

# IPmux-2L

## TDM Pseudowire Gateway



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



- 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.



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## 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.

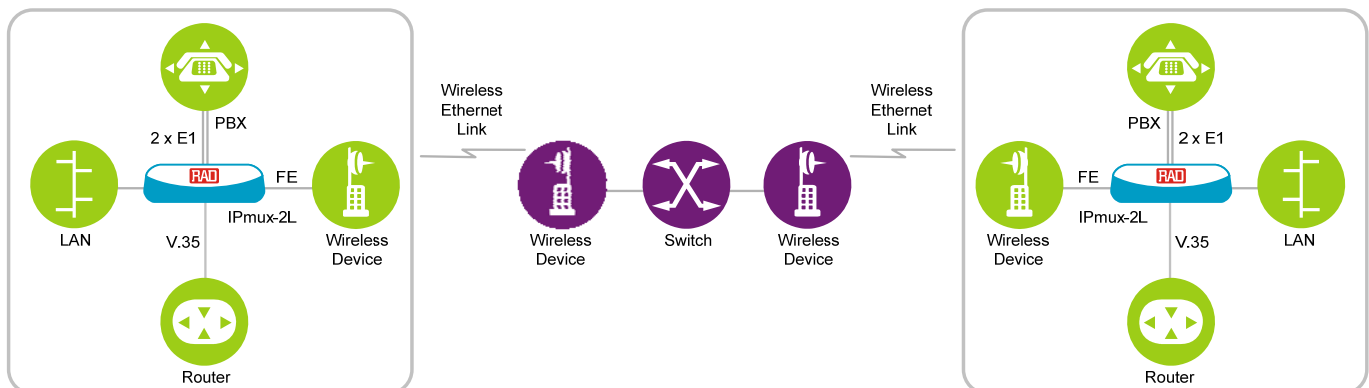


Figure 1. LAN and TDM Services over a Wireless Ethernet Link

### 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.

Lowest Opex of TDM service by utilizing packet infrastructure

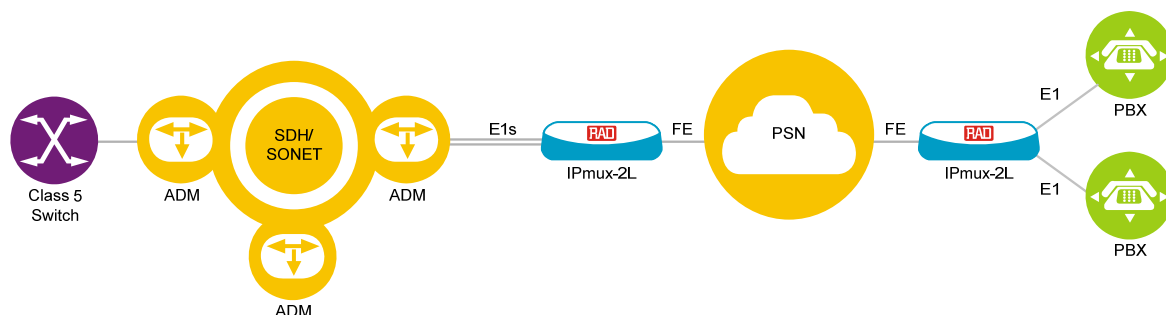


Figure 2. TDM Backhaul and Trunking over a PSN

# 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.

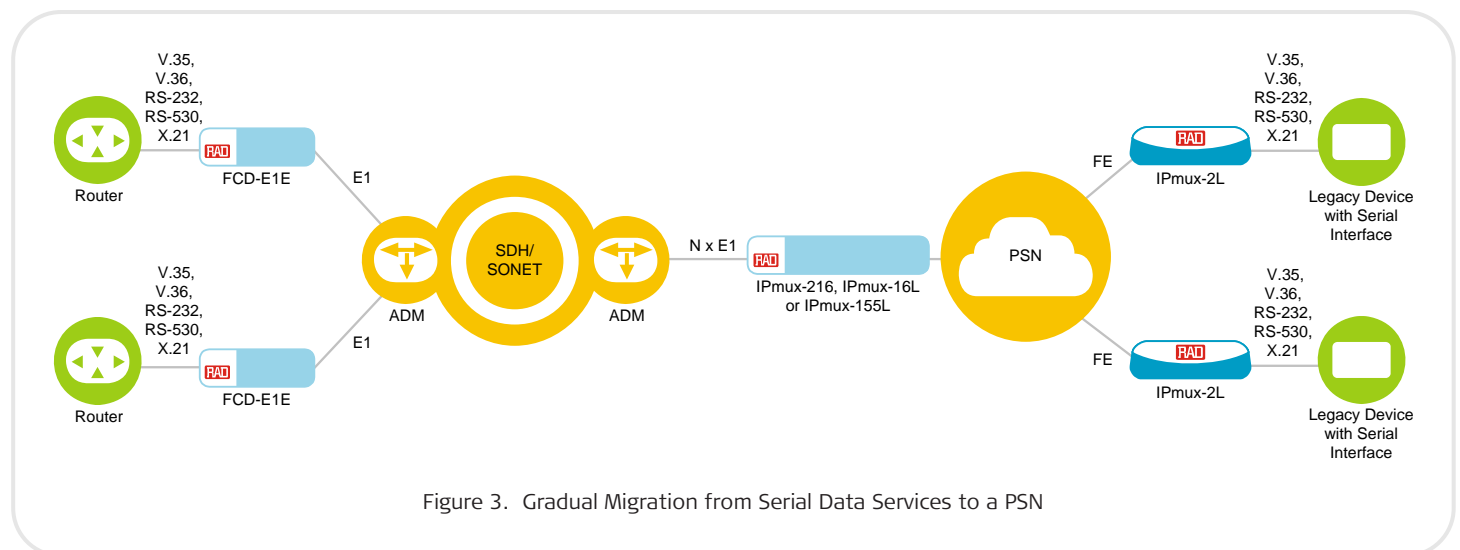


Figure 3. Gradual Migration from Serial Data Services to a PSN

## 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

120 $\Omega$ , balanced  
75 $\Omega$ , 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 ( $N = 1, 2, \dots, 32$ )

#### Connector

25-pin, D-type, female

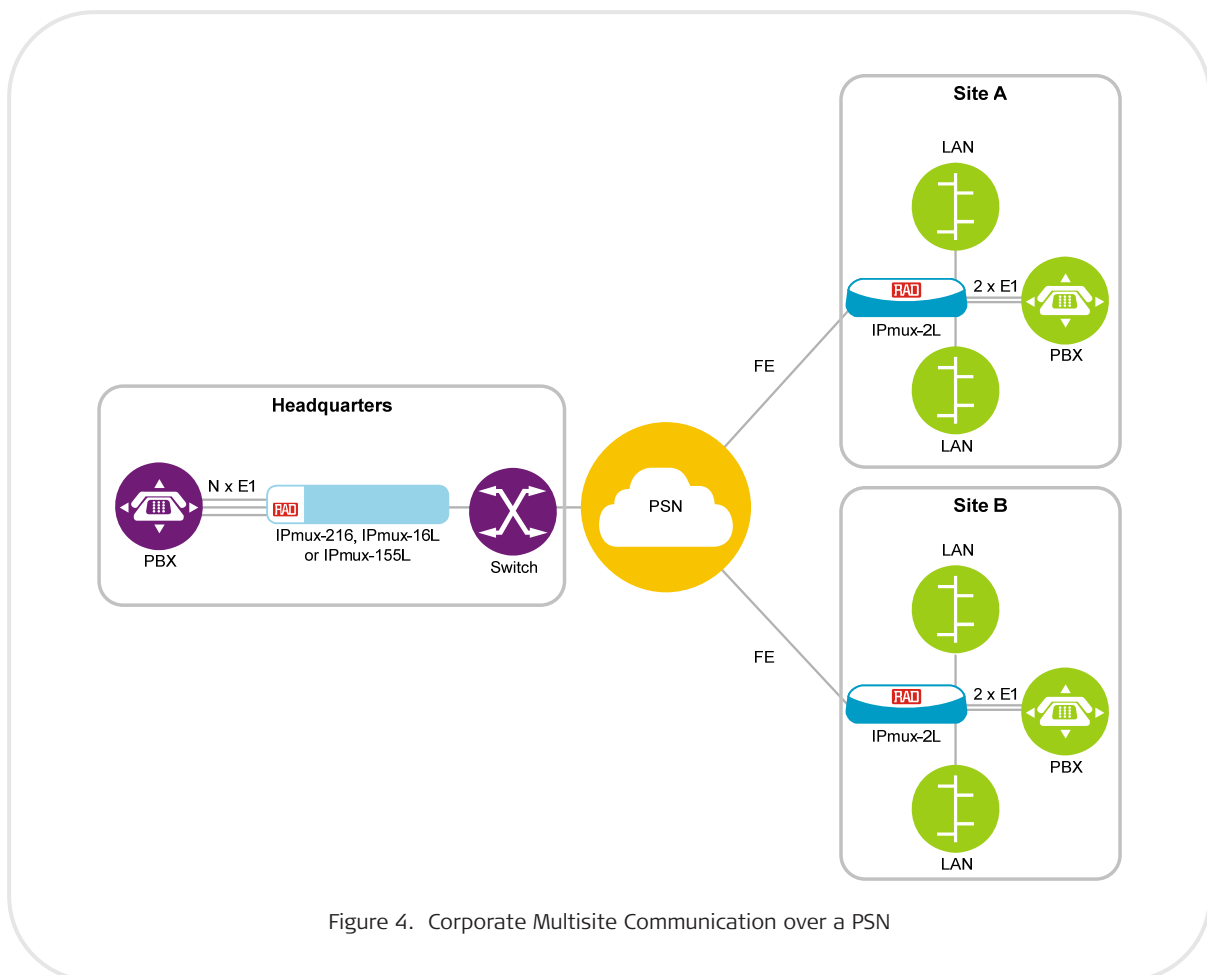


Figure 4. Corporate Multisite Communication over a PSN

# 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](http://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

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