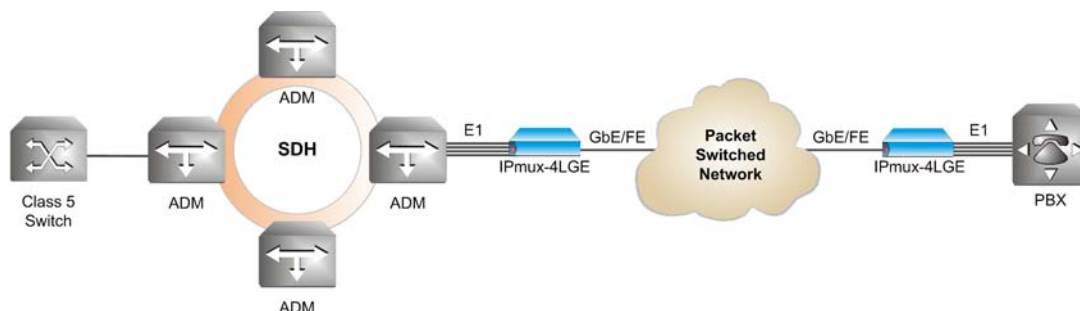


Figure 2. TDM Backhaul and Trunking over a PSN

IPmux-4LGE (GbE)

TDM Pseudowire Gateway

Carrier-grade voice
quality without
compression, or
silence suppression

MANAGEMENT

IPmux-4LGE 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.

Software can be downloaded via a local terminal using XMODEM/YMODEM, or remotely, using TFTP. After downloading a new software version, IPmux-4LGE 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.

The Syslog protocol is used by IPmux-4LGE to generate and transmit event notification messages over IP networks to the central Syslog server. The Syslog operation is compliant with the RFC 3164 requirements.

DIAGNOSTICS

External and internal loopbacks check TDM and serial link connectivity.

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

Virtual Cable Test (VCT) check the quality of Ethernet cables, connectors and terminations, identifying a cable break or short.

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.

DYING GASP

AC-powered units report power failures to defined network management stations by sending a trap, thus enabling the devices to properly disconnect from the network with notification of the reason for the service problem.

Specifications

E1 INTERFACE

Number of Ports

4

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

120 Ω , balanced

75 Ω , 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 ITU-T G.823

Connector

RJ-45, balanced

BNC coax, unbalanced

ETHERNET INTERFACE**Number of Ports**

Up to 7

Port Combinations

Fast Ethernet: 4 UTP

Gigabit Ethernet:

- 1 SFP
- 3 SFP

Type

Fast Ethernet: UTP (10/100BaseT)

Gigabit Ethernet: Fiber optic SFP
(1000BaseFx)**Fast and Gigabit Ethernet SFPs**For full details, see the SFP Transceivers data sheet at www.rad.com**Connector**

LC

PSEUDOWIRE CONNECTIONS**Standards Compliance**IETF: RFC 4553 (SAToP), RFC 5087
(TDMoIP), RFC 5086 (CESoPSN) and
RFC 4618 (HDLCoPSN)

ITU-T: Y.1413

MFA: IA 4.1, IA 8.0.0

Number of PW Connections

64

Jitter Buffer Size0.5–200 msec (unframed) with 0.1 msec
granularity1.5–200 msec (framed) with 0.5 msec
granularity**GENERAL****Timing**Internal
System
Loopback
Adaptive**Adaptive Clock Characteristics**

According to G.823 traffic interface

ManagementSNMPv1v2c
Telnet
ASCII terminal via V.24 (RS-232) DCE port
Web browser**Diagnostics**Loopbacks: E1 port local/remote, serial
port local/remote

BERT: E1 port internal/external

VCT: Ethernet ports

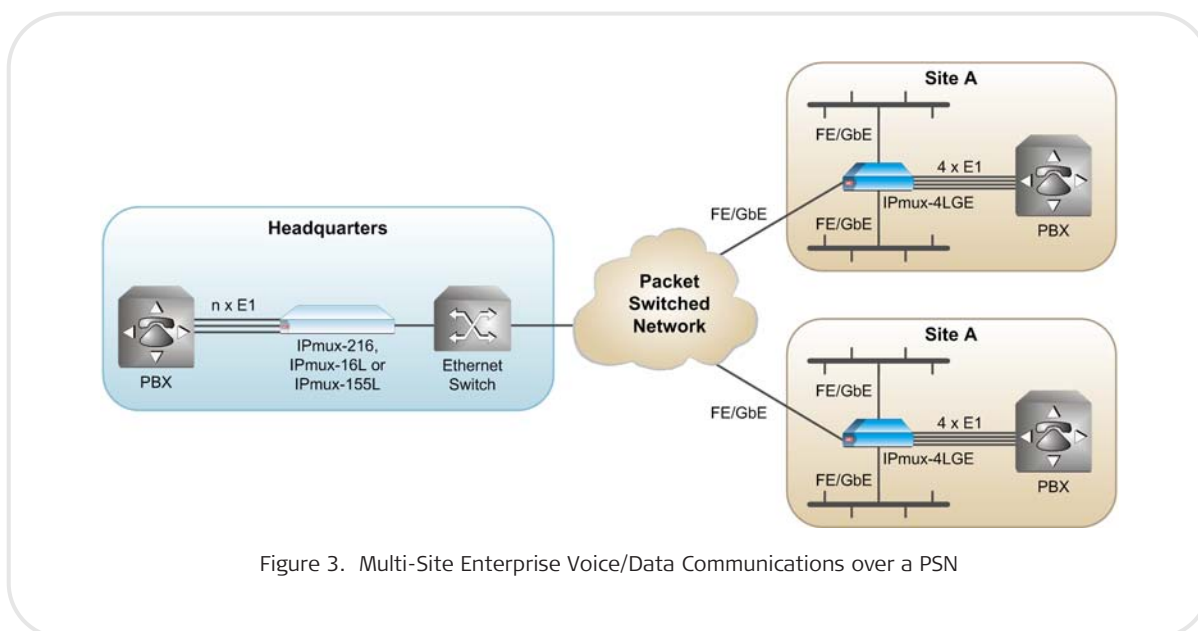


Figure 3. Multi-Site Enterprise Voice/Data Communications over a PSN

IPmux-4LGE (GbE)

TDM Pseudowire Gateway

Statistics

E1 (per G.826 and RFC 2495)

Ethernet (per RFC 2819)

Jitter buffer indication (overflow, underflow, sequence error, max/min jitter buffer levels)

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

Power Consumption

9W max

Physical

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)

Environment

Temperature: 0° to 50°C (32° to 122°F)

Humidity: Up to 90%, non-condensing

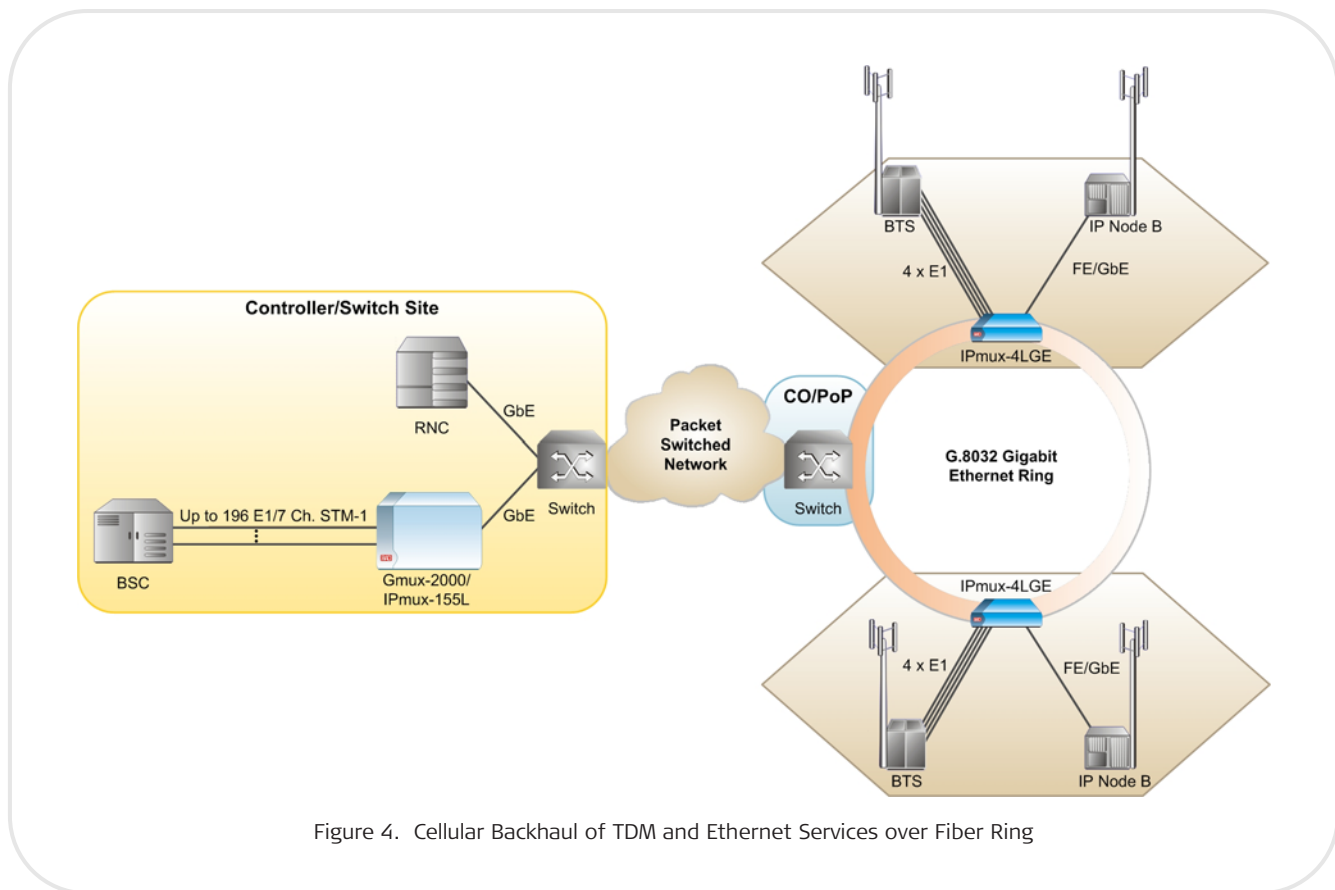
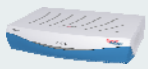







Figure 4. Cellular Backhaul of TDM and Ethernet Services over Fiber Ring

Table 1. IPmux Family Product Comparison

| Feature | IPmux-2L (Ver. 1.0) | 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, optional serial data | 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 | 1 or 2 × FE | 1 or 2 × FE | 4 × FE | | 1 × GbE/FE | 1 × GbE/FE |
| Number of PWs | 63 | 64 | 64 | 256 | 64 | 256 |
| Advanced clock recovery (OCXO) | - | ✓ | ✓ | ✓ | ✓ | ✓ |
| Redundant power supply | - | - | - | - | - | ✓ |
| External clock port | - | - | - | - | Optional | ✓ |
| SSH, SSL, RADIUS | - | - | - | - | ✓ | ✓ |
| Network management system | RV-SC/TDMoIP, RV-EMS | RV-SC/TDMoIP, RV-EMS | RV-SC/TDMoIP, RV-EMS | RV-SC/TDMoIP, RV-EMS | RV-SC/TDMoIP, RV-EMS (basic shelf view) | RV-SC/TDMoIP, RV-EMS (basic shelf view) |

IPmux-4LGE (GbE)

TDM Pseudowire Gateway

Ordering

STANDARD CONFIGURATIONS

IPMUX-4LGE/4E1/1XGESFP

IPMUX-4LGE/4E1/1XGEUTP

IPMUX-4LGE/4E1/3XGESFP

IPMUX-4LGE/4E1/3XGESFP/A

SPECIAL CONFIGURATIONS

IPMUX-4LGE/\$/+1/~

Legend

\$ TDM interface:

4E1 4 balanced E1
4E1CX 4 unbalanced E1
 (BNC connectors)

+1 Network/user GbE interface

(in addition to default 4 FE UTP ports):

1XGESFP 1 SFP GbE port
3XGESFP 3 SFP GbE ports
1XGEUTP 1 UTP GbE port
3XGEUTP 3 UTP GbE ports
3GE1UTP2SFP 3 GbE ports
 (1 UTP and 2 SFPs)
3GE2UTP1SFP 3 GbE ports
 (2 UTPs and 1 SFP)

Note: 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.

~ Clock recovery (Default=standard clock recovery):

A Advanced clock recovery mechanism (OCXO)

SUPPLIED ACCESSORIES

Power cord

AC/DC adapter plug

OPTIONAL ACCESSORIES

CBL-DB9F-DB9M-STR

Control port cable

RM-35/@

Hardware kit for mounting one or two

IPmux-4LGE units into a 19-inch rack

Legend

@ Rack mounting kit (Default=both kits):

P1 Kit for mounting one unit
P2 Kit for mounting two units