Data Sheet

IPmux-216

TDM Pseudowire Access Gateway

TDM circuit emulation over packet-switched networks

- Comprehensive support for pseudowire/circuit emulation standards including TDMoIP, CESoPSN, SAToP and HDLCoPSN
- Industry-leading adaptive clock recovery mechanism suitable for cellular backhaul over packet-based networks
- Comprehensive OAM and performance monitoring
- Three auto-detecting Gigabit or Fast Ethernet SFP- or UTP-based ports, and 8 or 16 TDM service ports

TDMoIP Driven®

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. The frame format of these packets is IP or MPLS. These packets are transmitted via the IPmux-216 Ethernet network port to the PSN. A remote pseudowire device converts the packets back to the original user traffic format.

PSEUDOWIRE FUNCTIONALITY

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

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

PSEUDOWIRE QoS/CoS

Ethernet networks – outgoing pseudowire packets are assigned a dedicated VLAN ID according to 802.1q and marked for priority using 802.1p bits.

RAD data communications
The Access Company

IP networks – outgoing pseudowire packets are marked for priority using DSCP or IP Precedence methods.

MPLS networks – outgoing pseudowire packets are assigned to a specific MPLS tunnel and marked for priority using EXP bits.

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

TDM INTERFACE

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

E1 and T1 interfaces support:

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

ETHERNET INTERFACE

IPmux-216 provides the following Ethernet ports:

- 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 interfaces. One or two ports can be ordered with built-in 10/100BaseT interfaces.

ETHERNET CAPABILITIES

IPmux-216 features 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.

IPmux-216 provides four priority queues for each port or pseudowire traffic. User traffic can be prioritized according to the VLAN priority, DSCP, IP Precedence or per port basis.

Ingress and egress rate limitation can be activated per user and network port. The rate limitation is configured per packet types.

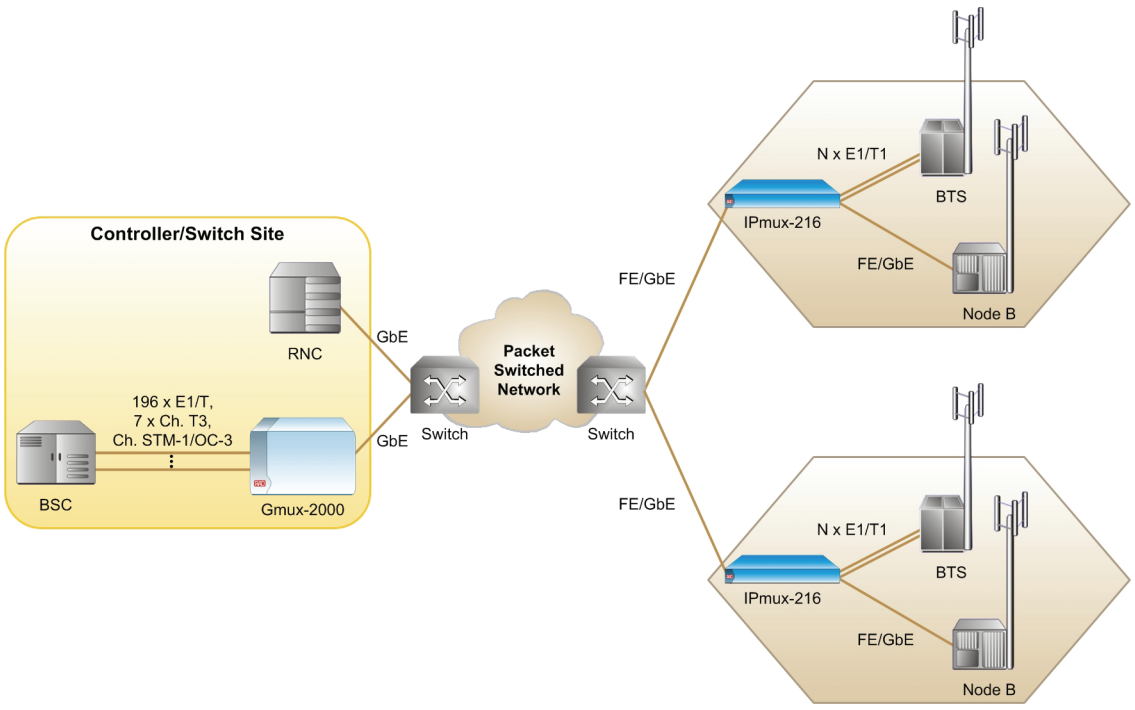

Figure 1. 2G/3G Cellular Backhaul

MANAGEMENT

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.

Software download is supported 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.

OAM 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 packet 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.

Performance monitoring is provided by Ethernet and IP-layer network condition statistics, such as packet sequence errors (loss or misorder) and packet delay variation (jitter), which are monitored and stored by the device.

RAD's TDM PW OAM mechanism ensures connectivity verification, round trip delay measurement and pseudowire configuration mismatch prevention.

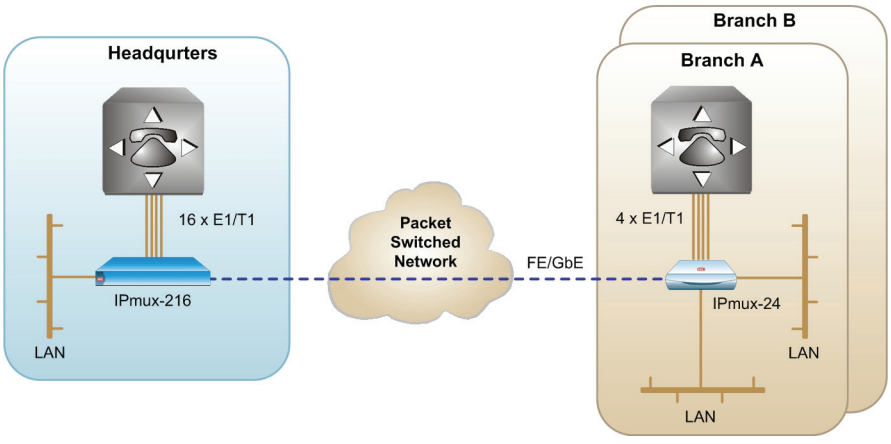

Figure 2. Private or Leased Line over PSN

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)

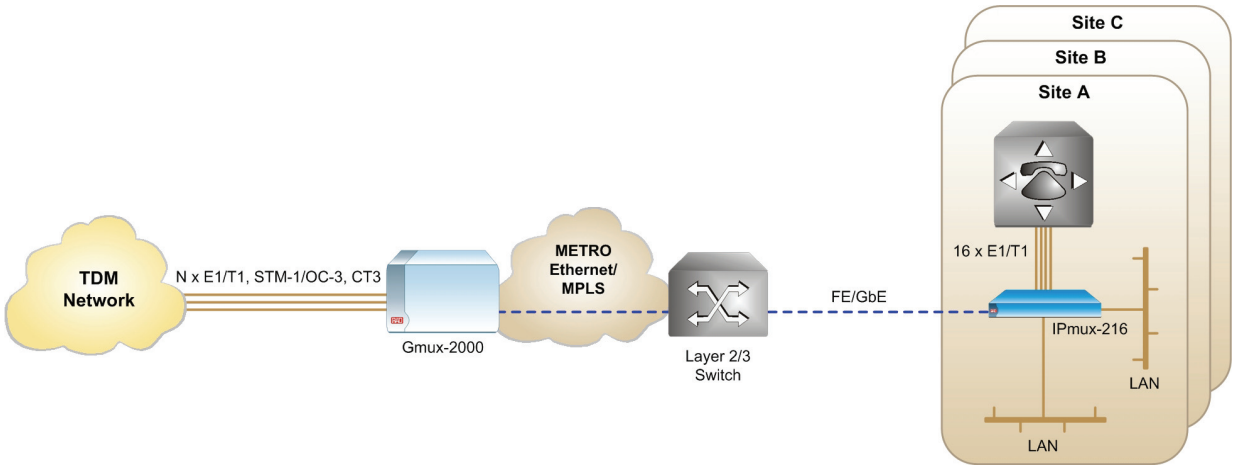

Figure 3. Providing Ethernet and TDM Services in the First Mile

T1 INTERFACE

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

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

Standard Compliance
IEEE 802.3, 802.3u, 802.1p&Q

Number of Ports
3, network and user

Type
Gigabit Ethernet: fiber optic or electrical (via SFP)

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

Port Combinations
3 fiber optic SFPs

2 fiber optic SFPs + 1 UTP

1 fiber optic SFP + 2 UTPs

3 UTPs

Type
SFP-based:

- Gigabit Ethernet – 1000BaseSx, 1000BaseLX10, 1000BaseBx10
- Fast Ethernet –100BaseFx, 100BaseLX10, 100BaseBx10

GbE SPFs Specifications and Ranges
SFP-5: 850 nm, 0.55 km (0.3 miles)

SFP-6: 1310 nm, 10 km (6.2 miles)

SFP-7: 1550 nm, 80 km (49.7 miles)

SFP-8: 1310 nm, 40 km (24.8 miles)

SFP-17a: Tx – 1310 nm, Rx – 1490 nm, single fiber, 10 km (6.2 miles)

SFP-17b: Tx – 1490 nm, Rx – 1310 nm, single fiber, 10 km (6.2 miles)

SFP-20: 1550 nm, 120 km (74.5 miles)

SFP-22a: Tx – 1490 nm Rx – 1570 nm, single fiber, 80 km (49.7 miles)

SFP-22b: Tx – 1570 nm, Rx – 1490 nm, single fiber, 80 km (49.7 miles)

SFP-9F: 100BaseFx-to-100BaseTx converter, 100m (328 ft)

FE SPFs Specifications and Ranges
SFP-1: 1310 nm, 2 km (1.2 miles)

SFP-2: 1310 nm, 15 km (9.3 miles)

SFP-3: 1310 nm, 40 km (24.8 miles)

SFP-4: 1550 nm, 80 km (49.7 miles)

SFP-10a: Tx – 1310 nm, Rx – 1550 nm, single fiber, 20 km (12.4 miles)

SFP-10b: Tx – 1550 nm, Rx – 1310 nm, single fiber, 20 km (12.4 miles)

SFP-18A: Tx – 1310 nm, Rx – 1550 nm, single fiber, 40 km (24.8 miles)

SFP-18B: Tx – 1550 nm, Rx – 1310 nm, single fiber, 40 km (24.8 miles)

SFP-19a: Tx – 1490 nm Rx – 1570 nm, single fiber, 80 km (49.7 miles)

SFP-19b: Tx – 1570 nm, Rx – 1490 nm, single fiber, 80 km (49.7 miles)

SFP-9G: 1000BaseFx-to-1000BaseTx converter, 100m (328 ft)

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.*

Connector
LC

IPmux-216
TDM Pseudowire Access Gateway

PSEUDOWIRE

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

ITU-T: Y.1413

MFA: IA 4.1, IA 8.0.0

MEF: 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

GENERAL

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

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

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

Ethernet (per RFC 2819)

Jitter buffer indication (overflow, underflow, sequence error)

Indicators

PWR (green) – Power status

TST (yellow) – A diagnostic loopback status

MAJ. ALARM (red) – Major alarm status

MIN. ALARM (red) – Minor alarm status

SYNC (green) – E1/T1 synchronization status

LOS (red) – Critical alarm on a TDM port

LINK (green) – Ethernet link status

ACT (yellow) – Ethernet activity status

SD (green/red) – External clock status

POWER (green) –Power supply connection status

Power

AC: 100–240 VAC

DC: -48 VDC (-40 to -60 VDC)

Power Consumption

27W 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

	IPmux-14 (Ver. 2.0)	IPmux-24 (Ver. 1.0)	IPmux-216 (Ver. 1.0)
TDM service ports	2, 4	1,2, 4	8, 16
Ethernet network ports	1 × FE network, 1 × 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 × FE	1 × GbE/FE	1 × GbE/FE
Number of PWs	64	64	256
Multi-pseudowire	✓	✓	✓
Jitter buffer size (msec)	0.5–180	0.5–180	0.5–180
Advanced clock recovery	✓	✓	✓
Redundant power supply	–	–	✓
External clock port	Optional	Optional	✓

IPmux-216

TDM Pseudowire Access Gateway

Ordering

IPmux-216/@/~/$/+1/+2/+3

@ Power supply type:

AC	Single 100 to 240 VAC
48	Single -48 VDC
ACR	Dual 100 to 240 VAC
48R	Dual -48 VDC
AC48	One 100 to 240 VAC and one -48 VDC

~ Clock recovery mechanism (Default=standard clock recovery):

A	Advanced clock recovery

$ TDM interface type:

8E1	8 balanced E1 interfaces
8E1CX	8 unbalanced E1 interfaces
8T1	8 balanced T1 interfaces
16E1	16 balanced E1 interfaces
16E1CX	16 unbalanced E1 interfaces
16T1	16 balanced T1 interfaces

Note: *Unbalanced E1 interfaces are provided via RJ-45 to BNC adapter cables supplied with the product.*

+1 Network interface type:

N	SFP-ready slot
1	SFP-1 FE transceiver
2	SFP-2 FE transceiver
3	SFP-3 FE transceiver
4	SFP-4 FE transceiver
10A	SFP-10A single fiber FE transceiver
10B	SFP-10B single fiber FE transceiver
18A	SFP-18A single fiber FE transceiver
18B	SFP-18B single fiber FE transceiver
19A	SFP-19A single fiber FE transceiver
19B	SFP-19B single fiber FE transceiver
5	SFP-5 GbE transceiver
6	SFP-6 GbE transceiver
7	SFP-7 GbE transceiver
8	SFP-8 GbE transceiver
17A	SFP-17A single fiber GbE transceiver
17B	SFP-17B single fiber GbE transceiver
20	SFP-20 GbE transceiver
22A	SFP-22A single fiber GbE transceiver
22B	SFP-22B single fiber GbE transceiver
9F	SFP-9F FE transceiver
9G	SFP-9G GbE transceiver
UTP	Built-in 10/100BaseT

+2 Network/user interface type:
See the network interface ordering options above

+3 User interface type:
See the network/user interface ordering options above

Table 1. Valid Port Combinations

Network	Network/User	User
Null	Null	Null
Null	Null	UTP
Null	UTP	UTP
UTP	UTP	UTP
UTP	UTP	Null
UTP	Null	Null

Note: *The Null option in Table 1 can be replaced with any SFP transceiver supported by IPmux-216.*

SUPPLIED ACCESSORIES

Power cord

AC/DC adapter plug

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

OPTIONAL ACCESSORIES

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

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

CBL-DB9F-DB9M-STR
Control port cable

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