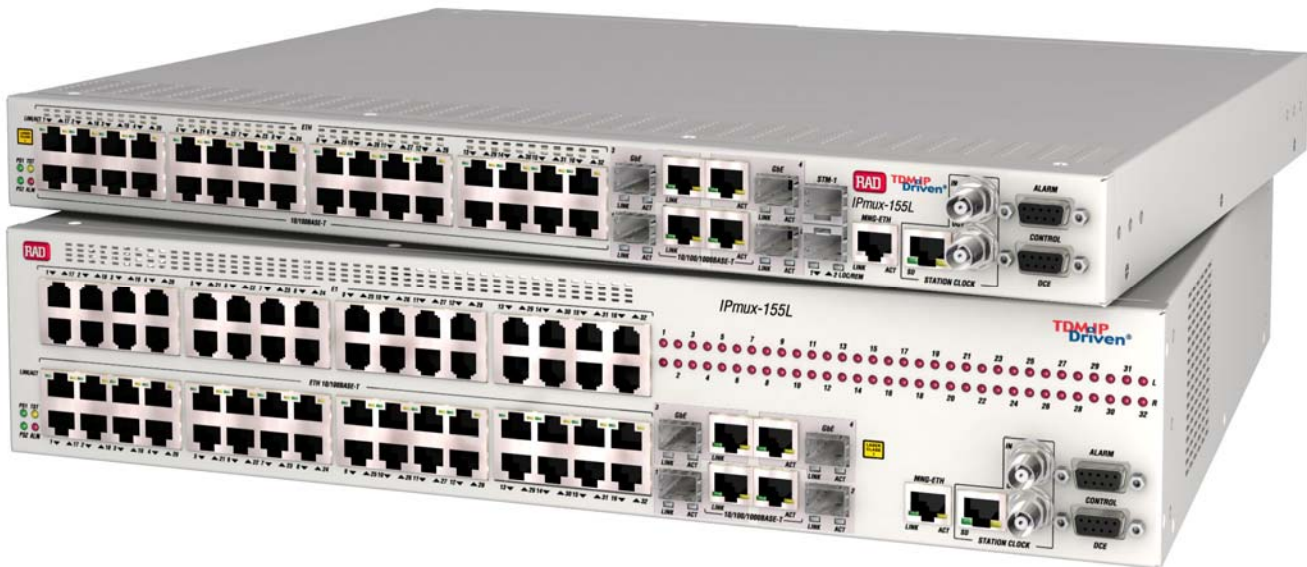


IPmux-155L

Hub-Site Pseudowire Access Gateway



Multiservice
pseudowire gateway
converging TDM voice
or data services over
packet-switched
networks

TDM
Driven

- High capacity pseudowire gateway, transporting TDM traffic (fully populated channelized STM-1 stream or up to 32 E1 channels) over packet-switched networks
- Pseudowire technology, compliant with IETF, MFA Forum and ITU-T standards for Pseudowire Emulation Edge-to-Edge (PWE3)
- Aggregation of 32 fiber optic or electrical Fast Ethernet interfaces into four Gigabit Ethernet links
- 1U or 2U, 19" enclosure with redundant power supply and fan units

IPmux[®]-155L is a pseudowire gateway that transports TDM traffic (originating from legacy circuit-switched networks) over packet-switched networks (PSNs). This is achieved by converting TDM data streams coming from the TDM ports into packets transported over the PSN.

IPmux-155L includes the following ports:

- 1 + 1 redundant STM-1 or 32 E1 ports
- Four Gigabit Ethernet ports with traffic protection
- 32 fiber optic or electrical Fast Ethernet user ports.

RAD

data communications

The Access Company

IPmux-155L

Hub-Site Pseudowire Access Gateway

The unit is used for:

- Aggregating traffic from remote pseudowire devices, such as IPmux-24 or IPmux-2L, at a small PoP or CO, while eliminating the need for an additional Ethernet switch.
- Transporting STM-1 or E1 traffic over PSN, saving TDM leased line costs.

PEUDOWIRE FUNCTIONALITY

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

The unit employs SAToP, CESoPSN and TDMoIP pseudowire encapsulation methods.

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 200 msec in the network.

PEUDOWIRE TIMING

End-to-end synchronization between circuits is maintained by the adaptive clock recovery mechanism.

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

The system clock uses master and fallback timing sources for clock redundancy. IPmux-155L also provides system clock input and output via an external clock port.

SDH INTERFACE

The SDH interface provides direct access to the Synchronous Digital Hierarchy (SDH) transmission cores at the STM-1 level (155.520 Mbps).

SDH mapping mechanism collects payload from 63 internal E1 streams and directs it towards STM-1 link.

The physical STM-1 ports can be ordered with field-replaceable SFP transceivers with optical interfaces, for meeting a wide range of operational requirements.

1+1 APS line redundancy ensures rapid restoration of service in case of STM-1 line failure.

AU4/TU12 pointer operation complies with G.783, G.707 requirements. Trace messages with 16-byte sequences (J1 and J2 bytes) are generated and monitored.

E1 INTERFACE

32 external E1 interfaces provide connectivity to any standard E1 devices.

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-155L features the following PSN ports:

- Four Gigabit Ethernet ports with SFP-UTP combo connectors
- 32 Fast Ethernet ports with fiber optic SFP or UTP connectors.

The GbE interface operation complies with IEEE 802.3, 802.1Q and 802.1p requirements.

Link aggregation is performed as per 802.3ad (with or without LACP). This enables operators to use up to four Ethernet links as a single virtual interface, sharing traffic load and providing link resiliency.

G.8032 ETHERNET RING

The unit employs a G.8032 Layer-2 Ethernet ring mechanism to protect against link and node failures.

ETHERNET OAM

IPmux-155L provides OAM to monitor and troubleshoot the Ethernet network and quickly detect failures. The OAM mechanism operates according to IEEE 802.3ah requirements for fault indication and loopback activation response.

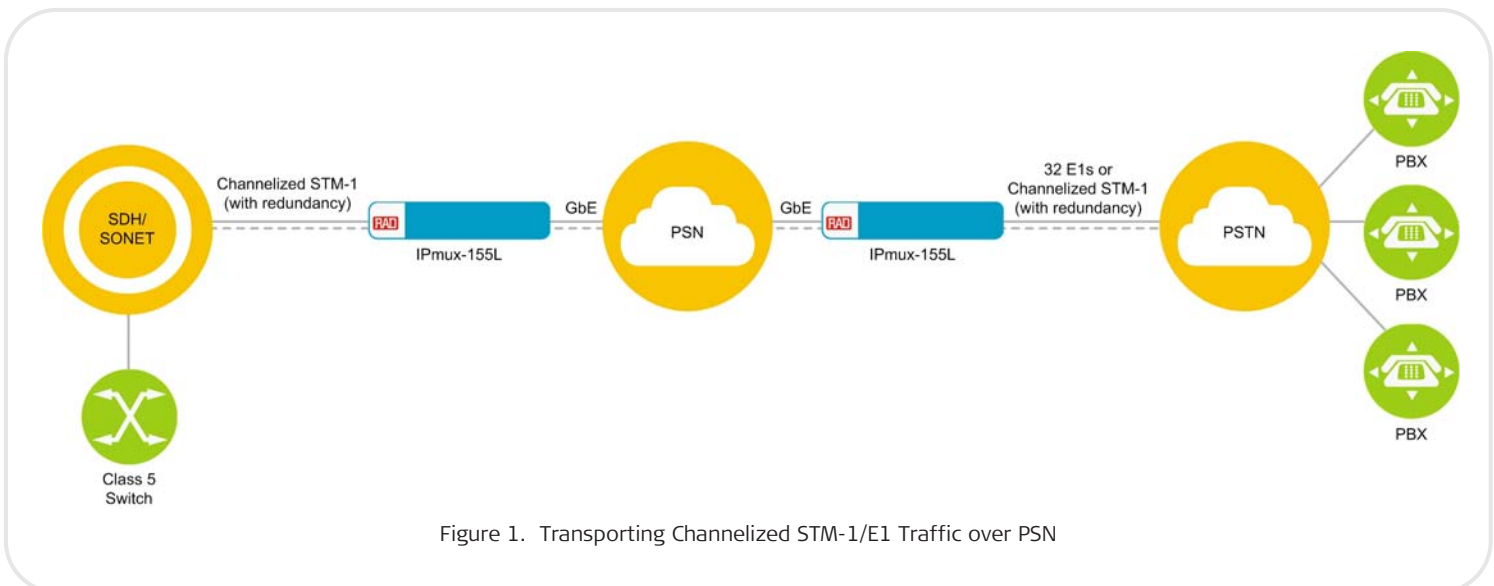


Figure 1. Transporting Channelized STM-1/E1 Traffic over PSN

ETHERNET CAPABILITIES

IPmux-155L includes an internal bridge, operating in VLAN-aware and VLAN-unaware modes.

VLAN stacking can be 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.

User traffic can be queued and prioritized according to VLAN priority and ToS/Diffserv.

Ingress and egress rate can be limited per user and network ports.

Policing and classification of the traffic flows are performed between any ingress and any egress Ethernet port of the device. IPmux-155L monitors traffic with specified flow parameters, allocates bandwidth, forwards traffic to different queues according to classification parameters etc.

SYSTEM REDUNDANCY

System architecture provides redundancy at different levels:

- GbE interface with 802.3ad-based link aggregation
- STM-1 1+1 line redundancy with less than 50 ms restoration of service in case of link faults
- Redundant power supply units and fans.

MIRICI-E3T3 SUPPORT

When equipped with a removable MiRiCi-E3T3 module (ver. 2.5), a fiber FE port can operate as an E3 or T3 port, forwarding LAN packets to TDM-based WAN. When operating in the T3 mode, MiRiCi-E3T3 modules are fully controllable via IPmux-155L management application.

Note: IPmux-155L equipped with the AC or 48 power supply modules supports up to 16 MiRiCi-E3T3 units.

When equipped with two high-power ACP or 48HP power supply modules, IPmux-155L can host up to 32 MiRiCi-E3T3 units.

Lowers Opex of TDM service by utilizing packet infrastructure

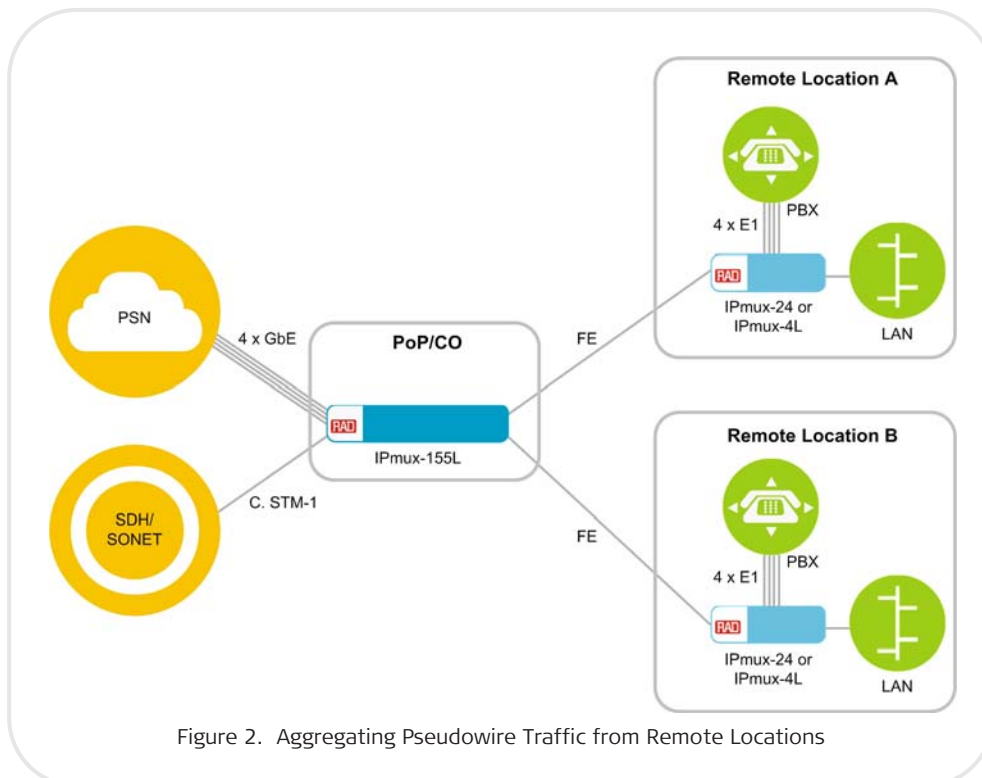


Figure 2. Aggregating Pseudowire Traffic from Remote Locations

IPmux-155L

Hub-Site Pseudowire Access Gateway

MANAGEMENT CAPABILITIES

The unit can be managed using different ports and applications:

- Local out-of-band management via a terminal connected to the RS-232 port
- Remote out-of-band management via the dedicated 10/100BaseT port
- Remote inband management via the GbE or FE interface. Remote management is performed using Telnet or RADview, RAD's SNMP-based EMS.

Software is downloaded via the local terminal, using XMODEM/YMODEM, or remotely, using TFTP/FTP.

The Syslog protocol is used by IPmux-155L 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.

OAM AND STATISTICS

Comprehensive monitoring and diagnostic capabilities include port status indication and statistic counters for Gigabit Ethernet and STM-1 interfaces.

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

ALARM REPORTING

The device includes a dry-contact connector for reporting alarms to external equipment. The connector also has an external alarm input for monitoring external sensors.

TIMING

IPmux-155L features a flexible clock mechanism using external and internal timing signals coming from:

- SDH clock (8 kHz)
- 2.048 MHz clock recovered from a PW flow, E1 line or GbE port (Sync-E)

- External station clock source via station clock port, providing out-of-band synchronization.

DIAGNOSTICS

For diagnostic purposes, IPmux-155L maintains a cyclic event log file that stores up to 2048 time-stamped events and a real-time current alarm list.

To verify the TDM link integrity, IPmux-155L provides local or remote loopbacks on the VC-4 and E1 interfaces.

User-activated BER tests can be generated to analyze E1 streams.

An internal built-in test (BIT) performed after power-up checks the internal circuitry of the unit. The results of the test are visible via the local terminal.

Table 1. IPmux Family Product Comparison

Feature	IPmux-2L (Ver. 2.0)	IPmux-4L (Ver. 1.0)	IPmux-4LGE) (Ver. 2.0)	IPmux-155L (Ver. 2.1)	IPmux-24 (Ver. 3.5)	IPmux-216 (Ver. 3.5)
TDM service ports	1, 2 × E1	2, 4 × E1	4 × E1	1 × channelized STM-1 or 32 × E1	1, 2, 4 × E1/T1	8, 16 × E1/T1
Ethernet network ports	1 × FE	1 × FE	1 × GbE network, 2 × GbE network/user	4 × GbE	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	32 × FE	1 × GbE/FE	1 × GbE/FE
Number of PWs	63	64	64	480	64	256
Advanced clock recovery	-	✓	✓	-	✓	✓
Redundant power supply	-	-	-	✓	-	✓
External clock port	-	-	-	✓	Optional	✓
Serial data port	Optional	-	-	-	-	-
SSH, SSL	-	-	-	-	✓	✓
RADIUS, Syslog	-	-	-	✓	✓	✓
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)

Specifications

CHANNELIZED STM-1 INTERFACE

Number of Ports

2 (1+1)

Payload Capacity

63 VC-12

Payload Routing

E1 stream to any VC-12 within the STM-1 payload

Compliance

G.957, G.707

Nominal Bit Rate

155.520 Mbps

Redundancy

1+1 unidirectional as per G.841

Clock Source

System clock derived from:

- STM-1 or E1 (loopback)
- Adaptive
- Internal
- Station

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, see the SFP Transceivers data sheet.

INTERNAL E1 INTERFACE

Number of Ports

63

Framing

Unframed, framed, multiframed, with or without CRC-4

Clock Source

Loopback, adaptive, system

EXTERNAL E1 INTERFACE

Number of Ports

32

Compliance

ITU-T Rec. G.703, G.704, G.706, G.732, G.823, G.826

Data Rate

2.048 Mbps

Line Code

HDB3, AMI

Framing

Unframed, framed, multiframed, with or without CRC-4

Signaling

CAS, CCS (transparent)

Connector

RJ-45, balanced

High-density 160-pin D-type for external BNC/RJ-45 patch panels

ETHERNET INTERFACE

Number of Ports

Gigabit Ethernet: 4 ports

Fast Ethernet: 32 ports

Connector

Gigabit Ethernet: SFP-UTP combo

Fast Ethernet: fiber optic (via SFP) or built-in 10/100BaseT

Interface

Fiber optic:

Gigabit Ethernet: 1000BaseSX, 1000BaseLX

Fast Ethernet: 100BaseFX, 100BaseLX10, 100BaseBX10

Electrical:

Gigabit Ethernet: 10/100/1000BaseT

Fast Ethernet: 10/100BaseT

Carrier-grade voice
quality without
compression, or
silence suppression

IPmux-155L

Hub-Site Pseudowire Access Gateway

Allows enterprises, utility companies and government agencies to save on leased-line costs by transporting STM-1 traffic over PSN

ETHERNET CAPABILITIES

Priority Mapping

VLAN priority, ToS/Diffserv

Redundancy

LAG (GbE ports only), with or without LACP

G.8032 Ethernet Ring

OAM

802.3ah

Bridging

VLAN-aware, VLAN-unaware

Filtering

MAC learning and filtering

Number of Service Host IPs

Up to 4

PSEUDOWIRE

Compliance

RFC 4553, RFC 5086, RFC 5087, Y.1413

PSN

UDP/IP, MPLS, MEF-8

PW Types

TDMoIP, SAToP, HDLCoPSN, CESoPSN

Number of PW Connections

480

Jitter Buffer Size

0.5–200 msec with 0.1 msec granularity

Adaptive Clock

According to G.823 traffic interface

QoS

Rate Limitation

Ingress, ingress storm, egress

Scheduling

HQP, WRR

Classification

P-bit, IP Precedence, IP DSCP

Flows

Ingress port, egress port, drop action, traffic class

Policer profile: CIR+CBS

Classification rules: VLAN, VLAN + P-bit, IP ToS, IP DSCP

GENERAL**Management**

SNMPv1, SNMPv2c, SNMPv3
 Telnet
 RADIUS client authentication
 SNTP
 DHCP server/client
 ASCII terminal via V.24 (RS-232) DCE port

External Clock

2.048 Mbps input/output via two BNC, unbalanced (75Ω) connectors, G.703, HDB3/AMI code
 2.048 Mbps via dedicated RJ-45 balanced 120Ω connector, G.703, HDB3/AMI code, 2048 kHz squarewave (RS-485 electrical levels)

Diagnostics

Local and remote loopbacks on VC-4 and internal E1
 External/internal BERT on E1
 Ping and traceroute utilities
 Virtual Cable Test (VCT)

Statistics

STM-1
 E1
 Ethernet (RFC 2819, RFC 4188, RFC 1213)
 Jitter buffer status (overflow, underflow, sequence error, max/min jitter buffer levels)
 Pseudowire connection (OAM)

Alarm Relay

Via dedicated DB-9 female connector

Indicators

LINK (green) – Ethernet link status
 ACT (yellow) – Ethernet activity status
 TST (yellow) – Test status
 ALM (red) – Alarm status
 PS1 (green) – Power supply 1 status
 PS2 (green) – Power supply 2 status
 LOC (red)/REM (yellow) – STM-1 or E1 signal status
 SD (green/red) – External clock status

Power

AC: 100 to 240 VAC
 (115/230 VAC nominal), 50/60 Hz
 DC: 40 to 72 VDC (48 or 60 VDC nominal)

Power Consumption

75W max

Physical

Height: 43 mm (1.7 in) – STM-1 version,
 86 mm (3.4 in) – E1 version
 Width: 440 mm (17.5 in)
 Depth: 350 mm (13.7 in)
 Weight: 5 kg (11 lb)

Environment

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

Reduces PoP/CO costs
 by combining high-
 density pseudowire
 aggregation with
 Ethernet switch
 functionalities

IPmux-155L

Hub-Site Pseudowire Access Gateway

Ordering

STANDARD CONFIGURATIONS

IPMUX-155L/ACR/N/FR/NULL/4N

IPMUX-155L/ACR/N/UNFR/NULL/4N

IPMUX-155L/ACR/N/UNFR/NULL/4N/32N

IPMUX-155L/ACR/NULL/32E1/4N

IPMUX-155L/ACR/NULL/32E1/4N/32N

IPMUX-155L/ACR/NULL/32E1/4N/32UTP

SPECIAL CONFIGURATIONS

IPMUX-155L/!/#/C/\$/+1/+3

Legend

! Power supply:

ACR Dual 100–240 VAC

48R Dual -48 VDC

ACHPR Dual high-power 100–240 VAC

48HPR Dual high-power -48 VDC

Note: HP power supplies are required for supporting more than 16 MiRiCi-E3T3 units.

STM-1 interfaces:

N 2 × SFP-ready slots

2 2 × SFP-2: 1310 nm, single mode, laser, 15 km (9.3 mi)

NULL STM-1 interfaces are not assembled. Use the \$ option below to order E1 enclosure.

C VC-12 interface:

FR Framed

UNFR Unframed

Note: VC-12 type is specified for STM-1 devices only. Omit this option for E1 enclosures.

\$ E1 interface:

32E1 32 E1 interfaces via RJ-45 connectors

32E1HD 32 E1 interfaces via high-density 160-pin connector

NULL E1 interfaces are not assembled. Use # and C options above to order STM-1 enclosure.

+1 Gigabit Ethernet network interface:

4N Four SFP-UTP combo ports

+3 Fast Ethernet user interface

(Default=no user interface):

32N 32 SFP-ready slots

32UTP 32 built-in 10/100BaseT

SUPPLIED ACCESSORIES

Power cord

DC power connection kit

RM-34

Hardware kit for mounting one IPmux-155L unit with STM-1 interfaces into a 19-inch rack

RM-42

Hardware kit for mounting one IPmux-155L unit with E1 interfaces into a 19-inch rack

OPTIONAL ACCESSORIES

IPMUX-155L-PS/@

Spare power supply and fan module

@ Power supply:

AC 100 to 240 VAC

48 -48 VDC

CBL-DB9F-DB9M-STR

Control port cable

PANEL-32/^

Patch panel/cable assembly for IPmux-155L with 32 E1 interfaces terminating in 160-pin connector (IPmux-155L/!/#/C/32E1HD/+1/+3 option).

Legend

Interface:

^ BAL Balanced RJ-45 patch panel

UNBAL Unbalanced BNC patch panel

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