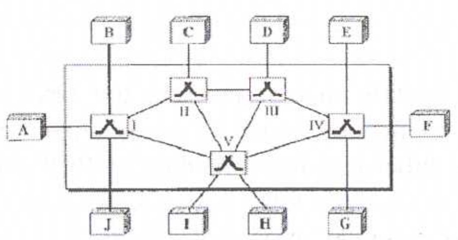
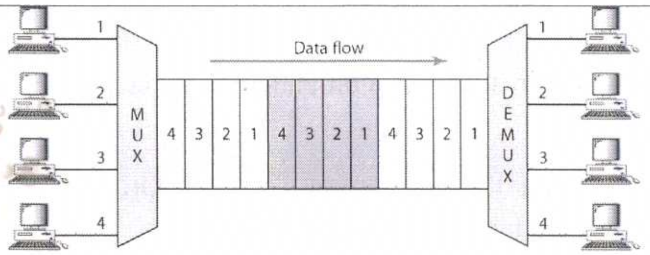
QID : 4176

TED(15)-4132 Revision -2015

DIPLOMA EXAMINATION IN ENGINEERING/ TECHNOLOGY

DATA COMMUNICATION– Scheme of Evaluation

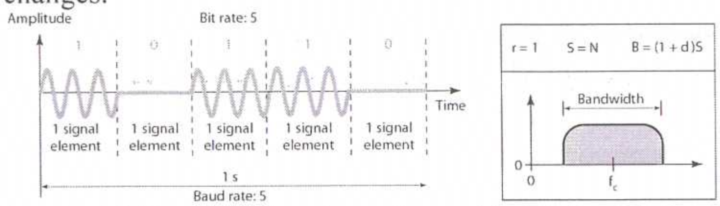
Qn No	Answer	Mark splitup
	PART A	
1	Performance , reliability, security	2
2	to ensure interconnectivity necessary in today's marketplace and in international communications.	2
3	The range of frequencies contained in a composite signal is its bandwidth. The bandwidth of a composite signal is the difference between the highest and the lowest frequencies contained in that signal.	2
4	Figure 8.1 *Switched network*  The end systems (communicating devices) are labeled A, B, C, D, and so on, and the switches are labeled I, II, III, IV, and V. Each switch is connected to multiple links.	Sketch - 1 label - 1
5	A technique called piggybacking is used to improve the efficiency of the bidirectional protocols. When a frame is carrying data from A to B, it can also carry control information about frames from B; when a frame is carrying data from B to A, it can also carry control information about frames from A.	2
1	1. *Text* ➢ In data communications, text is represented as a bit pattern, a sequence of bits (0s or 1s). ➢ Each set is called a code ➢ prevalent coding system is called Unicode, which uses 32 bits to represent a symbol or character used in any language in the world. *Numbers* ➢ Numbers are also represented by bit patterns.	Any 3x2=6

	➢ the number is directly converted to a binary . *Images* ➢ Images are also represented by bit patterns. ➢ an image is composed of a matrix of pixels (picture elements), ➢ where each pixel is a small dot. ➢ The size of the pixel depends on the *resolution..* ➢ After an image is divided into pixels, each pixel is assigned a bit pattern. *Audio* ➢ Audio refers to the recording or broadcasting of sound or music. ➢ Audio is by nature different from text, numbers, or images. ➢ It is continuous, not discrete. ➢ Even when we use a microphone to change voice or music to an electric signal, we create a continuous signal. *Video* ➢ Video refers to the recording or broadcasting of a picture or movie. ➢ Video can either be produced as a continuous entity (e.g., by a TV camera), or it can be a combination of images, each a discrete entity, arranged to convey the idea of motion. ➢ we can change video to a digital or an analog signal	
2	Two n/w models are TCP/IP and OSI (1970). TCP/IP is a protocol suite (a set of protocols organized in different layers) used in internet today. TCP/IP protocol suite was developed prior to the OSI model. Therefore, the layers in the TCP/IP protocol suite do not exactly match those in the OSI model. TCP/IP is connection-oriented: A connection must be established between both ends of a transmission before either can transmit data.TCP/IP protocol suite is made of five layers: physical, data link, network, transport, and application. The first four layers provide physical standards, network interfaces, internetworking, and transport functions that correspond to the first four layers of the OSI model. The three topmost layers in the OSI model, however, are represented in TCP/IP by a single layer called the *application layer* At the transport layer, *TCP/IP* defines three protocols: Transmission Control Protocol (TCP), User Datagram Protocol (UDP), and Stream Control Transmission Protocol (SCTP). At the network layer, the main protocol defined by TCP/IP is the Internetworking Protocol (IP);	3x2-6
3		

<table>
<tr>
<td></td>
<td>Time-division multiplexing (TDM) is a digital process that allows several connections to share the high bandwidth of a line Instead of sharing a portion of the bandwidth as in FDM, time is shared. Each connection occupies a portion of time in the link</td>
<td>fig-3
expl-3</td>
</tr>
<tr>
<td>4</td>
<td>

<u>Amplitude Shift Keying</u>

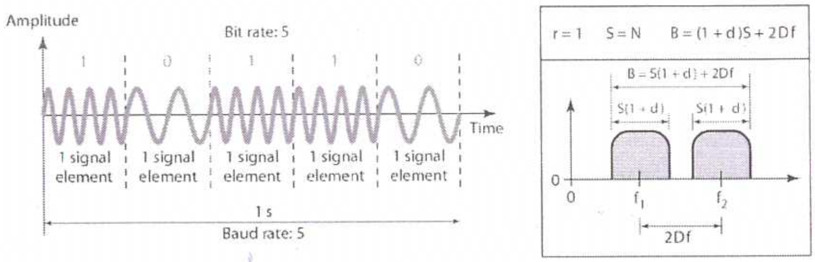
In amplitude shift keying, the amplitude of the carrier signal is varied to create signal
elements. Both frequency and phase remain constant while the amplitude changes.



bandwidth B signal rate S. d is a value of either 0 or 1.

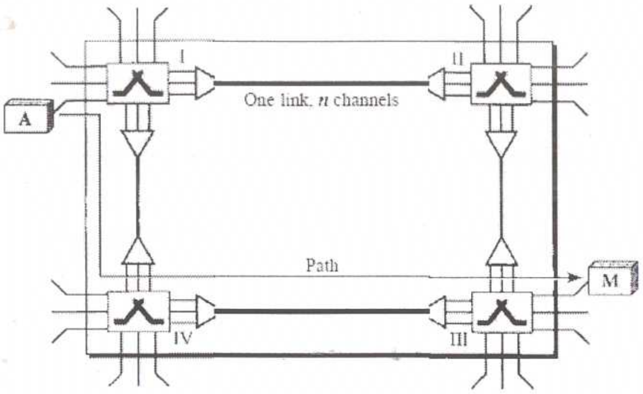
<u>Frequency Shift Keying</u>

In frequency shift keying, the frequency of the carrier signal is varied to represent data.



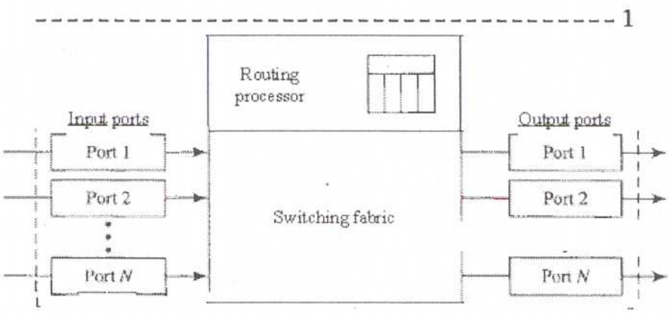
</td>
<td>3×2=6</td>
</tr>
<tr>
<td>5</td>
<td>A circuit-switched network is made of a set of switches connected by physical links, in which each link is divided into n channels. Figure shows a trivial circuit-switched network with four switches and four links. Each link is divided into n (n is 3 in the figure) channels by using FDM or TDM.
The end systems, such as computers or telephones, are directly connected to a switch. We have shown only two end systems for simplicity. When end system A needs to communicate with end system M, system A needs to request a connection to M that must be accepted by all switches as well as by M itself. This is called the setup phase; a circuit (channel) is reserved on each link, and the combination of circuits or channels defines the dedicated path. After the dedicated path made of connected circuits (channels) is established, data transfer can take place. After all data have been transferred, the circuits are torn down.</td>
<td>fig-2
expl-4</td>
</tr>
</table>

A trivial circuit-switched network



6

Figure 8.21 *Packet switch components*



An input port performs the physical and data link functions of the packet switch.

- The bits are constructed from the received signal.
- The packet is decapsulated from the frame.
- Errors are detected and corrected.
- The packet is now ready to be routed by the network layer.

Input port has buffers (queues) to hold the packet before it is directed to the switching fabric.

The output port performs the same functions as the input port, in the reverse order.

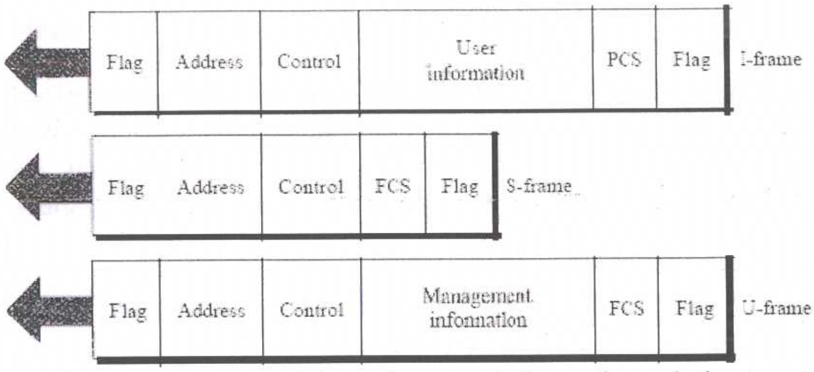
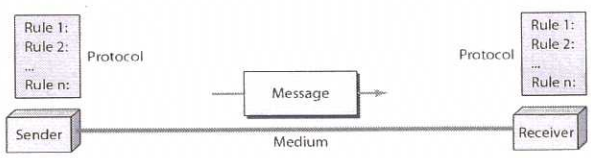
First the outgoing packets are queued, then the packet is encapsulated in a frame, and the physical layer functions are applied to the frame to create the signal to be sent on the line.

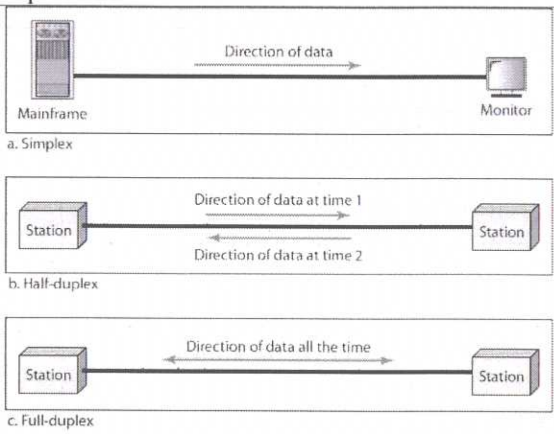
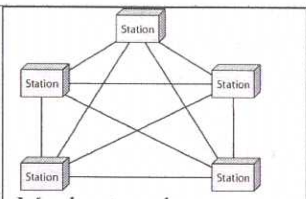
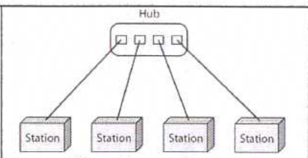
Routing Processor

The routing processor performs the functions of the network layer.

The destination address is used to find the address of the next hop

Switching Fabric- task in a packet switch is to move the packet from the input queue to the output queue.

7	HDLC defines three types of frames: information frames(I-frames), supervisory frames (S-frames), unnumbered frames (V-frames). Figure 11.27 *HDLC frames*  I-frames are used to transport user data and control information relating to user data (piggybacking). S-frames are used only to transport control information. V-frames are reserved for system management. Information carried by V-frames is for managing the link itself. o Flag field. is an 8-bit sequence with the bit pattern 01111110 that identifies both the beginning and the end of a frame - serves as a synchronization pattern for the receiver. o Address field. address of the secondary station. If a primary station created the frame, it contains a *to* address. If a secondary creates the frame, it contains *a from* address. o Control field. The control field is a 1- or 2-byte for flow and error control. o Information field. The information field contains the user's data from the network layer or management information. Its length can vary from one network to another. o FCS field. The frame check sequence (FCS) is the HDLC error detection field.	3x2=6
	Part C	
	MODULE – 1	
III a.	1.1.1  1. Message. The message is the information (data) to be communicated. Popular forms of information include text, numbers, pictures, audio, and	6x1=6

	video. 2. Sender. The sender is the device that sends the data message. It can be a computer, workstation, telephone handset, video camera, and so on. 3. Receiver. The receiver is the device that receives the message. It can be a computer, workstation, telephone handset, television, and so on. 4. Transmission medium. The transmission medium is the physical path by which a message travels from sender to receiver. Some examples of transmission media include twisted-pair wire, coaxial cable, fiber-optic cable, and radio waves 5. Protocol. A protocol is a set of rules that govern data communications. It represents an agreement between the communicating devices. Without a protocol, two devices may be connected but not communicating, just as a person speaking French cannot be understood by a person who speaks only Japanese	
b.	 	fig - 3 exp - 3x2=6
	OR	
IV a.	 Mesh topology  Star topology	fig = 4 exp - 2x2 = 4

b.

Figure 2.2 Seven layers of the OSI model

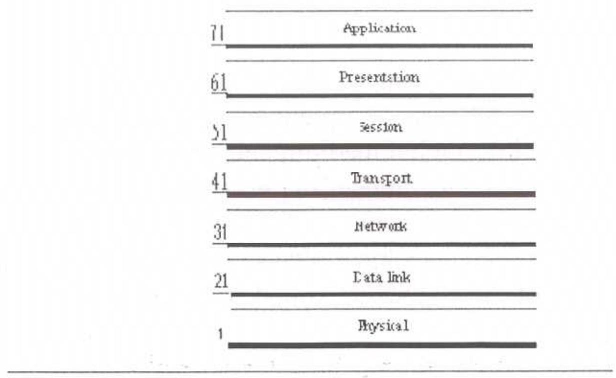


fig - 3

expl - 2x2 = 4

PHYSICAL LAYER: The physical layer is responsible for movements of individual bits from one hop to the next.

Responsibilities:

Data rate : The number of bits sent each second.

Synchronization of bits : The sender and receiver clocks must be synchronized.

Line configuration : Connection of device to the media.

Physical topology : How devices are connected to make a n/w.

Transmission mode : Direction of transmission b/w two devices.

DATA LINK LAYER: The Data link layer is responsible for moving frames from one hop to the next.

Responsibilities:

Framing : Divides the stream of bits into manageable units called frames.

Flow control : A technique to control the rate of flow of frames.

Error control : To handling errors in data transmission and to detect and retransmit lost or damaged frames.

Access control : To determine which device has control over the link at any given time.

Physical addressing : To handle the addressing problem locally.

MODULE - 2

V a.

Signals travel through transmission media, which are not perfect. The imperfection causes signal impairment. This means that the signal at the beginning of the medium is not the same as the signal at the end of the medium. What is sent is not what is received. Three causes of impairment are attenuation, distortion, and noise.

def - 2

Attenuation

Attenuation means a loss of energy. When a signal, simple or composite, travels through a medium, it loses some of its energy in overcoming the resistance of the medium. That is why a wire carrying electric signals gets

expl 3x2 = 6

warm, if not hot, after a while. Some of the electrical energy in the signal is converted to heat. To compensate for this loss, amplifiers are used to amplify the signal.

Distortion

Distortion means that the signal changes its form or shape. Distortion can occur in a composite signal made of different frequencies. Each signal component has its own propagation speed through a medium and, therefore, its own delay in arriving at the final destination. Differences in delay may create a difference in phase if the delay is not exactly the same as the period duration. In other words, signal components at the receiver have phases different from what they had at the sender. The shape of the composite signal is therefore not the same.

Noise

Noise is another cause of impairment. Several types of noise, such as thermal noise, induced noise, crosstalk, and impulse noise, may corrupt the signal. Thermal noise is the random motion of electrons in a wire which creates an extra signal not originally sent by the transmitter. Induced noise comes from sources such as motors and appliances. These devices act as a sending antenna, and the transmission medium acts as the receiving antenna. Crosstalk is the effect of one wire on the other. One wire acts as a sending antenna and the other as the receiving antenna. Impulse noise is a spike (a signal with high energy in a very short time) that comes from power lines, lightning, and so on.

b.

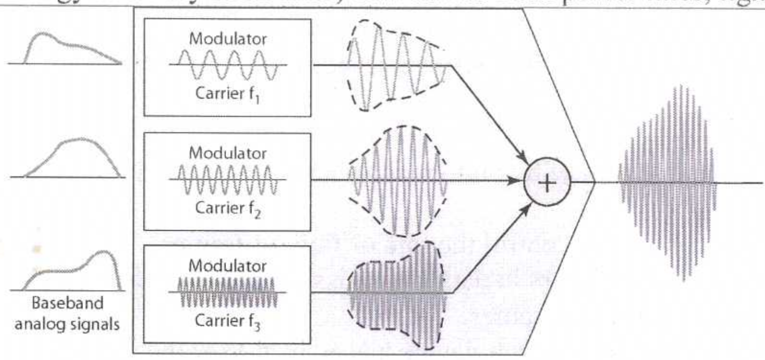
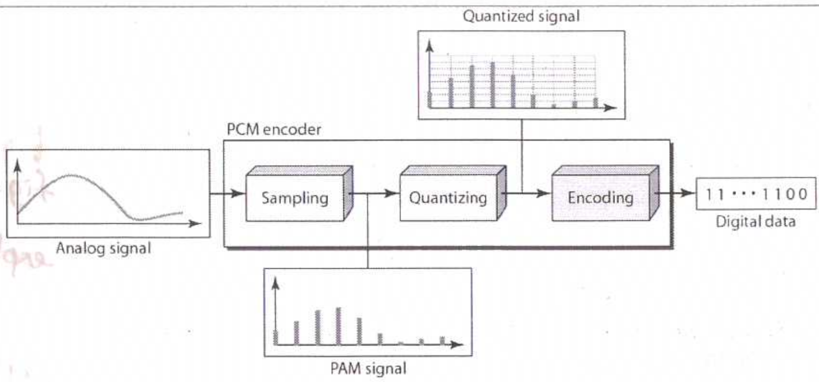


fig-3

Frequency-division multiplexing (FDM) is an analog technique that can be applied when the bandwidth of a link (in hertz) is greater than the combined bandwidths of the signals to be transmitted. In FDM, signals generated by each sending device modulate different carrier frequencies. These modulated signals are then combined into a single composite signal that can be transported by the link. Carrier frequencies are separated by sufficient bandwidth to accommodate the modulated signal. These bandwidth ranges are the channels through which the various signals travel. Channels can be separated by strips of unused bandwidth-guard bands-to prevent signals from overlapping.

expl-4

OR

<table>
<tr><td>VI
a.</td><td>Parallel Transmission
➢ Binary data, consisting of Is and Os, may be organized into groups of n bits each.
➢ The mechanism for parallel transmission Use n wires to send n bits at one time.
➢ The advantage of parallel transmission is speed. Parallel transmission increase the transfer speed by a factor of n over serial transmission.
➢ But there is a significant disadvantage: cost.
➢ Parallel transmission requires n communication lines (wires in the example) just to transmit the data stream.
➢ Because this is expensive, parallel transmission is usually limited to short distances.
Serial Transmission
➢ In serial transmission one bit follows another, so we need only one communication channel rather than n to transmit data between two communicating devices
➢ The advantage of serial over parallel transmission is that with only one communication channel, serial transmission reduces the cost of transmission over parallel by roughly a factor of n.
➢ Since communication within devices is parallel, conversion devices are required at the interface between the sender and the line (parallel-to-serial) and between the line and the receiver (serial-to-parallel).
Serial transmission occurs in one of three ways: asynchronous, synchronous, and isochronous.</td><td>3½ 7
4x2=8</td></tr>
<tr><td>b.</td><td>

1. The analog signal is sampled.
2. The sampled signal is quantized.
3. The quantized values are encoded as streams of bits.
Sampling
The first step in PCM is sampling. The analog signal is sampled every Ts s, where Ts is the sample interval or period. The inverse of the sampling interval is called the sampling rate or sampling frequency . There are three sampling methods-ideal, natural, and flat-top

<u>Quantization</u></td><td>fig - 2

expl
3x2=6</td></tr>
</table>

- Sampling results in a series of pulses of varying amplitude values ranging between two limits: a min and a max.
- The amplitude values are infinite between the two limits.
- We need to map the *infinite* amplitude values onto a finite set of known values.
- This is achieved by dividing the distance between min and max into L zones, each of height Δ.

  $\Delta = (max - min)/L$
- The midpoint of each zone is assigned a value from 0 to L-1 (resulting in L values)
- Each sample falling in a zone is then approximated to the value of the midpoint.

Encoding

The last step is encoding. After each sample is quantized and the number of bits per sample is decided, each sample can be changed to an Nb-bit code word. The number of bits for each sample is determined from the number of quantization levels

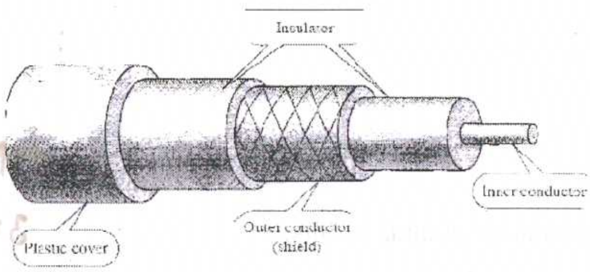
MODULE - 3

VII a. Coaxial cable (or *coax)* carries signals of higher frequency ranges than those in twisted pair cable coax has a central core conductor of solid or stranded wire (usually copper) enclosed in an insulating sheath, which is, encased in an outer conductor of metal foil, braid, or a combination of the two. The outer metallic wrapping serves both as a shield against noise and as the second conductor, which completes the circuit.

This outer conductor is also enclosed in an insulating sheath, and the whole cable is protected by a plastic cover

fig-2
expl - 4

Coaxial cable



categorized by their radio government (RG) ratings. Each RG number denotes a unique set of physical specifications, such as

wire gauge of the inner conductor,

the thickness and type of the inner insulator,

the construction of the shield,

and the size and type of the outer casing

b. no clear-cut demarcation between radio waves and microwaves, electromagnetic waves ranging in frequencies between 3 kHz and 1 GHz are normally called radio waves; waves ranging in frequencies between 1 and 300 GHz are called microwaves

Radio waves are omnidirectional. When an antenna transmits radio waves, they are propagated in all directions. This means that the sending and receiving antennas do not have to be aligned. A sending antenna sends waves that can be received by any receiving antenna. The disadvantage is radio waves transmitted by one antenna are susceptible to interference by another antenna that may send signals using the same frequency or band.

Radio waves, that propagate in the sky mode, can travel long distances. So radio waves are good candidate for long-distance broadcasting such as AM radio.

Radio waves of low and medium frequencies can penetrate walls.

Advantage is AM radio can receive signals inside a building.

Disadvantage we cannot isolate a communication to just inside or outside a building. The radio wave band is narrow, compared to the microwave band. When this band is divided into subbands, the subbands are also narrow, leading to a low data rate for digital communications. Entire band is regulated by authorities (e.g., the FCC in the United States). Using any part of the band requires permission from the authorities.

Any 9 points -9 marks

OR

VIII a. Time-division switching uses time-division multiplexing (TDM) inside a switch. The most popular technology is called the time-slot interchange (TSI).

Figure 8.19 *Time-slot interchange*

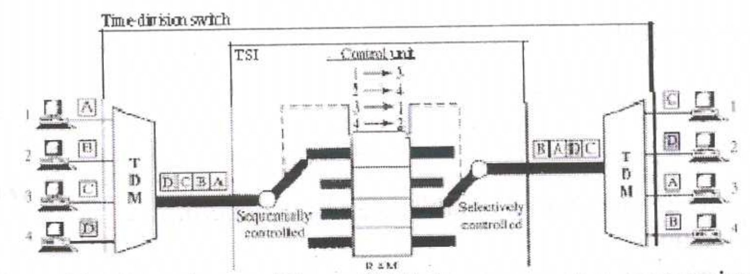


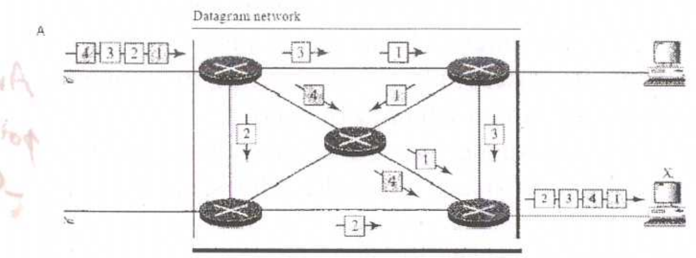
fig-4 Expl-4

Time-Slot Interchange Figure 8.19 shows a system connecting four input lines to four output lines. Each input line wants to send data to an output line figure combines a TDM multiplexer, a TDM demultiplexer, and a TSI consisting of random access memory (RAM) with several memory locations. The size of each location is the same as the size of a single time slot. The number of locations is the same as the number of inputs (in most cases, the numbers of inputs and outputs are equal). The RAM fills up with incoming data from time slots in the order received. Slots are then sent out in an order based on the decisions of a control unit.

b. **In a datagram network**, each packet is treated independently of all others. Even if a packet is part of a multi packet transmission, the network treats it as though it existed alone. Packets in this approach are referred to as datagrams.

Datagram switching is normally done at the network layer. Figure 8.7 shows how the datagram approach is used to deliver four packets from station A to station X. The switches in a datagram network are traditionally referred to as routers. That is why we use a different symbol for the switches in the figure.

Figure 8.7 *A datagram network with four switches (routers)*



In this example, all four packets (or datagrams) belong to the same message, but may travel different paths to reach their destination. This is so because the links may be involved in carrying packets from other sources and do not have the necessary bandwidth available to carry all the packets from A to X.

This approach the datagrams of a transmission to arrive at their destination out of order with different delays between the packets.

Packets may also be lost or dropped because of a lack of resources.

In most protocols, it is the responsibility of an upper-layer protocol to reorder the datagrams or ask for lost datagrams before passing them on to the application.

The datagram networks are connectionless networks, means that the switch (packet switch) does not keep information about the connection state. There are no setup or teardown phases. Each packet is treated the same by a switch regardless of its source or destination.

fig-3

Expl-4

MODULE – 4

IX a. Flow Control

- Flow control coordinates the amount of data that can be sent before receiving an acknowledgment
- flow control is a set of procedures that tells the sender how much data it can transmit before it must wait for an acknowledgment from the receiver.
- The flow of data must not be allowed to overwhelm the receiver.
- Any receiving device has a limited speed at which it can process incoming data and a limited amount of memory in which to store incoming data.
- The receiving device must be able to inform the sending device before those limits are reached and to request that the transmitting device send fewer frames or stop temporarily.
- Incoming data must be checked and processed before they can be used.
- The rate of such processing is often slower than the rate of transmission, so each receiving device has a block of memory, called a *buffer,* reserved for storing incoming data until they are processed.

- If the buffer begins to fill up, the receiver must be able to tell the sender to halt transmission until it is once again able to receive.

Error Control

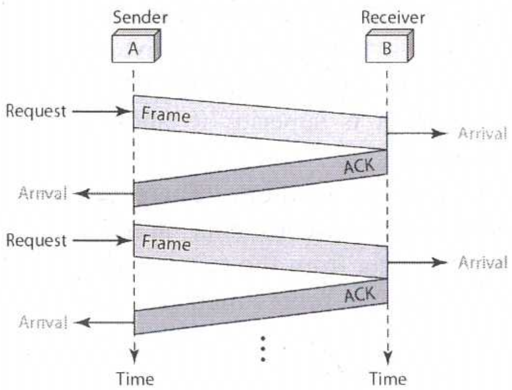
- Error control is both error detection and error correction.
- It allows the receiver to inform the sender of any frames lost or damaged in transmission and coordinates the retransmission of those frames by the sender. 4x2=8
- In the data link layer, the term *error control* refers primarily to methods of error detection and retransmission
- Any time an error is detected in an exchange, specified frames are retransmitted. This process is called automatic repeat request (ARQ).

b. Stop-and-Wait Protocol

- If data frames arrive at the receiver site faster than they can be processed, the frames must be stored until their use.
- receiver does not have enough storage space, especially if it is receiving data from many sources. This may result in either the discarding of frames or denial of service.
- To prevent the receiver from becoming overwhelmed with frames, need to tell the sender to slow down.
- There must be feedback from the receiver to the sender.
- The protocol is called the Stop-and-Wait Protocol because the sender sends one frame, stops until it receives confirmation from the receiver, and then sends the next frame.
- It is unidirectional communication for data frames, but auxiliary ACK frames travel from the other direction.
- add flow control to our previous protocol. fig-2

Flow diagram for Stop-and-Wait Protocol Expl

- ***It is still very simple.***
- ***The sender sends one frame and waits for feedback from the receiver.***
- ***When the ACK arrives, the sender sends the next frame.***
- ***sending two frames in the protocol involves the sender in four events and the receiver in two events.***



OR

X

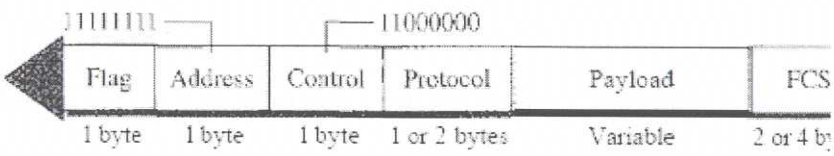
a.

PPP provides several services:

1. PPP defines the format of the frame to be exchanged between devices.
2. PPP defines how two devices can negotiate the establishment of the link and the exchange of data.
3. PPP defines how network layer data are encapsulated in the data link frame.
4. PPP defines how two devices can authenticate each other.
5. PPP provides multiple network layer services supporting a variety of network layer protocols.
6. PPP provides connections over multiple links.
7. PPP provides network address configuration. This is particularly useful when a home user needs a temporary network address to connect to the Internet.

4

Figure 11.32 *PPP frame format*



Flag. A PPP frame starts and ends with a l-byte flag with the bit pattern 01111110. Although this pattern is the same as that used in HDLC, there is a big difference.

PPP is a byte-oriented protocol; HDLC is a bit-oriented protocol. The flag is treated as a byte.

o Address. The address field in this protocol is a constant value and set to 11111111 (broadcast address).

o Control. This field is set to the constant value . PPP does not provide any flow control.

Error control is also limited to error detection.

o Protocol. The protocol field defines what is being carried in the data field: either user data or other information. This field is by default 2 bytes long, but the two parties can agree to use only l byte.

o Payload field. This field carries either the user data or other information. The data field is a sequence of bytes with the default of a maximum of 1500 bytes.

o FCS. The frame check sequence (FCS) is a 2-byte or 4-byte standard CRC

fig-2
expl-3

b.

In random access or contention methods, no station is superior to another station and none is assigned the control over another.

ALOHA allows multiple access (MA) to the shared medium. There are potential collisions in this arrangement. When a station sends data, another station may attempt to do so at the same time. The data from the two stations collide and become garbled. ALOHA, the earliest random access method, was developed at the University of Hawaii in early 1970. It was designed for a radio (wireless) LAN, but it can be used on any shared medium.

CSMA - To minimize the chance of collision and, therefore, increase the performance, the CSMA method was developed. The chance of collision can be reduced if a station senses the medium before trying to use it. Carrier sense

	multiple access (CSMA) requires that each station first listen to the medium before sending. Three methods have been devised for carrier sensing: I-persistent, nonpersistent, and p-persistent. Carrier sense multiple access with collision detection (CSMA/CD) augments the CSMA algorithm to handle collision. In this method, a station monitors the medium after it sends a frame to see if the transmission was successful. If so, the station is finished. If, however, there is a collision, the frame is sent again.	3x2 = 6

CODE : 4132

COURSE: Data Communications VERSION: 4176

BLUE PRINT

Sl No.	Module	Type of Questions							
		Part A		Part B		Part C		Total	
		No. of Questions	Score	No. of Questions	Score	No. of Questions	Score	No. of Questions	Score
1		2	4	2	12	4	30	8	46
2		1	2	2	12	4	30	7	44
3		1	2	2	12	4	30	7	44
4		1	2	1	6	4	30	6	38
Total		5	10	7	42	16	120	28	

QUESTION WISE ANALYSIS

COURSE : Data Communication

VERSION : 4176

Qn No.	Specific outcome (as per syllabus)	Module	Content Details	Score	Time in Minutes	
I 1	1.2.1	I	Network attribute	2	3.6	
2.	1.2.6	I	Various standards	2	3.6	
3	2.1.3	II	Band width	2	3.6	
4	3.3.1	III	Switched network	2	3.6	
5	4.2.3	IV	Data link Layer Protocol	2	3.6	
II 1.	1.1.3	I	Data representation form	6	10.8	
2	1.3.	I	Network model	6	10.8	any 5 - 54 mks
3.	2.3.3	II	TDM	6	10.8	
4.	2.2.1	II	Digital to Analog Conversion	6	10.8	
5	3.3	III	Switched Network	6	10.8	
6	3.3.3	III	Structure of switch	6	10.8	
7	4.2.4	IV	HDLC	6	10.8	
		Part C				
III a	1.1.2	I	components of data communication	6	10.8	27 mks
b	1.1.3	I	Data flow methods	9	16.2	
IV a	1.2.2	I	Topology	8	14.4	27
b	1.3.3	I	ISO/OSI model	7	12.6	
V a	2.1.7	II	Transmission impairments	8	14.4	27
b	2.3.1	II	FDM	7	12.6	
VI a	2.2.2	II	Transmission modes	7	12.6	27
b	2.2.1	II	Analog to Digital conv	8	14.4	
VII a	3.1.2	III	Coaxial cable	6	10.8	27
b	3.2.2	III	Radio waves	9	16.2	
VIII a	3.3.3	III	Structure of Switch	8	14.4	27
b	3.3.2	III	data gram switching	7	12.6	
			Total Time = 3.6×5 + 10.8×5 + 27×4		180 mks	

18 + 54 + 108

PTO

Signature :

Name, Designation & Institution :

IX	a	4.2.2		– 8	– 14.4	27
	b	4.2.3		– 7	– 12.6	
X	a	4.2.5	PPP	– 9	– 16.2	27
	b	4.3		– 6	– 10.8	