Chapter 10: Protocols in Telecommunications (8hrs)

10.1 OSI model

10.2 X.25 packet switched network

10.3 Frame relay

10.4 Integrated Services Digital Network, ISDN features, service and application, architecture and data rate, protocols like link access procedure for D channlel, channel data link protocol and ISDN layer three protocol, broadband-ISDN

10.5 ATM services and application, ATM network access, ATM header and payload,

(Reference: Chapter 11 from Digital Telephony, J Bellamy, 3e

Chapter 10 from J.E Flood, Telecommunications Switching, Network and Traffic,

Chapter 10/11 from Thiagarajan Viswanathan, "Telecommunication Switching Systems and Networks")

OSI Reference Model

Reference:

“Computer Networks”, by Tanenbaum

And Wetherall,5th edition

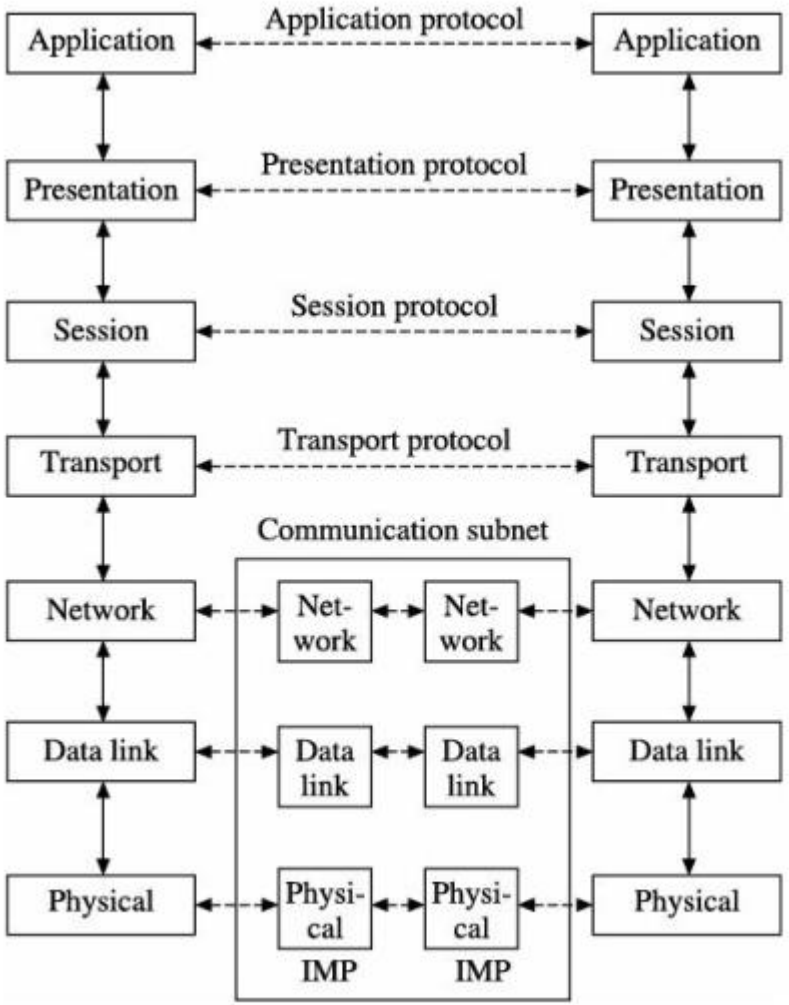


Figure 10.17 **ISO** OSI reference model.

Physical Layer:

The physical layer is concerned with transmitting raw bits over communication channel.

Data Link Layer:

The main task of the data link layer is to transform a raw transmission facility into a line that appears free of undetected transmission errors.

Network Layer;

The network layer controls the operation of the subnet.A key design issue is determining how packets are routed from source to destination.

The transport Layer:

The basic function of the transport layer is to accept data from above it, split it up into smaller units if need be, pass these to the network layer, and insure that the pieces all arrive correctly at the other end.

The Session Layer:

The session layer allows users on different machines to establish sessions between them. Sessions offer various services, including dialog control , token management and synchronization.

The presentation Layer:

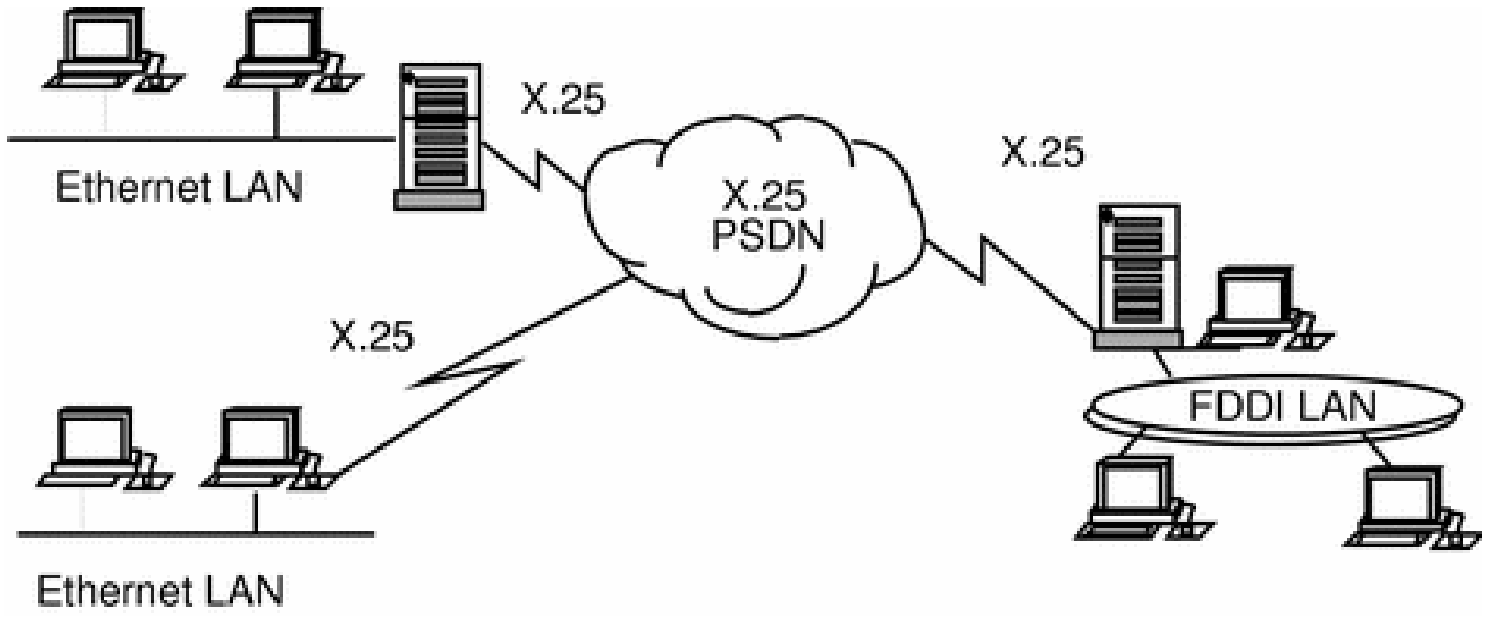
It is concerned with the syntax and semantics of information transmitted.

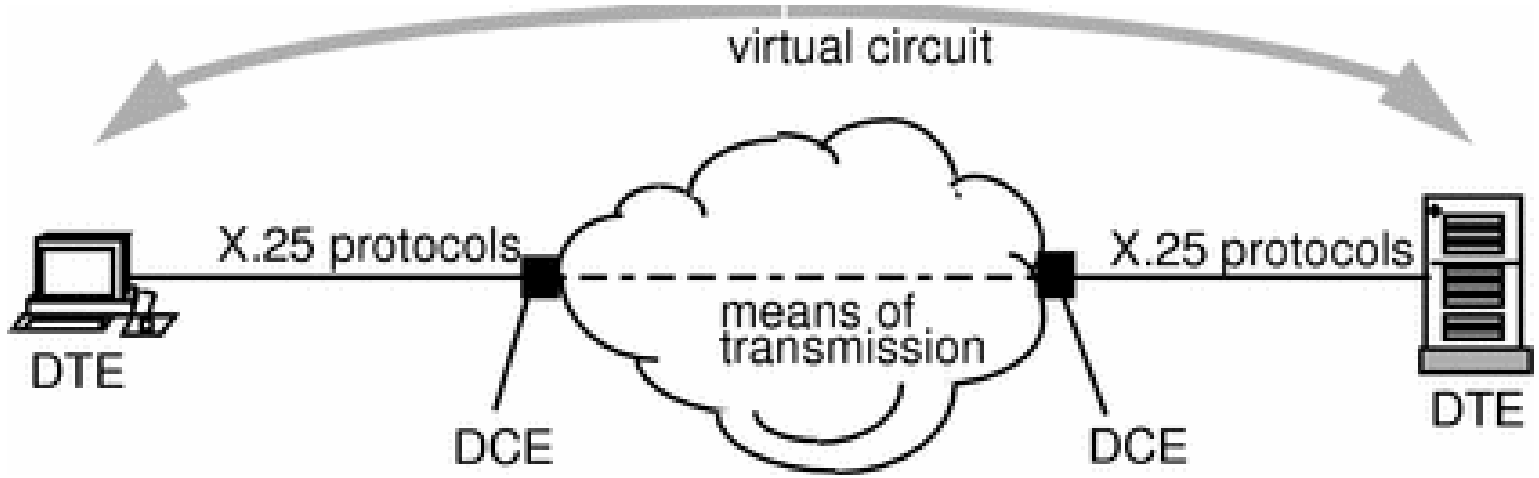
The Application Layer:

The application layer contains a variety of protocols that are commonly needed by users. Like HTTP, FTP,SNMP etc.

X.25 Overview

It is conventional to represent an X.25 network as a cloud.





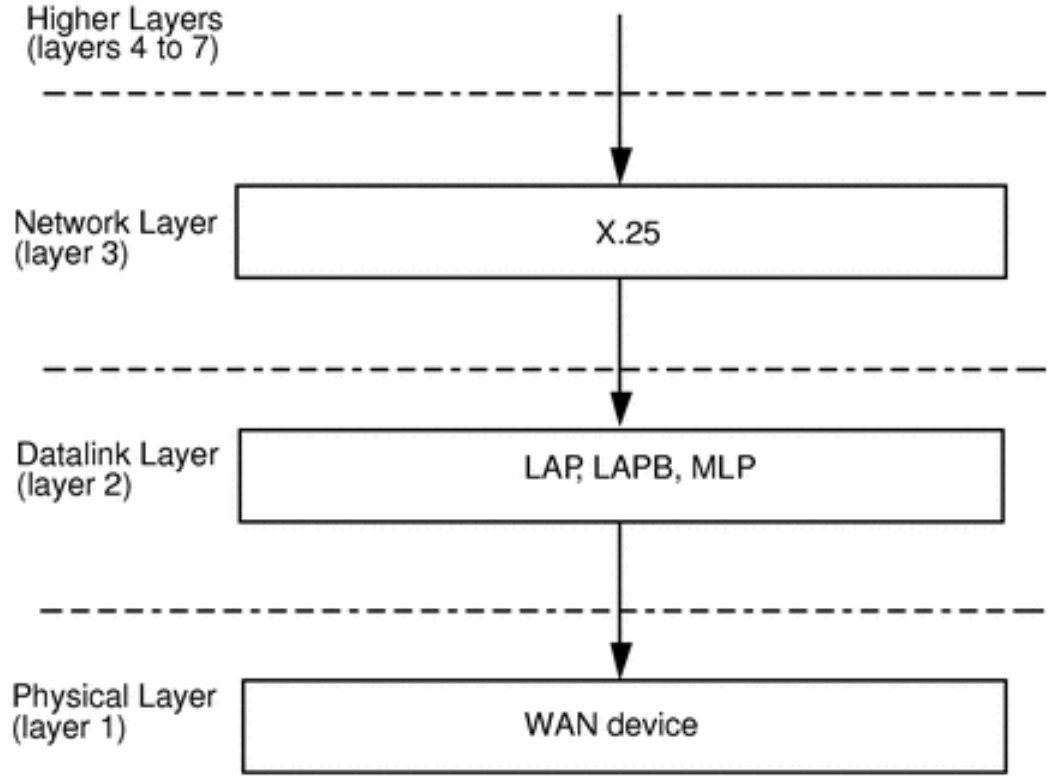
X.25 defines the way the interface between a system running X.25 (often referred to as a DTE) and a system providing a network connection (often referred to as a DCE) works.

X.25 is an ITU standard protocol established in 1976 for accessing a public packet switching network. X.25 defines the physical layer, link layer , network level of the OSI reference model.

X.25 network is an interface between data terminal equipment (DTE) and data circuit-terminating equipment(DCE) that operates in the packet mode.

X.25 Protocol Layers Overview

The data link layer of X.25 is link access procedure balanced (LAPB) using high level data link control (HDLC).



Datalink Layer Frame Format

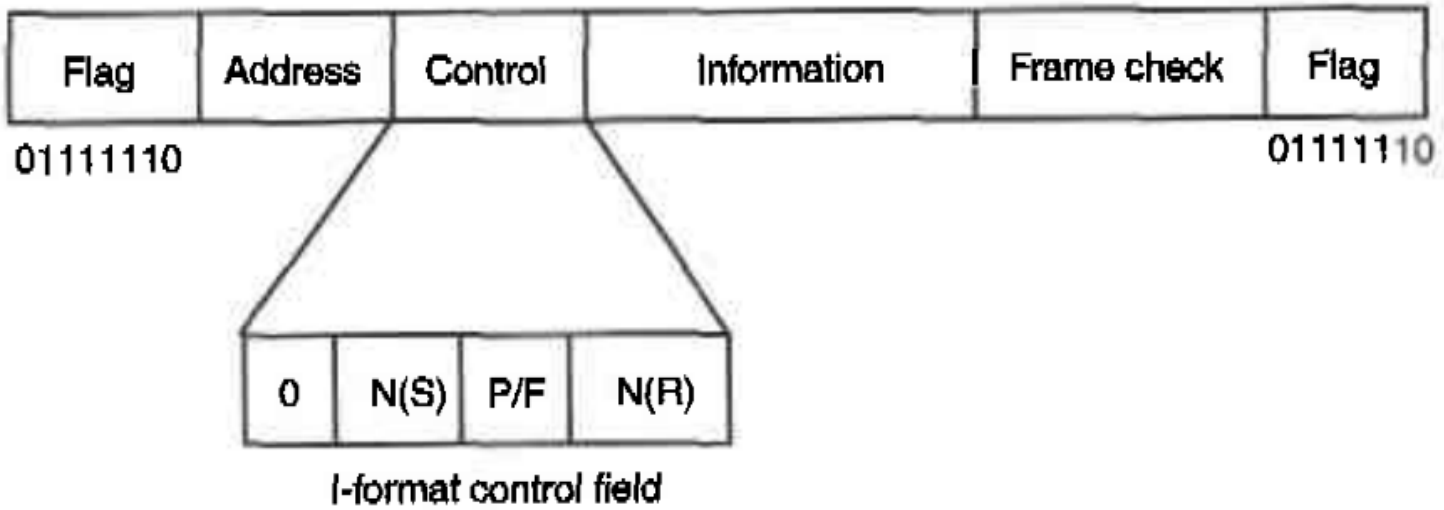
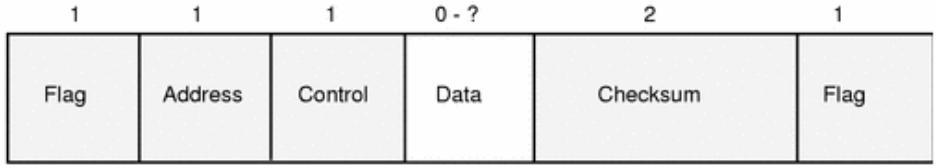


Figure 10.5 HDLC frame format.

Please see page 469 in text book for more details (J Bellamy)



Datalink layer frames are structured as follows:

Flag

Frames are delimited at each end by a flag, with the value 01111110. This is necessary because X.25 is synchronous - in other words, data is transmitted as a continuous stream.

Address

This is one octet. The value varies, depending on the direction of data flow, and on whether this is a single or multilink operation.

Control

The control octet define the type of frame this is: an I(nformation)-frame containing data, a S(upervisory)-frame, which is a response frame, or an U(nnumbered)-frame, which performs control functions.

Data

The data field contains X.25 protocol information, as well as user data from higher layer protocols. A frame need not contain data.

Checksum

The two-octet checksum follows the data, and is derived from the contents of the data packet. It is usually generated automatically by the hardware.

Reference: https://docs.oracle.com/cd/E19069-01/sol.x25.92/806-1234/6jahkbs4i/index.html

Frame Relay

(Please see page 471 in J Bellamy)

Three ways to connect remote LANS

1) X.25
2) Leased Line
3) Frame Relay

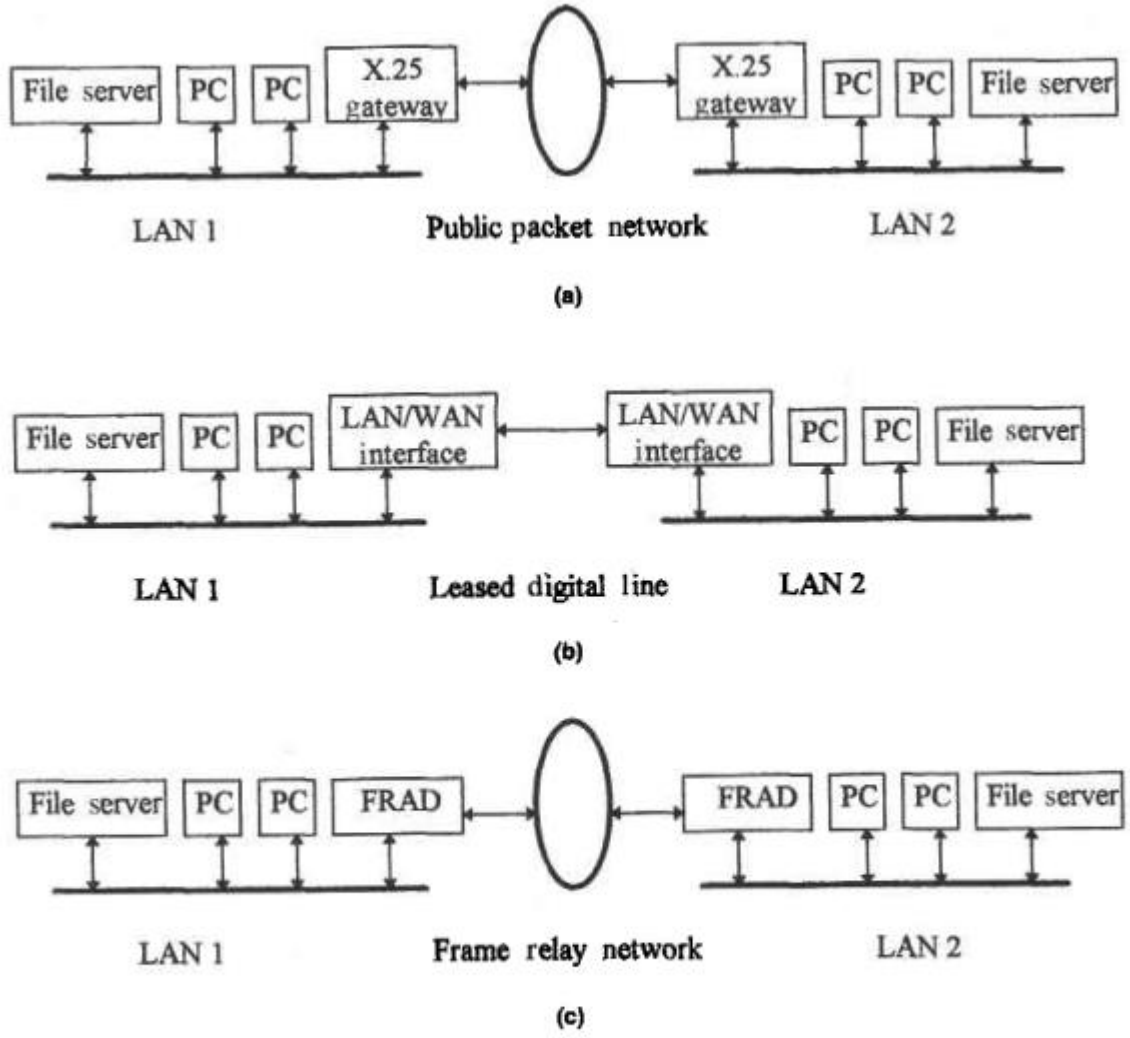


Figure 10.6 LAN-to-LAN interconnection methods: (*a*) through X.25 packet-switching netowrk; (*b*) through leased line; (*c*) through frame relay network.

- Frame relay is a packet-switching protocol but is faster than X.25 networks because it does not provide error control. It defines how frames are routed through a fast-packet network based on the address field in the frame.

- Error control at the data link layer (eg X.25) requires receipt of an entire packet before it can be forwarded from one link to another.

FRAD stands for Frame Relay Access Device

(Reference: https://www.ibm.com/docs/en/i/7.1?topic=standards-frame-relay-networks)

Frame relay also supports shortened address processing with a data link connection identifier (DCLI) field in the header.

ATM services and application, ATM network access, ATM header and payload (see page 474 in text book)

ATM Network:

In contrast to TCP/IP , the Asynchronous Transfer Mode (ATM) network architecture incorporated features for supporting real-time traffic such as voice and video in initial implementation.

The principal aspects of ATM directed to real-time support are short, fixed-sized packets(cells), short headers, and no link-by-link error control.

ATM standardizes the wide range of services by defining quality-of-service requirements for various traffic types. The quality-of-service parameters specifically intended for voice services are maximum delay, delay variation, and cell loss probability.

ATM Cells

The ATM transmission format consists of fixed-sized cells of 53 bytes each.

There are 5 overhead bytes within each cell, which leads to 48 bytes of payload per cell. The use of fixed-sized cells for all applications facilitates hardware only implementations of switching functions (queuing and transfer)

Cell Loss Priority (CLP)

CLP: 0 cells with CLP 0 are never discarded

CLP:1 cells with CLP 1 are discarded at a heavily congested network element

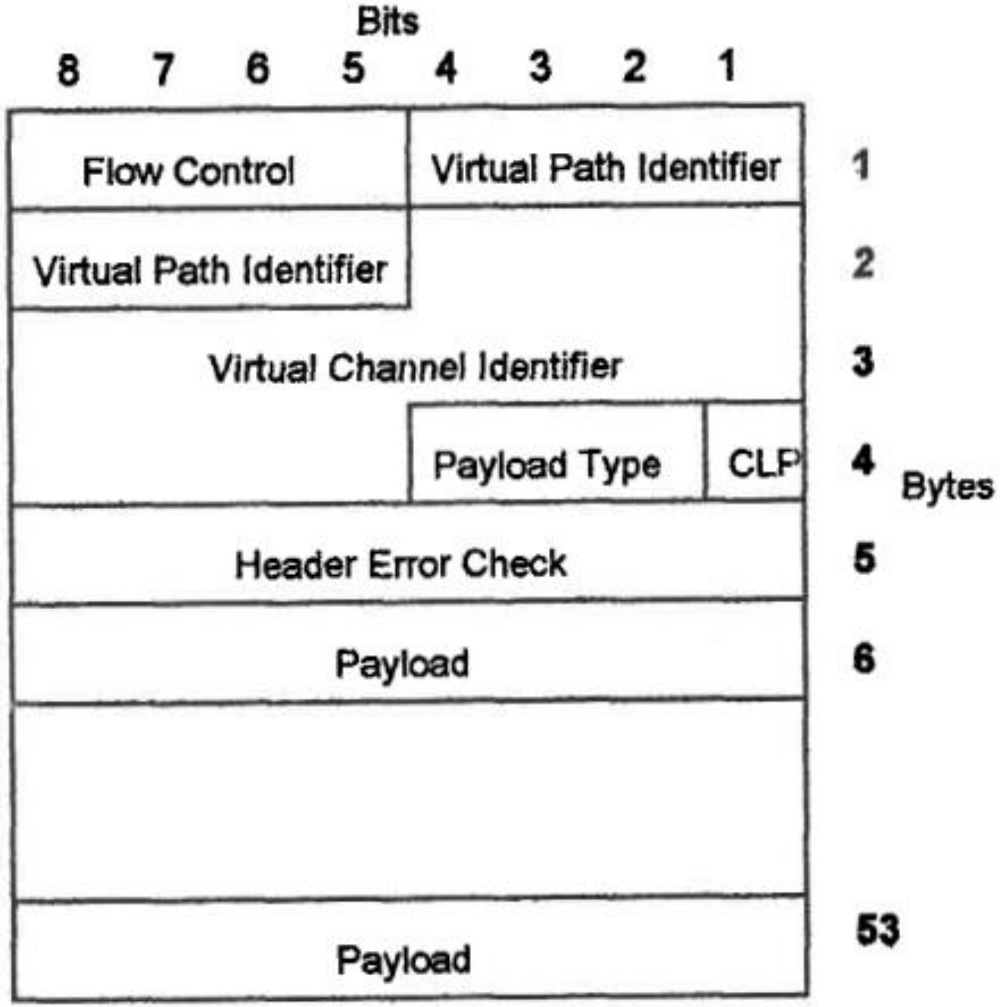


Figure 10.7 ATM cell format: CLP, cell loss priority.

ATM Service Categories

ATM services are categorized into the following categories related to the stastistical name of the data rate requirements of the respective sources and the quality of service (QoS) that the network can provide for those services.

1) Constant-bit-rate(CBR) services
2) Variable-bit-rate(VBR) services
3) Available bit rate (ABR) services
4) Unspecified bit rate (UBR) services

ISDN (Integrated Services Digital Network)

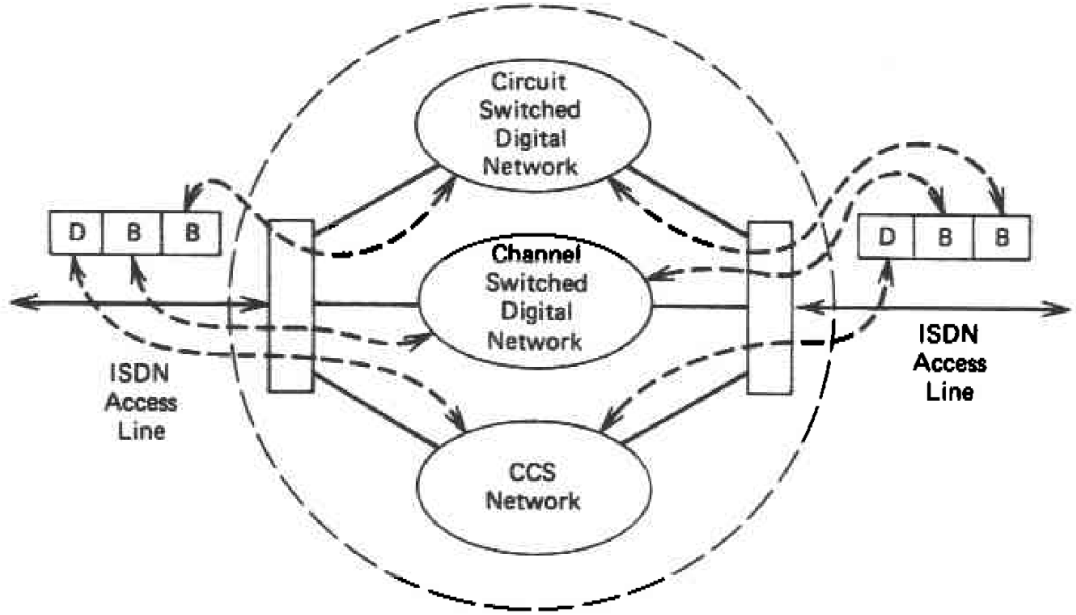


Figure 11.1 Integrated Services Digital Network access to circuits, channels, leased lines, and common-channel signaling.

ISDN (Integrated Services Digital Network) is a network that provides various types of services, including telephone data,fax,and video, through a single and universal user-network interface (UNI). The customer has a single access point to the network, instead of a separate interface for each service.

Services Available:

The services available from an ISDN are those already provided by a PSTN, those that obtain a significant benefit from an ISDN and those that could not be carried on a normal PSTN. The use of an ISDN can enable a telephone to provide a range of supplementary services (e.g calling line identification, call transfer, conference calls etc). Examples of new services that can be provided are high-speed data transmission and video-conferencing over switched connections.

Two levels of digital access to the ISDN network have been standardized by CCITT: **basic rate access** and **primary rate access**.

Basic Rate Interface (BRI): BRI is also referred to as a 2B + D interface

The customer's line carries two 64k bit/s 'B' channels plus a 16 k bit/se "D" channel (for a common signalling channel) in each direction. Basic-rate requires a bit rate of 2*64 + 16 = 144kbit/s. The addition of "overhead" for frame alignment, etc., gives a total digit rate of about 160 kbit/s.

Primary Rate Interface (PRI): PRI is also referred to as 23B + D (US)

30 B + D (ITU standard)

US PRI is a fundamentally a 1.544 Mbps DS1 (T1 carrier) signal with the D channel replacing one of the 24 message channels (usually the last one).

The ITU-T PRI is a 2.048 Mbps E1 digital signal with the D channel occupying the signalling channel (time slot 16).

Access to ISDN

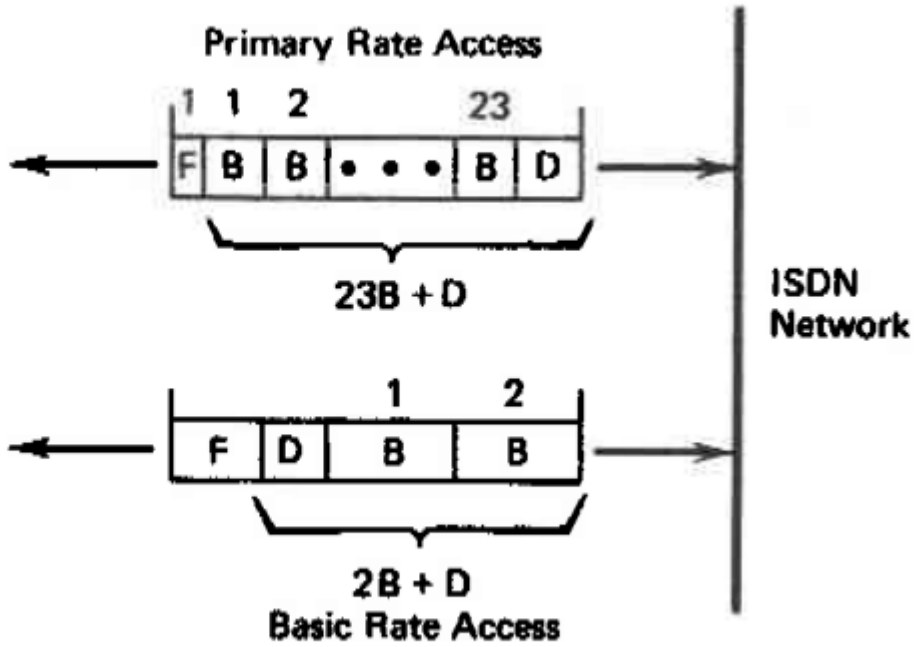


Figure 11.2 Basic rate and primary rate access to ISDN.

Architecture of BRI

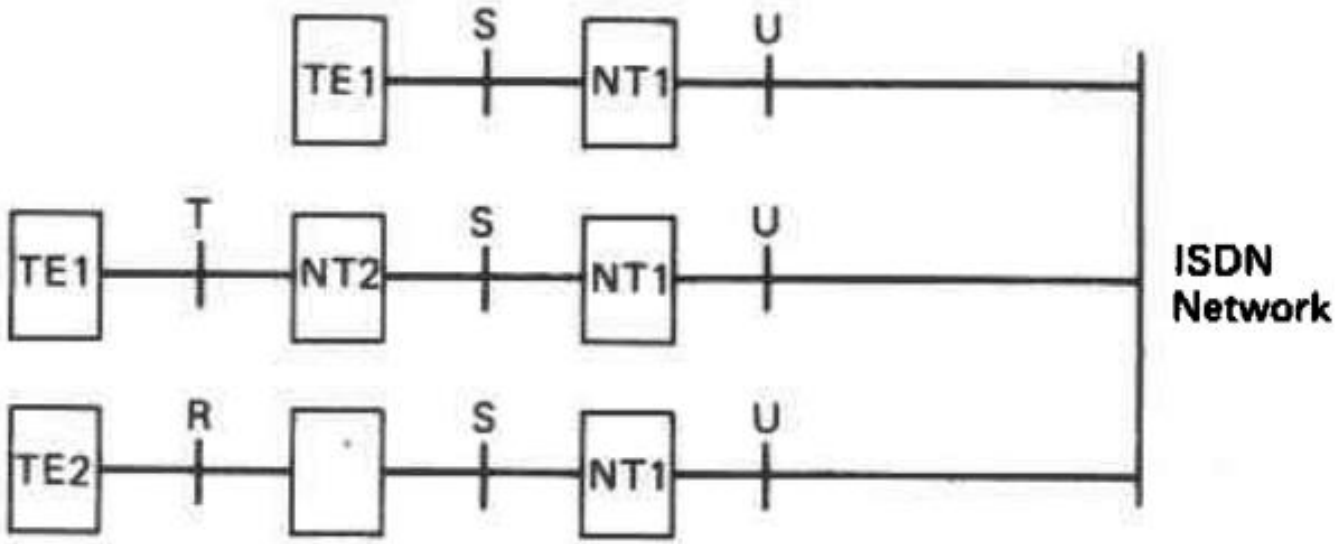


Figure 11.3 Basic rate interface architecture.

Module Definitions

NT1: A network termination module for layer 1 functions that provides physical and electrical termination of the transmission link only. In essence, the NT1 isolates the user from the transmission technology but does not demultiplex or process D channel messages.

NT2: A second level of network termination that implements functions associated with layers 2 and 3 of the OSI protocol stack. Thus, NT2 equipment extracts and processes D channel messages. Representative NT2 equipment includes PBXs, multiplexers, or LAN gateways.

TE1: Type 1 terminal equipment such as a digital telephone that complies with the ISDN S interface recommendation.

TA: Terminal adapter used to convert from an arbitrary (R) interface to the ISDN S interface.

TE2: A non-ISDN terminal that requires a terminal adapter to interface to the ISDN S interface. Prevalent examples of a TE2 equipment are analog telephones or asynchronous (RS-232) data terminals.

Reference Points

U: Interface to the two-wire transmission line.

T: CCITT ISDN interface defined in Recommendation I.430.

S: Interface to NT2 equipment identical to a T interface.

R: A non-ISDN interface such as an analog tip and ring.

ISDN D Channel Protocol (page 503)

The D channel protocol is defined in two separate series of ITU-T recommendations: the I series and the Q series. The data link layer (LAPD) is defined in I.441 or Q.921. This protocol is similar to LAPB of the X.25.

When a B channel accesses a packet network, the X.25 protocol is used while in the connected state.

BISDN Architecture

BISDN is a service requiring transmission channels capable of supporting rates higher than the primary rate. BISDN allows for the services like video services, which require the data rates in orders of magnitudes beyond those that can be delivered by ISDN.

The main aim of BISDN is a to support video and image services. BISDN are broadly classified as

1) Interactive services
2) Distributed Services

Reference: Text book

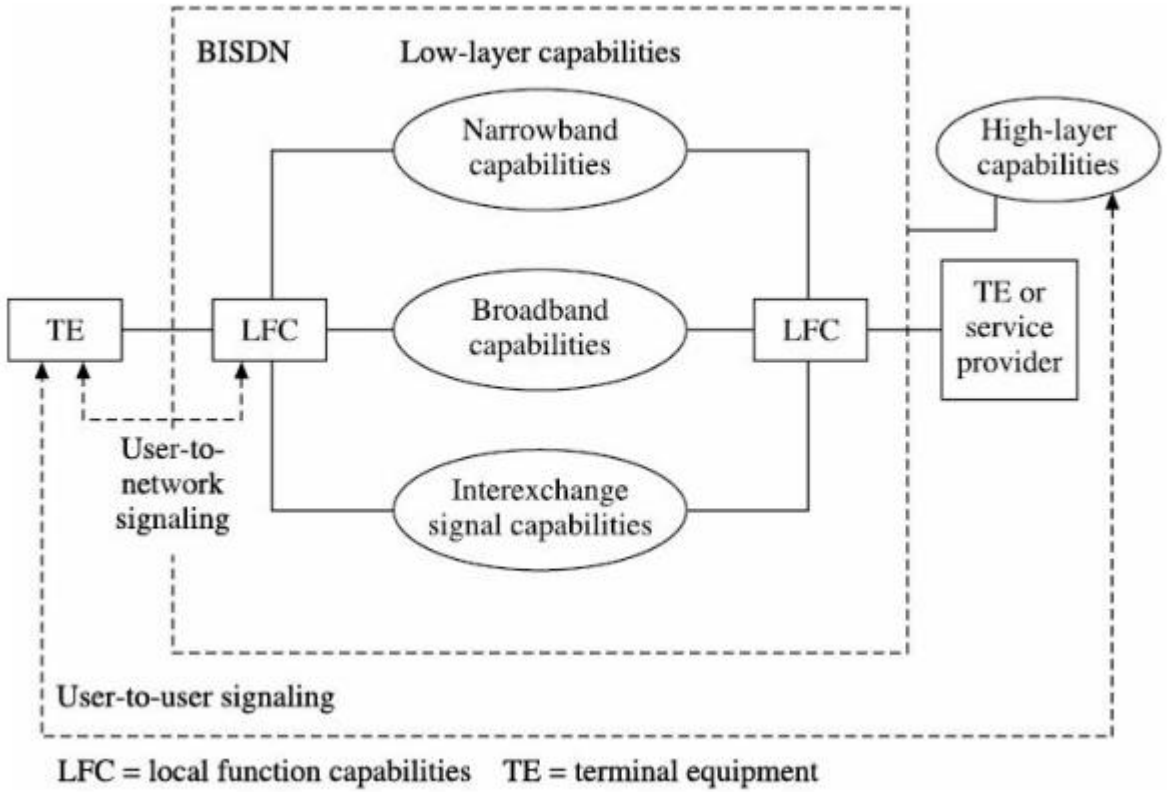


Figure 11.23 **BISDN** functional architecture.

THANK YOU