IPmux-216

TDM Pseudowire Access Gateway

- Comprehensive compliance with 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 8 or 16 TDM service ports

IPmux-216 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-216 Ethernet network port to the PSN. A remote pseudowire device converts the packets back to their original format.

TDM PSEUDOWIRE

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.

OAM

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

Link-layer OAM according to IEEE 802.3ah is used for fault indication and loopback activation response.

BRIDGE

IPmux-216 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-216 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.

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

Outgoing pseudowire packets are prioritized as follows:

- Over Ethernet networks, assigned a dedicated VLAN ID according to 802.1q and marked for priority using 802.1P bits.
- Over IP networks, marked for priority using DSCP, ToS, or Diffserv bits.
- Over MPLS networks, assigned to a specific MPLS tunnel and marked for priority using EXP bits.

TIMING AND SYNCHRONIZATION

Simple Network Time Protocol
IPmux-216 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.

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

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for clock redundancy. IPmux-216 also provides system clock input and output via an external clock port.

MANAGEMENT AND SECURITY

IPmux-216 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-216 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-216 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.

Each management and service host has a separate MAC address. As the unit provides one default gateway, the user can also specify static routes to enhance the IP routing capabilities of the management and pseudowire traffic.

Software is downloaded via the local terminal, using XMODEM, or remotely, using TFTP. After downloading a new software version, IPmux-216 automatically saves the previous version in non-volatile memory for backup purposes. Similarly, copies of the configuration file may be downloaded and uploaded to a remote workstation for backup and restore purposes.

RESILIENCY

Ethernet Ring Topologies

A G.8032 Layer-2 Ethernet ring is used by IPmux-216 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. Failures in the ring are detected by using Ethernet OAM (Y.1731) continuity check (CC) messages between adjacent nodes.

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.

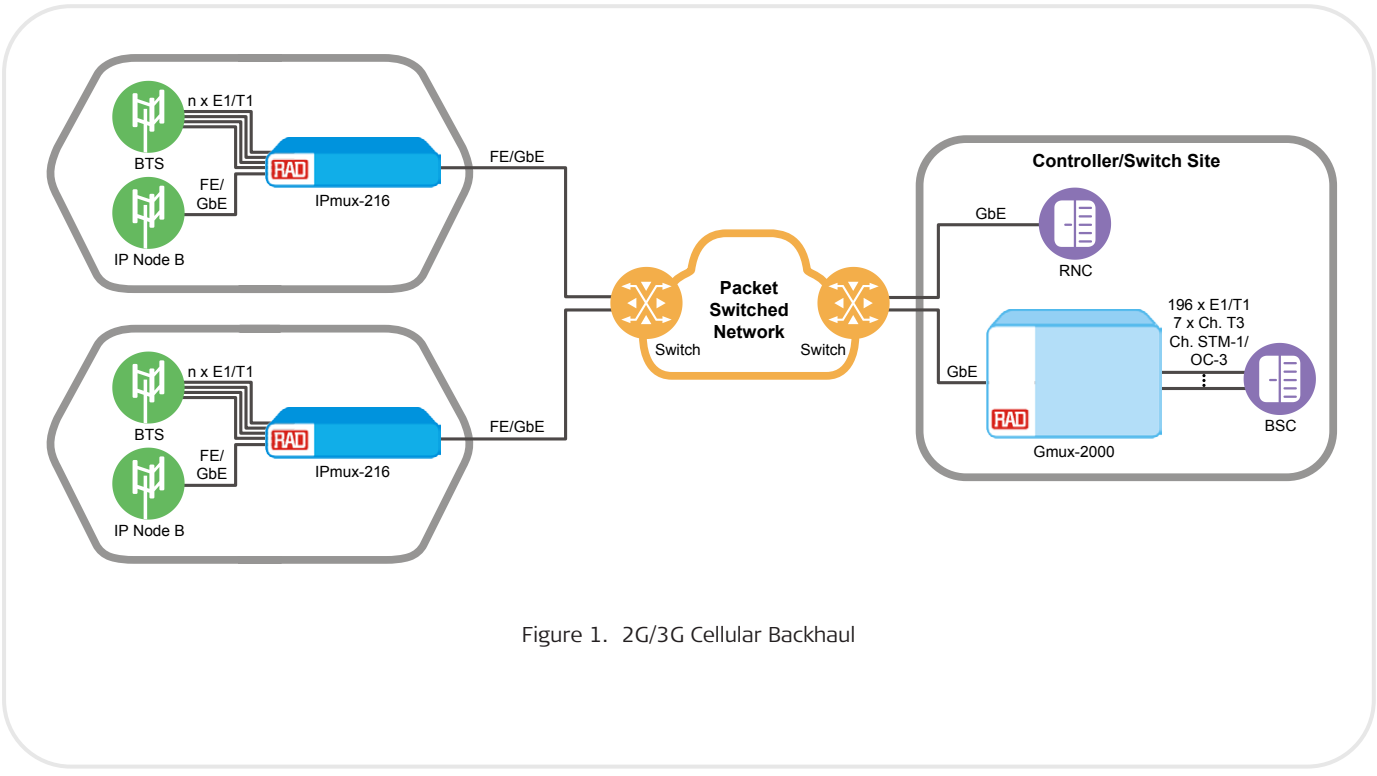

Figure 1. 2G/3G Cellular Backhaul

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

Dual homing technology (1:1) allows IPmux-216 to be connected to two different upstream devices.

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.

TDM INTERFACE

8 or 16 E1 or T1 ports provide connectivity to any standard E1 or T1 device.

The E1 and T1 interfaces feature:

- Integral LTU/CSU for long haul applications
- G.703 and G.704 framing modes
- CAS and CRC-4 bit generation (E1)
- D4/SF and ESF framing (T1)
- Robbed bit (T1).

ETHERNET INTERFACE

The following Ethernet ports are available:

- One network port
- One network/user port
- One user port.

The Ethernet ports accept a wide range of Gigabit and Fast Ethernet SFP-based fiber optic and electric, as well as built-in UTP interfaces.

MONITORING AND DIAGNOSTICS

The following RFC-2495 E1/T1 physical layer performance statistics are available: LOS, LOF, LCV, RAI, AIS, FEBE, BES, DM, ES, SES, UAS and LOMF.

IPmux-216 performs an internal built-in test (BIT) after power-up. The results of the test are visible via the local terminal.

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 available.

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.

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.

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

ENVIRONMENT

IPmux-216/H is an environmentally hardened version intended for street-cabinet and cellular-tower installations.

Notes: *The /H version requires temperature hardened SFP transceivers.*

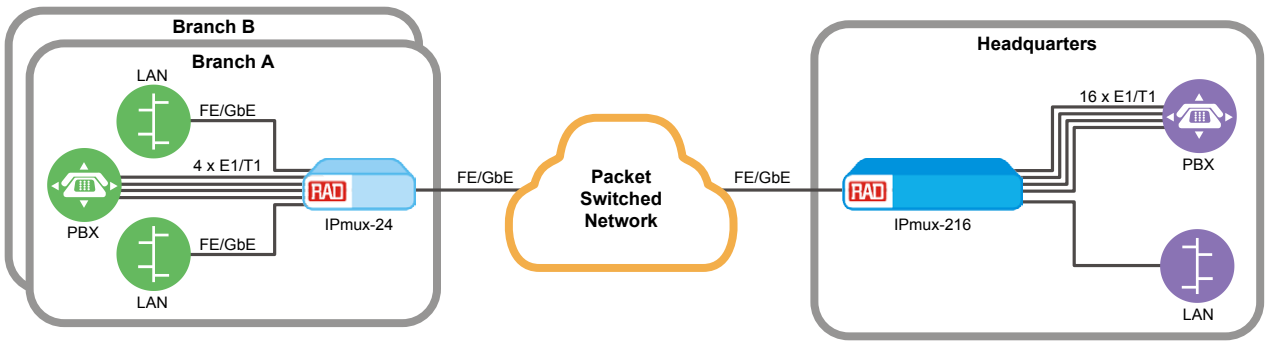

Figure 2. Private or Leased Line over PSN

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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

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 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 INTFERFACE

Number of Ports
8 or 16

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
100Ω, balanced

Signal Levels
Receive: 0 to -36 dB

Transmit pulse amplitude:

- ±3V ±20%; 0 dB, -7.5 dB, 15 dB (CSU), user-selectable
- ±2.7V ±10%, 0 to 655 feet, (DSU), user-selectable

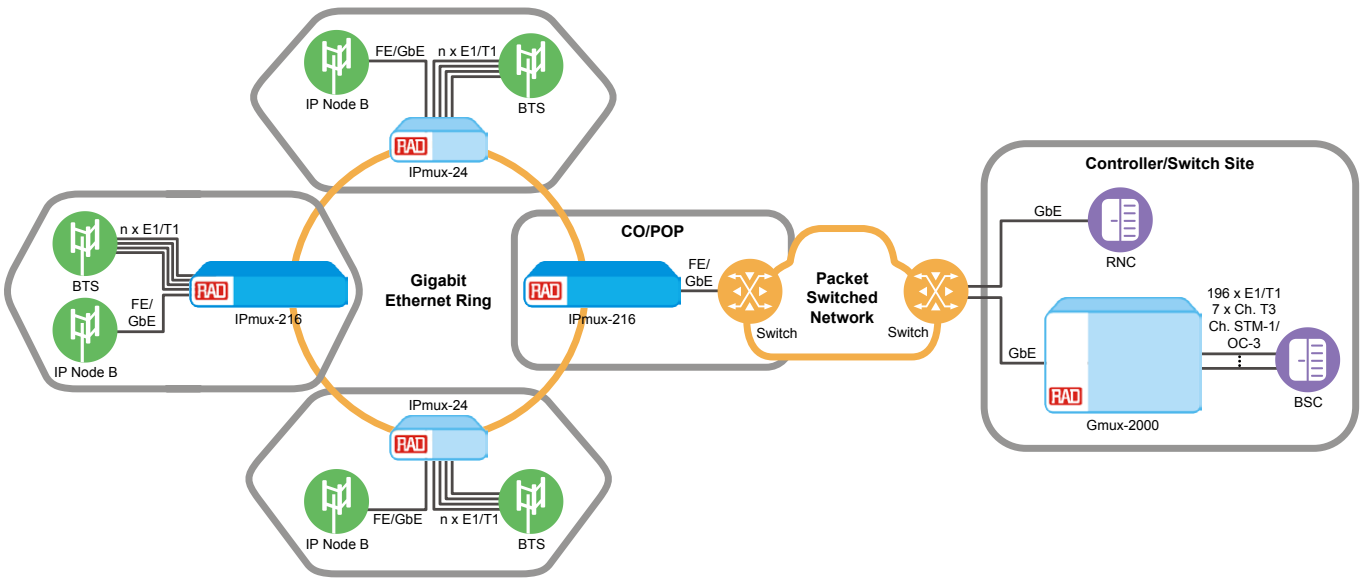

Figure 3. Delivering Ethernet and TDM Services over Fiber Ring in the First Mile

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

Connector
RJ-45

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

PSEUDOWIRE

Compliance
IETF: RFC 4553 (SAToP), 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
256

Jitter Buffer Size
0.5–180 msec (unframed) with 0.1 msec granularity

2.5–180 msec (framed) with 0.5 msec granularity

IPmux-216/A Adaptive Clock
Frequency accuracy: ±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: ±16 ppb ±1 ppb of aging per day

TIMING (PER PORT)

Internal

Loopback

Adaptive

External input or output via dedicated port: E1/T1 or 2048/1544 kHz squarewave (RS-485 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

GENERAL

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

Ethernet (per RFC 2819)

Jitter buffer indication (overflow, underflow, sequence error)

Alarm Relay
Via dedicated DB-9 female connector

Indicators
PWR (green) – Power

TST (yellow) – A diagnostic loopback

MAJ. ALARM (red) – Major alarm

MIN. ALARM (red) – Minor alarm

SYNC (green) – E1/T1 synchronization

LOS (red) – Critical alarm on a TDM port

LINK (green) – Ethernet link

ACT (yellow) – Ethernet activity

SD (green/red) – External clock

POWER (green) – Power supply connection

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)

Power
AC: 100–240 VAC

DC: 24 VDC (20 to 36 VDC) or -48 VDC (-40 to -70 VDC)

Power Consumption
27W max

Environment
Temperature:
IPmux-216: 0 to 50°C (32 to 122°F)
IPmux-216/H: -30 to 65°C (-22 to 149°F)

Humidity: Up to 90%, non-condensing

Data Sheet

IPmux-216

TDM Pseudowire Access Gateway

Ordering

RECOMMENDED CONFIGURATIONS

IPMUX-216/48R/16E1/N/N/UTP
Dual -48 VDC power supply, 16 balanced E1 interfaces, 1 network interface SFP-ready slot, 1 network/user interface SFP-ready slot, 1 user interface built-in 10/100BaseT slot

IPMUX-216/48R/16E1/UTP/UTP/UTP
IPmux-216 with dual -48 VDC power supply, 16 balanced E1 interfaces, 1 network interface built-in 10/100BaseT slot, 1 network/user interface built-in 10/100BaseT slot, 1 user interface built-in 10/100BaseT slot

IPMUX-216/48R/16E1CX/N/N/UTP
Dual -48 VDC power supply, 16 unbalanced E1 interfaces, 1 network interface SFP-ready slot, 1 network/user interface SFP-ready slot and 1 user interface built-in 10/100BaseT slot

IPMUX-216/48R/16E1CX/UTP/UTP/UTP
Dual -48 VDC power supply, 16 unbalanced E1 interfaces, 1 network interface built-in 10/100BaseT slot, 1 network/user interface built-in 10/100BaseT slot, 1 user interface built-in 10/100BaseT slot

IPMUX-216/48R/16T1/UTP/UTP/UTP
Dual -48 VDC power supply, 16 balanced T1 interfaces , 1 network interface built-in 10/100BaseT slot, 1 network/user interface built-in 10/100BaseT slot, 1 user interface built-in 10/100BaseT slot

IPMUX-216/48R/8T1/UTP/UTP/N
Dual -48 VDC power supply, 8 balanced T1 interfaces, 1 network interface built-in 10/100BaseT slot, 1 network/user interface built-in 10/100BaseT slot, 1 user interface SFP-ready slot

IPMUX-216/AC/16E1CX/UTP/UTP/UTP
Single 100 to 240 VAC power supply, 16 unbalanced E1 interfaces, 1 network interface built-in 10/100BaseT slot, 1 network/user interface built-in 10/100BaseT slot, 1 user interface built-in 10/100BaseT slot

IPMUX-216/AC/16E1/UTP/UTP/UTP
Single 100 to 240 VAC power supply, 16 balanced E1 interfaces, 1 network interface built-in 10/100BaseT slot, 1 network/user interface built-in 10/100BaseT slot, 1 user interface built-in 10/100BaseT slot

IPMUX-216/AC/8T1/UTP/UTP/UTP
Single 100 to 240 VAC power supply, 8 balanced T1 interfaces, 1 network interface built-in 10/100BaseT slot, 1 network/user interface built-in 10/100BaseT slot, 1 user interface built-in 10/100BaseT slot

IPMUX-216/ACR/16E1/UTP/UTP/UTP
Dual 100 to 240 VAC power supply, 16 balanced E1 interfaces, 1 network interface built-in 10/100BaseT slot, 1 network/user interface built-in 10/100BaseT slot, 1 user interface built-in 10/100BaseT slot

IPMUX-216/ACR/16E1CX/UTP/UTP/UTP
Dual 100 to 240 VAC power supply, 16 unbalanced E1 interfaces, 1 network interface built-in 10/100BaseT slot, 1 network/user interface built-in 10/100BaseT slot, 1 user interface built-in 10/100BaseT slot

IPMUX-216/ACR/16T1/UTP/UTP/UTP
Dual 100 to 240 VAC power supply, 16 balanced T1 interfaces, 1 network interface built-in 10/100BaseT slot, 1 network/user interface built-in 10/100BaseT slot, 1 user interface built-in 10/100BaseT slot

IPMUX-216/ACR/8T1/UTP/UTP/UTP
Dual 100 to 240 VAC power supply, 8 balanced T1 interfaces, 1 network interface built-in 10/100BaseT slot, 1 network/user interface built-in 10/100BaseT slot, 1 user interface built-in 10/100BaseT slot

SPECIAL CONFIGURATIONS

Please contact your local RAD partner for additional configuration options

SUPPLIED ACCESSORIES

Power cord

DC power connection kit

CBL-RJ45/2BNC/E1/X
RJ-45 to BNC adapter cable (if an unbalanced E1 interface is ordered)

RM-34
Hardware kit for mounting one IPmux-216 unit into a 19-inch rack

OPTIONAL ACCESSORIES

IPMUX-216-M/@
Spare power supply module

@ Power supply:

AC	100 to 240 VAC
24	24 VDC
48	-48 VDC

WM-34
Hardware kit for mounting one IPmux-216 unit on a wall

CBL-DB9F-DB9M-STR
Control port cable

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