UNIT

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UNIT

Introduction Concepts

CONTENTS

Long Answer Ty

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1. A computer networ
2. A node can be any
3. The communicatin
4. Categories of netw
5. The three basic ca
   - **a. Local Area N**
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2. High reliability b
3. Greater flexibilit
4. Increase product users.

PART-1

Introduction Concepts : Goals and Application of Network.

Questions-Answers

Long Answer Type and Medium Answer Type Questions

Que 1.1. Write a short note on computer network.

Answer

1. A computer network can be defined as a collection of nodes.
2. A node can be any device capable of transmitting or receiving data.
3. The communicating nodes have to be connected by communication links.
4. Categories of network are categorized on the basis of their size.
5. The three basic categories of computer networks are :
   - **a. Local Area Network (LAN) :**
     - i. LAN is usually limited to a few kilometers of area.
     - ii. It may be privately owned and could be a network inside an office on one of the floor of a building or a LAN could be a network consisting of the computers in an entire building.
   - **b. Wide Area Network (WAN) :**
     - i. WAN is made of all the networks in a (geographically) large area.
     - ii. The network in the entire state of Maharashtra could be a WAN.
   - **c. Metropolitan Area Network (MAN) :**
     - i. MAN is of size between LAN and WAN.
     - ii. It is larger than LAN but smaller than WAN.
     - iii. It may comprise the entire network in a city like Mumbai.

Que 1.2. Describe the goals and application of network.

Answer

Goals of network are :

1. Cost reduction by sharing hardware and software resources.
2. High reliability by having multiple sources of supply.
3. Greater flexibility because of possibility to connect devices.
4. Increase productivity by making it easier to access data by the several users.

5. To increase the systems performance, as the work load increases, by just adding more processors.
6. Computer networks provide a powerful communication medium.

Applications of network are :

1. **Marketing and sales :**
   i. Marketing professional use to collect, exchange and analyze data relating to customer needs and product development cycles.
   ii. Sales application includes teleshopping, which uses order entry computers or telephone connected to an order processing network, and online reservation services for railways, hotels, airlines, restaurants, theatre etc.
2. **Financial services :** It include credit history searches, foreign exchange and investment services and Electronic Fund Transfer (EFT), which allow a user to transfer money without going to bank.
3. **Electronic messaging :**
   i. Emails transfer the messages between two and more users in a network.
   ii. With this application user can transfer the information in the form of text, picture and voice.
4. **Directory services :** It allows list of files to be stored in central location to speed up the world wide search operation.
5. **Information services :**
   i. It includes bulletin boards and data bank.
   ii. A 'www' site offering the technical specification for a new product in an information services.

PART-2

Network Structure and Architecture, the OSI Reference Model.

CONCEPT OUTLINE

- OSI model consists of seven layers :
  i. Physical layer
  ii. Data link layer
  iii. Network layer
  iv. Transport layer
  v. Session layer
  vi. Presentation layer
  vii. Application layer

Questions-Answers

Long Answer Type and Medium Answer Type Questions

Que 1.3. **Describe OSI reference model in detail.**

OR

Discuss the services of each layer of OSI reference model.

AKTU 2014-15, Marks 05

OR

Explain functionalities of every layer in OSI reference model with neat block diagram.

AKTU 2016-17, Marks 7.5

Answer

a. OSI reference model is a seven layer architecture which defines seven levels or layers in a complete communication system. The lowest layer is physical layer and highest one is called as the application layer.

b. It is called as OSI (Open System Interconnection) reference model because it is designed to deal with open systems *i.e.*, the systems which are open for communication with other systems.

c. The OSI model suggested by IEEE has seven layers :

1. Physical layer :

i. The physical layer coordinates the functions required to transmit a bit stream over a physical medium.

ii. It deals with the mechanical and electrical specifications of the interface and transmission medium.

iii. Fig. 1.3.1 shows the position of the physical layer with respect to the transmission medium and the data link layer.

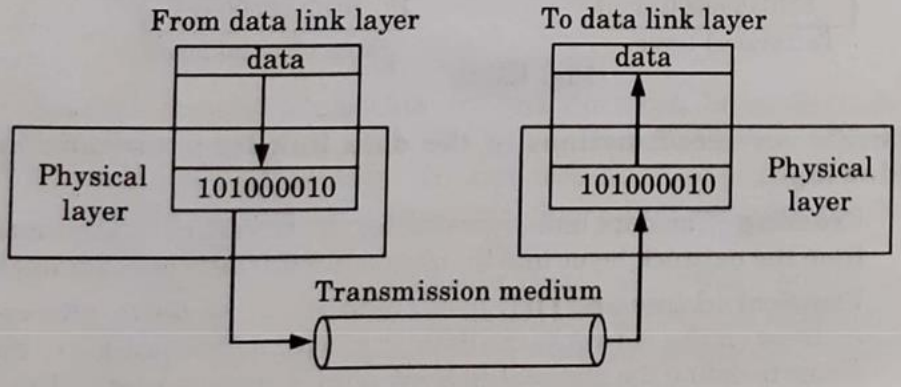

Fig. 1.3.1.

Specific services/functions of the physical layer are :

i. **Physical characteristics of interfaces and media :** The physical layer defines the characteristics of the interface between the devices and the transmission medium. It also defines the type of transmission medium.

ii. **Representation of bits :** The physical layer defines the type of encoding (how 0s and 1s are changed to signals) of bit which is to be transmitted.

iii. **Data rate :** The transmission rate, the number of bits sent per second, is also defined by the physical layer.

iv. **Synchronization of bits :** The sender and receiver must be synchronized at the bit level.

v. **Line configuration :** The physical layer is concerned with the connection of devices to the medium. In a point-to-point configuration, two devices are connected together through a dedicated link. In a multipoint configuration, a link is shared between several devices.

2. **Data link layer :**

i. The data link layer transforms the physical layer, a raw transmission facility, to a reliable link and is responsible for node-to-node delivery.

ii. It makes the physical layer appear error free to the upper layer (network layer).

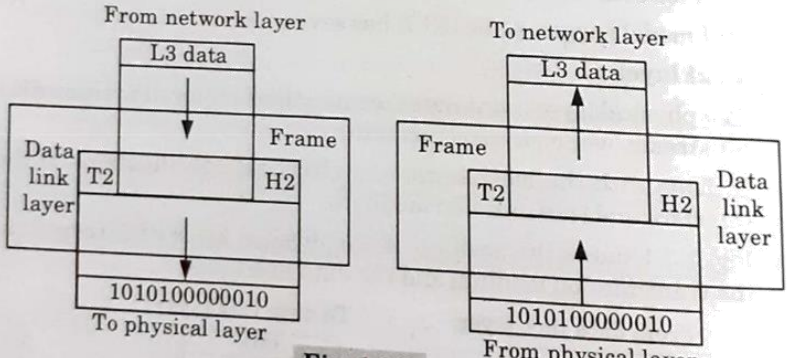

Fig. 1.3.2.

Specific services/functions of the data link layer include the following :

i. **Framing :** The data link layer divides the stream of bits received from the network layer into manageable data units called frames.

ii. **Physical addressing :** If frames are to be distributed to different systems on the network, the data link layer adds a header to the frame to define the physical address of the sender (source address) and/or receiver (destination address) of the frame.

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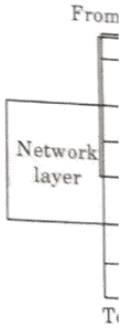

Specific
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ii. **Rout**
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route

iii. **Flow control :** If the rate at which the data are absorbed by the receiver is less than the rate produced by the sender, the data link layer imposes a flow control mechanism to prevent overwhelming the receiver.

iv. **Error control :** The data link layer adds reliability to the physical layer by adding mechanisms to detect and retransmit damaged or lost frames. It also uses a mechanism to prevent duplication of frames.

v. **Access control :** When two or more devices are connected to the same link, data link layer protocols are necessary to determine which device has control over the link at any given time.

3. **Network layer :**

i. The network layer is responsible for the source to destination delivery of a packet possibly across multiple networks (links).

ii. The network layer ensures that each packet gets from its point of origin to its final destination.

iii. If two systems are connected to the same link, there is no need for a network layer. However, if the two systems are attached to different networks (links), there is a need for the network layer to accomplish source-to-destination delivery.

iv. Fig. 1.3.3 shows the relationship of the network layer to the data link and transport layers.

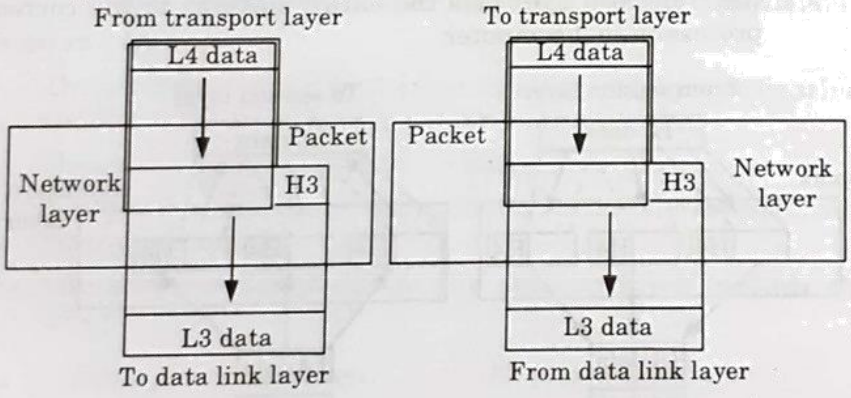

Fig. 1.3.3.

Specific services/functions of the network layer include the following :

i. **Logical addressing :** The network layer adds a header to the packet coming from the upper layer that includes the logical addresses of the sender and receiver.

ii. **Routing :** When independent networks or links are connected together to create an internetwork (a network of networks) or a large network, the connecting devices (called routers or gateways) route the packets to their final destination.

4. Transport layer :

i. The transport layer is responsible for source-to-destination (end-to-end) delivery of the entire message.

ii. The transport layer ensures that the whole message arrives intact and in order, overseeing both error control and flow control at the source-to-destination level.

iii. Fig. 1.3.4 shows the relationship of the transport layer to the network and session layers.

iv. For added security, the transport layer may create a connection between the two end ports.

Specific services/functions of the transport layer include the following :

i. Service point addressing :

a. Computers often run several programs at the same time. For this reason, source-to-destination delivery means delivery not only from one computer to the next but also from a specific process (running program) on one computer to a specific process (running program) on the other.

b. The transport layer header therefore must include a type of address called a service-point address (or port address).

c. The network layer gets each packet to the correct computer; the transport layer gets the entire message to the correct process on that computer.

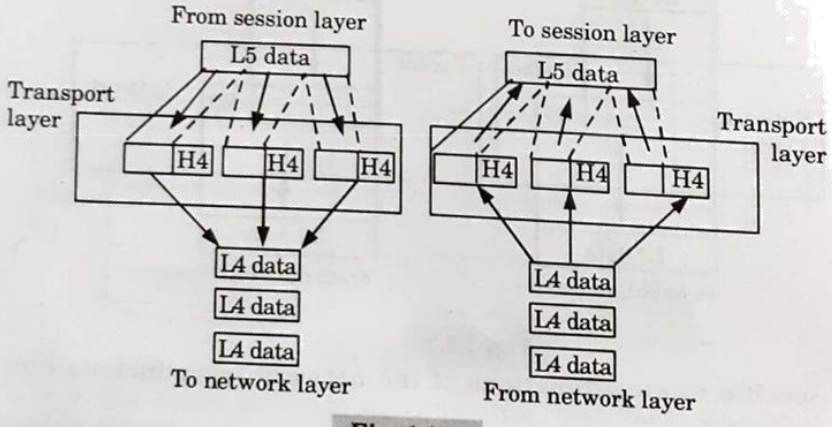

Fig. 1.3.4.

ii. Segmentation and reassembly :

a. A message is divided into transmittable segments, each segment containing a sequence number.

b. These numbers enable the transport layer to reassemble the message correctly upon arriving at the destination and to identify and replace packets that were lost in the transmission.

iii. **Connection control :**

a. The transport can be either connectionless or connection-oriented.

b. A connectionless transport layer treats each segment as an independent packet and delivers it to the transport layer at the destination machine.

c. A connection-oriented transport layer makes a connection with the transport layer at the destination machine before delivering the packets.

d. After all the data are transferred, the connection is terminated.

iv. **Flow control :** Like the data link layer, the transport layer is responsible for flow control. However, flow control at this layer is performed end-to-end rather than across a single link.

v. **Error control :**

a. Error control at this layer is performed end-to-end rather than across a single link.

b. The sending transport layer makes sure that the entire message arrives at the receiving transport layer without error (damage, loss or duplication).

c. Error correction is usually achieved through retransmission.

5. Session layer :

i. The services provided by the first three layers (physical, data link, and network) are not sufficient for some processes.

ii. The session layer is the network dialog controller.

iii. It establishes, maintains, and synchronizes the interaction between communicating systems.

Specific services/functions of the session layer include the following :

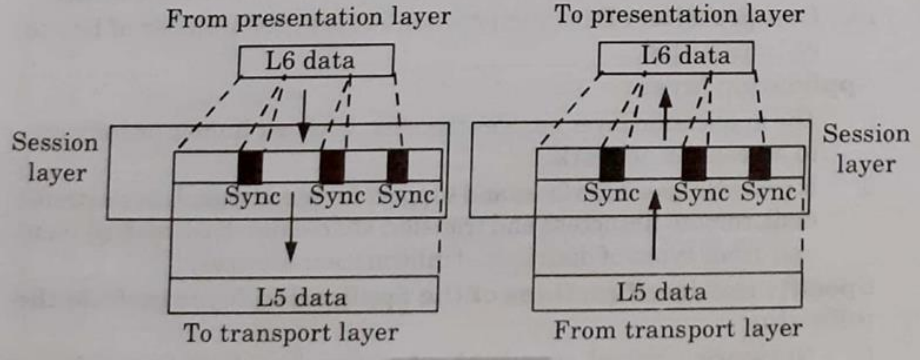

Fig. 1.3.5.

i. **Dialog control :**
   a. The session layer allows two systems to enter into a dialog.
   b. It allows the communication between two processes to take place either in half-duplex (one way at a time) or full-duplex (two ways at a time).

ii. **Synchronization :** The session layer allows a process to add checkpoints (synchronization points) into a stream of data.

6. **Presentation layer :**
   i. The presentation layer is concerned with the syntax and semantics of the information exchanged between two systems.
   ii. Fig. 1.3.6 shows the relationship between the presentation layer, application layer and session layer.

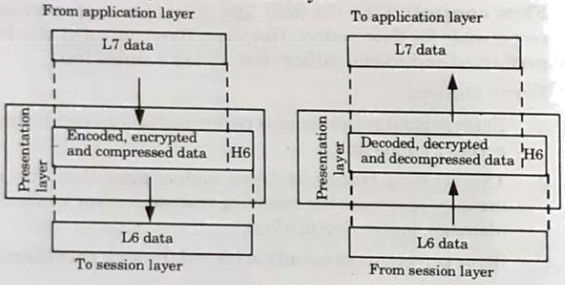

Fig. 1.3.6.

Specific services/functions of the presentation layer include the following :

i. **Translation :** The processes (running programs) in two systems are usually exchanging information in the form of character strings, numbers, and so on. The information should be changed to bit streams before being transmitted.

ii. **Encryption :** To carry sensitive information a system must be able to assure privacy. This layer encrypts the data to be transmitted.

iii. **Compression :** Data compression reduces the number of bits to be transmitted.

7. **Application layer :**
   i. The application layer enables the user, whether human or software, to access the network.
   ii. It provides user interfaces and support for services such as electronic mail, remote file access and transfer, shared database management and other types of distributed information services.

Specific services/functions of the application layer include the following :

i. **Network virtual terminal :** A network virtual terminal is a software version of a physical terminal and allows a user to log on to a remote host.

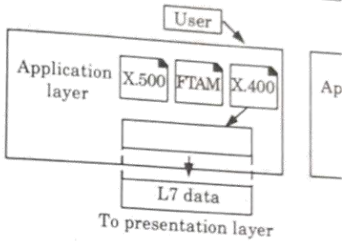

Fig. 1.

ii. **File Transfer, Access and** application allows a user to acces retrieve files from a remote com files in a remote computer.

iii. **Mail services :** This applicatio forwarding and storage.

iv. **Directory services :** This applicat sources and access for global infor services.

Que 1.4. **What is OSI model ? Expl and services of each layer.** AK

Answer

OSI model its function and services : R

Protocols of each layer :

S. No.	Layers	
1.	Application layer	TELNET HTTP, N
2.	Presentation layer	LLC, MA
3.	Session layer	PSAP, SS
4.	Transport layer	TCP, UD
5.	Network layer	IP (Interr
6.	Data link layer	HDLC, S
7.	Physical layer	RS – 232

Que 1.5. **List the layers in the TCP/I**

OR

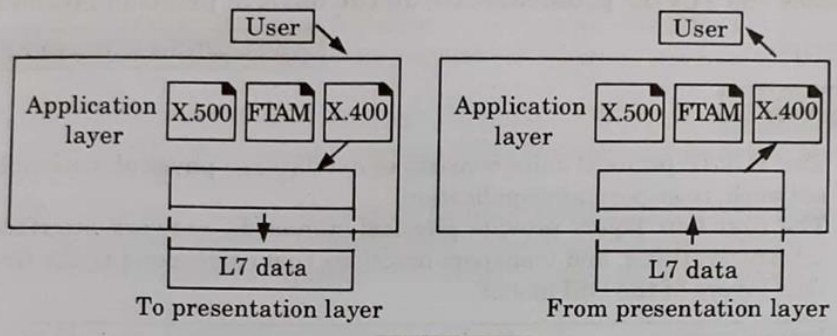

Fig. 1.3.7.

ii. **File Transfer, Access and Management (FTAM) :** This application allows a user to access files in a remote computer, to retrieve files from a remote computer, and to manage or control files in a remote computer.

iii. **Mail services :** This application provides the basis for email forwarding and storage.

iv. **Directory services :** This application provides distributed database sources and access for global information about various objects and services.

Que 1.4. **What is OSI model ? Explain the functions, protocols and services of each layer.** **AKTU 2015-16, 2017-18; Marks 10**

Answer

OSI model its function and services : Refer Q. 1.3, Page 1–4A, Unit-1.

Protocols of each layer :

S. No.	Layers	Protocols
1.	Application layer	TELNET, FTP, SMPTP, DNS HTTP, NNTP
2.	Presentation layer	LLC, MAC
3.	Session layer	PSAP, SSAP
4.	Transport layer	TCP, UDP
5.	Network layer	IP (Internet Protocols)
6.	Data link layer	HDLC, SDLC, X.25 protocols
7.	Physical layer	RS – 232 or RS – 449 standards

Que 1.5. **List the layers in the TCP/IP model.**

OR

Discuss the TCP/IP protocol suite on the basis of protocol layering principle. **AKTU 2013-14, Marks 05**

Answer

1. The TCP/IP protocol suite consists of five layers : physical, data link, network, transport, and application.
2. The first four layers provide physical standards, network interface, internetworking, and transport functions that correspond to the first four layers of the OSI model.

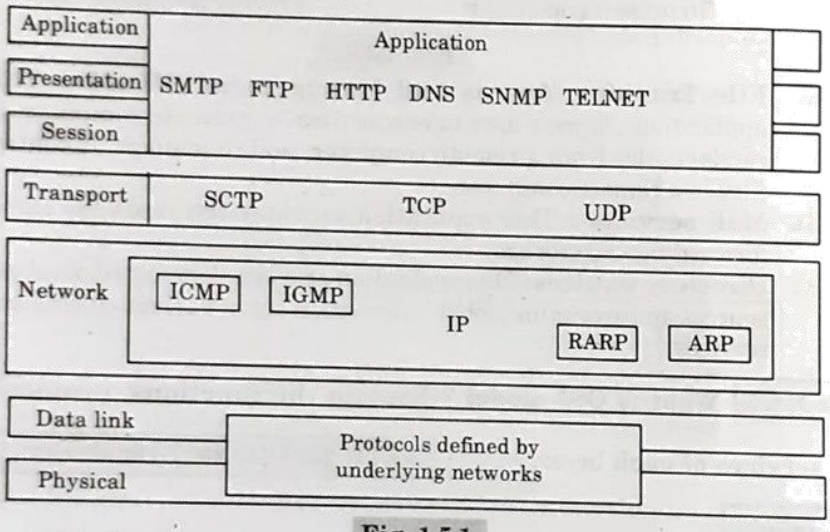

Fig. 1.5.1.

3. The three topmost layers in the OSI model, however, are represented in TCP/IP by a single layer called the application layer as shown in Fig. 1.5.1.
4. At the transport layer, TCP/IP defines three protocols : Transmission Control Protocol (TCP), User Datagram Protocol (UDP), and Stream Control Transmission Protocol (SCTP).

Layers of TCP/IP model :

1. **Physical and data link layers :**
   a. At the physical and data link layers, TCP/IP does not define any specific protocol.
   b. It supports all of the standard and proprietary protocols.
   c. A network in a TCP/IP internetwork can be a Local Area Network (LAN) or a Wide Area Network (WAN).
2. **Network layer :** At the network layer, TCP/IP uses four supporting protocols : ARP, RARP, ICMP, and IGMP.
   a. **Internet Protocol (IP) :** It is an unreliable and connectionless protocol offering a best effort delivery service.
   b. **Address Resolution Protocol (ARP) :** It is used to associate an IP address with the physical address.

c. **Reverse Address Resolution Protocol (RARP) :** It allows a host to discover its internet address when its physical address is known.

d. **Internet Control Message Protocol (ICMP) :** It is a mechanism used by hosts and gateways to send notification of datagram problems back to the sender.

e. **Internet Group Message Protocol (IGMP) :** It is used to facilitate the simultaneous transmission of a message to a group of recipients.

3. **Transport layer :** Transport layer is represented in TCP/IP by following three protocols :

a. **User Datagram Protocol (UDP) :** It is a process-to-process protocol that adds only port addresses, checksum error control, and length information to the data from the upper layer.

b. **Transmission Control Protocol (TCP) :** It provides full transport layer services to applications.

c. **Stream Control Transmission Protocol (SCTP) :** It provides support for newer applications such as voice over the internet.

4. **Application layer :** Many protocols like Simple Mail Transfer Protocol (SMTP), File Transfer Protocol (FTP), Hyper Text Transfer Protocol (HTTP), Domain Name System (DNS), Simple Network Management Protocol (SNMP), Telnet, etc., are defined at application layer.

Que 1.6. What is the difference between TCP/IP and OSI model ?

Answer

S. No.	TCP/IP model	OSI model
1.	TCP/IP model contains five layers.	OSI model has seven layers.
2.	It does not distinguish between service, interface and protocol.	It distinguishes between service, interface and protocol.
3.	Protocol comes first and description of model later.	Firstly description of model and then protocol came next.
4.	TCP/IP has only one mode in network layer but supports both modes in transport layer.	It supports connectionless and connection-oriented communication in network layer and only connection-oriented communication in transport layer.
5.	Protocols in TCP/IP are not hidden and thus cannot be replaced easily.	Protocols in OSI model are hidden and can be replaced easily.
6.	It is the implemented model.	It is a reference model.

PART-3

Services.

Questions-Answers

Long Answer Type and Medium Answer Type Questions

Que 1.7. Explain the services offered by layer.

Answer

Two types of services are offered by the layer :

1. **Connection-oriented service :**
   a. The connection-oriented service is similar to the one provided in the telephone system.
   b. The services user of the connection-oriented service undergo the following sequence of operation :
      i. Establish a connection.
      ii. Use the connection.
      iii. Release the connection.
   c. The connection acts like a tube. The sender pushes bits from one end of the tube and the receiver takes them out from the outer end.
   d. The order is generally preserved. That means the order in which the bits are sent is same as the order in which they are received.
   e. Sometimes after establishing a connection, the sender and receiver can discuss and negotiate about parameters to be used such as maximum message size, quality of service and some other issues.
2. **Connectionless service :**
   a. The connectionless service is similar to the postal service.
   b. Each message (analogous to a letter) carries the full address of the destination. Each message is routed independently from source to destination through the system.
   c. It is possible that the order in which the messages are sent and the order in which they are received may be different.

Que 1.8. What do you mean by service primitives ?

AKTU 2014-15, Marks 05

Answer

1. A service is specified by a set of primitives available to a user process to access the service.
2. These primitives tell the service to perform some action or report on an action taken by a peer entity.
3. The primitives for connection-oriented service are different from the connectionless service.
4. The five different service primitives for implementing a simple connection-oriented service are :
   a. **Listen :** The server executes LISTEN to indicate that it is prepared to accept the incoming connection.
   b. **Connect :** The client executes a CONNECT call to establish the connection with the server and also specify the address.
   c. **Receive :** The server executes RECEIVE to prepare the first request. This call blocks the server.
   d. **Send :** The client executes SEND to transmit its request followed by the execution of RECEIVE to get the reply.
   e. **Disconnect :** The client use DISCONNECT to end the connection.

PART-4

Network Topology : Delay Analysis.

CONCEPT OUTLINE

- Different types of delay are :
  i. Processing delay
  ii. Queueing delay
  iii. Transmission delay
  iv. Propagation delay

Questions-Answers

Long Answer Type and Medium Answer Type Questions

Que 1.9. **What do you mean by topology ? Explain in brief any three such network topologies.**

OR

Explain network topological design with necessary diagram and brief the advantages and disadvantages of various topologies.

AKTU 2016-17, 2017-18; Marks 10

OR

Define topology and explain the advantage and disadvantage of bus, star and ring topologies.

AKTU 2013-14, Marks 05

Answer

Network topology is the arrangement of the various elements of a communication network. Network topology is a topological structure of network and may be depicted physically or logically.

Some network topologies are as follows :

1. Bus topology :

i. In a bus topology, all stations are attached to the same cable.
ii. In the bus network, messages are sent in both directions from a single point.
iii. In a bus topology, signals are broadcasted to all stations.
iv. Each computer checks the address on the signal (data frame) as it passes along the bus.
v. If the signal's address matches that of the computer, the computer processes the signal. If the address does not match, the computer takes no action and the signal travels on down the bus.

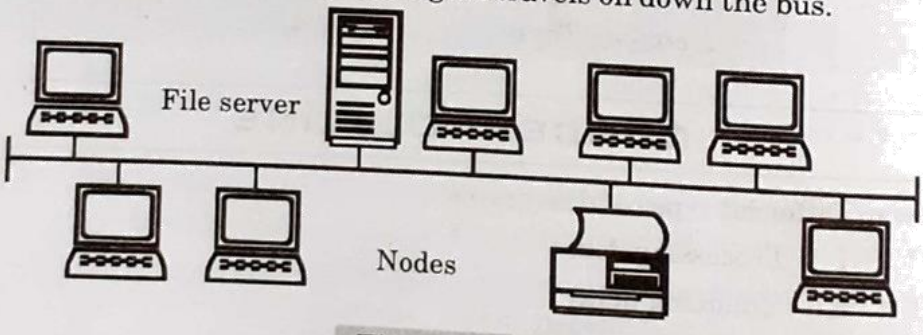

Fig. 1.9.1.

Advantages of bus topology are :

i. Bus topologies are relatively easy to install.
ii. It requires less cable length.
iii. It is simple and easy to implement and extend.

Disadvantages of bus topology are :

i. Maintenance costs may be higher in the long run.
ii. More expensive cabling.

2. Star topology :

i. In a star network, all the nodes (PCs, printers and peripherals) are connected to the central server.

ii. It has a central connection point, like a hub or switch.

iii. A star topology is designed with each node connected directly to a central network as shown in Fig. 1.9.2.

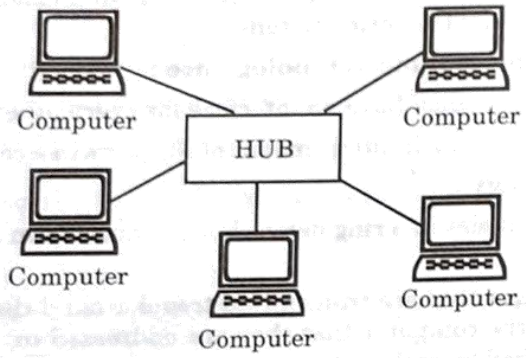

Fig. 1.9.2. Star topology.

Advantages of star topology are :

i. Easy to install and wire.

ii. It can accommodate different wiring.

Disadvantages of star topology are :

i. Star networks can require more cable length than a linear topology.

ii. More expensive cabling.

3. Mesh topology :

i. In a mesh topology, every device has a dedicated point-to-point link to every other device.

ii. Such a network is called complete because between any two devices there is a special link and no any non-redundant links can be added to mesh network.

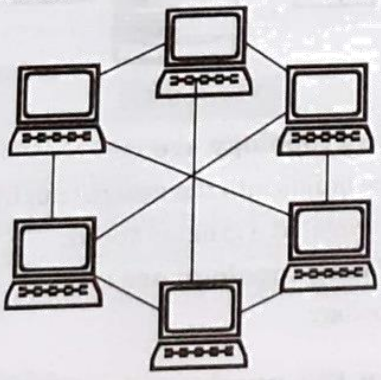

Fig. 1.9.3.

iii. In mesh topology, if we have to connect 'n' computers then we need of $n*(n-1)/2$ cables and each computer must have $(n-1)$ Ethernet cards.

Advantages of mesh topology are :

i. Redundant links between devices.

ii. Easy fault identification and isolation, an unusable link does not incapacitate the entire system.

Disadvantages of mesh topology are :

i. Each node must have an interface for every other device.

ii. There is only a limited amount of I/O ports in a computer.

4. **Ring topology :**

i. All the nodes in a ring network are connected in a closed circle of cable.

ii. Messages that are transmitted travel around the ring until they reach the computer that they are addressed to, the signal being refreshed by each node.

iii. In a ring network, every device has exactly two neighbours for communication purposes.

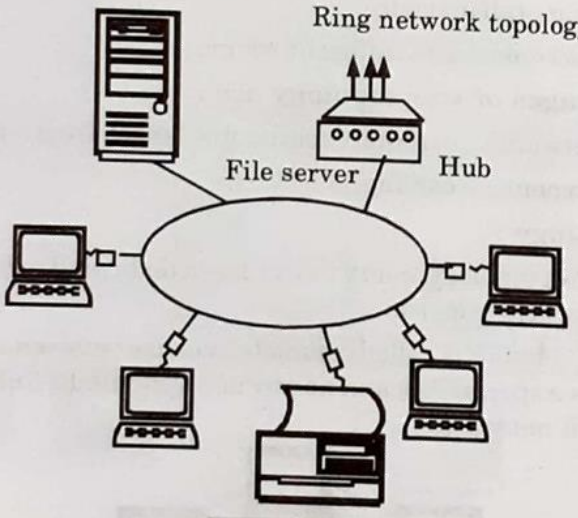

Fig. 1.9.4.

Advantages of ring topology are :

i. Fault tolerance builds into the design (can bypass damaged nodes).

ii. Data packets travel at a greater speed.

Disadvantage of ring topology are :

i. Expensive topology.

Que 1.10. **What are the number of cable links required for *n* devices connected in mesh, ring, bus and star topology ?**

AKTU 2014-15, Marks 05

Answer

For n connected device,

Cable link required for mesh topology = $n(n-1)/2$

Cable link required for ring topology = n

Cable link required for bus topology = $n-1$

Cable link required for star topology = n

Que 1.11. Describe the different types of delay in network.

Answer

In a packet switched network, the packets undergo different types of delays, such as :

1. **Processing delay :**
   a. A packet consists of a header and a data fields as shown in Fig. 1.11.1. The header contains the destination address.
   b. The time required to examine the packet header and determine where to direct the packet is a part of the processing delay.
   c. The processing delay is of the order of microseconds or less.

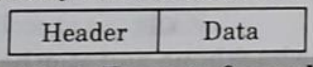

Fig. 1.11.1. Format of a packet.

2. **Queueing delay :**
   a. At the queue, the packet experiences a queueing delay, when they wait to transmit on the links.
   b. The queueing delay depends on the number of packets arrived earlier in the queue.
   c. Queueing delays can be of the order of microseconds or milliseconds.
3. **Transmission delay :**
   a. The packets are transmitted on the first come first served basis. So a particular packet can get transmitted only after all the earlier packets are transmitted.
   b. Transmission delay is also called as store and forward delay. It is the time required to push (transmit) all the packet bits into the link.
   c. The transmission delay is of the order of microseconds or milliseconds.
4. **Propagation delay :**
   a. The time required for the packet bits to reach from the beginning of the link to the desired router is called as propagation delay.
   b. Propagation delay is the ratio of the distance to be travelled by the signal to the speed of propagation.

c. The propagation delays are of the order of few milliseconds.

PART-5

Backbone Design.

CONCEPT OUTLINE

- Two architecture of backbone design are :
  i. Star backbone
  ii. Bus backbone

Questions-Answers

Long Answer Type and Medium Answer Type Questions

Que 1.12. Discuss backbone LAN. Explain different types of backbone LAN.

OR

Explain briefly the bus backbone and star backbone.

AKTU 2013-14, Marks 05

Answer

1. The alternative of using a single LAN is to use low cost low capacity LANs in each building or department and then to interconnect all these LANs with a higher capacity LAN. Such a network is called as the backbone LAN.
2. The backbone network allows several LANs to be interconnected.
3. In the backbone network no station is directly connected to the backbone, instead each station is a part of LAN, and the LANs are connected to backbone.
4. The backbone itself is a LAN. It uses a LAN protocol such as Ethernet. So each connection to the backbone is itself another LAN.
5. The two very commonly used architectures are :
   a. **Bus backbone :**
      i. In a bus backbone, the backbone of topology is a bus.
      ii. Bus backbones are normally used as a distribution backbone to connect different buildings in an organization.
      iii. Each building can comprise either a single LAN or another backbone (normally a star backbone).

iv. The backbone itself can use one of the protocols that support a bus topology such as 10Base5 or 10Base2.

v. A good example of a bus backbone is one that connects single or multiple-floor buildings on a campus.

vi. Each single-floor building usually has a single LAN.

vii. Each multiple-floor building has a backbone (usually a star) that connects each LAN on a floor.

b. Star backbone :

i. In a star backbone, sometimes called a collapsed or switched backbone, the backbone of topology is a star.

ii. In this configuration, the backbone is just one switch that connects the LANs.

iii. Star backbones are mostly used as a distribution backbone inside a building.

iv. In a multi-floor building, we usually find one LAN that serves each particular floor.

v. A star backbone connects these LANs.

vi. The backbone network, which is just a switch, can be installed in the basement or the first floor, and separate cables can run from the switch to each LAN.

vii. If the individual LANs have a physical star topology, then either the hubs (or switches) can be installed in a close to the corresponding floor, or all can be installed close to the switch.

PART-6

Local Access Network Design.

Questions-Answers

Long Answer Type and Medium Answer Type Questions

Que 1.13. Discuss local access network. What are the different types of access network ?

Answer

Local access networks :

a. The access network is defined as the physical link which connects an end system to its edge router. An edge router is the first router met while travelling from one end system to the other.

b. The access network thus provides the infrastructure to connect the customers in a network.

c. The access network technology is closely tied to the physical media technology, such as optical fibers, coaxial cables, twisted pair line, RF links etc.

Different types of access network are :

i. Residential access :

1. The residential access refers to connecting a home end system to an edge router.
2. Access network is simply a pair of modems along with a point dial up line.
3. There are two types of broadband residential access :
   a. Digital Subscriber Line (DSL)
   b. Hybrid Fiber-coaxial Cable (HFC).
4. The DSL uses Frequency Division Multiplexing (FDM), where as HFC requires a special type of modem called cable modem.

ii. Company access network :

1. In companies or on the university campus, the LANs are used for connecting an end system to the edge router.

   Out of many technologies, the ethernet technology is used for network.
3. It operates at 10 Mbps or 100 Mbps or 1 Gbps and uses either twisted pair copper wire or coaxial cable for connecting a number of end systems with each other and with the edge router.
4. Like HFC, the Ethernet also uses a shared medium (coaxial plus optical fiber cable).

iii. Wireless access :

1. In a wireless LAN, the wireless users will transmit and receive packets to and from the base stations (also called as wireless access point) which is stationed within a radius of a few meters.
2. The IEEE standard had to work in two different modes :
   a. **In the presence of a base station :** In the network with base station, all the communication is passed through the base station. The Base Station (BS) is also called as the Access Point (AP) in 802.11 terminology.
   b. **In the absence of base station :** In the network without base station, the computers will communicate among each other. This mode is also called as adhoc networking.

PART-7

Physical Layer Transmission Media.

CONCEPT OUTLINE

- Transmission medium is a physical path between transmitter and receiver in a data transmission system.
- Transmission media can be classified as :
  i. Guided media
  ii. Unguided media

Questions-Answers

Long Answer Type and Medium Answer Type Questions

Que 1.14. What do you mean by transmission media ? Discuss the types of transmission media.

OR

Discuss the different physical layer transmission media.

AKTU 2017-18, Marks 10

AKTU 2014-15, Marks 05

Answer

Transmission media is a pathway that carries the information from sender to receiver.

1. We use different types of cables or waves to transmit data.
2. Data is transmitted normally through electrical or electromagnetic signals.
3. An electrical signal is in the form of current.
4. An electromagnetic signal is series of electromagnetic energy pulses at various frequencies.
5. These signals can be transmitted through copper wires, optical fibers, atmosphere, water and vacuum.
6. Different media have different properties like bandwidth, delay, cost and ease of installation and maintenance.
7. Transmission media is also called communication channel.

Types of transmission media are :

1. **Wired or guided media or bound transmission media :**
   a. Guided transmission media are the cables that are tangible or have physical existence and are limited by the physical geography.
   b. Popular guided transmission media in use are twisted pair cable, co-axial cable and optical fiber cable.
   c. Each of them has its own characteristics like transmission speed, effect of noise, physical appearance, cost etc.
2. **Wireless or unguided media or unbound transmission media :**
   a. Unguided transmission media are the ways of transmitting data without using any cables.
   b. These media are not bounded by physical geography.
   c. This type of transmission is called wireless communication.
   d. This transmission uses microwave, radiowave, infrared which are some of popular unguided transmission media.

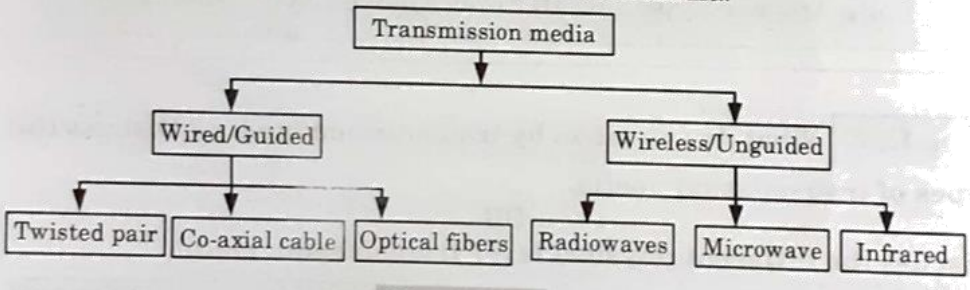

Fig. 1.14.1.

Que 1.15. Write a short note on following :

a. **Twisted pair cable**
b. **Co-axial cable**
c. **Optical fiber cable**

OR

What are the different types of guided media ?

Answer

a. **Twisted pair cable :**

Fig. 1.15.1. Twisted pair cable

i. The wires are twisted together in pairs.
ii. Each pair would consist of wire used for the positive data signal and a wire used for the negative data signal. Any noise that appears on positive/negative wire of the pair would occur on the other wire.

iii. Because the wires are opposite polarities, they are 180 degrees out of phase (180 degree phases or definition of opposite polarity) when the noise appears on both wires, it cancels or nulls itself out at the receiving used.

iv. Twisted pair cables are most effectively used in a system that uses a balanced line method of transmission.

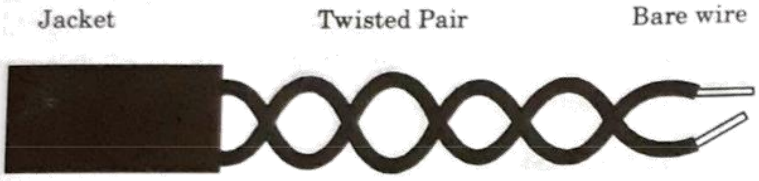

Fig. 1.15.2. Unshielded twisted pair cable.

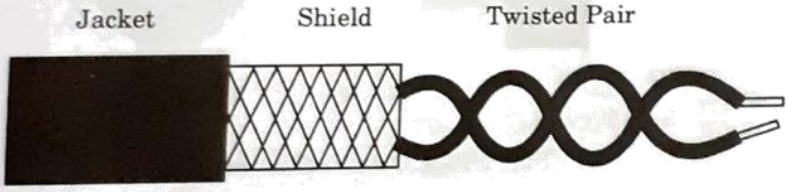

Fig. 1.15.3. Shielded twisted pair cable.

v. Cables with the shield are called shielded twisted pair and commonly abbreviated STP.

vi. Cables without a shield are called unshielded twisted pair or UTP.

vii. Twisting the wires together results in characteristics impedance for the cable.

viii. UTP or unshielded twisted pair cable is used on Ethernet.

ix. UTP cables are used for Ethernet cabling where four twisted pair cables (a total of 8 wires are used).

b. Co-axial cable :

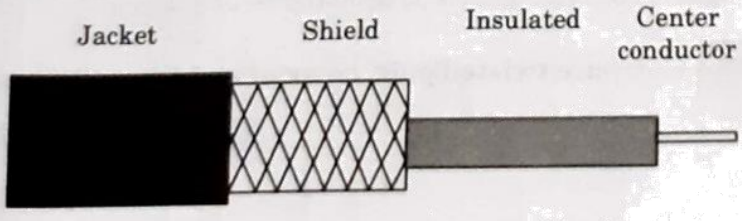

Fig. 1.15.4. Co-axial cable.

i. Co-axial cable consists of two conductors.

ii. The inner conductor is contained inside the insulator with the other conductor weaves around it providing a shield.

iii. An insulating protective coating called a jacket covers the outer conductor.

iv. The outer shield protects the inner conductor from outside electrical signals.

v. The distance between the outer conductor (shield) and inner conductor plus the type of material used for insulating the inner conductor determine the cable properties or impedance.

c. Optical fiber cable :

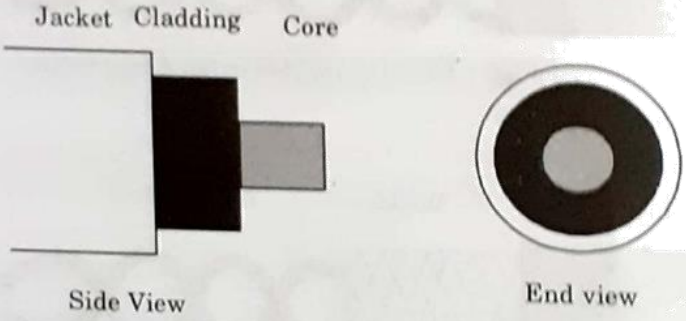

Fig. 1.15.5. Optical fiber cable.

i. Optical fiber consists of thin glass fiber that can carry information at frequencies in the visible light spectrum.

ii. The typical optical fiber consists of a very narrow strand of glass called the cladding.

iii. A typical core diameter is 62.5 microns.

iv. Typically cladding has a diameter of 125 minors. Coating the cladding is a protective coating consisting of plastic, it is called the jacket.

v. The device generating the message has it in electromagnetic form (electrical signal); this has to be converted into light (*i.e.*, optical signal) to send it on optical fiber cable. The process of converting light to electric signal is done on the receiving side.

Que 1.16. Compare twisted pair, co-axial and fiber optic cable.

AKTU 2013-14, Marks 05

Answer

S.No.	Characteristic	Twisted pair cable	Co-axial cable	Optical fiber cable
1.	Signal transmission	Takes place in the electrical form over the metallic conducting wires	Takes place in the electrical form over the inner conductor of cable	Takes place in an optical form over a glass fiber
2.	Noise immunity	Low	Higher	Highest
3.	External magnetic field	Affected due to external magnetic field	Less affected	Not affected
4.	Bandwidth	Low bandwidth	Moderately high	Very high
5.	Attenuation	Very high	Low	Very low
6.	Cause of power loss	Power loss due to conduction and radiation	Power loss due to conduction	Power loss due to absorption, scattering and bending
7.	Installation	Easy	Fairly easy	Difficult
8.	Cost	Cheapest	Moderately expensive	Expensive
9.	Data rate	Support low data rate	Moderately high data rate	Very high data rate
10.	Electromagnetic interference (EMI)	EMI can take place	EMI is reduced to shielding	EMI is not present

PART-8

Switching Method.

CONCEPT OUTLINE

- The three basic methods of switching are :
  i. Circuit switching
  ii. Packet switching
  iii. Message switching

Questions-Answers

Long Answer Type and Medium Answer Type Questions

Que 1.17. Explain the types of switching.

OR

Explain the various types of switching methods with suitable examples.

AKTU 2013-14, Marks 05

Answer

Types of switching :

A. Circuit switching :

1. Circuit switching is a transfer mode of a network that involves setting up a dedicated end-to-end connection.
2. In circuit switching, the routing decision is made when the path is set up across the network.
3. After the link has been set between the sender and receiver, the information is forwarded continuously over the link. After the link has been set up no additional address information about the receiver or destination machine is required.
4. In circuit switching, a dedicated path is established between the sender and the receiver which is maintained for the entire duration of conversion, as shown in Fig. 1.17.1.

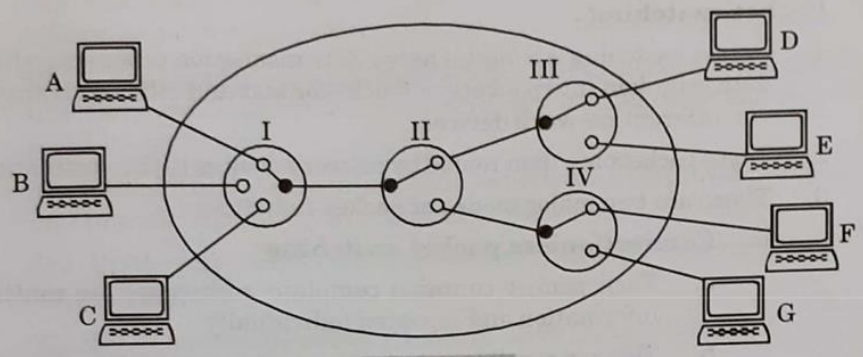

Fig. 1.17.1.

5. I, II, III and IV are the circuit switches or nodes. Nodes I, III, and IV are connected to the communicating devices while II is only routing node.
6. In telephone systems, circuit switching is used.

B. Message switching :

1. Message switching does not establish a dedicated path between two communicating devices.
2. In message switching, each message is treated as an independent unit and includes its own destination and source address.
3. In message switching, each complete message is then transmitted from device to device through the internetwork as shown in Fig. 1.17.2.
4. In message switching, each intermediate device receives the message, stores it, until the next device is ready to receive it and then forwards it to the next device. For this reason, a message switching network is sometimes called as a store and forward network.

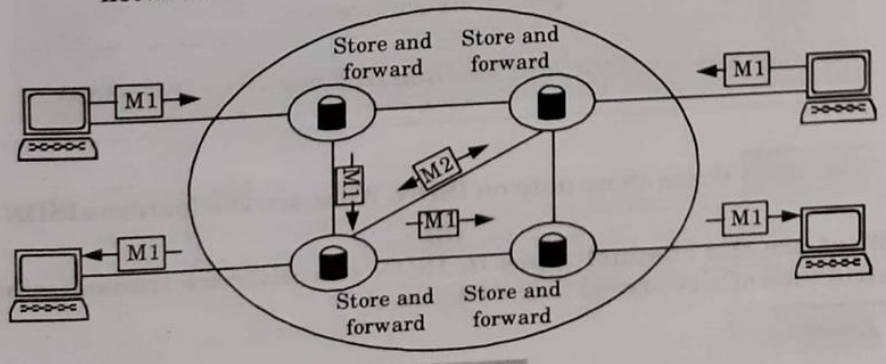

Fig. 1.17.2.

C. Packet switching :

1. Packet switching is a digital network transmission process in which data is broken into packets or blocks for fast and efficient transfer via different network devices.
2. These packets are then routed by network devices to the destination.
3. There are two major modes of packet switching :

i. Connectionless packet switching :

a. Each packet contains complete addressing or routing information and is routed individually.

b. This can result in out-of-order delivery and different paths of transmission, depending on the variable loads on different network nodes (adapters, switches and routers) at any given time.

c. After reaching the destination through different routes, the packets are rearranged to form the original message.

ii. Connection-oriented packet switching :

a. Data packets are sent sequentially over a predefined route.

b. Packets are assembled, given a sequence number and then transported over the network to a destination in order.

c. In this mode, address information is not required. This is also known as virtual circuit switching.

PART-9

ISDN, Terminal Handling.

Questions-Answers

Long Answer Type and Medium Answer Type Questions

Que 1.18. Write short note on ISDN. What are the features ISDN ?

OR

What are the channel types in ISDN to construct transmission structure of any access link ? Discuss.

Answer

1. Integrated Services Digital Network (ISDN) is a set of protocols that combines digital telephony and data transport services.

2. The whole idea is to digitize the telephone network to permit the transmission of audio, video, and text over existing telephone lines.
3. ISDN is an effort to standardize subscriber services, provide user/network interfaces and facilitate the internetworking capabilities of existing voice and data networks.
4. The goal of ISDN is to form a wide area network that provides universal end-to-end connectivity over digital media.
5. The ISDN integrates customer services with the integrated digital networking.
6. The ISDN standards define following three types of channels :

i. B channels :

a. A bearer channel (B channel) is defined at a rate of 64 kbps.

b. It is the basic user channel and can carry any type of digital information in full-duplex mode as long as the required transmission rate does not exceed 64 kbps.

c. For example, a B channel can be used to carry digital data, digitized voice or other low data-rate information.

d. Several transmissions can be accommodated at once if the signals are multiplexed first.

ii. D channels :

a. A data channel (D channel) can be either 16 or 64 kbps, depending on the needs of the user. Although the name says data, the primary function of a D channel is to carry control signaling for the B channels.

b. Control information (such as call establishment, ringing, call interrupt, or synchronization) is carried by the same channel that carries the message data.

c. The ISDN separates control signals onto a channel of their own, the D channel.

d. A D channel carries the control signaling for all of the channels in a given path, using a method called common-channel (out-of-band) signaling.

iii. H channels :

a. Hybrid channels (H Channels) are available with data rates of 384 kbps (H0), 1536 kbps (H11) or 1920 kbps (H12).

b. These rates suit H channels for high data-rate applications such as video, teleconferencing and so on.

Salient features of ISDN :

i. The ISDN is supported by a wide range of voice and non-voice applications of the same networks.

ii. It provides a range of services using a limited set of connections and multipurpose user-network interface arrangements.

iii. It supports a variety of applications that include both switched and non switched connections. The switched connection, include both circuit switched and packet switched connections.

iv. ISDN contains intelligence for providing service feature, maintenance and network management.

Que 1.19. Explain the user access in ISDN.

AKTU 2013-14, Marks 05

Answer

1. ISDN user access is done by devices that enables the user to access the service of Basic Rate Interface (BRI) or Primary Rate Interface (PRI) are described by their functional duties.
2. Functional duties are divided into two groups :
   a. **Functional grouping :** Functional grouping is a model that can be implemented using devices or equipment chosen by subscriber (user).
   b. **Reference points :** Reference point corresponds to conceptual points used in order to separate groups of functions.
3. The architecture on the subscriber premises is divided into small groups. Such a grouping is done on the basis of the functions and the groups are separated by reference points.

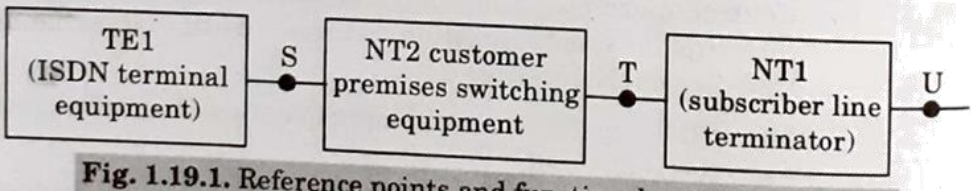

Fig. 1.19.1. Reference points and functional grouping in ISDN.

4. NT1 is the network termination which includes the functions associated with the physical and electrical termination of the ISDN on the user's premises which correspond to layer 1 of OSI.
5. NT2 is a customer premises switching equipment and it is an intelligent device which performs switching and concentration functions.
6. TE1 is the device which supports the standard ISDN interface.

Que 1.20. Write a short note on terminal handling.

Answer

1. A computer terminal is an electronic or electromechanical hardware device that is used for entering data into, and displaying data from, a computer or a computing system.
2. The function of a terminal is confined to display and input of data; a device with significant local programmable data processing capability may be called a "smart terminal" or fat client.
3. A terminal that depends on the host computer for its processing power is called a dumb terminal or thin client.
4. A personal computer can run software that emulates the function of a terminal, sometimes allowing concurrent use of local programs and access to a distant terminal host system.

Que 1.21. Differentiate between bit rate and baud rate. A modem constellation diagram has data point at coordinates : (1, 1), (1, –1), (–1, 1) and (–1, –1). How many bps can a modem with these parameters achieve at 1200 baud ? State two reason for using layered protocols. **AKTU 2014-15, Marks 05**

Answer

Basis for comparison	Bit rate	Baud rate
Basic	Bit rate is the number of bits per second.	Baud rate is the number of signal units per second.
Meaning	It determines the number of bits travelled per second.	It determines how many times the state of a signal is changing.
Term usually used	While the emphasis is on computer efficiency.	While data transmission over the channel is more concerned.
Bandwidth determination	Cannot determine the bandwidth.	It can determine how much bandwidth is required to send the signal.
Equation	Bit rate = baud rate × the number of bits per signal unit	Baud rate = bit rate / the number of bits per signal unit

Numerical :

Since there are four legal values per band. Therefore, bit rate is twice of baud rate. At 1200 baud, the data rate will be

$$= 2 \times 1200 = 2400 \text{ bps}$$

The two reasons for using layered protocols are :

a. It breaks up the design problem into smaller and more manageable pieces.

b. Protocols can be changed easily without affecting higher or lower layers.

Que 1.22. **Calculate the required bandwidth, if in a communication channel the signal power is 10W, and the information transmission rate is 10 kbps.**

AKTU 2014-15, Marks 05

Answer

$$R = 10 \text{ kbps}$$
$$S = 10 \text{ W}$$
$$R = B \log_2 \left[1 + \frac{S}{N}\right]$$

Since N is not given so bandwidth cannot be calculated.

Que 1.23. **It is required to transmit a data at a rate of 64 kbps over a 3 kHz telephone channel. What is the minimum SNR required to accomplish this ?**

AKTU 2014-15, Marks 05

Answer

$$R = 64 \text{ kbps} = 64 \times 1000 \text{ bps}$$
$$B = 3 \text{ kHz} = 3000 \text{ Hz}$$
$$R = B \log_2 \left[1 + \frac{S}{N}\right]$$
$$\log_2 \left[1 + \frac{S}{N}\right] = \frac{64 \times 1000}{3000} = \frac{64}{3}$$
$$1 + \frac{S}{N} = 2^{64/3}$$
$$\frac{S}{N} = 2^{64/3} - 1 \approx 2^{64/3} \text{ dB}$$