

IPmux-2L

TDM Pseudowire Gateway



Legacy over PSN
solution for
transmitting E1
streams over packet
switched networks

TDM IP
Driven®

- Comprehensive compliance with pseudowire/circuit emulation standards including TDMoIP, CESoPSN, SAToP and HDLCoPSN
- Built on TDMoIP technology, implementing IETF, MFA Forum, ITU-T for Pseudowire Emulation Edge-to-Edge (PWE3)
- E1 and serial traffic emulation over MPLS, IP and Ethernet networks
- Transmission of both framed (full or fractional) and unframed E1 traffic

IPmux-2L is a TDM pseudowire access gateway extending TDM-based services over packet switched networks. It also serves as an Ethernet-based access device.

PSEUDOWIRE PERFORMANCE

The unit provides a legacy over PSN solution for transmitting E1 streams over packet switched networks (PSNs). The device converts the data stream from its user E1 and high-speed data ports into packets for transmission over the network. The addressing scheme of these packets is IP or MPLS.

These packets are transmitted via the IPmux-2L Ethernet network port to the PSN. A remote pseudowire device converts the packets back to TDM traffic.

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

The unit employs various legacy over packet protocols, including TDMoIP, CESoPSN, SAToP and HDLCoPSN.

RAD

data communications

The Access Company

IPmux-2L

TDM Pseudowire Gateway

Preserves investment in legacy equipment in migration to PSN

High-performance ASIC-based buffering and forwarding techniques achieve minimal end-to-end processing delay. Configurable packet size balances PSN throughput and delay, while a jitter buffer compensates for packet delay variation (jitter) of up to 200 msec in the network.

An assigned, IANA-registered UDP port number for pseudowire simplifies flow classification through switches and routers.

CLOCKING

Synchronization between TDM devices is maintained by deploying advanced clock distribution mechanisms. The clocking options are:

- Internal – The IPmux-2L internal clock oscillator provides the master clock source for the TDM circuit
- Loopback – The transmit clock is derived from the TDM or serial data receive clock
- Adaptive – The clock is recovered from the PSN
- Receive – The system timing is locked to the clock received via one of the TDM ports or the third FE port (Sync-E option).

The system clock ensures a single clock source for all TDM links and uses master and fallback timing sources for clock redundancy. The system timing also supports two different clock sources from two TDM links at the same time.

TIMING OVER PACKET

IPmux-2L utilizes standard Synchronous Ethernet (Sync-E) technology to ensure highly accurate clock recovery over PSN (special ordering option). The clock operation conforms to ITU-T G.8261 requirements.

PSEUDOWIRE QoS

IPmux-2L performs VLAN tagging and priority labeling according to 802.1p&Q. Pseudowire packets are assigned a dedicated VLAN ID and 802.1p bit.

The ToS or Diffserv of the outgoing pseudowire packets are user-configurable. This allows assigning pseudowire packets a higher priority in IP networks.

EXP bits are used for QoS marking of the TDMoMPLS traffic in MPLS networks.

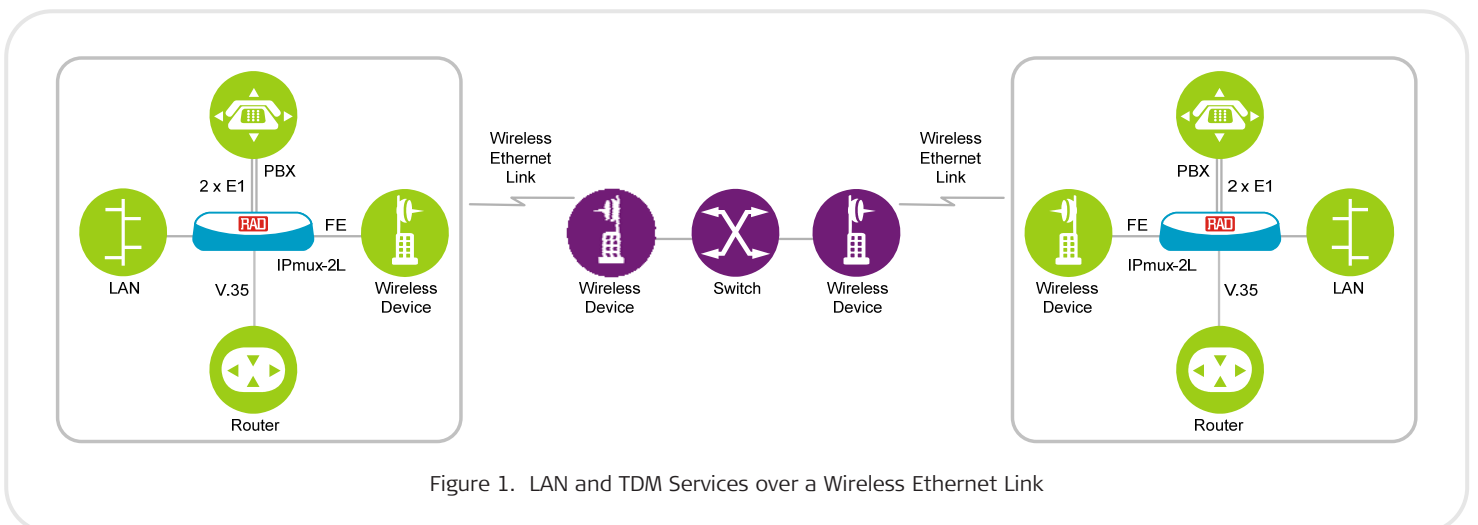


Figure 1. LAN and TDM Services over a Wireless Ethernet Link

TDM INTERFACE

One or two E1 ports provide connectivity to any standard E1 device.

E1 interfaces feature:

- Integral LTU for long haul applications
- G.703 unframed and G.704 framed modes
- CAS and CRC-4 bit generation (E1).

SERIAL INTERFACE

An IPmux-2L data port is available for an n×64 kbps serial connection to legacy equipment.

Provided via 25-pin D-type connector, the serial port features the following interfaces:

- X.21
- V.24/RS-232
- RS-530/RS-422
- V.35
- V.36/RS-449.

DCE/DTE modes are selected via adapter cables and IPmux-2L clock configuration.

Note: IPmux-2L can be ordered with serial data port only, with no E1 interfaces installed.

ETHERNET CAPABILITIES

IPmux-2L features an internal Layer-2 Ethernet switch with three Ethernet ports. The ports can be configured to operate as network or user interfaces.

Each Ethernet port features:

- Port-based rate limiting for bandwidth control
- Four priority queues (strict or weighted) for handling traffic with different service demands. Traffic is classified according to IP Precedence, 802.1P, DSCP or port default priority.
- Port-based VLAN membership for ingress traffic restriction
- Port-based VLAN tagging
- Double VLAN tagging (VLAN stacking)
- Bridging and filtering.

The device supports standard IP features, such as ICMP (ping), ARP, next hop and default gateway.

Lowers Opex of TDM service by utilizing packet infrastructure

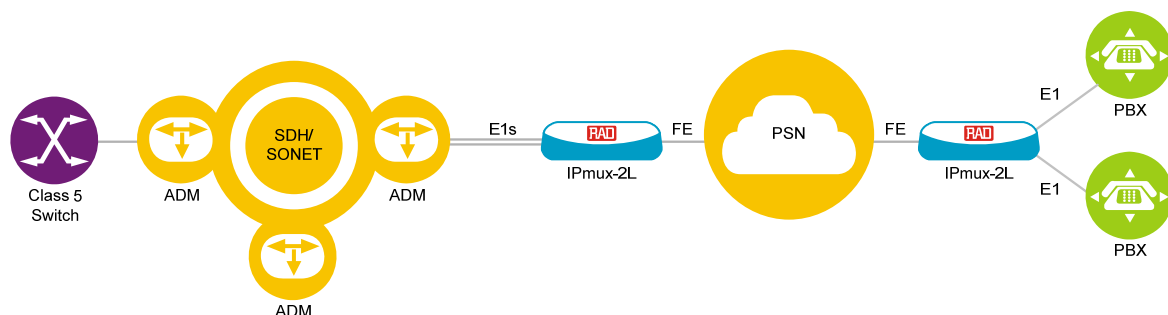


Figure 2. TDM Backhaul and Trunking over a PSN

IPmux-2L

TDM Pseudowire Gateway

Carrier-grade voice quality without compression, or silence suppression

MANAGEMENT

IPmux-2L can be configured and monitored locally via an ASCII terminal, or remotely via Telnet or Web browser.

Management traffic can run over a dedicated VLAN.

Software can be downloaded via a local terminal using XMODEM/YMODEM, or remotely, using TFTP. After downloading a new software version, IPmux-2L automatically saves the previous version in non-volatile memory for backup purposes. Also, copies of the configuration file may be downloaded and uploaded to a remote workstation for backup and restore purposes.

Current date and time are retrieved from a dedicated server, using SNTP.

DIAGNOSTICS

External and internal loopbacks check TDM and serial link connectivity.

A built-in internal and external BERT utility is used to monitor the TDM link quality.

Virtual Cable Test (VCT) checks the quality of Ethernet cables, connectors and terminations, identifying a cable break or short.

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

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 also available.

RAD's TDM PW OAM verifies connectivity and prevents pseudowire configuration mismatch.

DYING GASP

AC-powered units report power failures to defined network management stations by sending a trap, thus enabling the devices to properly disconnect from the network with notification of the reason for the service problem.

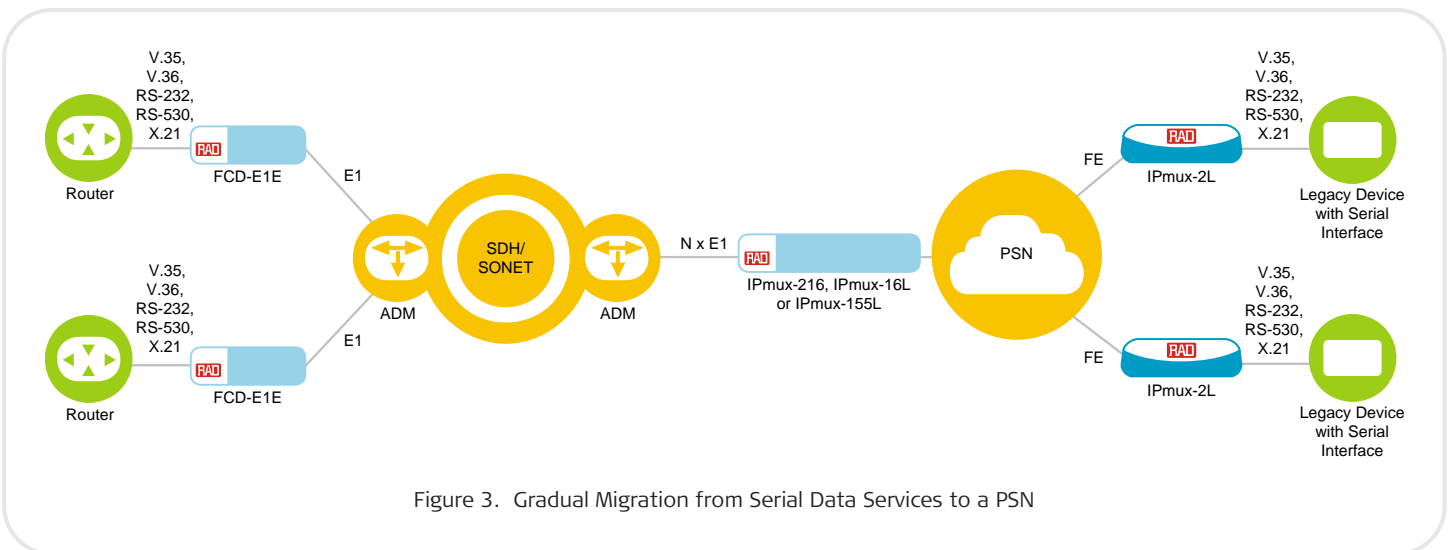


Figure 3. Gradual Migration from Serial Data Services to a PSN

Specifications

E1 INTERFACE

Number of Ports

1 or 2

Compliance

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

Data Rate

2.048 Mbps

Line Code

HDB3, AMI

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: $\pm 3V \pm 10\%$

Transmit unbalanced: $\pm 2.37V \pm 10\%$

Jitter and Wander Performance

Per ITU-T G.823

Connector

Balanced: RJ-45

Unbalanced: coax BNC

SERIAL INTERFACE

Number of Ports

1

Interface Type

X.21, V.24/RS-232, RS-530/RS 422, V.35, V.36/RS 449

Timing

DCE – IPmux-2L provides both Tx and Rx clock to the user equipment. Optionally, the incoming data can be sampled with an inverted clock.

DTE1 – IPmux-2L provides the Rx clock.

The attached user equipment provides the Tx clock.

DTE2 – The attached user equipment provides both Tx and Rx clocks.

Note: The X.21 interface supports DCE mode only.

The V.24 interface supports asynchronous DCE mode only.

Control Signals

CTS – constantly ON or follows RTS, user-selectable

DCD – constantly ON, unless a fault is detected in the PSN network

Data Rate

$n \times 64$ kbps (N = 1, 2, ... 32)

Connector

25-pin, D-type, female

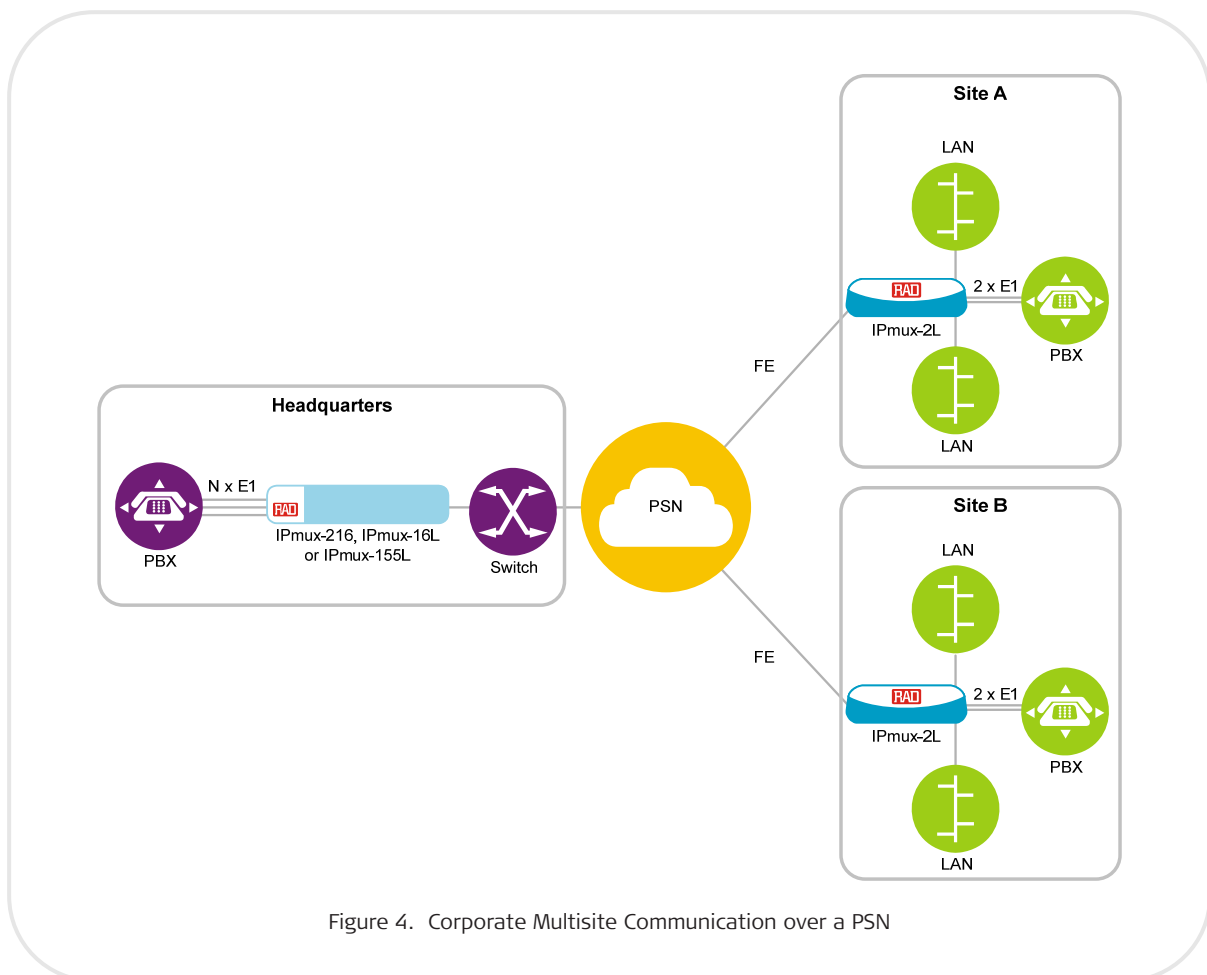


Figure 4. Corporate Multisite Communication over a PSN

IPmux-2L

TDM Pseudowire Gateway

ETHERNET INTERFACE

Number of Ports

3 (1 network, up to 2 user)

Port Combinations

3 UTP or 2 UTP and 1 SFP

Type

Electrical: 10/100BaseT

Fiber optic: 100BaseFx, 100BaseLX10, 100BaseBx10

Fast Ethernet SFPs

For full details, see the SFP Transceivers data sheet at www.rad.com

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, refer to the SFP Transceivers data sheet.

Connector

LC

PSEUDOWIRE CONNECTIONS

Compliance

IETF: RFC 4553 (SAToP), RFC 5087 (TDMoIP), RFC 5086 (CESoPSN) and RFC 4618 (HDLCoPSN)

ITU-T: Y.1413

MFA: IA 4.1, IA 8.0.0

Number of PW Connections

63

Jitter Buffer Size

0.5–200 msec (unframed) with 0.1 msec granularity

1.5–200 msec (framed) with 0.5 msec granularity

Table 1. IPmux Family Product Comparison

Feature	IPmux-2L (Ver. 2.0)	IPmux-4L (Ver. 1.0)	IPmux-4LGE (Ver. 2.0)	IPmux-16L (Ver. 1.0)	IPmux-24 (Ver. 3.5)	IPmux-216 (Ver. 3.5)
TDM service ports	1, 2 × E1	2, 4 × E1	4 × E1	8, 16 × E1	1, 2, 4 × E1/T1	8, 16 × E1/T1
Ethernet network ports	1 × FE	1 × FE	1 × GbE network, 2 × GbE network/user	3 × GbE network/user 3 × FE network/user	1 × GbE/FE network, 1 × GbE/FE network/user	1 × GbE/FE network 1 × GbE/FE network/user
Ethernet subscriber ports	2 × FE	2 × FE	4 × FE		1 × GbE/FE	1 × GbE/FE
Number of PWs	63	64	64	256	64	256
Multi-pseudowire	✓	✓	✓	✓	✓	✓
Advanced clock recovery	–	✓	✓	✓	✓	✓
Redundant power supply	–	–	–	–	–	✓
External clock port	–	–	–	–	Optional	✓
Serial data port	Optional	–	–	–	–	–
SSH, SSL, RADIUS	–	–	–	–	✓	✓
Network management system	RV-EMS	RV-EMS	RV-EMS	RV-EMS	RV-SC/TDMoIP, RV-EMS (basic shelf view)	RV-SC/TDMoIP, RV-EMS (basic shelf view)

GENERAL**Timing**

Internal
Receive
Loopback
Adaptive

Adaptive Clock Characteristics

According to G.823 traffic interface

Sync-E

Per G.8261 (no ESSM/CSM), via Ethernet port 3 (ordering option, see Ordering below)

Management

SNMPv1v2c
Telnet
ASCII terminal via V.24 (RS-232) DCE port
Web browser
Entity MIB (RFC 4133)

Dying Gasp

AC-powered units only (ordering option, see Ordering below)

Diagnostics

Loopbacks: E1 port local/remote, serial port local/remote
BERT: E1 port internal/external
VCT: Ethernet ports

Statistics

E1 (per G.826 and RFC 2495)
Ethernet (per RFC 2819)
Jitter buffer indication (overflow, underflow, sequence error, max/min jitter buffer levels)

Indicators

PWR (green) – Power status
TST (yellow) – Test status
ALM (red) – Alarm status
LOC/REM (red/red) – E1 local/remote sync loss
LINK/ACT (green/yellow) – Ethernet link/activity status on RJ-45 or SFP

Power

AC/DC: 100–240 VAC or 48/60 VDC nominal (40 to 72 VDC)

Power Consumption

8W max

Physical

Height: 43 mm (1.7 in)
Width: 217 mm (8.5 in)
Depth: 170 mm (6.7 in)
Weight: 0.5 kg (1.1 lb)

Environment

Temperature: 0° to 50°C (32° to 122°F)
Humidity: Up to 90%, non-condensing

IPmux-2L

TDM Pseudowire Gateway

Ordering

STANDARD CONFIGURATIONS

IPMUX-2L/1E1
 IPMUX-2L/1E1/N
 IPMUX-2L/1E1/RS232/N
 IPMUX-2L/1E1/V35
 IPMUX-2L/1E1CX
 IPMUX-2L/1E1CX/N
 IPMUX-2L/2E1
 IPMUX-2L/2E1/N

SPECIAL CONFIGURATIONS

IPmux-2L/~/#/\$/{/+1/

Legend

~ Synchronous Ethernet capability
 (leave empty for no Sync-E):
 SYE Sync-E per G.8261

Note: For Sync-E connection, order the third FE port (ordering option +1 below).

Dying Gasp (leave empty for no Dying Gasp):

DG Dying Gasp (AC-powered units only)

\$ TDM interface (leave empty for no E1):

1E1 1 balanced E1
 1E1CX 1 unbalanced E1
 2E1 2 balanced E1
 2E1CX 2 unbalanced E1

{ Serial interface (leave empty for no serial interface):

V35 V.35 interface
 V36 V.36/RS-449 interface
 RS530 RS-530 interface
 X21 X.21 interface
 RS232 RS-232 interface

Note: IPmux-2L must be ordered with at least one user interface option: E1 or serial port.

+1 Fast Ethernet interface (in addition to two 10/100BaseT UTP ports)

N SFP-ready slot
 1 Fast Ethernet, 1310 nm, multimode, LED, 2 km (1.2 mi)
 2 Fast Ethernet, 1310 nm, single mode, laser, 15 km (9.3 mi)
 3 Fast Ethernet, 1310 nm, single mode, laser, 40 km (24.8 mi)
 4 Fast Ethernet, 1310 nm, single mode, laser, 80 km (49.7 mi)
 10A Fast Ethernet, Tx - 1310 nm, Rx - 1550 nm, single mode (single fiber), laser (WDM), 20 km (12.4 mi)
 10B Fast Ethernet, Tx - 1550 nm, Rx - 1310 nm, single mode (single fiber), laser (WDM), 20 km (12.4 mi)
 UTP 10/100BaseT

Notes:

- The third Fast Ethernet port is optional, unless the Sync-E functionality is required.
- For single-fiber applications, a device with the SFP-10A interface should always work with a device with the SFP-10B interface, and vice versa.

SUPPLIED ACCESSORIES

Power cord

AC/DC adapter plug

Matching adapter cable if a serial interface has been ordered:

- CBL-HS2/V/1/F for V.35
- CBL-HS2/R/1/M for V.36/RS-449
- CBL-HS2/X/1/F for X.21

OPTIONAL ACCESSORIES

The following cables convert the IPmux-2L 25-pin serial data port connector into the respective interface. Cable length is 2m (6 ft).

CBL-HS2/V/1/\$

Adapter cable for connecting a data port in DCE timing mode to V.35 port

CBL-HS2/V/2/\$

Adapter cable for connecting a data port in DTE1 timing mode to V.35 port

CBL-HS2/V/3/\$

Adapter cable for connecting a data port in DTE2 timing mode to V.35 port

CBL-HS2/R/1/\$

Adapter cable for connecting a data port in DCE timing mode to V.36/RS-449 port

CBL-HS2/R/2/\$

Adapter cable for connecting a data port in DTE1 timing mode to V.36/RS-449 equipment

CBL-HS2/R/3/\$

Adapter cable for connecting a data port in DTE2 timing mode to V.36/RS-449 port

CBL-HS2/X/1/\$

Adapter cable for connecting a data port in DCE timing mode to X.21 port

Legend

\$ Cable connector:
 F Female
 M Male

CBL-DB9F-DB9M-STR

Control port cable

RM-33-2

Hardware kit for mounting one or two IPmux-2L units into a 19-inch rack

International Headquarters

24 Raoul Wallenberg Street
 Tel Aviv 69719, Israel
 Tel. 972-3-6458181
 Fax 972-3-6498250, 6474436
 E-mail market@rad.com

North America Headquarters

900 Corporate Drive
 Mahwah, NJ 07430, USA
 Tel. 201-5291100
 Toll free 1-800-4447234
 Fax 201-5295777
 E-mail market@rad.com