Global Networking Using X.25

By Eddie Ho and John Ellis

The RISC System/6000 (RS/6000) is the preferred platform for global networking. NAFTA and the democratization of the Eastern European nations have created significant international business opportunities for many types of companies and industries. And communications is an important component of these trade opportunities. The primary networking infrastructure of these developing areas is based on X.25. The AIXLink/X.25 package (AIXLink/X.25 on AIX 3.25 and 4.1) can bridge the transformation from a host-centric model to a wide-area client/server application model.

Despite the widespread availability of Integrated Services Digital Network (ISDN) and frame relay in the U.S. and Europe, they are still not available in many areas of the world. But X.25-based packet switching is available worldwide and is the only stable, reliable service in some countries. Each country has its own Postal Telephone and Telegraph (PTT) that provides the communications within its borders, including the X.25 technology.

The International Telegraph and Telephone Consultative Committee (CCITT) defined the X.25 standard for attaching computer equipment to a Packet-Switched Data Network (PSDN). The data is carried in packets over circuits that are shared by many users. The packet can vary in size from 16 to 4096 bytes. Each connection—the point-to-point communication between two computers—is called a *virtual circuit.* Tariffs are typically based on a monthly subscription charge plus usage charges based on the number of packets transmitted.

X.25 has several advantages compared to a leased-line point-to-point connection.

- **Global standards**: Since X.25 is available in all countries, there are standards that apply to all locations.
- **Vendor independence**: The technology and equipment comes from one source—generally the PTT; therefore, equipment and technology are always compatible.
- **Security**: Security is available at the access level to the network and also at the destination location.
- **Ownership of your network without managing one**: The PTT is usually the network provider, which manages the networking technology.
- **Available in almost every country**: Because of its widespread acceptance, X.25 is available internationally.

Figure 1 shows the X.25 network in an enterprise environment in which workgroup users in a LAN environment are accessing remote data/source using the PSDN.

X.25 Architecture

The Open Systems Interconnection (OSI) reference model has three separate layers in its network:

Physical layer: This level of function is implemented at the AIX device-driver level. It consists of functions such as maintaining interface consistency, providing error recovery for High-level Data Link Control (HDLC) frames, and supporting auto call units. CCITT recommends the V.24, V.35, and X.21 physical interfaces.

Frame layer: The frame level uses a link access procedure to ensure that data and control information are accurately exchanged over the circuit between the computer and the network. Its error recovery procedure is based on `LAP_B`, which is a subset of HDLC.

Packet layer: X.25 is a connection-oriented protocol. The primary function of this layer is to give users access to the virtual circuit. The packet-

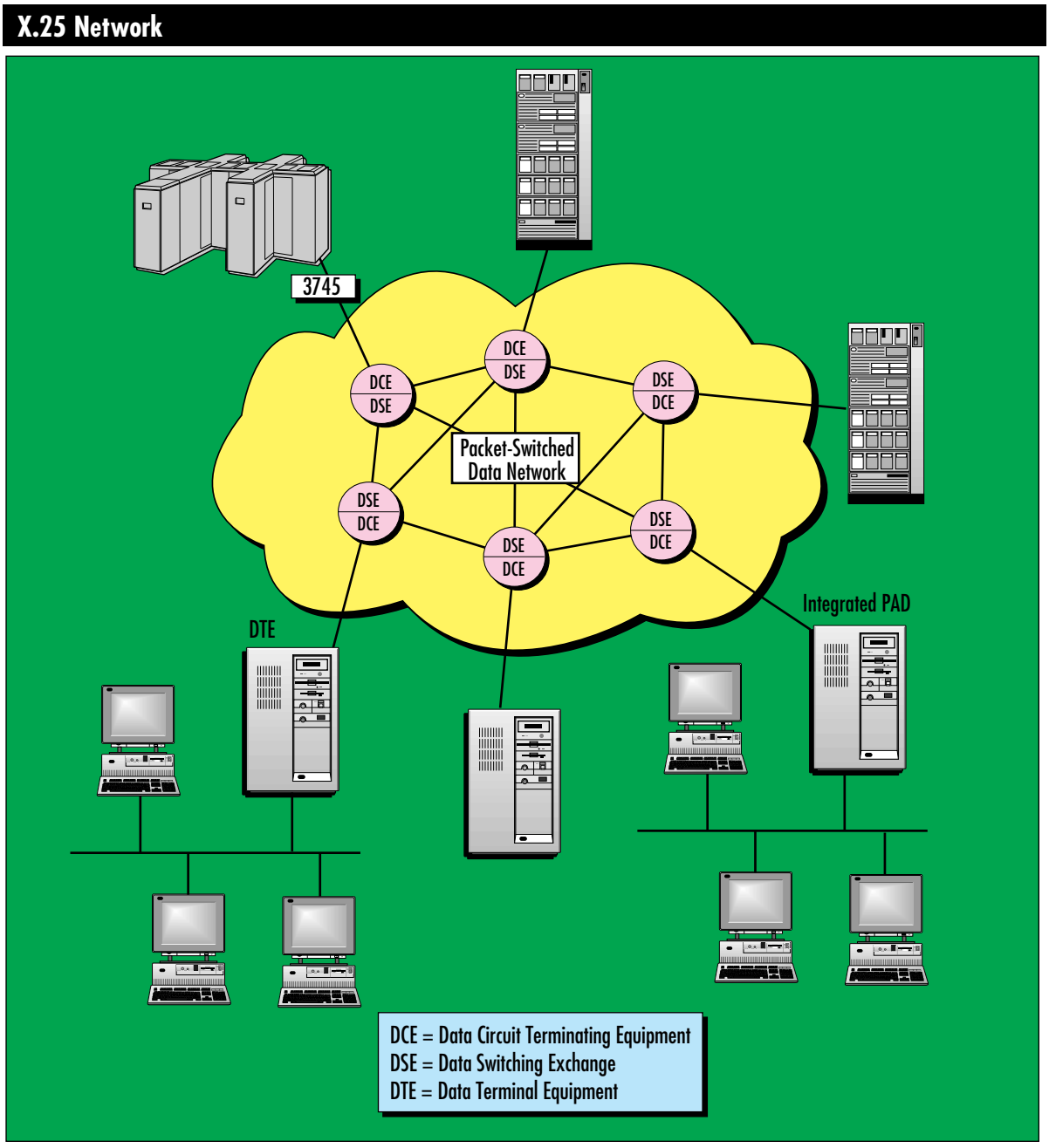

Figure 1. X.25 network in an enterprise environment

level protocol specifies how virtual circuits are established, maintained, and cleared.

The AIXLink/X.25 package implements these three layers. Transport protocols such as Systems Network Architecture (SNA) or TCP/IP use the packet layer. Figure 2 illustrates this layered network model.

Communication to the X.25 network uses logical channels assigned by the carrier. Each channel is mapped into a *virtual circuit*—the point-to-point communication between two computers. A virtual circuit exists only for the duration of the call for Switched Virtual Circuits (SVCs). After that, the *logical channel*—a communication path between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE)—can be reused for other applications. Another type of circuit is a Permanent Virtual Circuit, which provides a long-term connection between DTE and DCE.

The network carrier determines the number of concurrent channels—the RS/6000 hardware can

support up to 1024 channels, depending on the adapter type. The administrator predetermines and configures the number of circuits for incoming, outgoing, and two-way circuits. Figure 3 illustrates the relationship of the logical channel and virtual circuit.

AIXLink/X.25

AIXLink/X.25 is available on both AIX Version 3.2.5 and 4.1. Some important new features are listed below:

- Complies with the CCITT 1988 X.25 standard
- Supports X.3, X.28, and X.29 Packet Assembler/Disassembler (PAD)
- Supports Simple Network Management Protocol (SNMP) for Management Information Bases (MIBs) for the packet (RFC 1382) and frame (RFC 1381) layers
- Supports dedicated or switched circuits
- Supports automatic or user-defined point-to-point DTE/DCE configuration
- Supports up to 512 logical channels per line
- Supports X.21, V.24, and V.35 interfaces
- Supports speeds up to 64 Kbits/second

The networking protocols used with AIXLink/X.25 include TCP/IP, which supports all TCP/IP applications and interfaces, and SNA, which supports all SNA architectures including sub-area, Low-Entry Networking (LEN), and Advanced Peer-to-Peer Networking® (APPN®).

AIXLink/X.25 has three types of Application Programming Interfaces (APIs) supporting programming at the packet or frame level. These APIs are usually protocol suites, such as TCP/IP and SNA, or special commands. The APIs are as follows:

- **Network Provider Interface (NPI)**: This is an API at the packet layer that provides a connection-oriented interface based on the UNIX International Standard NPI Version 2.0. The API is based on the STREAMS model. The PAD implementation uses this interface.
- **Data Link Provider Interface (DLPI)**: This API, at the frame layer, is based on Version 2.0 of DLPI from UNIX International. The interface model is STREAMS.
- **Common Input/Output (COMMIO)**: These are compatible interfaces for AIX 3.2.5 applications, used by the SNA protocol suite.

Commands for the Administrator

Since AIXLink/X.25 has new features and functions, the commands listed in Figure 4 provide administrators with some help in setting up and managing the X.25 network.

Packet Assembler/Disassembler

In many regions, the PAD protocol converter is used for protocol support. It enables you to attach a low-cost terminal device, such as an ASCII terminal, to the X.25 network. The X.3 standard defines PAD protocol.

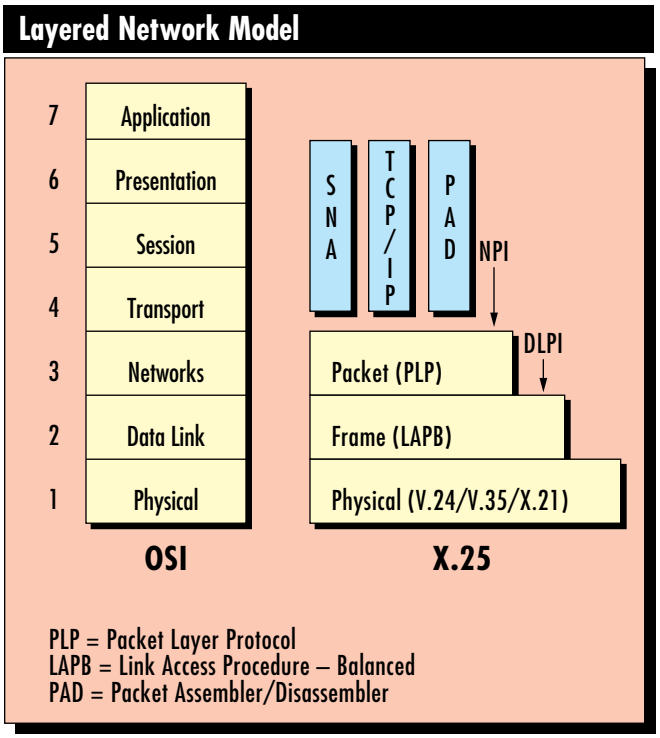

Figure 2. Layered network model

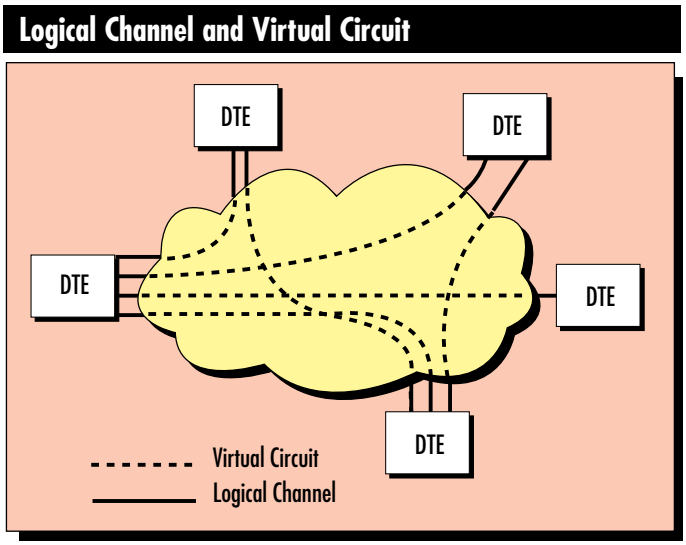

Figure 3. Relationship of logical channel and virtual circuit

AIXLink/X.25 Commands

Troubleshooting Commands

xtalk	Communicates with other DTE; manages address lists for outgoing calls
x25mon	Monitors the X.25 port activity
x25status	Shows all the link status

Operation Commands

chsx25	Re-initializes the attributes of an X.25 port
lspvc	Lists the non-default Permanent Virtual Circuit (PVC) attributes for an X.25 port
lsx25	Lists the configuration of the X.25 support on the system
mkpvc	Creates or modifies a non-default PVC on an X.25 port
mksx25	Adds an X.25 port
rmsx25	Removes an X.25 port
chdev	Allows modification for the X.25 adapter attributes
lsattr	Shows the X.25 adapter and port attributes

Networking Protocol Commands

x25ip	Manages a translation table from IP addresses into X.25 Network User Addresses (NUAs)
xspad	Starts a terminal PAD session
x29d	Starts the X.29 daemon

Figure 4. AIXLink/X.25 Commands

PAD Standard and Application Environment

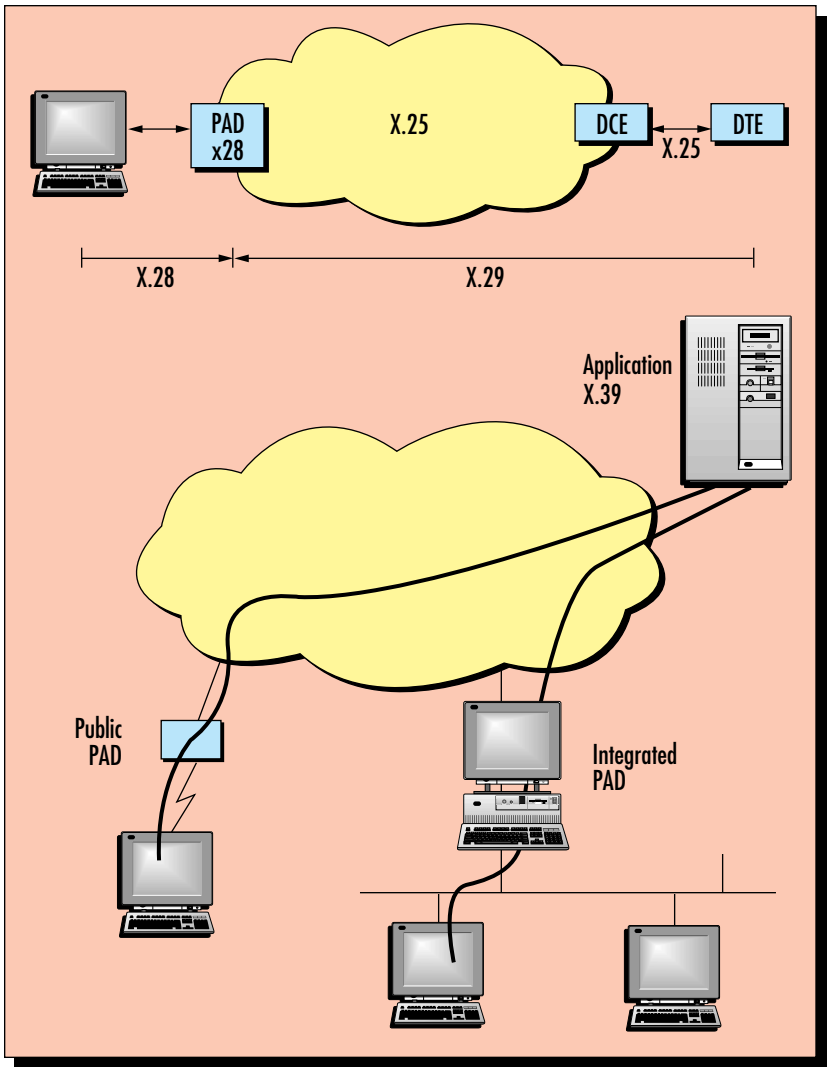

Figure 5. PAD standard and application environment

The PAD is usually provided by the PTT, carrier, or telco. The communication between the PAD and an ASCII terminal is X.28, which defines the ASCII terminal control behavior and characteristics. The communication between the remote DTE and the PAD is X.29 through X.25. X.29 defines the way in which a PAD and a remote DTE exchange control messages.

AIXLink/X.25 provides an integrated solution using both PAD and the ASCII terminal. Attaching an RS/6000 to a public PAD does not require AIXLink/X.25 software because the operating system emulates an ASCII terminal using AIX utilities such as `cu` or `ate`. Figure 5 illustrates both the communication standards and the application environments.

Communication Adapters

There are two families of adapter types based on the number of ports required. Each adapter family has multiple feature codes with different accessories. Figure 6 shows the features for each adapter to help you choose the right accessory for your adapter. AIXLink/X.25 can support two adapter types:

- **ARCTIC Portmaster Adapter/A**
  - —8 ports (V.24 interface) or 6 ports (V.35 or X.21 interface)
  - —Up to 64 Kbits/second at full duplex concurrently for each port
  - —Up to 512 virtual circuits per port with a maximum of 1024 per adapter

- **X.25 Interface Co-Processor**
  - —Single-port support with a V.24, V.35, or X.21 interface; either a Micro Channel® or ISA interface
  - —Supports up to 512 virtual circuits per port

A WAN Services Primer

Some commonly available communication services are listed below. Services not listed are T3 and SONET, high-bandwidth circuits usually used for private networks in a campus environment.

56-Kbits/second: The traditional low-bandwidth leased line has been the point-to-point 56-Kbits/second service. The customer specifies the locations to be connected and installs a Customer Service Unit/Data Services Unit (CSU/DSU) at either end of the link; the carrier establishes the connection between the sites. This is also known as Digital Data Service (DDS).

Switched 56: This is the switched version of 56-Kbits/second link. Charges are typically less than dedicated 56-Kbits/second circuits, but users also pay usage charges by the minute for the flexibility of connecting to multiple sites.

ISDN: Integrated Services Digital Network is an alternative to leased-line connections. Like Plain Old Telephone Service (POTS), ISDN is a switched service with a digital interface that eliminates the need for a modem. An ISDN terminal adapter is used in place of a modem. ISDN includes three types of services:

- B-channel service runs at 64 Kbits/second and is used for voice, circuit-switched data, or packet-switched data.
- D-channel, typically used for sideband signaling information, runs at 16 Kbits/second.
- H-channel service, sometimes referred to as ISDN 384, runs from 384 Kbits/second to 2 Mbits/second. It is intended for multimedia applications.

ISDN lines are provided in two configurations:

- Basic Rate Interface (BRI) = 2 B + 1 D
- Primary Rate Interface (PRI) = 23 B + 1 D

Frame Relay: Often characterized as "fast X.25", frame relay has little of the overhead associated with X.25, omitting packet sequencing and error checking. Frame relay is designed to accommodate bursty LAN traffic. In the U.S., carriers offer speeds from 56 Kbits/second to 1.544 Mbits/second. Frame relay can support both Permanent Virtual Circuits (PVCs) and Switched Virtual Circuits (SVCs). Few carriers today offer SVCs, so frame relay connections are typically point-to-point. Users generally need a leased line to the carrier's location to support frame relay connections.

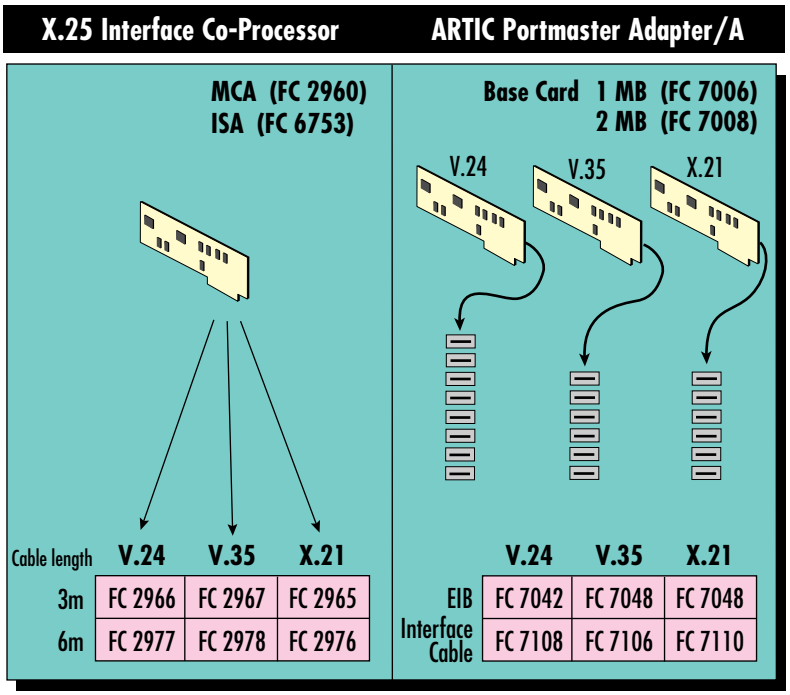

Figure 6. ARTIC and X.25 adapter accessories

T1: This is a digital service with a bandwidth of 1.544 Mbits/second. Also referred to as DS1 channel, T1 service has been the traditional high-bandwidth communications service of choice for private networks.

SMDS: Switched Multimegabit Data Service offers high-bandwidth, packet-switched circuits. Because SMDS supports bandwidth up to 45 Mbits/second, high-performance communications equipment (such as DSU/CSUs and routers) is required. SMDS is offered only within the coverage area of certain local carriers.

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