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IPmux-4L
TDM Pseudowire Gateway

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

TDMoIP 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 traffic emulation over MPLS, IP and Ethernet networks
- Transmission of both framed (full or fractional) and unframed E1 traffic

IPmux-4L 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 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-4L Ethernet network port to the PSN. A remote pseudowire device converts the packets back to TDM traffic.

The ASIC-based architecture provides a robust and high performance pseudowire solution with minimal processing delay.

The unit employs various legacy over packet protocols, including TDMoIP, CESoPSN, SAToP and HDLCoPSN.

RAD data communications
The Access Company

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-4L internal clock oscillator provides the master clock source for the TDM circuit

- Loopback – The transmit clock is derived from the TDM receive clock

- Adaptive – The clock is recovered from the PSN

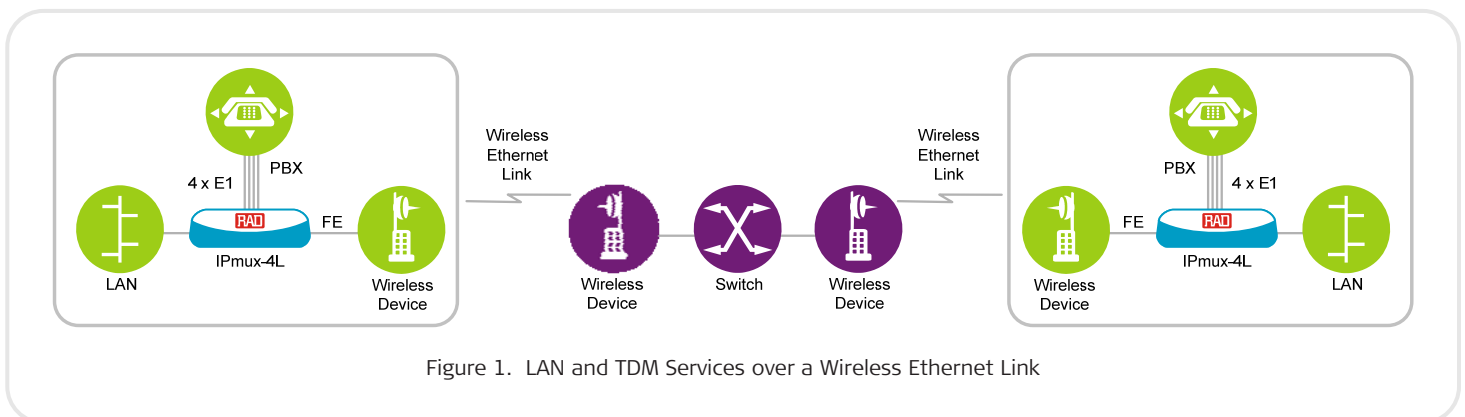- Receive – The system timing is locked to the clock received via one of the TDM ports.

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

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

PSEUDOWIRE QoS

IPmux-4L performs 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.

TDM INTERFACE

Two or 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 CAPABILITIES

IPmux-4L features an internal Layer-2 Ethernet switch with three Ethernet ports. The ports can be configured to operate as network or user interfaces.

Each Ethernet port features:

- Port-based 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.
- 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.

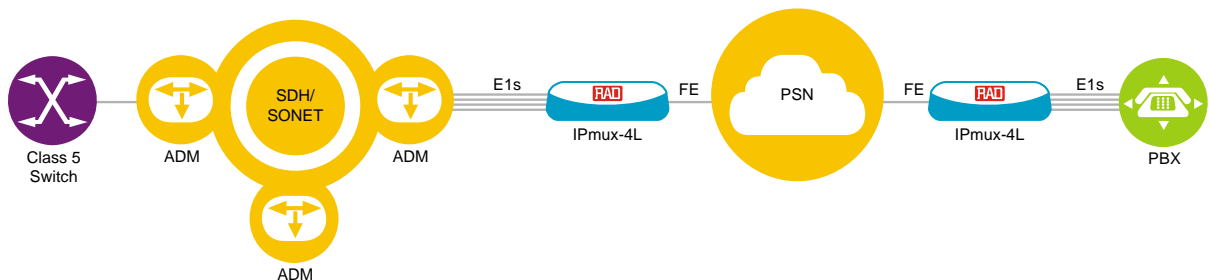Lowers Opex of TDM service by utilizing packet infrastructure

Figure 2. TDM Backhaul and Trunking over a PSN

Carrier-grade voice quality without compression, or silence suppression

MANAGEMENT

IPmux-4L 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-4L 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.

Current date and time are retrieved from a dedicated server, using SNTP.

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.

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

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.
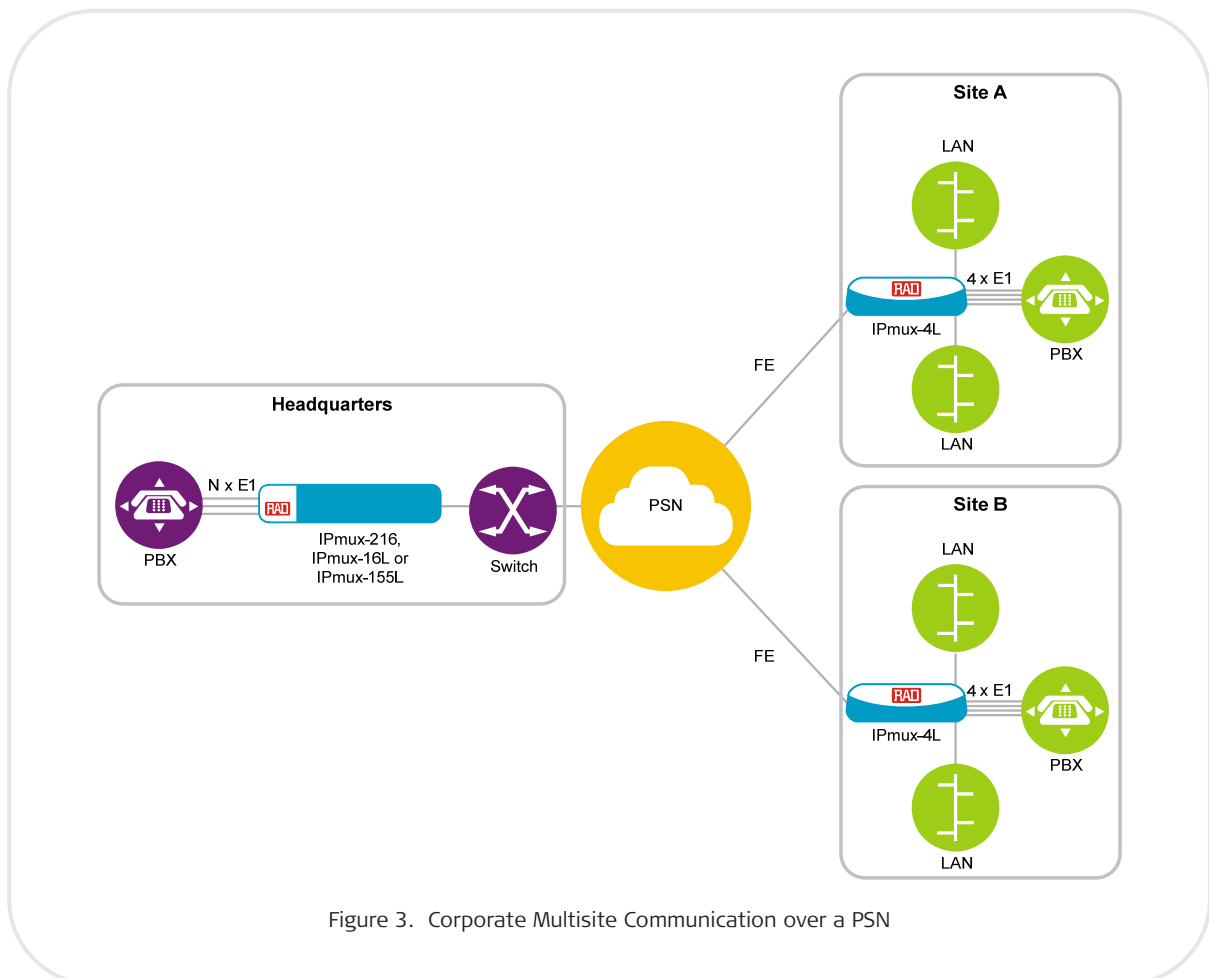
Figure 3. Corporate Multisite Communication over a PSN

Specifications

E1 INTERFACE

Number of Ports
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, AMI

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

Signaling
CAS, CCS (transparent)

Line Impedance
120Ω, balanced
75Ω, unbalanced

Signal Levels
Receive:
    0 to -36 dB with LTU (long haul)
    0 to -10 dB without LTU (short haul)
Transmit balanced: ±3V ±10%
Transmit unbalanced: ±2.37V ±10%

Jitter and Wander Performance
Per ITU-T G.823

Connector
Balanced: RJ-45
Unbalanced: coax BNC

Table 1. IPmux Family Product Comparison

Feature	IPmux-2L (Ver. 2.0)	IPmux-4L (Ver. 1.4)	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-4L

TDM Pseudowire Gateway

Easily manages and provisions TDM pseudowire connections

ETHERNET INTERFACE

Number of Ports
3 (1 network, up to 2 user)

Port Combinations
3 UTP or 2 UTP and 1 SFP

Type
Electrical: 10/100BaseT

Fiber optic: 100BaseFx, 100BaseLX10,
     100BaseBx10

Fast Ethernet SFPs
For full details, see the SFP Transceivers
data sheet at 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,
refer to the SFP Transceivers data sheet.*

Connector
LC

PSEUDOWIRE CONNECTIONS

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 Size
0.5–200 msec (unframed) with 0.1 msec
     granularity
1.5–200 msec (framed) with 0.5 msec
     granularity

GENERAL

Timing
Internal
Receive
Loopback
Adaptive

Adaptive Clock Characteristics
According to G.823 traffic interface

Management
SNMPv1v2c

Telnet

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

Web browser

Entity MIB (RFC 4133)

Diagnostics
Loopbacks: E1 port local/remote

BERT: E1 port internal/external

VCT: Ethernet ports

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

8W max

Physical

Height: 43 mm (1.7 in)
Width: 217 mm (8.5 in)
Depth: 170 mm (6.7 in)
Weight: 0.5 kg (1.1 lb)

Environment

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

Ensures Ethernet QoS with Ethernet switching and bridging capabilities

IPmux-4L

TDM Pseudowire Gateway

Ordering

STANDARD CONFIGURATIONS

IPMUX-4L/2E1/UTP

IPMUX-4L/4E1

IPMUX-4L/4E1/N

IPMUX-4L/4E1/UTP

IPMUX-4L/4E1CX/N/A

SPECIAL CONFIGURATIONS

IPMUX-4L/$/+1

Legend

$ TDM interface:

2E1	2 balanced E1
2E1CX	2 unbalanced E1
4E1	4 balanced E1
4E1CX	4 unbalanced E1

+1 Fast Ethernet interface (optional, in addition to two 10/100BaseT UTP ports)

N	SFP-ready slot
1	Fast Ethernet, 1310 nm, multimode, LED, 2 km (1.2 mi)
2	Fast Ethernet, 1310 nm, single mode, laser, 15 km (9.3 mi)
3	Fast Ethernet, 1310 nm, single mode, laser, 40 km (24.8 mi)
4	Fast Ethernet, 1310 nm, single mode, laser, 80 km (49.7 mi)
10A	Fast Ethernet, Tx - 1310 nm, Rx - 1550 nm, single mode (single fiber), laser (WDM), 20 km (12.4 mi)
10B	Fast Ethernet, Tx - 1550 nm, Rx - 1310 nm, single mode (single fiber), laser (WDM), 20 km (12.4 mi)
UTP	10/100BaseT

Note: *For single-fiber applications, a device with the SFP-10A interface should always work with a device with the SFP-10B interface, and vice versa.*

SUPPLIED ACCESSORIES

Power cord

AC/DC adapter plug

OPTIONAL ACCESSORIES

CBL-DB9F-DB9M-STR
Control port cable

RM-33-2
Hardware kit for mounting one or two IPmux-4L units into a 19-inch rack

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