



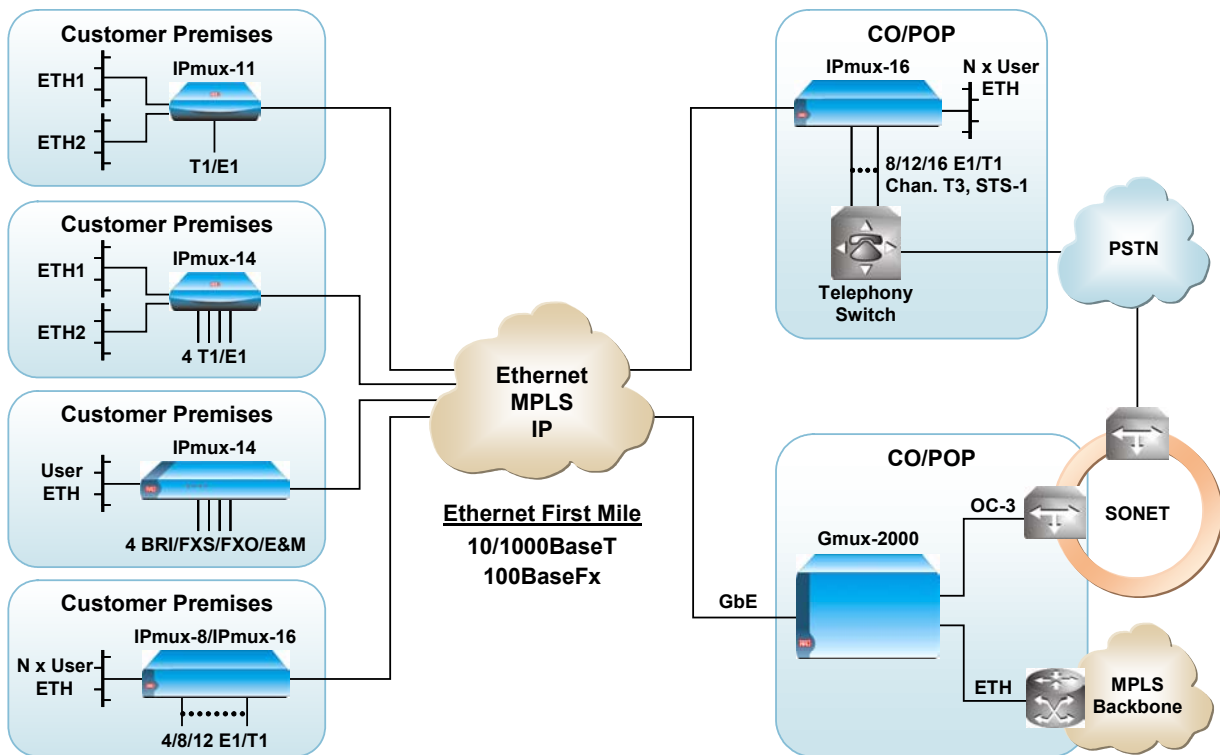
E1/T1 Services over IP, Ethernet & MPLS

This document describes a unique solution for extending E1/T1 and E3/T3 circuits transparently across IP, Ethernet and MPLS networks. Service providers can offer revenue-generating leased-line services while minimizing capital and operating expenses:

- Capital expenses are minimized with RAD's new cost-effective, ASIC-based TDMoIP® gateways
- Operating expenses are minimized by leveraging the efficiencies and ubiquity of IP, Ethernet and MPLS

Solution:

TDMoIP® (Time Division Multiplexing over Internet Protocol) is a patented transport technology, developed by RAD, that enables service providers to inexpensively offer leased-line services, such as E1/T1 and E3/T3 voice, video and data, over IP/Ethernet/MPLS networks. TDMoIP enables these services to be delivered without compromising the reliability and quality that customers expect of leased-line services. TDMoIP is enjoying growing popularity as service providers migrate from legacy to next generation networks.



Solution Benefits:

- New service revenues: Service providers with IP, Ethernet or MPLS infrastructures can offer protocol-transparent E1/T1 or E3/T3 circuits (i.e., TDM leased line services for voice, H.320 video, ATM, Frame Relay, etc.)
- Low cost deployment with quick return on investment (ROI):
 - TDMoIP equipment costs less than \$1,000 per E1/T1 link (includes IPmux at both ends.)
 - Ethernet, IP and MPLS infrastructures are inexpensive, fast to provision and easily scalable.
 - Easy installation with simple, low cost IP-based management and diagnostics (SNMP, Telnet, TFTP, Ping, etc.).
- Protects investment in traditional telephony and TDM data equipment and avoids expensive upgrades.
- Provides IP mobility for E1/T1 circuits and better disaster recovery with 1+1 and 1:1 redundancy.
- Additional bandwidth: Customers get more bandwidth for the buck with E1/T1 and E3/T3 bundled into an Ethernet access service, rather than vice versa.

Next Generation service providers can create a competitive advantage over incumbent local exchange carriers by utilizing efficient packet-based delivery mechanisms to bundle T1 or E1 with switched Ethernet into new service packages.

How TDMoIP Works:

TDMoIP emulates T1, E1, T3, E3, N*64K links by *adapting* and *encapsulating* the TDM traffic. Adaptation denotes mechanisms that modify the payload to enable its proper restoration at the PSN egress. By using proper adaptation, the TDM signaling and timing can be recovered, and a certain amount of packet loss can be accommodated. Encapsulation signifies placing the adapted payload into packets of the format required by the underlying PSN. TDMoIP encapsulations are presently defined for User Datagram Protocol (UDP)/IP, MPLS and Layer 2 Tunneling Protocol (L2TP)/IP networks, and even pure Ethernet can be utilized with minimal adjustments.

RAD's IPmux Product Line:

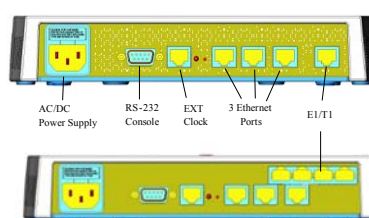
RAD's [IPmux family](#) of TDMoIP gateways transparently extends TDM circuits over new packet-switched networks (IP, Ethernet, MPLS). The IPmux family of TDMoIP gateways handles the full range of TDM interfaces including full, fractional and unframed E1/T1, unframed E3/T3, Channelized E3/T3 and OC-3/STS-1. RAD's new IPmux-11 and IPmux-14 products provide industry-leading price-performance, especially when deployed in conjunction with the IPmux-16 featuring new channelized T3 capabilities or the carrier-class Gmux-2000 that concentrates up to 168 T1 or 126 E1, or 12 E3/T3 links from several sites onto two 155 Mbps STM-1/OC-3 trunks. The IPmux-11 accepts single T1 or E1 input along with dual user Ethernet feeds with traffic management capabilities such as rate limiting, prioritization, etc. The IPmux-14 has the same capabilities as the IPmux-11, but can accept up to four T1 or E1 inputs. In addition, the IPmux product line also includes the lower density IPmux-8 that supports four or eight E1/T1 and the IPmux-1E that includes analog FXS, FXO and E&M interfaces, as well as RADview-HPOV for SNMP-based network management.



IPmux-16 Rear Panel (16 T1 option)



IPmux-16 Rear Panel (Dual T3 option)



IPmux-11 and IPmux-14 Rear Panels

TDMoIP Standardization

TDMoIP standardization is proceeding in several standards bodies and technical forums. In the Internet Engineering Task Force (**IETF**), this work is being carried out under the aegis of the Pseudo-Wire Emulation Edge-to-Edge (PWE3) working group. RAD's TDMoIP complies with TDMoIP/PWE3 and will soon comply with SAToP. In the **MPLS/ Frame Relay Alliance**, TDMoIP has been divided into two proposed implementation agreements, "TDM Transport over MPLS using AAL1" and "I.366.2 Voice Trunking over MPLS". RAD's TDMoIP conforms to implementation agreement I.A 4.0 (TDM over MPLS using AAL1*).

A similar division exists in the **ITU-T**, where Study Group 13 has developed a recommendation for "TDM-MPLS Interworking" called Y.1413. RAD's TDMoIP conforms to this recommendation. In addition RAD is the main contributor for voice services over MPLS, which includes the AAL2 mode (work also being done within SG-13).

Conclusion

TDMoIP technology supports all current PSTN features while effectively utilizing shared bandwidth IP/Ethernet or IP/MPLS networks. Service providers seeking new sources of revenue from their packet-switched networks and enterprises seeking a simple and robust migration path to voice/data convergence can employ TDMoIP to realize these goals.

About RAD:

Since 1981, RAD Data Communications has served both service providers and enterprises through the design and manufacture of unique access solutions for a wide variety of TDM, IP, ATM and fiber-based networks.

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