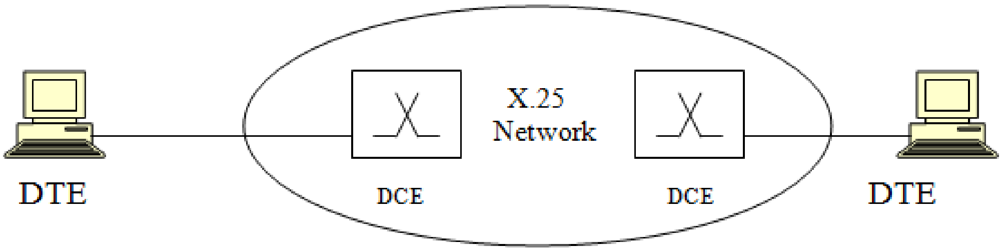
X.25

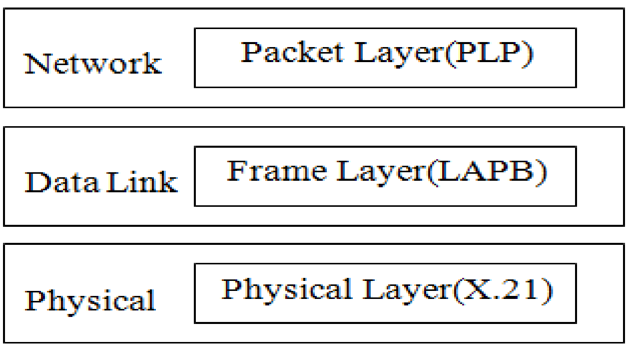
X.25 is a packet switching wide area network developed in 1976. Since then it has undergone several revisions. According to the formal definition, X.25 is an interface between data terminal equipment (DTE) and data circuit terminating equipment (DCE) (or X.25 is an interface between public packet switched networks and their customers). The following figure gives a conceptual overview of x.25.



X.25 describes the procedures necessary for establishing, maintaining, and terminating connections. X.25 is known as a subscriber network interface (SNI) protocol. It defines how the user's DTE communicates with the network and how packets are sent over that network using DCEs. It uses a virtual circuit approach to packet switching (SVC and PVC) and uses asynchronous TDM to multiplex packets. X.25 networks work at speed up to 64 kbps which make them obsolete for many purposes. In fact older networks outside U.S follow X.25 standards.

X.25 Layers:

X.25 protocol specifies three layers: (physical layer, frame layer, and packet layer). The following figure shows the relationship between the x.25 layers and the OSI layers.

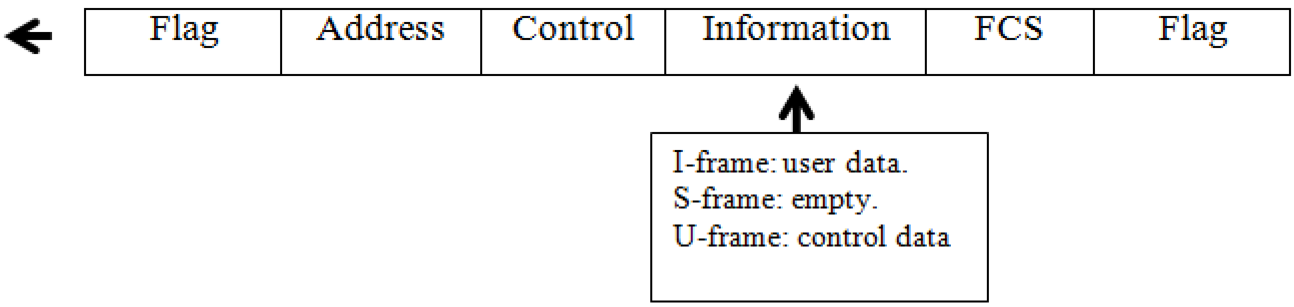


Physical layer:

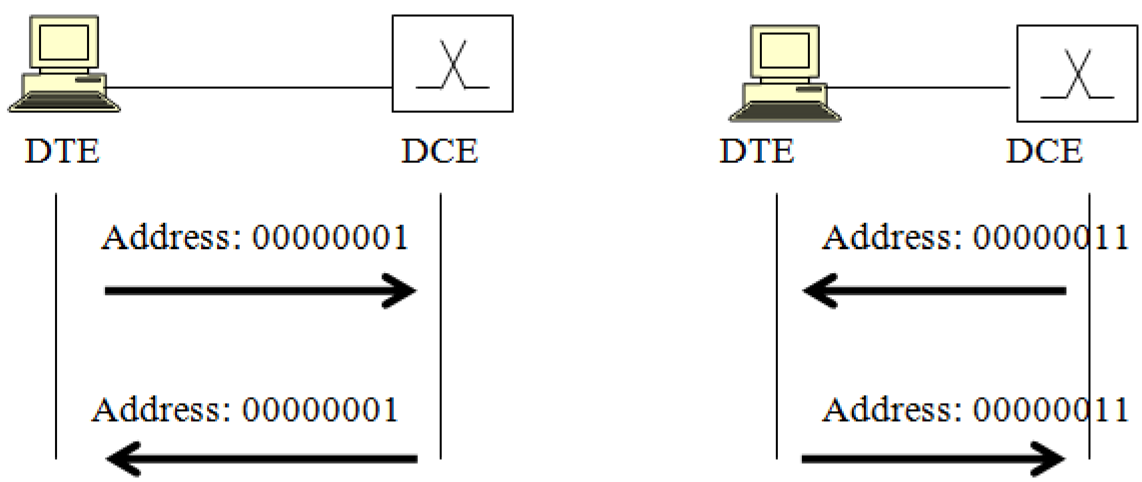
At physical layer, X.25 specifies a protocol called X.21 (or X.21 bits), which has been specifically defined for X.25. X.21 specifies the physical, electrical and procedural interface between the host and the network (very few public networks actually support this standard because it requires digital rather than analogue signaling on the telephone system).

Frame (Data Link) layer:

At the frame layer, X.25 provides data link controls (transmission errors control) using a bit-oriented protocol called Link access procedure, Balanced (LAPB), which is a subset of HDLC. The following figure shows the general format of the LAPB packet.



Because the communication here is point-to-point, the only two addresses are 00000001 (for command issued by a DTE and the response to this command) and 00000011 (for a command issued by a DCE and the response to this command). The following figure shows how addresses are used in the frame (data link) layer.



Three categories of frames:

LAPB has three categories:

I-Frame: are used to encapsulate PLP packets from the network layer.

S-Frame: are for flow and error control in the frame layer.

U-Frame: are used to set up and disconnect the links between a DTE and DCE.

Frame layer Phases:

In the frame layer, communication between DTE and DCE involves three phases:

Link setup: The link between DTE and DCE must be set up before packets from the packet layer can be transferred. Either the DTE or the DCE can set up the link by sending an SABM (Set Asynchronous Balanced Mode) frame; the responding party sends a UA (Unnumbered Acknowledgement) frame to show that the link is actually set.

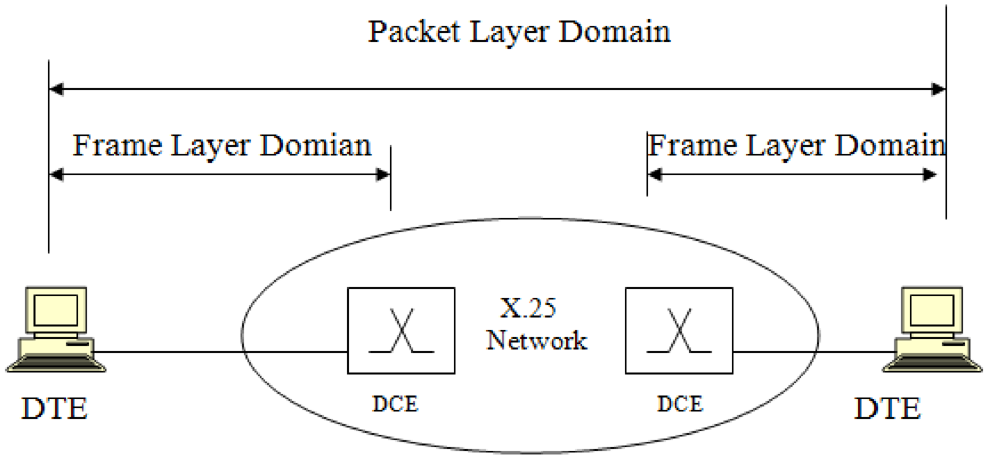
Transferring Data: After the link has been established, the two parties can send and receive network layer packets (data and control) using I-frames and S-frames.

Link Disconnect: When the network layer no longer needs the link, one of the parties can issue disconnect (DISC) frame to request disconnection. The other party can answer with a UA frame.

Packet (network) Layer:

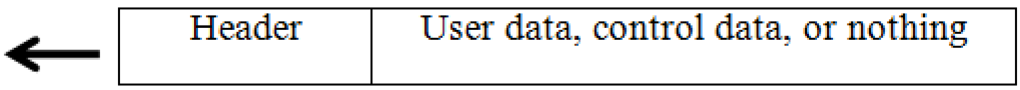
The network layer in X.25 is called the Packet Layer Protocol (PLP). This layer is responsible for establishing the connection, transferring the data, and terminating the connection. In addition, it responsible about negotiating network services between two DTEs. While the frame layer is responsible for making connection between DTE and DCE, the packet layer is responsible for making connection between two DTEs. Note that X.25 uses flow and error control at two levels (frame layer and packet layer). Flow and error control between DTE and DCE (link) are under frame layer. End to end flow

and error control between DTEs are under packet layer. The following figure shows the difference between the frame layer and packet layer



PLP Packets:

The general format of a PLP packet, shown in following figure, has three or four bytes of header and an optional information field up to 128 bytes.



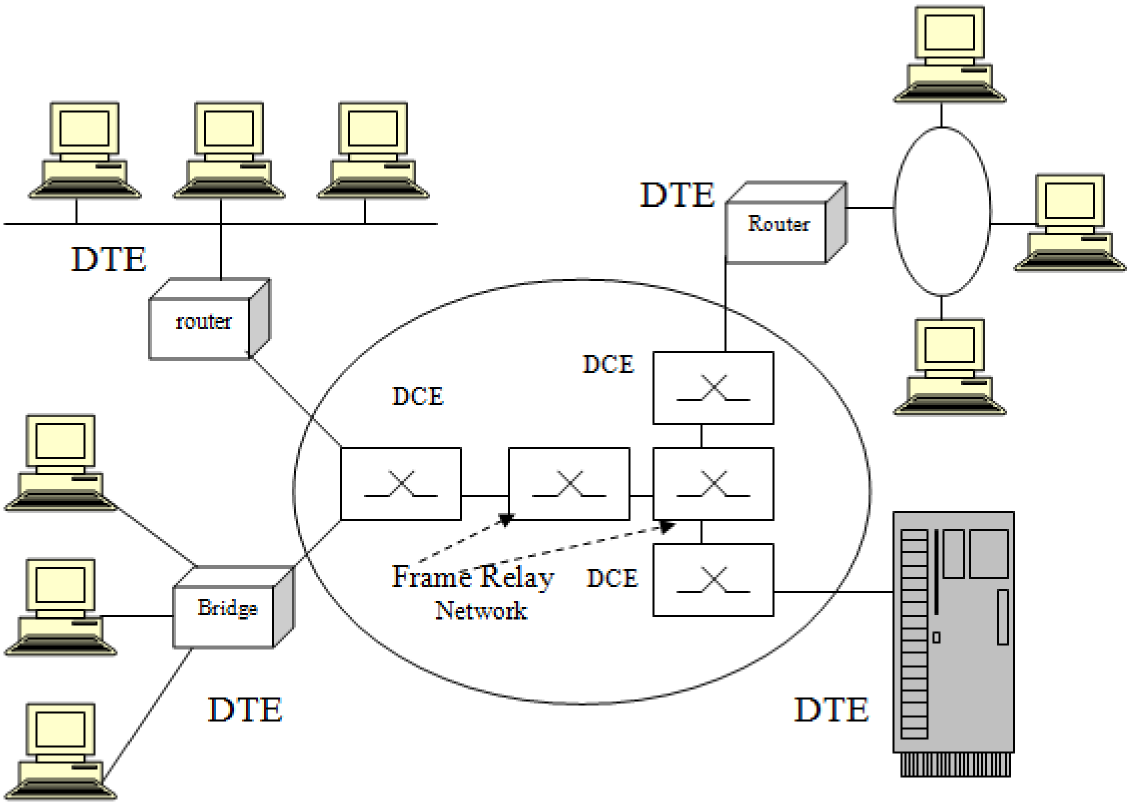
Packets at the PLP level can be divided into two categories: data packets and control packets.

Frame Relay

Frame relay can be used as a low cost, reasonable speed wide area network to connect local area networks that do not need real time communication but may have bursty data to send. In addition, today, frame relay provides both permanent and switched connections. A user who needs a permanent connection pays on a leased basis. A user who needs a switched connection pays on a used basis.

Frame Relay Operation:

Frame relay is normally used as a WAN to connect LANs or mainframe computers, as shown in figure below:



In the first case, a router or a bridge can serve as the DTE and connects, through a leased line, the LAN to the frame relay switch, which is considered a DCE. In the second case, the mainframe itself can be used as a DTE with the installation of appropriate software.

Frame relay can best be thought of as a virtual leased line. The customer leases a permanent virtual circuit between two points and send frames of 1600 bytes between them. It is also possible to lease permanent virtual circuits between a given site and multiple other sites, so each frame carries 10 bit number telling which virtual circuit to use.

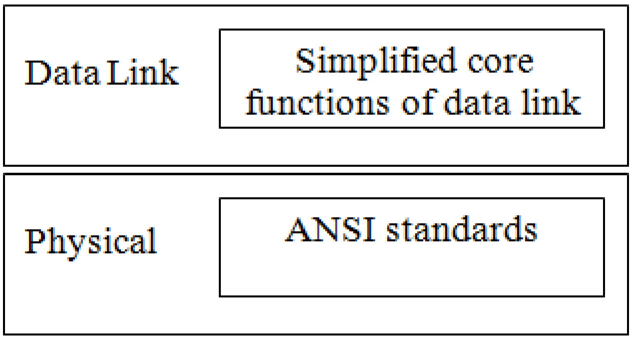
The difference between actual and virtual leased line is that with actual one, the user can send traffic all day long at maximum speed. With virtual one, data bursts may be sent at

full speed, but the average usage must be below a predetermined level, i.e, the carrier charges much less for a virtual line than a physical one.

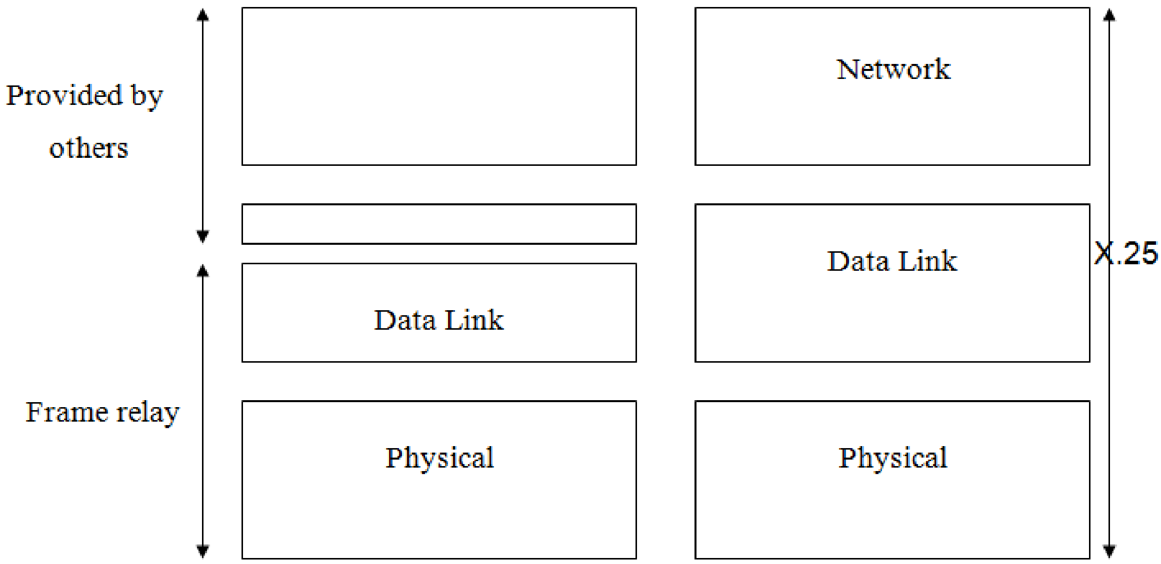
Frame relay operates at speed higher than X.25 networks. This speed is 1.5 Mbps.

Frame Relay Layers:

The following figure shows the frame relay layers.



Frame relay has only physical and data link layers. The following figure compares frame relay layers to the conventional layers of a packet switching network X.25.



Frame relay has only 1.5 layers whereas X.25 has 3 layers. Frame relay eliminates all of the network layer functions and a portion of the convetional data link functions.

Physical Layer:

No specific protocol is defined for the physical layer in frame relay. Instead, it is left to the implementer to use whatever is available. Frame relay supports any of the protocols recognized by ANSI.

Data Link Layer:

At the data link layer, frame relay employs a simplified version of HDLC called core LAPF. The simpler version is used because HDLC provides extensive error and flow control fields that are not needed in frame relay.