Converters and Connectivity

Many IT users still work in an environment using legacy equipment typically characterized by lower speed data rates and specialized data communications protocols. RAD is one of the few vendors in the market today offering connectivity products for these devices.

Data solutions for Frame Relay and X.25 networks

RAD's packet switching family includes packet assemblers/disassemblers (PADs) and multiprotocol packet switches. All are designed to the latest ITU specifications and ANSI recommendations. They support various protocols, including HDLC, async, SLIP, PPP, IP, and ISDN. The products can be used to transport Frame Relay and X.25 over IP or to construct high performance, private X.25/Frame Relay networks or efficient extensions of public X.25/Frame Relay networks. In addition, RAD offers a wide range of interchangeable interfaces, such as built-in CSU/DSUs and ISDN BRI terminal adapters.

GPRS connectivity

For backup and special access purposes, the async channel can connect to a GPRS modem to transmit data where wire lines are not available, or for backup purposes.

Remote Ethernet connectivity

RAD's remote connectivity solutions offer a range of products that provide users with the desired transparent connectivity and their corporate network managers with the flexibility to choose the WAN services, port quantities and security features that best suit their applications.

Management over extended Ethernet and IP networks

Management of networking devices over increasingly complex, heterogeneous environments has created challenges for carriers and corporate network managers, as well as for vendors of communications equipment. RAD's unique combination of routing technology and modem and E1/T1 technologies provides comprehensive support of Ethernet and IP to answer customers' remote management needs. Plugging devices such as the TinyBridge into the Ethernet management port of any network device, for example, allows immediate remote management access over any available WAN service. This enables transparent management of the remote networking device, as if it were connected to the local network.

Rate and interface converters

RAD's wide range of converters provides conversion between different interfaces. Depending on the application, the conversion may involve one or more of the following:
• Electrical: converting the signal levels
• Physical: providing a different connector type
• Functional: converting the functional operation of the signals
• Speed: converting from one data rate to another

Fiber optic distance and bandwidth

Distance and bandwidth are determined by fiber type and light source.

Fiber type – There are two types of fiber optic strands: multimode and single mode. Multimode fiber allows propagation of light along various paths, resulting in high attenuation, while single mode fiber allows a single transmission path, which results in lower attenuation and higher speeds.

Light source – Signal attenuation in fiber optics also depends on wavelength. Low attenuation occurs at three different wavelengths: 850 nm, 1310 nm and 1550 nm.

RAD's fiber converters support connectivity over these different fiber types and light sources.

RIC-E1, RIC-T1
E1 or T1 Interface Converters

- **Converts between V.35, X.21, V.36, RS-530, or Ethernet or Fast Ethernet bridge to unframed E1 or T1 interfaces**
- **2.048 Mbps bit rate in E1 and 1.544 Mbps in T1**
- **Available as standalone units or as cards for the ASM-MN-214 rack**
- **Receive, internal and external clocking options**
- **AC or DC power supply**

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The RIC-E1 and RIC-T1 offer conversion between E1 or T1 interfaces and standard data communications interfaces. The units convert the ITU-T G.703 E1 2.048 Mbps and T1 1.544 Mbps interfaces to V.35, X.21, V.36, RS-530, Fast Ethernet, or Ethernet bridge.

VLAN capabilities

When equipped with an Ethernet interface, RIC-E1 and RIC-T1 transparently connect remote LANs and VLANs over unframed E1/T1 links, utilizing the full E1/T1 bandwidth. All of the above mentioned interfaces are easily interchangeable thanks to the modular design. Operating full duplex at a rate of 2.048 Mbps or 1.544 Mbps, respectively, the RIC-E1 and RIC-T1 have a range of 300 meters (1,000 ft) from the G.703 equipment. They perform a diagnostic loop test in compliance with ITU V.54 standard (loop 3) local analog loop (LLB). The bridge loops are activated by the DTE interface or by a strap jumper on the PCB.

The RIC-E1 and RIC-T1 support receive, external and internal clocking options from G.703 equipment.

The products are available as standalone units in lightweight enclosures, or as cards for the ASM-MN-214 rack. The ASM-MN-214 can hold up to 14 hot-swappable converter cards, allowing mixing and matching any combination of card types.
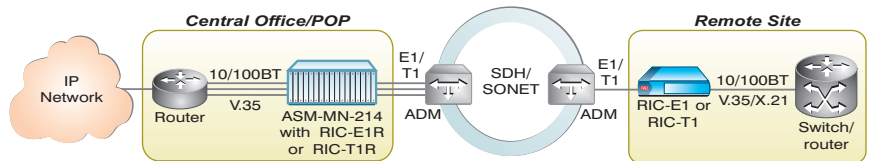
SPD-703-1
G.703 Codirectional Rate and Interface Converter

- **Interface conversion between G.703 (64 kbps) and V.35, V.36/RS-422, RS-530, or X.21**
- **Selectable data rates: 48, 56 or 64 kbps**
- **Selectable transmit timing source**
- **Analog and digital loopback**
- **56 kbps to 64 kbps rate conversion complies with V.110**

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The SPD-703-1 rate and interface converter transfers between the G.703 interface and other data communications interfaces.

The SPD-703-1 codirectional converter converts the ITU G.703 64 kbps codirectional interface to V.35, V.36/V.11, X.21/V.11, RS-530 or V.24.

Operating full duplex at a transmission rate of 64 kbps, the SPD-703-1 has a range of 800 meters (0.5 miles) from the G.703 equipment. It has a built-in BERT complying with the V.52 standard that provides fault isolation capability with the activation and monitoring performed via the front panel.

V.54 diagnostic capabilities provide local analog, local digital and remote digital loopbacks. These may be activated from the front panel or via the interface control signal.

The SPD-703-1 is available as a standalone unit that can be mounted in a 19-inch rack, or as a card for the ASM-MN-214 rack.
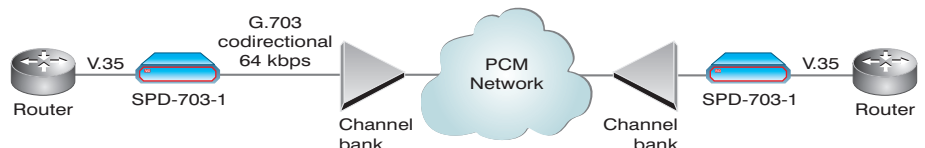
RSD-1, RSD-10

4, 8-Channel Programmable Sharing Devices

The RSD digital sharing devices enable any combination of DCEs and/or DTEs to share a modem, multiplexer or computer port in a multipoint environment. RSD-1 supports up to four DCEs/DTEs; RSD-10 supports up to eight. They are completely transparent to the system and the data, and operate with sync or async equipment. The units generate timing signals internally or operate with external clocks, either from the main channel or from subchannel 1.

The main channel broadcasts information to all subchannels in parallel. Subchannels contend to transmit to the main channel by activating RTS/DCD or by data transitions.

The devices can be configured to automatically disable any channel that stays active for longer than a preset time and blocks all other subchannels.

Permanent disabling of a subchannel is possible by setting the front panel switches.

Installation and configuration of the RSD units are easy. All necessary crossover connections are defined internally via a DCE/DTE switch, and only straight-through cables are used to connect the modems or terminals to the RSD-1 and RSD-10. The interfaces are RS-232/V.24 and the connectors are 25-pin D-type, female.

- **RSD-1: four subchannels; RSD-10: eight subchannels**
- **Any combination of modems (DCEs) and terminals (DTEs)**
- **Sync or async, data rates up to 19.2 kbps**
- **RS-232/V.24 interface**
- **Automatic disabling of streaming subchannel**
- **Operates with dial-up or leased line modems**
- **Internal or external clocks**

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# BE-1
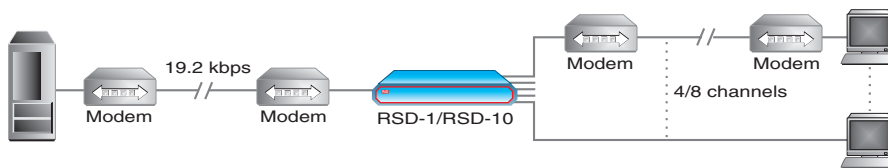
Coax-to-Twisted Pair Converter (Balun) for E1

The BE-1 coax-to-twisted pair converter (balun) enables any E1 equipment with an unbalanced (coax) interface to operate over a twisted pair connection instead of over more expensive coax cables.

The BE-1 enables any E1 or ISDN equipment with a balanced twisted pair interface to use existing coaxial cables.

The BE-1 is a miniature, lightweight balun that operates without AC or DC power and provides insulation of up to 100V.

- **Conversion between coax cables and twisted pairs for E1 G.703 applications (2.048 Mbps)**
- **Miniature, lightweight balun**
- **No AC or DC power required**
- **Immediate installation**
- **Not sensitive to the direction of the signals**

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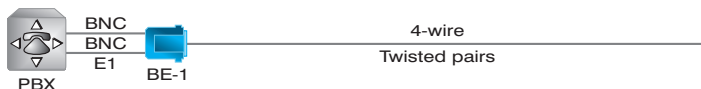
FPS-8
Multiprotocol Fast Packet Switch

- **Eight-port multiprotocol FRAD and packet switch**
- **Two optional built-in Ethernet ports**
- **Protocols supported: Frame Relay, X.25, ISDN, HDLC, SLIP, PPP, MLPPP, RIP, RIP-2, async**
- **IP support**
  - **IP routing**
  - **Standard IP encapsulation over Frame Relay (RFC 1490), X.25 (RFC 1356) or Ethernet**
- **Unique support of legacy services (i.e., X.25, FR) over IP networks**
- **Transparent bridging**
- **Dynamic bandwidth allocation**
- **Data prioritization**
- **Automatic backup facility**
- **Telnet (client and server) support**
- **X.25/Frame Relay multicasting**

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The FPS-8 is a Frame Relay/X.25 switch suitable for headquarters and central sites requiring high throughput. Each port can be configured to one of several protocols: Frame Relay, X.25, RIP, RIP-2, PPP, MLPPP, HDLC, SLIP, or async.

The FPS-8 can perform packet switching between different applications, such as X.25 to X.25; X.25 to Frame Relay; Frame Relay to Frame Relay; and SLIP to SLIP. It can also encapsulate various protocols over Frame Relay and X.25.

Legacy data over IP

The FPS-8 can also offer a unique solution for transmitting legacy data over high speed IP networks by encapsulating the data into IP packets.

Each of the eight sync ports operates at data rates up to 2 Mbps. The FPS provides throughput of more than 3,000 pps in Frame Relay.

The built-in management agent enables configuration, compilation of statistics and status reports, and diagnostics. The management agent can be accessed from any location in the network. It can be programmed to transmit this information as a result of an alarm event.

SNMP management support via RADview

The SNMP agent enables management by the RADview graphical user interface on a PC or HP OpenView UNIX station, allowing the products to be configured and controlled via the X.25/Frame Relay network.

Link interfaces are modular and can be ordered for RS-232/V.24, V.35, RS-530, X.21, V.36, or Ethernet. Each interface is switch-selectable for DCE or DTE. Both the protocol and the interface can be independently selected on any port.
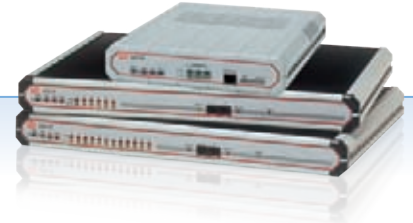
The FPS-8 offers optional support for ISDN BRI interface.
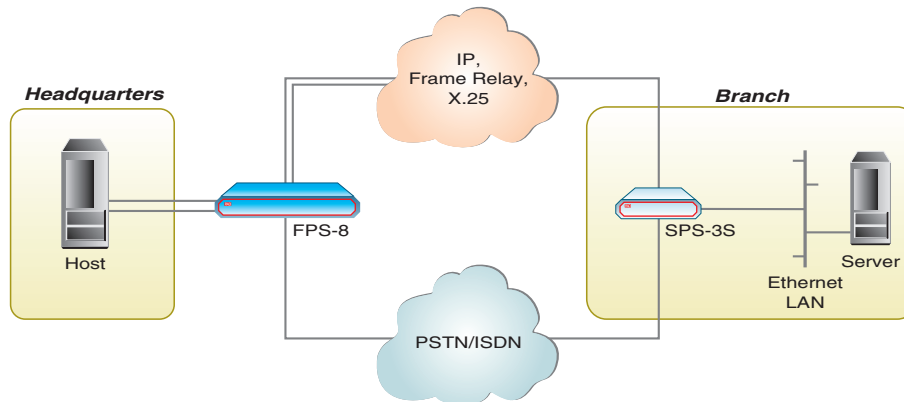
SPS-3S, SPS-6, SPS-12
Multiprotocol Packet Switches

The SPS-3S, SPS-6 and SPS-12 are high performance Frame Relay/X.25 multiprotocol switches. Each port can be configured to one of several protocols: Frame Relay, X.25, ISDN, RIP, RIP-2, PPP, MLPPP, SDLC, HDLC, SLIP, async, or Ethernet.

The products support an aggregate data rate on three links of up to 2 Mbps. In addition, the products feature a wide range of interfaces, including CSU/DSU and Ethernet.

The SPS-3S, SPS-6 and SPS-12 can perform packet switching between different applications, such as X.25 to X.25; X.25 to Frame Relay; Frame Relay to Frame Relay; and SLIP to SLIP. They can also encapsulate various protocols over Frame Relay and X.25.

Legacy data over IP

In addition, the SPS products offer a unique solution for transmitting legacy data over high speed IP networks by encapsulating the data into IP packets.

The units perform dynamic bandwidth allocation and data prioritization for optimal network results.

Management capabilities

The built-in management agent enables configuration, compilation of statistics and status reports, and diagnostics. The management agent can be accessed from any location in the network. It can be programmed to transmit this information as the result of an alarm event.

The SNMP agent enables management by the RADview graphical user interface on a PC or HP OpenView UNIX station, permitting the products to be configured and controlled via the X.25/Frame Relay network.

Link interfaces are modular and can be ordered for RS-232/V.24, V.35, RS-530, X.21, V.36, as well as ISDN S and U interfaces. Each interface is switch-selectable for DCE or DTE. Both the protocol and the interface can be independently selected on any port.

SPS-3S, SPS-6 and SPS-12 are 1U high, standalone units. The SPS-3S is half 19-inch and SPS-6 and SPS-12 are 19-inch units.

- **Three, six or 12-port multiprotocol FRAD and packet switch**
- **Protocols supported: Frame Relay, X.25, ISDN, SDLC, HDLC, MLPPP, RIP, RIP-2, SLIP, PPP, async, Ethernet**
- **IP support**
  - **IP routing**
  - **Standard IP encapsulation over Frame Relay (RFC 1490), X.25 (RFC 1356) or Ethernet**
- **Unique support of legacy services (i.e., X.25, FR) over IP networks**
- **Transparent bridging**

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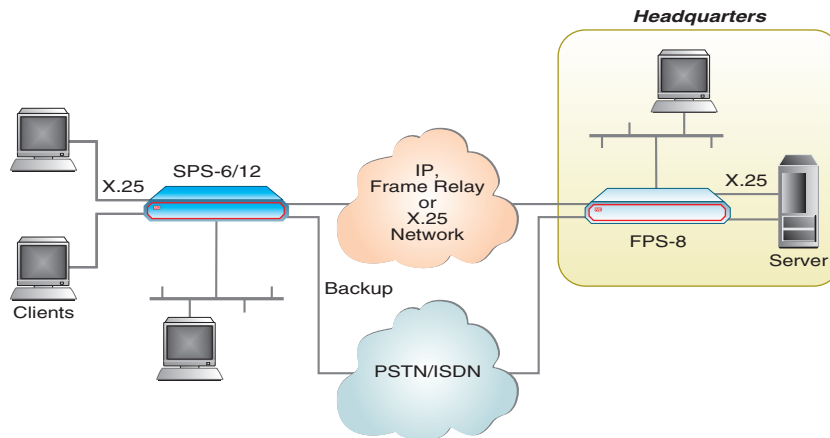
SPS-6 or SPS-12 used to consolidate X.25 and IP for medium-sized branch office
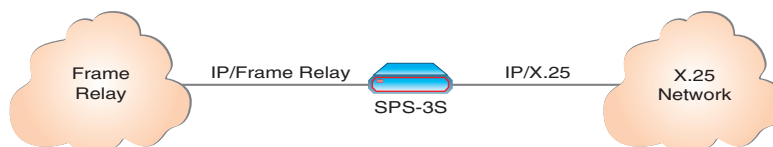
**IP transport from X.25 to a Frame Relay network**

SPS-4
Multiprotocol Packet Switch

- **Unique support of legacy services over IP networks**
- **Supports Frame Relay, X.25, ISDN, HDLC, MLPPP, RIP, RIP-2, SLIP, PPP, async, Ethernet**
- **One or two synchronous data links**
- **One asynchronous data link supporting packet switching over a cellular GPRS network**
- **Standard IP encapsulation over Frame Relay (RFC 1490), X.25 (RFC 1356) or Ethernet**
- **Transparent bridging**
- **Dynamic bandwidth allocation**
- **Automatic backup capability**
- **Telnet (client and server) support**

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The SPS-4 is a flexible, compact switch, providing multiprotocol connectivity for transporting data from X.25 and Frame Relay equipment over newer xDSL, E1/T1 and IP networks. SPS-4 provides up to three sync/async links that can be independently configured to one of several protocols: Frame Relay, X.25, ISDN, RIP, RIP-2, PPP, MLPPP, HDLC, SLIP, or async.
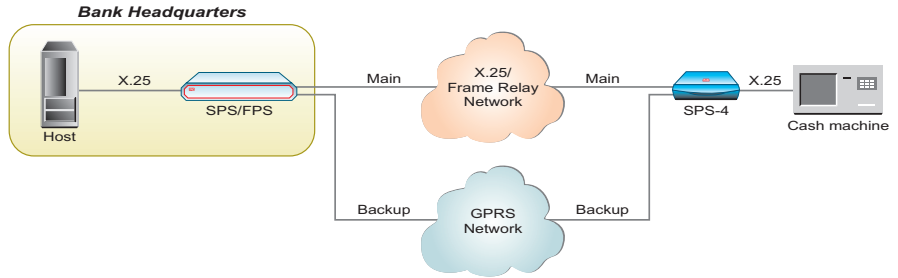
Bank Headquarters

Connection of ATMs (Automatic Teller Machines) to bank headquarters over a Frame Relay network with backup over GPRS

Connects legacy equipment to modern networks

SPS-4 performs packet switching between different applications, such as X.25 to X.25; X.25 to Frame Relay; Frame Relay to Frame Relay; and SLIP to SLIP. It can also encapsulate various protocols over Frame Relay and X.25.

The product is ideal for banks, hospitals, universities, or other organizations with a large installed base of legacy equipment that needs to be connected over more modern networks.

Radio backup link for mission-critical applications

SPS-4's single RS-232/V.24 asynchronous data port can support GPRS packet streams so that it can be utilized as a radio backup link for critical link applications. Switching to the backup link occurs automatically upon detection of main link failure. After the network recovery, the SPS-4 automatically synchronizes itself and returns transmission to the main facility link.

The synchronous data links on the SPS-4 can be ordered with V.24/RS-232, V.35, RS-530, X.21, V.36 interface with DCE or DTE settings, or with ISDN S or U interface options. This provides connectivity for any device with a standard network interface. For added flexibility, the synchronous links can also be configured for asynchronous operation.

Management options

The built-in management agent enables configuration, compilation of statistics and status reports, and diagnostics. The management agent can be accessed from any location in the network. It can be programmed to transmit this information as the result of an alarm event.

Advanced FCAPS (Fault, Configuration, Administration, Performance, Security) and diagnostic tools are provided by RADview-EMS, RAD's carrier-class element management system, via a Web browser.

The standalone SPS-4 is a compact, 1U-high, half 19-inch wide unit.

Lottery Authority Main Office
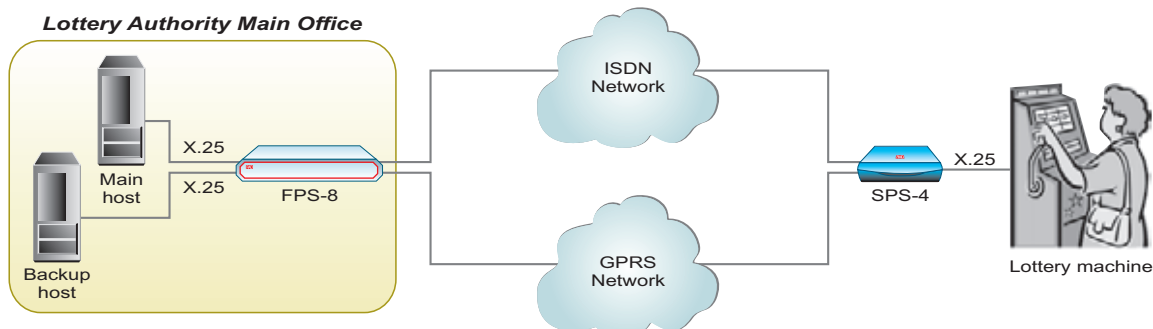
X.25 lottery machine connection and backup over multiple networks

SPS-4X
Multiprotocol Packet Switch

The SPS-4X is a multiprotocol packet switch, providing X.25, Frame Relay and HDLC data connectivity across packet switched networks. The SPS-4X is therefore ideal for hospitals, universities, or other organizations with distributed locations and a large installed base of legacy equipment that needs to be connected over next-generation networks to reduce costs associated with network connectivity and operations. The device also enables seamless multi-site integration in the military, banking, gaming, PoS, utilities, and transportation sectors.

The SPS-4X employs pseudowire encapsulation techniques, such as HDLCoPSN, to ensure transparent data delivery between remote and central locations. It provides up to three sync/async links that can be independently configured to deliver one of several protocols: Frame Relay, X.25, ISDN, RIP, RIP-2, PPP, MLPPP, HDLC, or async.

X.25 and XOT connectivity

The SPS-4X provides extended X.25 support, including permanent virtual circuits (PVCs), switched virtual circuits (SVCs) and multicasting, as well as dial-up X.25 links.

In addition, the device allows X.25 traffic to be carried over TCP/IP connections using the XOT standard, supporting up to 16 simultaneous XOT sessions over an IP network and ensuring third-party interoperability.

HDLC and Frame Relay connectivity

Each of the device's ports can be configured to operate in transparent HDLC mode for connecting bridges, routers and other HDLC communication devices. This is achieved by encapsulating the HDLC protocol over X.25, Frame Relay or HDLCoPSN pseudowire connections.

As a Frame Relay switch, the SPS-4X integrates traffic belonging to the same data link connection from several sources into a single port. It also supports BECN/FECN signaling, rate limiting and traffic shaping to handle congestion and ensure QoS.

Backup links for mission-critical applications

The SPS-4X supports an asynchronous backup channel over PSTN and GPRS networks. For example, the device's asynchronous RS-232/V.24 data port can be utilized as a radio backup link for mission-critical applications, automatically activating upon detection of main link failure. When the network recovers, the SPS-4X automatically synchronizes itself and switches transmission back to the main facility link.

The standalone SPS-4X is a compact, 1U-high, half 19-inch wide unit, with a wide range of AC/DC power supply options.

- **Delivers Frame Relay, X.25 and HDLC over packet switched networks**
- **Three synchronous/asynchronous data ports**
- **Two 10/100BaseT Fast Ethernet ports**
- **Supports HDLCoPSN with up to 300 simultaneous PWE sessions**
- **Standard XOT encapsulation per IETF RFC 1613**
- **High performance CPU: 10,000 pps**
- **Dedicated GPRS backup channel**
- **Routing and bridging capabilities**
- **Cost-effective, single-box solution for central and remote sites**
- **Local and remote management**

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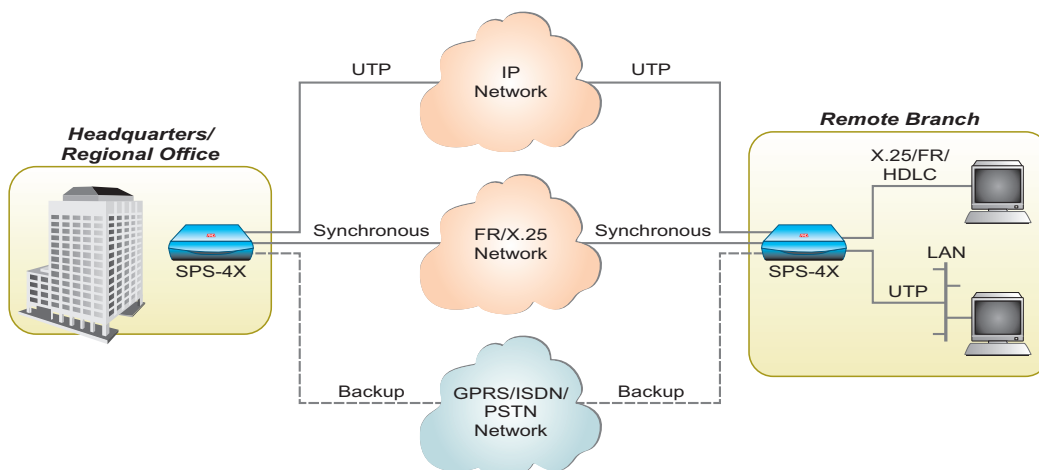
Multiprotocol connectivity and backup between headquarters and a remote branch
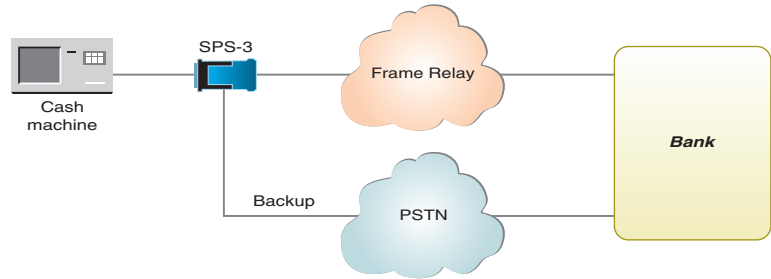
SPS-3
Miniature Multiprotocol Packet Switch

- **Three-port miniature multiprotocol packet switch**
- **Miniature protocol converter for Frame Relay, X.25, HDLC, SLIP, async**
- **Interfaces: V.24/RS-232**

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The SPS-3 is a miniature protocol converter and multiprotocol packet switch, offering users Frame Relay or X.25 connectivity. The three-port miniature packet switch is a converter for Frame Relay, X.25, HDLC, SLIP, and async. RAD's SPS-3 miniature multiprotocol packet switch enables small remote branch offices easy connectivity to Frame Relay and X.25 networks. The product provides IP support via IP routing and standard IP encapsulation over Frame Relay.

Typical applications include encapsulation of IP/SLIP over Frame Relay, transport of HDLC over Frame Relay, or X.25 to Frame Relay conversion. The SPS-3 supports a data rate of up to 64 kbps per multiprotocol link. The SPS-3 features X.25 multicasting and automatic backup. The SPS-3 requires an external power supply. SNMP management is provided for the SPS-3 by RADview.

Typical applications include:
- Encapsulating IP/SLIP over a Frame Relay network using standard encapsulation RFC 1490 or RFC 1356
- Transparent encapsulation of HDLC over a Frame Relay or X.25 network
- Encapsulation of X.25 to X.25 over Frame Relay

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APS-8, APS-16, APS-24
8, 16, 24-Channel Multiprotocol FRADs/PADs and Switches

- **FRAD/X.25 PAD with eight, 16 or 24 async channels**
- **Protocols supported: Frame Relay, X.25, ISDN, RIP, RIP-2, HDLC, SLIP, MLPPP, PPP, async, Ethernet**
- **Standard IP encapsulation over Frame Relay (RFC 1490), X.25 (RFC 1356) or Ethernet**
- **Wide range of interfaces including CSU/DSU**

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The APS-8, APS-16 and APS-24 are high performance FRADs/X.25 PADs for access to Frame Relay or X.25 networks. All async channels can operate according to X.3, X.28 and X.29 profiles. Async traffic can be packetized directly over the
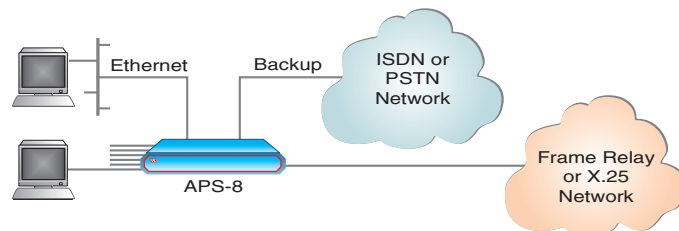
Frame Relay network, or packetized over the X.25 protocol and encapsulated over a Frame Relay network.

The APS is ideal where a large number of async channels is required; in a heterogeneous environment combining async traffic and synchronous or LAN traffic; and in applications that require backup, bandwidth-on-demand or dial-in. The units support X.25/Frame Relay multicasting.

Legacy data over IP

The APS products also offer a unique solution for transmitting legacy data over high speed IP networks by encapsulating the data into IP packets. It also enables secure migration from a terminal/host environment to a distributed client/server environment.

The units are provided with an integrated ISDN terminal adapter.

APD-8
8-Channel FRAD/X.25 PAD
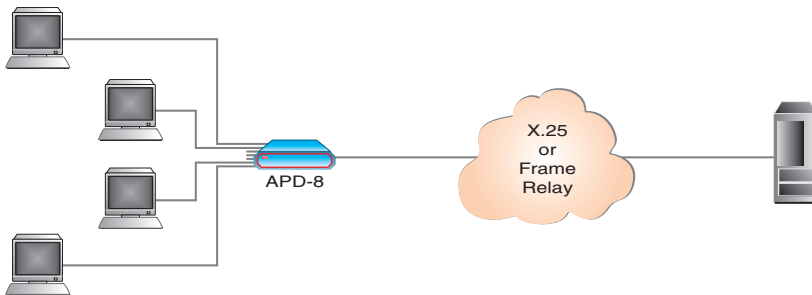
- **Eight-channel async FRAD/PAD with a single synchronous Frame Relay or X.25 link**
- **IP encapsulation over Frame Relay (RFC 1490) or X.25 (RFC 1356) networks**
- **Synchronous link interfaces: V.24/RS-232, V.35, X.21, RS-530, and V.36**
- **Can operate as a terminal server**

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The APD-8 is a FRAD/X.25 PAD that connects up to eight async channels to Frame Relay or X.25 networks.

The unit is provided with an integrated ISDN terminal adapter.
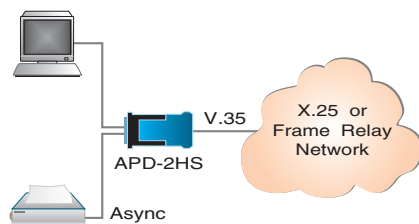
The APD-8 offers a synchronous link data rate up to 2 Mbps. The async channel data rate is up to 115.2 kbps.

All channels are configured and monitored by the management agent of the APD-8. All async channels operate according to X.3, X.28 and X.29 profiles or SLIP protocol. Async traffic can be packetized directly over a Frame Relay network, or packetized via X.25 protocol and encapsulated over a Frame Relay network.

The built-in management agent enables system

configuration and compilation of statistics, status reports and diagnostics. The units incorporate an SNMP agent, enabling management by RADview on a PC or HP OpenView station.

The APD-8 is available as a standalone unit, measuring 1U in height. Two units can be mounted side-by-side in a 19-inch rack.

APD-2HS
Miniature FRAD/X.25 PAD

- **Two-channel async FRAD/PAD with a single synchronous Frame Relay or X.25 link**
- **IP encapsulation over Frame Relay (RFC 1490) or X.25 (RFC 1356) networks**
- **SNMP management support via RADview**
- **Synchronous link data rate up to 256 kbps**
- **Async channel data rate up to 115.2 kbps**
- **Synchronous link interfaces: V.24/RS-232, V.35**

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The APD-2HS is a FRAD/X.25 PAD that connects two async channels to Frame Relay or X.25 networks.

Both channels are configured and monitored by the management agent of the APD-2HS. The async channels operate according to X.3, X.28 and X.29 profiles or SLIP protocol. Async traffic can be packetized directly over a Frame Relay network, or packetized via X.25 protocol and encapsulated over a Frame Relay network.

The built-in management agent enables system configuration and compilation of statistics, status reports and diagnostics. The unit incorporates an SNMP agent, enabling management by RADview on a PC or HP OpenView station.

The product is available in a miniature case with a 25-pin D-type connector for the link and two RJ-45 connectors for the DTEs. It requires an external power supply.

PACKET SWITCHES

8

SFP Transceivers
Small Form-Factor Pluggable Transceivers

- **Fiber optic or electrical transceiver units, providing pluggable interfaces according to known standards and specifications**
- **MSA (Multisource Agreement) compliance**
- **Fast Ethernet to E1/T1 or E3/T3 remote bridges, connecting Fast Ethernet LANs over E1/T1 or E3/T3 links**
- **TDM pseudowire gateways**

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SFP (small form-factor pluggable) transceivers (SFPs) are hot-swappable input/output optical and electrical transceiver units, each providing a different interface according to known compliance standards and pre-determined specifications. The units are plugged into other products to provide the required interface, thus enabling optimal combination of CapEx reduction, ease of network planning and stock flexibility.

RAD's SFP transceivers are fully compliant with the Multisource Agreement (MSA) specifications, and are fully interoperable with third-party standards-based devices.

On account of their small size, SFPs allow higher port densities than with other transceivers, resulting in more efficient host device design.

Note: It is strongly recommended to order RAD devices 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, see the SFP transceivers data sheet.

Electrical Interface Characteristics

Ordering Name, Interface, Connector	Standard	Cable Type	Impedance	Typical Max. Range (Attenuation)	
			[Ω]	[m]	[ft]
SFP-9F Fast Ethernet, RJ-45	100BaseT, IEEE 802.3	UTP, cat. 5	100	100	328
SFP-9G Gigabit Ethernet, RJ-45	1000BaseT, IEEE 802.3	UTP, cat. 5	100	100	328
SFP-11 STM-1E, mini BNC, DIN 1.0/2.3	G.703	Coaxial	75	135 (12.7 dB)**	442
SFP-12 E3, SMB	G.703	Coaxial	75	135 (12.7 dB)**	442
SFP-E1T1/GbE*** Gigabit Ethernet, E1/T1, remote bridge, RJ-45	1000Base-x, IEEE 802.3 (GbE), G.703 (E1/T1)	UTP, cat. 5 (AWG-22)	120/100	2550/1829	8202/6000
SFP-E1T1/FE*** Fast Ethernet, E1/T1, remote bridge, RJ-45	100BaseFX, IEEE 802.3 (Fast Ethernet), G.703 (E1/T1)	UTP, cat. 5 (AWG-22)	120/100	2550/1829	8202/6000
SFP-E3T3/FE*** Fast Ethernet, E3/T3, remote bridge, SMB	100BaseFX, IEEE 802.3 (Fast Ethernet), G.703 (E3/T3)	Coaxial (RG59)	75	275	900
SFP-E3T3/GbE*** Gigabit Ethernet, E3/T3, remote bridge, SMB	1000Base-x, IEEE 802.3, (GbE), G.703 (E3/T3)	Coaxial (RG59)	75	275	900
SFP-PWE1T1*** TDM to Ethernet-pseudowire gateway	100BaseFX, IEEE 802.3 (FE), G.703 (E1/T1)	UTP, cat.5	120/100	–	–

Notes:

** With SFP-11 and SFP-12, 135m range is attainable when using RG59 B/U (at 78 MHz, in accordance with the square root of frequency law).

*** These SFPs are designed to work with RAD products only. An internal mechanism in these SFP units checks whether the hosting device is a RAD product.

Fiber Optic Gigabit Ethernet SFPs

Notes:

D DDM internal calibration

H Industrial SFP temperature range –40° to 85°C

Ordering Name, Interface, Connector	Wavelength, Fiber Type [nm], [mm]	Standard	Transmitter Type	Input Power [dBm]		Output Power [dBm]		Typical Max. Range	
				(min)	(max)	(min)	(max)	[km]	[miles]
SFP-5/5D/5H/5DH Gigabit Ethernet, LC	850, 50/125 multimode	1000BaseSX, IEEE 802.3 (GbE)	VCSEL	-17	0	-9.5	0	0.55	0.3
SFP-6/6D/6H Gigabit Ethernet, LC	1310, 9/125 single mode	1000BaseLX10, IEEE 802.3 (GbE)	Laser	-20	-3	-9.5	-3	10	6.2
SFP-7/7D Gigabit Ethernet, LC	1550, 9/125 single mode	–	Laser	-22	-3	0	+5	80	49.7
SFP-8/8D/8H/8DH Gigabit Ethernet, LC	1310, 9/125 single mode	–	Laser	-21	-3	-4	+4	40	24.8
SFP-17a/17b Gigabit Ethernet, LC	TX – 1310/1490 RX – 1490/1310 9/125 single mode (single fiber)	1000BaseBX10, IEEE 802.3 (GbE)	Laser (WDM)	-20	-3	-9	-3	10	6.2
SFP-20 Gigabit Ethernet, LC	1550, 9/125 single mode	–	Laser	-32	-3	0	+5	120	74.5
SFP-21a/21b Gigabit Ethernet, LC	TX – 1310/1490 RX – 1490/1310 9/125 single mode (single fiber)	–	Laser (WDM)	-24	-3	-5	0	40	24.8
SFP-22a/22b Gigabit Ethernet, LC	TX – 1490/1570 RX – 1570/1490 9/125 single mode (single fiber)	–	Laser (WDM)	-24	-3	0	+5	80	49.7
SFP-23a/23b Gigabit Ethernet, LC	TX – 1310/1550 RX – 1550/1310 9/125 single mode (single fiber)	–	Laser (WDM)	-24	-3	-5	0	40	24.8
SFP-24 Fast Ethernet/STM-1, LC	850, 50/125 multimode	–	VCSEL	-25	-2	-10	-4	2	1.2
SFP-47DH Gigabit Ethernet, LC, DDM, internal calibration, extended temperature range -20˚ to 85˚ C (-4˚ to 185˚ F)	1470, 9/125 single mode	–	Laser (CWDM)	-24	-3	0	+5	80	49.7
SFP-49DH Gigabit Ethernet, LC, DDM, internal calibration, extended temperature range -20˚ to 85˚ C (-4˚ to 185˚ F)	1490, 9/125 single mode	–	Laser (CWDM)	-24	-3	0	+5	80	49.7
SFP-51DH Gigabit Ethernet, LC, DDM, internal calibration, extended temperature range -20˚ to 85˚ C (-4˚ to 185˚ F)	1510, 9/125 single mode	–	Laser (CWDM)	-24	-3	0	+5	80	49.7
SFP-55DH Gigabit Ethernet, LC, DDM, internal calibration, extended temperature range -20˚ to 85˚ C (-4˚ to 185˚ F)	1530, 9/125 single mode	–	Laser (CWDM)	-24	-3	0	+5	80	49.7
SFP-57DH Gigabit Ethernet, LC, DDM, internal calibration, extended temperature range -20˚ to 85˚ C (-4˚ to 185˚ F)	1550, 9/125 single mode	–	Laser (CWDM)	-24	-3	0	+6	80	49.7
SFP-59DH Gigabit Ethernet, LC, DDM, internal calibration, extended temperature range -20˚ to 85˚ C (-4˚ to 185˚ F)	1570, 9/125 single mode	–	Laser (CWDM)	-24	-3	0	+7	80	49.7
SFP-53DH Gigabit Ethernet, LC, DDM, internal calibration, extended temperature range -20˚ to 85˚ C (-4˚ to 185˚ F)	1590, 9/125 single mode	–	Laser (CWDM)	-24	-3	0	+8	80	49.7
SFP-61DH Gigabit Ethernet, LC, DDM, internal calibration, extended temperature range -20˚ to 85˚ C (-4˚ to 185˚ F)	1610, 9/125 single mode	–	Laser (CWDM)	-24	-3	0	+9	80	49.7

SFP TRANSCEIVERS

Fiber Optic Interface Characteristics

Ordering Name, Interface, Connector	Wavelength, Fiber Type [nm], [mm]	Standard	Transmitter Type	Input Power [dBm]		Output Power [dBm]		Typical Max. Range	
				(min)	(max)	(min)	(max)	[km]	[miles]
SFP-1/1D Fast Ethernet/STM-1, LC3	1310, 62.5/125 multimode	100BaseFX, IEEE 802.3 (FE), ANSI T1 646-1995 (STM-1)	LED	-30	-14	-20	-14	2	1.2
SFP-2/2D/2H Fast Ethernet/STM-1, LC	1310, 9/125 single mode	100BaseLX10, IEEE 802.3 (FE), G.957 S1.1 (STM-1)	Laser	-28	-8	-15	-8	15	9.3
SFP-3/3D/3H Fast Ethernet/STM-1, LC	1310, 9/125 single mode	G.957 L1.1 (STM-1)	Laser	-34	-10	-5	0	40	24.8
SFP-4/4D Fast Ethernet/STM-1, LC	1550, 9/125 single mode	G.957 L1.2 (STM-1)	Laser	-34	-10	-5	0	80	49.7
SFP-10a/10b/10aD/10bD Fast Ethernet/STM-1, LC	TX – 1310/1550 RX – 1550/1310 9/125 single mode (single fiber)	100BaseBX10, IEEE 802.3 (FE), G.957 (STM-1)	Laser (WDM)	-28	-8	-14	-8	20	12.4
SFP-14D STM-4, LC, DDM, internal calibration	1310, 62.5/125 multimode	–	Laser	-28	-14	-20	-14	0.5	0.3
SFP-15 STM-4, LC	1310, 9/125 single mode	G.957 S4.1	Laser	-28	-8	-15	-8	15	9.3
SFP-16 STM-4, LC	1550, 9/125 single mode	G.957 L4.2	Laser	-28	-8	-3	+2	80	49.7
SFP-18a/18b Fast Ethernet/STM-1, LC	TX – 1310/1550 RX – 1550/1310 9/125 single mode (single fiber)	–	Laser (WDM)	-28	-8	-5	0	40	24.8
SFP-19a/19b Fast Ethernet/STM-1, LC	TX – 1490/1570 RX – 1570/1490 9/125 single mode (single fiber)	–	Laser (WDM)	-30	-8	0	+5	80	49.7

Notes:

D DDM internal calibration

H Industrial SFP temperature range –40° to 85°C

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