IPmux-16

TDM Pseudowire Access Gateway

TDMoIP Driven®

FEATURES

- Modular TDM pseudowire access gateway extending up to sixteen E1/T1 or two E3/T3, or two channelized T3 (CT3) circuits over packet-switched networks (PSNs)
- Built on TDMoIP technology, implementing the emerging IETF, MFA Forum and ITU-T standards for Pseudowire Emulation Edge-to-Edge (PWE3)
- Simple transport solution for voice, video and data over PSNs
- Point-to-point and point-to-multipoint applications
- Transparent to protocols and signaling that run over E1/T1/E3/T3/CT3

- Transports E1/T1/E3/T3/CT3 (DS1) frames or DS0 bundles over the network according to IP addressing
- Integrated DS0 level grooming and cross-connect between E1 or T1 ports
- Single or dual 10/100BaseT or 100BaseFx uplink to the network, with redundancy at the Ethernet link and module levels
- QoS support:
  - Labeling IP level priority Type of Service (ToS)
  - VLAN tagging and priority labeling according to IEEE 802.1p&Q
- Low processing delay (under 2 msec)
- Compensates for packet delay variation of up to 42 msec
- Redundant, hot-swappable power supplies

- Management capabilities: SNMP, Telnet, TFTP and XMODEM with enhanced management tools and features
- Provisioning and monitoring of TDMoIP services via the RADview Service Center TDMoIP network management application
- Compact, 1.5U-high, 19-inch rack mountable enclosure, two TDM service slots, two PSN slots and two power supply slots

DESCRIPTION

- IPmux-16 provides a compact, simple to configure, easily scalable solution for transporting TDM E1/T1, E3/T3 or channelized T3 (CT3) services over IP and Ethernet-based networks.
- IPmux-16 can be located at a central site or POP, aggregating TDMoIP traffic from multiple sources.

IPmux-16

TDM Pseudowire Access Gateway

- The primary benefit of IPmux-16 is transparent E1/T1 and E3/T3/CT3 connectivity over Layer 2/3 packet networks, both in carrier and enterprise environments.

- The data streams of up to sixteen E1/T1 or up to two E3/T3, or up to two CT3 ports are converted into packets for transmission over the network. The addressing scheme of these packets is IP-based. The packets are transmitted via the Ethernet modules to the network. A remote TDMoIP gateway converts the IP packets back to TDM traffic.

- IPmux-16 is a standard IP device, supporting ICMP (ping), ARP, next hop and default gateway capabilities.

- The operation complies with the IETF TDMoIP protocol, working in conjunction with Gmux-2000, IPmux-1E, IPmux-11, IPmux-14, IPmux-8 and Megaplex ML-IP.

- A dry contact alarm port also serves as a general-purpose input port. The alarms are classified into three categories, stored in the event log, and can generate a system trap that is sent to an NMS.

PERFORMANCE

- IPmux-16 achieves minimal end-to-end processing delay, using high-performance buffering and forwarding techniques.

- IP packet size is configurable. Greater packet length results in greater processing delay, yet a smaller bandwidth overhead.

- An enhanced buffering mechanism compensates for packet delay variation (jitter) of up to 42 msec.

QoS SUPPORT

- VLAN tagging and priority labeling are implemented according to 802.1p&Q.

- VLAN-based user traffic is separated by attaching a dedicated VLAN tag to every TDMoIP circuit, and a dedicated VLAN for managing the device.

- Type of Service (ToS) of the outgoing IP frames is user-configurable. This allows an en-route Layer 3 router or switch, which supports ToS (or Diffserv), to give higher priority to the TDMoIP traffic for delay-sensitive applications.

- Assigned, IANA-registered UDP socket number for TDMoIP simplifies flow classification through switches and routers.

OPERATION MODES

- Two types of service are offered:
  - **Unframed**: Full E1/T1 or E3/T3 circuits are transparently extended across the network, regardless of framing structure. Channelized T3 supports up to 28 unframed T1 streams.
  - **Framed**: IPmux-16 can be configured on a per-timeslot basis for fractional E1/T1 services over the packet network. CAS is supported.
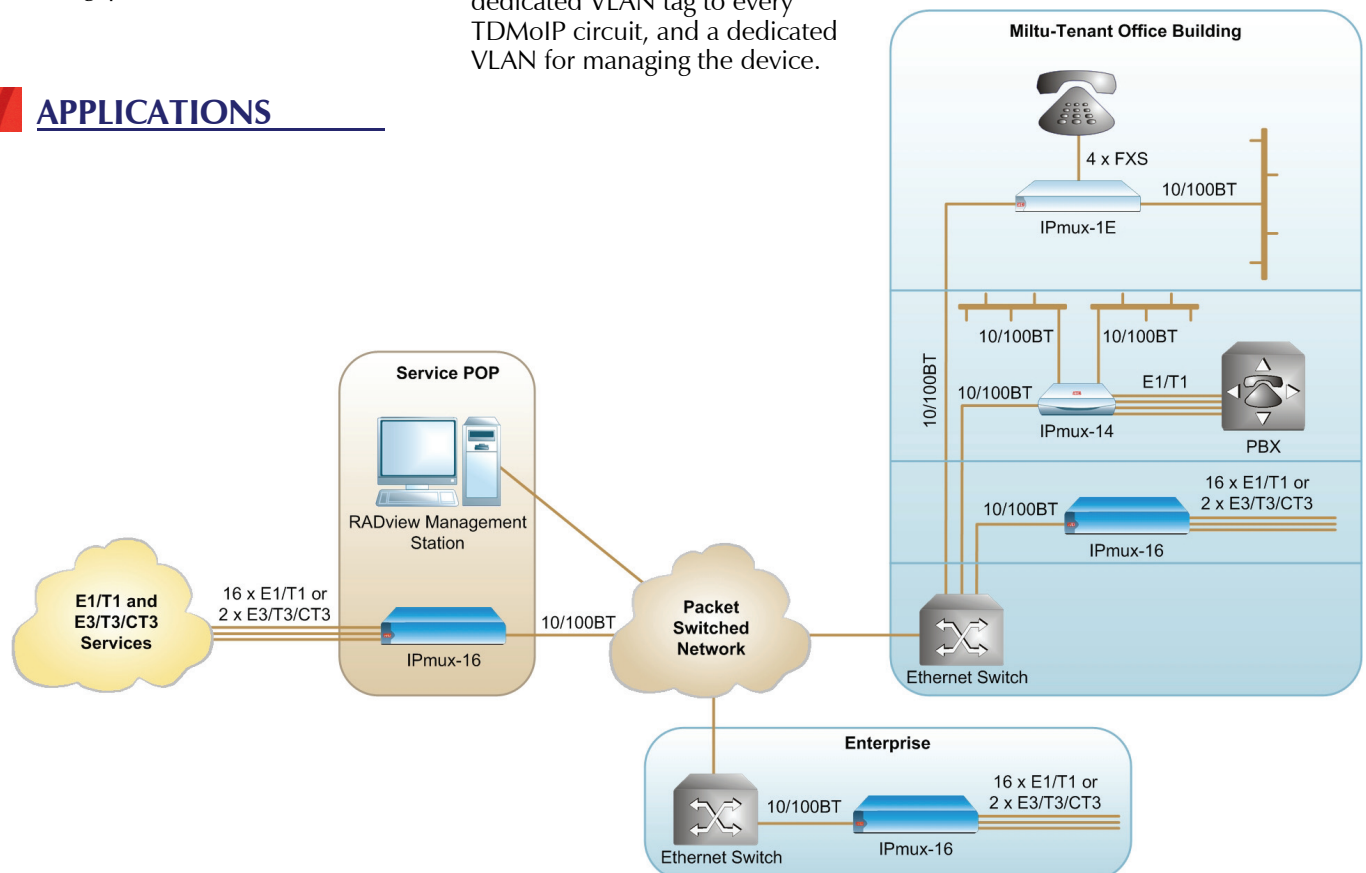
APPLICATIONS

Figure 1. Extending E1/T1 or E3/T3-Based Services over a Packet Switched Network

- Multibundling (grouping timeslots originating from a specific E1 or T1 port) can be performed for up to 31 bundles per E1 port and 24 bundles per T1 port for transport over the network. Both mesh and star topologies are supported.

- IPmux-16 allows DS0 cross-connect between its E1/T1 ports.

- 1:1 bundle redundancy is used to back up TDMoIP traffic in case of a bundle connection or TDM interface failure.

TIMING

- IPmux-16 maintains synchronization between TDM devices by deploying advanced clock distribution mechanisms. The clocking options are:
  - Internal: The IPmux-16 internal oscillator provides the master clock source for the TDM circuit.
  - Loopback: The transmit clock is derived from the respective port's receive clock.
  - Adaptive: The clock is recovered from the Ethernet network interface.
  - External: An optional station clock port can be used to synchronize E1/T1 interfaces.

ETHERNET MODULES

- One or two 1- or 4-port Ethernet modules can be installed in the IPmux-16 chassis, providing links to the packet network.

- Each module supports the following combinations of the 10/100BaseT or 100BaseFx ports:
  - 1-port Ethernet module, one network port per module
  - 4-port Ethernet module, four ports per module (one network and three user ports).

- The 4-port Ethernet modules use hot-swappable fiber optic SFP transceivers (up to two fiber optic ports per module).

- The Ethernet modules re-order packets that arrive from the network to ensure an uninterruptible TDM service.

- IPmux-16 units equipped with two Ethernet modules provide Ethernet network link redundancy.

- 4-port Ethernet modules support switching, rate limiting and VLAN stacking.

E1 AND T1 MODULES

- Each E1 or T1 module features either four or eight E1 or T1 interfaces for connecting IPmux-16 to any standard E1 or T1 device.

- Integral LTU/CSU can be enabled for line protection and long haul applications.

- Alarm detection and insertion are supported together with error statistics. SES/UAS statistics, LOS/AIS physical layer alarms and local/remote loopback tests are all supported. Standard E1/T1 alarms are transmitted end-to-end.

CHANNELIZED T3 MODULES

- A channelized T3 (CT3) module converts T3 service signals into 28 unframed T1 streams, and each T1 stream into IP frames that are sent via a Fast Ethernet network.

E3 AND T3 MODULES

- Each E3 or T3 module features a single, standard E3 or T3 interface.

- Alarm detection and insertion are supported together with error statistics. SES/UAS statistics, LOS/AIS physical layer alarms and local/remote loopback tests are supported. Standard E3 or T3 alarms are transmitted end-to-end.

POWER SUPPLY

- Modular hot-swappable power supplies of the chassis support carrier environments.

DIAGNOSTICS & MANAGEMENT

- IPmux-16 supports local and remote loopback tests. End-to-end alarm generation and end-to-end AIS indication are also provided. If a local E1/T1 port receives AIS, it is reported to the remote port via the Ethernet/IP network. If a local Ethernet port is disconnected, an AIS indication is generated both in the local and remote devices.

- SES and UAS statistics are collected in 15-minute intervals and are stored for 24 hours (96 intervals). E1/T1 physical layer alarms (LOS, AIS, LOF, LCV) are also supported.

- A dry contact alarm port allows the device to send/receive alarms by opening/closing the contact between the connector pins.

- An internal built-in test (BIT) is performed after power-up. The results of the test are displayed at the local terminal.
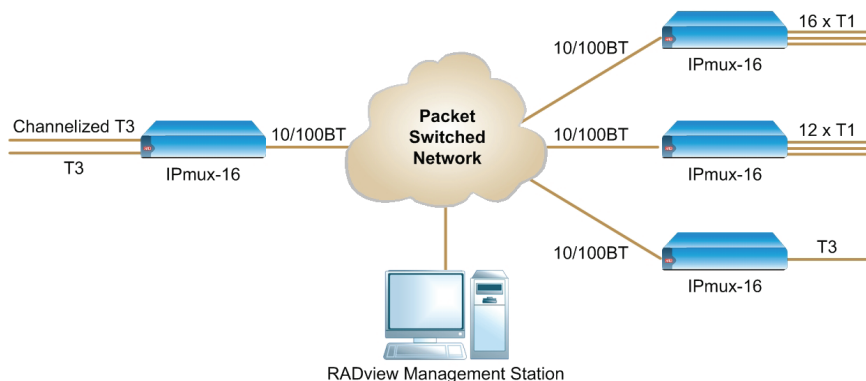

Figure 2. Extending T1 and T3 Circuits over IP/Ethernet

- IPmux-16 monitors LAN and IP layer network condition statistics, such as packet loss and packet delay variation (jitter). The events are stored in log files and generate SNMP traps.

- IPmux-16 can be configured and monitored:
  - Locally, via an ASCII terminal
  - Remotely, via Telnet or SNMP-based management software (RADview Service Center TDMoIP).

- RADview Service Center TDMoIP network management application provides TDMoIP service and manages the TDMoIP devices via a user-friendly graphical interface that allows monitoring and configuring multiple IPmux devices. Fault isolation, statistics and events gathering are available. The intuitive GUI, "point-and-click" functionality and easy-to-follow wizards increase the efficiency and accuracy of the service provisioning process.

- Software can be downloaded locally, using XMODEM protocol, or remotely, using TFTP. After downloading a new version of software, IPmux-16 automatically saves the previous version in non-volatile memory for backup purposes. Similarly, copies of the configuration file may be downloaded/uploaded to a remote workstation for backup and restore purposes.

SPECIFICATIONS

ETHERNET INTERFACE

- **Number of Ports**
  - 1-port Ethernet module: 1 per module (network)
  - 4-port Ethernet module: 4 per module (1 network and 3 user ports)

- **Standards**
  IEEE 802.3, 802.3u, 802.1p&Q
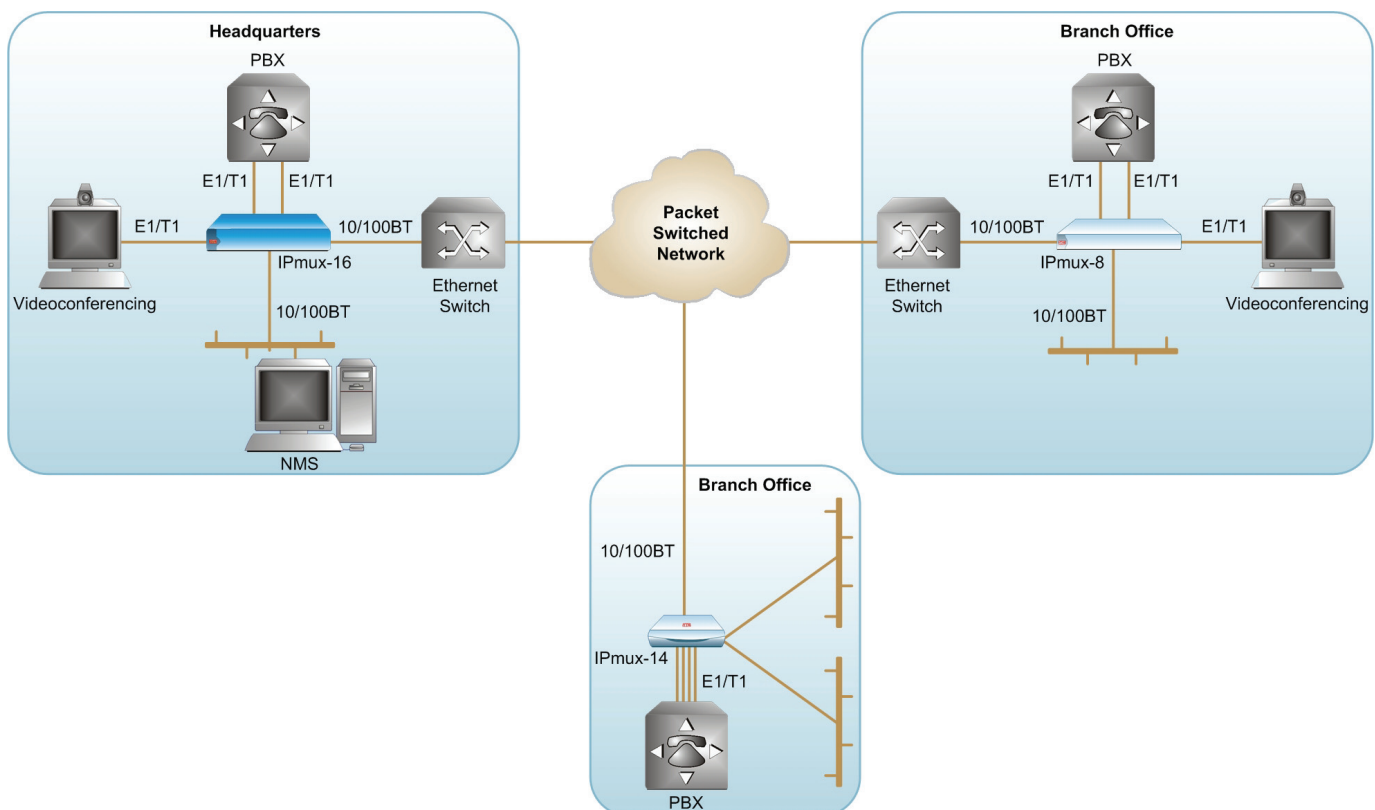
- **Maximum Frame Size**
  1536 bytes

- **Data Rate**
  10 or 100 Mbps, full duplex

- **Number of Modules**
  Up to 2 per unit

- **Connector (UTP)**
  RJ-45, 8-pin

- **Fiber Optic**
  1-port Ethernet modules:
  - 1310 nm multimode laser: 2 km (1.2 mi)
  - 1310 nm single mode laser: 15 km (9.3 mi)

  4-port Ethernet modules:
  - SFP-1: 1310 nm multimode LED, 2 km (1.2 miles)
  - SFP-2: 1310 nm single mode laser, 15 km (9.3 miles)
  - SFP-3: 1310 nm single mode laser, 40 km (24.8 miles)
  - SFP-4: 1550 nm single mode laser, 80 km (49.7 miles)

  Note: For detailed specifications of the SFP transceivers, see the SFP Transceivers data sheet.

Figure 3. Enterprise Connectivity over Campus or Metro Area Networks

ETHERNET MANAGEMENT INTERFACE

- **Number of Ports**
  1

- **Standards**
  IEEE 802.3, 802.34

- **Date Rate**
  10 Mbps full/half duplex

- **Connector**
  RJ-45, 8-pin

E1 INTERFACE

- **Number of Ports**
  4 or 8 ports per module,
  up to 2 modules per unit

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

- **Framing**
  Unframed, CRC-4 MF, CAS MF

- **Data Rate**
  2.048 Mbps

- **Line Code**
  HDB3

- **Receive Level**
  0 to -32 dB with LTU
  0 to -10 dB without LTU

- **Transmit Level**
  ±3V ±10%, balanced
  ±2.3V ±10%, unbalanced

- **Line Impedance**
  120Ω, balanced
  75Ω, unbalanced

- **Jitter Performance**
  Per ITU-T G.823

- **Connector**
  - RJ-45, 8-pin, balanced
  - BNC, unbalanced
    (via adapter cable)

T1 INTERFACE

- **Number of Ports**
  4 or 8 ports per module,
  up to 2 modules per unit

- **Standards**
  - AT&T TR-62411
  - ITU-T Rec. G.703, G.704
  - ANSI T1.403

- **Data Rate**
  1.544 Mbps

- **Line Code**
  AMI, B8ZS, B7ZS

- **Framing**
  Unframed, SF, ESF

- **Receive Level**
  0 to -30 dB

- **Transmit Level**
  ±2.7V ±10% at 0 to 655 ft
      with DSU
  0 dB, -7.5 dB, -15 dB, -22.5 dB
      with CSU

- **Line Impedance**
  100Ω, balanced

- **Jitter Performance**
  Per AT&T TR-62411

- **Connector**
  RJ-45, 8-pin

E3 INTERFACE

- **Number of Ports**
  1 per module, up to 2 modules
  per unit

- **Data Rate**
  34.368 Mbps

- **Line Code**
  HDB3

- **Line Impedance**
  75Ω, unbalanced

- **Standards**
  Receive and transmit signal levels
  according to G.703

- **E3 Framing**
  Unframed

- **Jitter Performance**
  Per G.823

- **Connector**
  BNC

T3 INTERFACE

- **Number of Ports**
  1 per module, up to 2 modules
  per unit

- **Data Rate**
  44.736 Mbps

- **Line Code**
  B3ZS

- **Line Impedance**
  75Ω, unbalanced

- **Standards**
  Receive and transmit signal levels
  according to ANSI T1.102 and
  Bellcore TR-NWT-000499

- **T3 Framing**
  Unframed

- **Jitter Performance**
  Per Bellcore TR-NWT-000499

- **Connector**
  BNC

CHANNELIZED T3 INTERFACE

- **Number of Ports**
  1 per module, up to 2 modules
  per unit

- **Standards**
  - Telcordia GR-253, GR-499
  - ANSI T1.102, T1.404
  - ITU-T G.703, G.755, G.824,
    G.151
  - AT&T TR54014

- **Data Rate**
  44.736 Mbps

- **Line Code**
  AMI, B3ZS

- **Line Impedance**
  75Ω, unbalanced

- **Connector**
  BNC

TERMINAL CONTROL INTERFACE

- **Type**
  RS-232/V.24 (DTE)

Note: Cross-cable for terminal connection is supplied.

- **Data Rate**
  9.6, 19.2, 38.4, 57.6, or
  115.2 kbps,

- **Connector**
  9-pin, D-type, male

IPmux-16

TDM Pseudowire Access Gateway

GENERAL

- **Chassis**
  Carrier-class, NEBS-compliant

- **Power**
  PSUs: Up to 2 redundant
    hot-swappable AC/AC, DC/DC
    or AC/DC power supplies
  AC: 100 to 240 VAC, 50/60 Hz
  DC: -40 to -72 VDC
    (-48 VDC nominal)

- **Power Consumption**
  75W max

- **Physical**
  Height: 760 mm (3.0 in)
  Width: 432 mm (17 in)
  Depth: 343 mm (13.5 in)
  Weight: 5.9 kg (13 lb)
  (depending on interface module
  combinations)

- **Environment**
  Operating temperature:
    0 to 50°C (32 to 122°F)
  Storage temperature:
    -20 to 70°C (32 to 110°F)
  Humidity: Up to 90%,
              non-condensing

ORDERING

IPMUX-16/#/&/*
TDM pseudowire access gateway

Specify station clock port
(optional, default is none):
  E1 for 2.048 Mbps clock port
  T1 for 1.544 Mbps clock port

& Specify power supply type:
  AC for 100 to 240 VAC
  48 for -48 VDC
  AC/48 for 100 to 240 VAC with
    redundant -48 VDC power
    supply

* Specify **R** for redundant identical
power supply

INTERFACE MODULES

*Note: At least one E1/T1 module and one
Ethernet module must be ordered per IPmux-16
chassis.*

IPMUX-M/^/%
IPmux-16 TDM module

^ Specify TDM interface type:
  E1 for balanced E1 interface, RJ-45
  T1 for balanced T1 interface, RJ-45
  E1CX for unbalanced E1 interface,
    RJ-45 (adapter cable is supplied)
  E3 for E3 interface, BNC
  T3 for T3 interface, BNC
  CT3 for channelized T3 interface,
    BNC

% Specify number of ports for E1
  and T1 module:
  4 for four ports
  8 for eight ports

IPMUX-M/ETH/~
1-port Ethernet module

~ Specify Ethernet network port type:
  UTP for 10/100BaseT interface,
    RJ-45
  MM-LC for 100BaseFx interface,
    multimode fiber, LC
  SM-LC for 100BaseFx interface,
    single mode fiber, LC

IPMUX-M/4ETH/4UTP
4-port Ethernet module with
4 copper ports

IPMUX-M/4ETH/@/3UTP
4-port Ethernet module with 1 SFP
fiber optic and 3 copper ports

IPMUX-M/4ETH/@/@/2UTP
4-port Ethernet module with 2 SFP
fiber optic and 2 copper ports

@ Specify SFP transceiver type:
  SFP-1 for 1310 nm multimode
    LED, 2 km (1.2 miles)
  SFP-2 for 1310 nm single mode
    laser, 15 km (9.3 miles)
  SFP-3 for 1310 nm single mode
    laser, 40 km (24.8 miles)
  SFP-4 for 1550 nm single mode
    laser, 80 km (49.7 miles)
  NULL for empty port slot

SUPPLIED ACCESSORIES

AC power cord for each ordered AC
power supply

DC connection kit for each ordered
DC power supply

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

CBL-DB9/DB9/NULL
Control port cross-cable

RM-27
Hardware kit for mounting one
IPmux-16 unit into a 19-inch rack