

IPmux-16

TDMoIP® Gateway



TDMoIP®
Driven

FEATURES

- Carrier-class, NEBS-compliant, modular TDMoIP gateway
- Extends up to sixteen E1/T1 or two E3/T3, or two channelized T3 (CT3) circuits over IP and Ethernet-based networks
- Fully supports TDM-based services by maintaining synchronization over any packet-switched network (Ethernet, IP or MPLS)
- Simple transport solution for voice, video and data over IP
- Point-to-point and point-to-multipoint applications
- Transparent to protocols and signaling that run over E1/T1/E3/T3
- E1/T1/E3/T3 frames or DS0 bundles are transported 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 network delay variation
- 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

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

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- The primary benefit of IPmux-16 is allowing transparent E1/T1 and E3/T3 connectivity over Layer 2/3 packet networks, both in carrier and enterprise environments.
- IPmux-16 converts data streams of up to sixteen E1/T1 or up to two E3/T3, or up to two CT3 ports and converts them 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.
- IPmux-16 complies with the TDMoIP protocol, working in conjunction with RAD's IPmux-1E, IPmux-11, IPmux-14, IPmux-8, Megaplex ML-IP, Kilomux KML.11, and other third-party products that implement the TDMoIP protocol.

- IPmux-16 features a dry contact alarm port that can serve 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 end-to-end processing delay as low as 1.7 msec, 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:
 - 32 msec for E1
 - 24 msec for T1
 - 20 msec for E3/T3
 - 42 msec for internal T1 in CT3.

QoS SUPPORT

- IPmux-16 supports VLAN tagging and priority labeling according to 802.1p&Q.
- VLAN-based user traffic is separated by applying 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.

APPLICATIONS

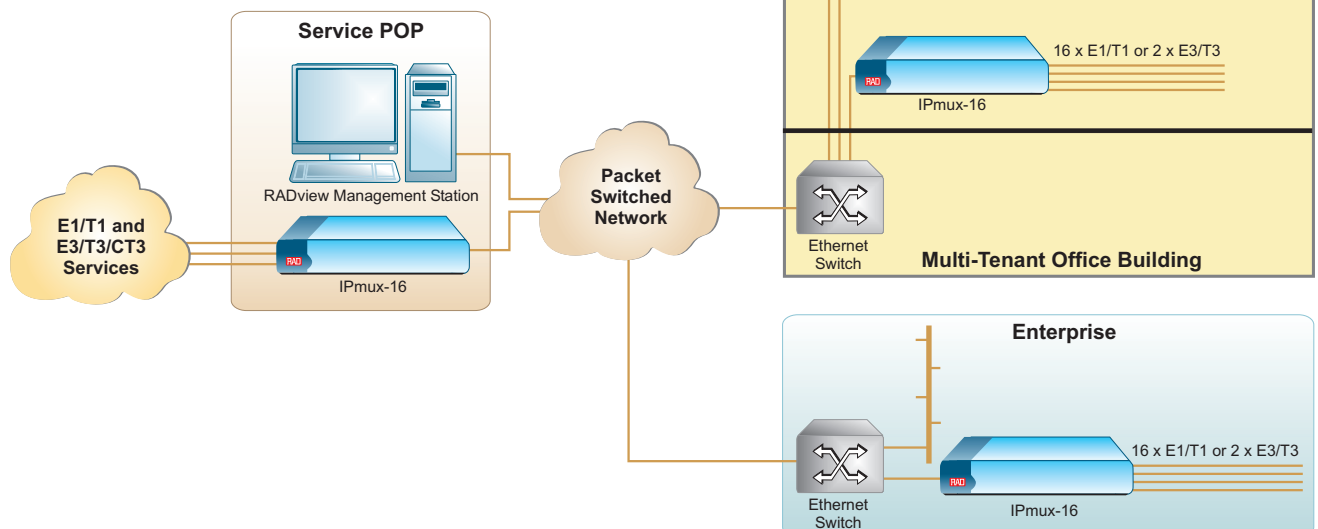


Figure 1. Extending E1/T1 or E3/T3-Based Services over a Packet Switched Network

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.
 - **Framed:** IPmux-16 can be configured on a per-timeslot basis for fractional E1/T1 services over the packet network. CAS is supported.
- 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 internal bundle cross-connect.

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

- Two Ethernet modules can be installed in the IPmux-16 chassis, providing the uplink to the packet network.
- Ethernet link redundancy to the network is supported when IPmux-16 is equipped with two Ethernet modules.
- Each module supports a single 10/100BaseT or 100BaseFx port.
- The network Ethernet modules re-order packets arriving from the network in the wrong order.

E1 AND T1 MODULES

- Each E1 or T1 module features either four or eight E1 or T1 interfaces, which enable connectivity 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 remote/local 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 remote/local 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. The maximum power supplied by one unit is 75W with maximum power consumption of 57W.

DIAGNOSTICS & MANAGEMENT

- IPmux-16 supports remote and local loopback testing. 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 the 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.

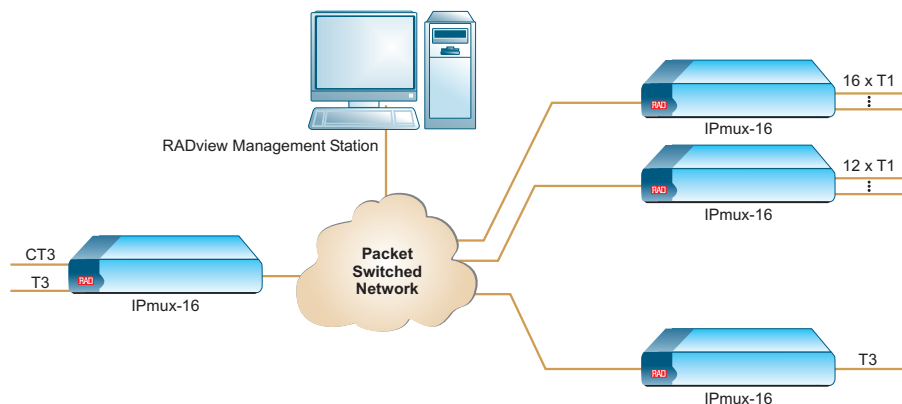


Figure 2. Extending T1 and T3 Circuits over IP/Ethernet

- A dry contact alarm port allows the device to send/receive alarms by opening/closing the contact between the connector pins.
- 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.
- An internal built-in test (BIT) is performed after power-up. The results of the test are displayed at the local terminal.
- Software download is supported locally using XMODEM, or remotely, using TFTP protocols. 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.
- 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 display that allows monitoring and configuring multiple IPmux devices. Fault isolation, statistics and events gathering are available. 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.

SPECIFICATIONS

ETHERNET INTERFACE

- **Number of Ports**
1 per module
- **Standards**
IEEE 802.3, 802.3u, 802.1p&Q
- **Data Rate**
10 or 100 Mbps, full-duplex
- **Range**
Up to 100m (328 ft) on Cat. 5 UTP
- **Fiber Optic Options**
 - Characteristics: see *Table 1*
 - Connector: LC
- **Connector**
RJ-45, 8-pin

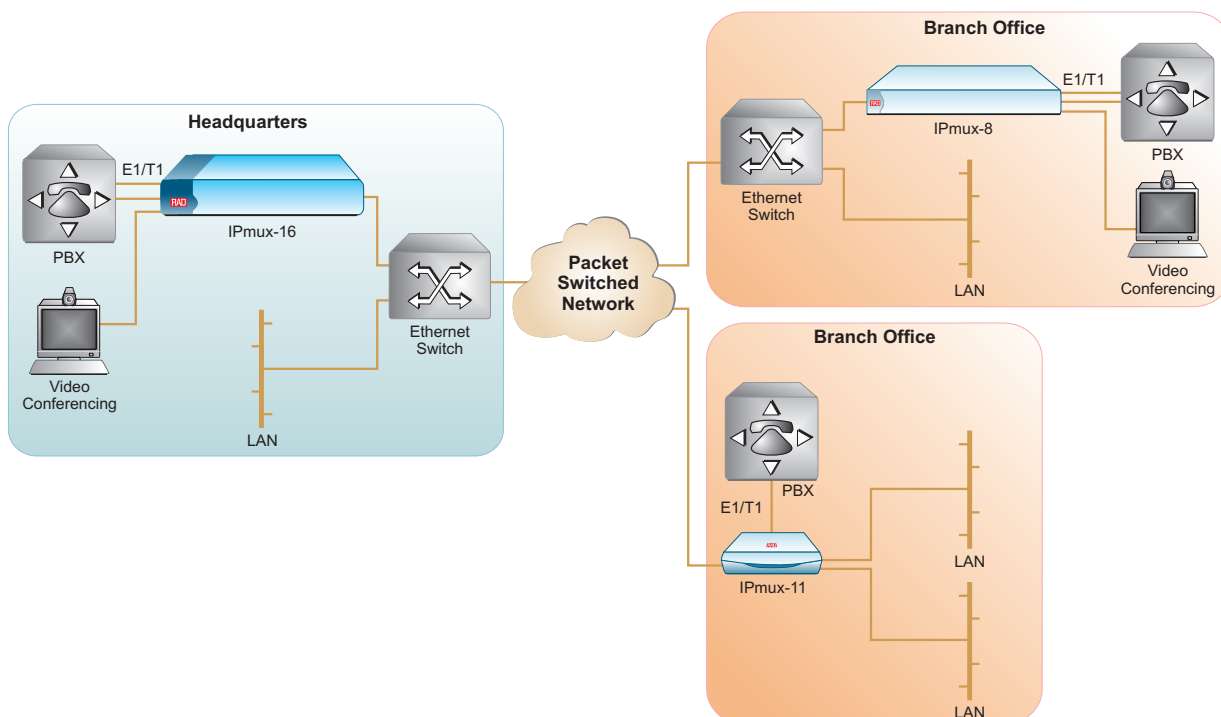


Figure 3. Enterprise Connectivity over Campus or Metro Area Networks

ETHERNET MANAGEMENT INTERFACE

- **Number of Ports**
1
- **Standards**
IEEE 802.3, 802.34
- **Date Rate**
10 Mbps full/half-duplex
- **Range**
Up to 100m (328 ft) on Cat. 5 UTP
- **Connector**
RJ-45, 8-pin

E1 INTERFACE

- **Number of Ports**
4 or 8 ports per module
- **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**
Balanced: $\pm 3V \pm 10\%$
Unbalanced: $\pm 2.3V \pm 10\%$
- **Line Impedance**
120 Ω , balanced
75 Ω , unbalanced
- **Jitter Performance**
Per ITU-T G.823
- **Connector**
Balanced: RJ-45, 8-pin
Unbalanced: RJ-45 (RJ-45 to BNC adapter cable is supplied)

T1 INTERFACE

- **Number of Ports**
4 or 8 ports per module
- **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**
 $\pm 2.7V \pm 10\%$ at 0 to 655 ft
with DSU
0 dB, -7.5 dB, -15 dB, -22.5 dB
with CSU
- **Line Impedance**
100 Ω , balanced
- **Jitter Performance**
Per AT&T TR-62411
- **Connector**
RJ-45, 8-pin

E3 INTERFACE

- **Number of Ports**
1 per module
- **Data Rate**
34.368 Mbps
- **Line Code**
HDB3
- **Line Impedance**
75 Ω , unbalanced
- **Standards**
Receive and transmit signal levels according to G.703
- **E3 Framing**
Unframed
- **Jitter Performance**
Per G.823
- **Connector**
BNC

Table 1. Fiber Optic Interface Characteristics

Type	Connector	Optical Power [dBm]		Receive Sensitivity [dBm]		Loss [dB/km]		Typical Range [km] [miles]	
		Min	Max	Min	Max	Min	Max		
Multimode	LC	-19	-14	-32	-8	1	4	2	1.2
Single mode	LC	-15	-8	-28	-8	0.5	0.8	15	9.3



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T3 INTERFACE

- **Number of Ports**
1 per module
- **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
- **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 MANAGEMENT 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

GENERAL

- **Power**
AC: 100 to 240 VAC, 50/60 Hz
DC: -40 to -72 VDC
(-48 VDC nominal)
Note: IPmux-16 supports redundant hot-swappable power supplies.
- **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

UNIT CHASSIS

IPMUX-16/#/&/*
TDMoIP 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 (RJ-45 to BNC 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/*

Ethernet network 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



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