

SCHEME OF VALUATION
(Scoring Indicators)

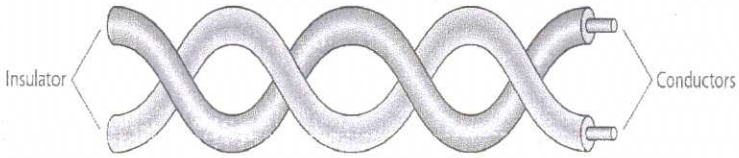
Revision : 2015

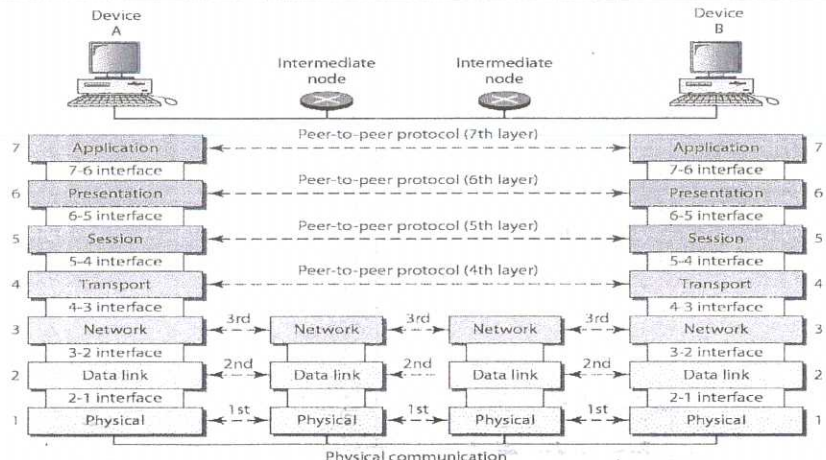
Course Code : 4132

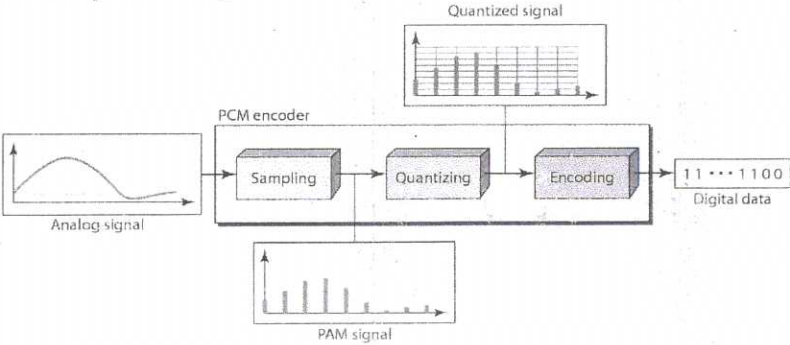
Course Title : DATA COMMUNICATION

Qst. No.	Scoring indicators	Split up Score	Sub Total	Total
<u>PART A</u>				
I (1)	Sender, receiver, medium, message, protocol	4x1/2		2
I (2)	A composite signal is made of many simple sine waves.	2		2
I(3)	The process of taking a group of bits from each input line for multiplexing is called interleaving.	2		2
I(4)	A glass or plastic core is surrounded by a cladding of less dense glass or plastic. The difference in density of the two materials must be such that a beam of light moving through the core is reflected off the cladding instead of being refracted into it.	2		2
I(5)	The Hamming distance between two words is the number of differences between corresponding bits.	2		2
<u>PART- B</u>				
II (1)	<p><u>LAN</u> (Local Area Network) is a computer network covering a small geographic area, like a home, office, school, or group of buildings. High speed (1000 mbps) Experiences fewer data transmission errors. Typically owned, controlled, and managed by a single person or organization. Installation cost is very low</p> <p><u>WAN</u> Computers connected to a wide-area network are often connected through public networks, such as the telephone system. They can also be connected through leased lines or satellites. Experiences more data transmission errors as compared to LAN WANs (like the Internet) are not owned by any one organization Low bandwidth is available for transmission. Installation cost is very high.</p>	3		6
		3		

II (2)	<p>A protocol is synonymous with rule. It consists of a set of rules that govern data communications. It determines what is communicated, how it is communicated and when it is communicated. The key elements of a protocol are syntax, semantics and timing.</p> <p><u>Syntax</u> Structure or format of the data Indicates how to read the bits - field delineation.</p> <p><u>Semantics</u> Interprets the meaning of the bits. Knows which fields define what action.</p> <p><u>Timing</u> When data should be sent and what Speed at which data should be sent or speed at which it is being received.</p>	2 2 2		6
II (3)	<p><i>A sine wave can be represented by three parameters: the peak amplitude, the frequency, and the phase. These three parameters fully describe a sine wave.</i></p> <p><u>Peak Amplitude</u> <i>The peak amplitude of a signal is the absolute value of its highest intensity, proportional to the energy it carries.</i></p> <p><u>Period and Frequency</u> <i>Period refers to the amount of time, in seconds, a signal needs to complete one cycle.</i></p> <p><u>Frequency</u> refers to the number of periods in one second.</p> <p><u>Phase</u> <i>The term phase describes the position of the waveform relative to time 0</i></p> <p>explain any three</p>	3x2		6
II (4)	<p><u>TRANSMISSION IMPAIRMENT</u> 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. Three causes of impairment are attenuation, distortion, and noise.</p>			

	<p><u>Attenuation</u> 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. Attenuation is measured in terms of Decibels.</p> <p><u>Distortion</u> Distortion means that the signal changes its form or shape. Distortion can occur in a composite signal made of different frequencies.</p> <p><u>Noise</u> Noise is another cause of impairment. Several types of noise, such as thermal noise, induced noise, crosstalk, and impulse noise, may corrupt the signal.</p>	2		
II(5)	<p>A twisted pair consists of two conductors (normally copper), each with its own plastic insulation, twisted together. One of the wires is used to carry signals to the receiver, and the other is used only as a ground reference. The receiver uses the difference between the two.</p>  <p>explanation</p>	2		6
II(6)	<p><u>Radio Waves</u> Waves ranging in frequencies between 3 kHz and 1 GHz are called radio waves. Radio waves, for the most part, 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.</p> <p>explanation</p>	3		
II(7)	<p>CSMA is based on the principle "sense before transmit" or "listen before talk." CSMA can reduce the possibility of collision, but it cannot eliminate it.</p>	1		

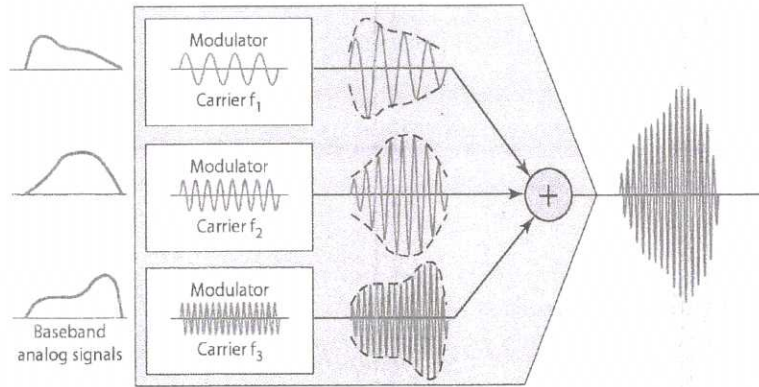
	<p>I-Persistent The I-persistent method is simple and straightforward. In this method, after the station finds the line idle, it sends its frame immediately</p> <p>Nonpersistent In the nonpersistent method, a station that has a frame to send senses the line. If the line is idle, it sends immediately. If the line is not idle, it waits a random amount of time and then senses the line again.</p> <p>p-Persistent The p-persistent method is used if the channel has time slots with a slot duration equal to or greater than the maximum propagation time.</p> <p>explanation</p>	1 1 1 2		6
III	<p style="text-align: center;"><i>PART-C</i></p> <p>The term physical topology refers to the way in which a network is laid out physically. The different types of topologies are</p> <ol style="list-style-type: none"> 1. Bus Topology 2. Ring Topology 3. Star Topology 4. Mesh Topology <p>Explain any three topologies</p>	3x5		15
IV	 <p>The diagram illustrates the seven layers of the OSI model between Device A and Device B. Layers 4 through 7 (Application, Presentation, Session, and Transport) are labeled as 'Peer-to-peer protocol' and show interfaces between adjacent layers. Layers 1 through 3 (Network, Data link, and Physical) are labeled as 'Physical communication' and show interfaces between adjacent layers. The layers are numbered 1 to 7 from bottom to top.</p> <p><u>Physical Layer</u> The physical layer is responsible for movements of individual bits from one hop (node) to the next.</p> <p><u>Data Link Layer</u> The data link layer is responsible for moving frames from one hop (node) to the next.</p>	5		

	<p><u>Network Layer</u> The network layer is responsible for the delivery of individual packets from the source host to the destination host.</p> <p><u>Transport Layer</u> The transport layer is responsible for the delivery of a message from one process to another.</p> <p><u>Session Layer</u> The session layer is responsible for dialog control and synchronization.</p> <p><u>Presentation Layer</u> The presentation layer is responsible for translation, compression, and encryption.</p> <p><u>Application Layer</u> The application layer is responsible for providing services to the user.</p> <p>explanation of any 5 layers</p>	5x2		15
V	<p>ANALOG-TO-DIGITAL CONVERSION</p> <p><i>A digital signal is superior to an analog signal because it is more robust to noise and can easily be recovered, corrected and amplified. For this reason, the tendency today is to change an analog signal to digital data.</i></p> <p>PCM consists of three steps to digitize an analog signal:</p> <ol style="list-style-type: none"> 1. Sampling 2. Quantization 3. Binary encoding  <p>The diagram illustrates the PCM encoding process. It starts with an 'Analog signal' represented by a smooth curve. This signal enters a 'PCM encoder' block, which is divided into three stages: 'Sampling', 'Quantizing', and 'Encoding'. Below the 'Sampling' stage, a 'PAM signal' is shown as a series of vertical pulses. Above the 'Quantizing' stage, a 'Quantized signal' is shown as a series of horizontal steps. The final output of the 'Encoding' stage is 'Digital data', represented by the binary sequence '11...1100'.</p>	2	4	15

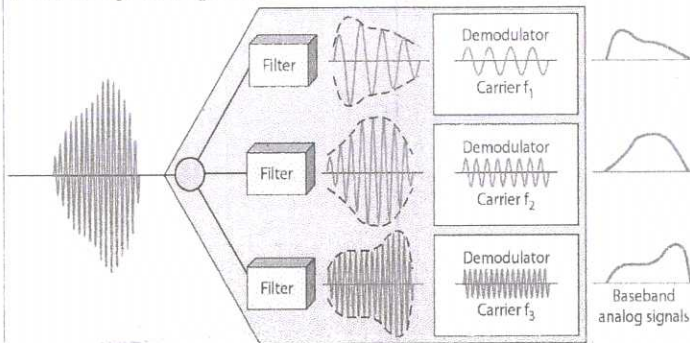
	<p><u>Sampling</u> Analog signal is sampled every T_s secs. T_s is referred to as the sampling interval. $f_s = 1/T_s$ is called the sampling rate or sampling frequency. There are 3 sampling methods: Ideal - an impulse at each sampling instant Natural - a pulse of short width with varying amplitude Flat top - sample and hold, like natural but with single amplitude value</p> <p><u>Quantisation</u> 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 <i>infinite</i> 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</p> $\Delta = (\max - \min)/L$ <p><u>Binary Encoding</u> To recover an analog signal from a digitized signal we follow the following steps: We use a hold circuit that holds the amplitude value of a pulse till the next pulse arrives. We pass this signal through a low pass filter with a cutoff frequency that is equal to the highest frequency in the pre-sampled signal. The higher the value of L, the less distorted a signal is recovered.</p>	3		
VI	<p><u>Frequency-Division Multiplexing</u> 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. In addition, carrier frequencies must not interfere</p>	3		

with the original data frequencies.

Multiplexing Process



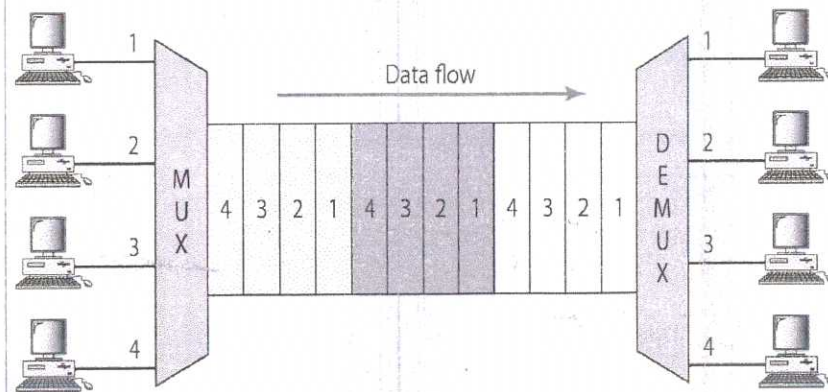
Demultiplexing Process



explanation

Time-Division Multiplexing

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.



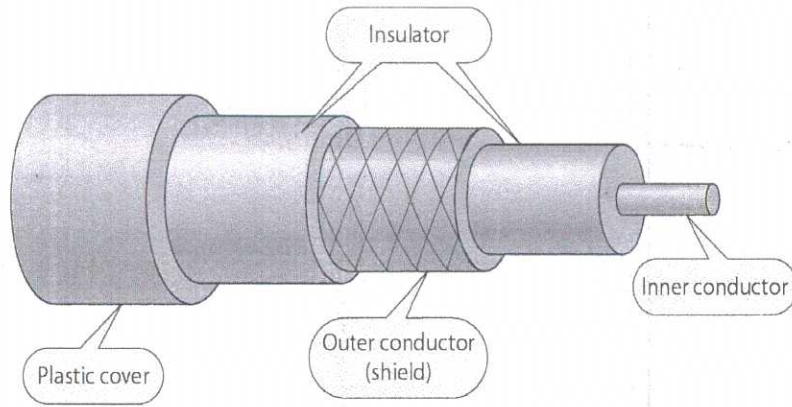
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VII(a) Coaxial cable



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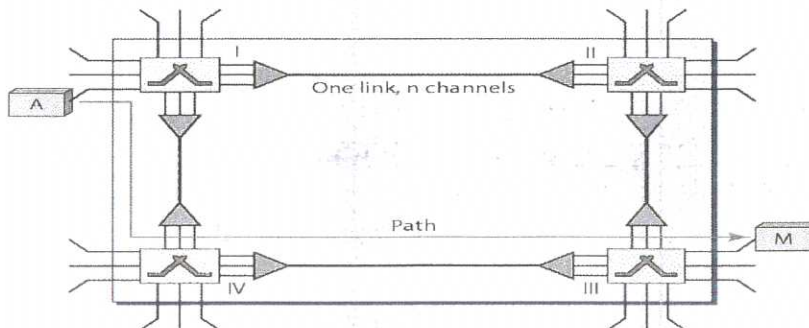
Coaxial cable (or coax) carries signals of higher frequency ranges than those in twisted pair cable. Coax has a central core conductor of solid or stranded wire (usually copper) enclosed in an insulating sheath, which is, in turn, encased in an outer conductor of metal foil, braid, or a combination of 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.

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explanation

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VII(b) *A circuit-switched network consists of a set of switches connected by physical links. A connection between two stations is a dedicated path made of one or more links.*



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Three Phases

The actual communication in a circuit-switched network

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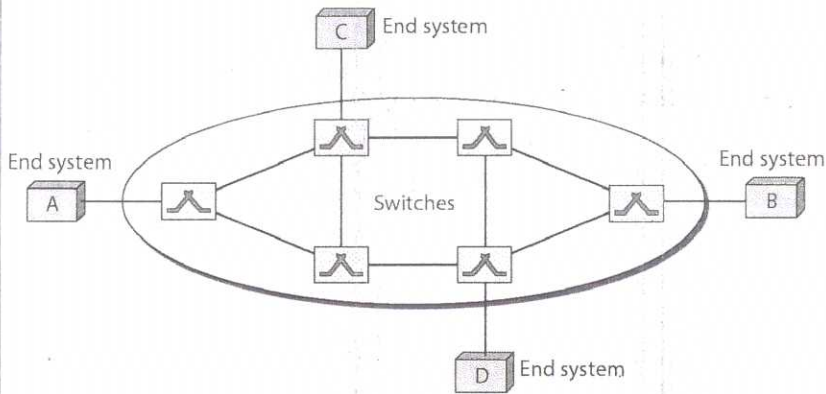
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	<p>requires three phases:</p> <ol style="list-style-type: none"> 1. connection setup, 2. data transfer, and 3. connection teardown. <p>When end system A needs to communicate with end system M, system A needs to request a connection to M that must be accepted by all switches as well as by M itself. This is called the setup phase.</p> <p>A circuit (channel) is reserved on each link, and the combination of circuits or channels defines the dedicated path.</p> <p>After the dedicated path made of connected circuits (channels) is established, data transfer can take place.</p> <p>After all data have been transferred, the circuits are tear down.</p>	6		
VIII (a)	<p><u>Advantages and Disadvantages of Optical Fiber Cable</u></p> <p><u>Advantages</u></p> <ol style="list-style-type: none"> a. Higher bandwidth. Fiber-optic cable can support dramatically higher bandwidths (and hence data rates) than either twisted-pair or coaxial cable. b. Less signal attenuation. Fiber-optic transmission distance is significantly greater than that of other guided media. c. Immunity to electromagnetic interference. Electromagnetic noise cannot affect fiber-optic cables. d. Resistance to corrosive materials. Glass is more resistant to corrosive materials than copper. e. Light weight. Fiber-optic cables are much lighter than copper cables. f. Greater immunity to tapping. Fiber-optic cables are more immune to tapping than copper cables. <p><u>Disadvantages</u></p> <p>There are some disadvantages in the use of optical fiber.</p> <ol style="list-style-type: none"> a. Installation and maintenance. Fiber-optic cable is a relatively new technology. Its installation and maintenance require expertise that is not yet available everywhere. b. Unidirectional light propagation. Propagation of light is unidirectional. If we need bidirectional communication, two fibers are needed. 	3	6	
		3		

c. Cost. The cable and the interfaces are relatively more expensive than those of other guided media.

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VIII(b) VIRTUAL-CIRCUIT NETWORKS



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A virtual-circuit network is a cross between a circuit-switched network and a datagram network.

It has some characteristics of both.

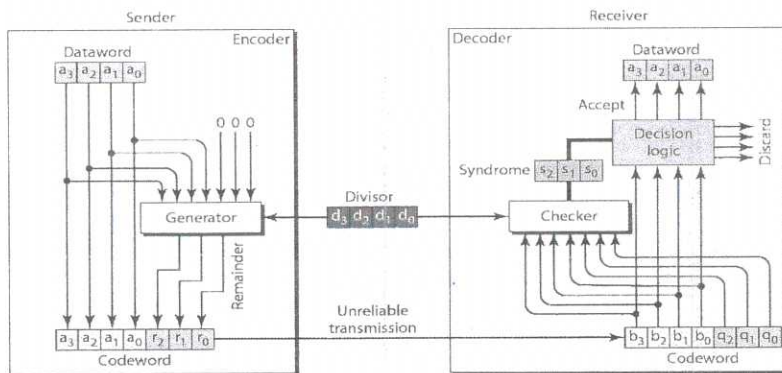
1. As in a circuit-switched network, there are setup and tear down phases in addition to the data transfer phase.
2. Resources can be allocated during the setup phase, as in a circuit-switched network, or on demand, as in a datagram network.
3. As in a datagram network, data are packetized and each packet carries an address in the header.
4. As in a circuit-switched network, all packets follow the same path established during the connection.
5. A virtual-circuit network is normally implemented in the data link layer, while a circuit-switched network is implemented in the physical layer and a datagram network in the network layer. But this may change in the future. The network has switches that allow traffic from sources to destinations. A source or destination can be a computer, packet switch, bridge, or any other device that connects other networks.

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IX (a) CYCLIC REDUNDANCY CHECK (CRC)

Cyclic codes are special linear block codes with one extra property. In a cyclic code, if a codeword is cyclically shifted (rotated), the result is another codeword.



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In the **encoder**, the dataword has k bits (4 here); the codeword has n bits (7 here). The size of the dataword is augmented by adding $n - k$ (3 here) 0s to the right-hand side of the word. The n -bit result is fed into the generator.

The generator uses a **divisor** of size $n - k + 1$ (4 here), predefined and agreed upon. The generator divides the augmented dataword by the divisor (modulo-2 division). The quotient of the division is discarded; the remainder ($r_2r_1r_0$) is appended to the dataword to create the codeword.

The **decoder** receives the possibly corrupted codeword. A copy of all n bits is fed to the checker which is a replica of the generator. The remainder produced by the checker is a syndrome of $n - k$ (3 here) bits, which is fed to the decision logic analyzer. The analyzer has a simple function. If the syndrome bits are all as, the 4 leftmost bits of the codeword are accepted as the dataword (interpreted as no error); otherwise, the 4 bits are discarded (error).

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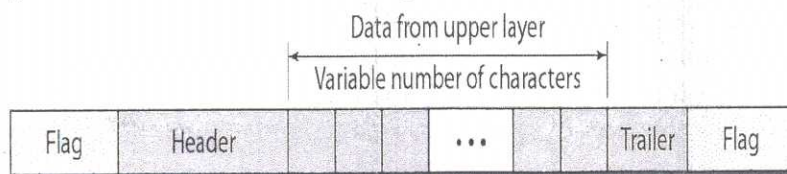
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IX (b)

Framing

The data link layer needs to pack bits into frames, so that each frame is distinguishable from another.

A frame in a character-oriented protocol



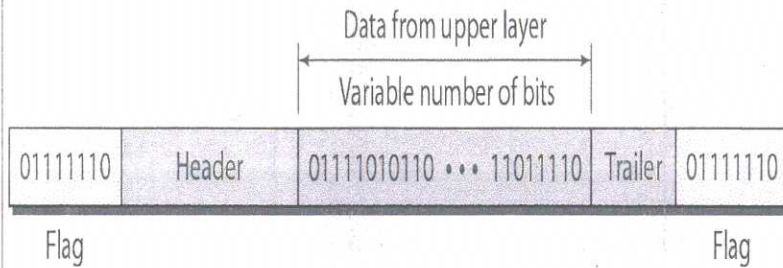
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Byte stuffing is the process of adding 1 extra byte whenever there is a flag or escape character in the text.

A frame in a bit-oriented protocol



2

Bit stuffing is the process of adding one extra 0 whenever five consecutive 1s follow a 0 in the data, so that the receiver does not mistake the pattern 0111110 for a flag.

X(a)

The checksum is used in the Internet by several protocols although not at the data link layer. The checksum is based on the concept of redundancy.

Idea

Suppose our data is a list of five 4-bit numbers that we want to send to a destination. In addition to sending these numbers, we send the sum of the numbers. For example, if the set of numbers is (7, 11, 12, 0, 6), we send (7, 11, 12, 0, 6, 36), where 36 is the sum of the original numbers. The receiver adds the five numbers and compares the result with the sum. If the two are the same, the receiver assumes no error, accepts the five numbers, and discards the sum. Otherwise, there is an error somewhere and the data are not accepted.

2

One's Complement

we can represent unsigned numbers between 0 and $2^n - 1$ using only n bits. If the number has more than n bits, the extra leftmost bits need to be added to the n rightmost bits (wrapping). In one's complement arithmetic, a negative number can be represented by inverting all bits (changing a 0 to a 1 and a 1 to a 0). This is the same as subtracting the number from $2^n - 1$.

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Internet Checksum

Traditionally, the Internet has been using a 16-bit checksum. The sender calculates the checksum by following these steps.

Sender site:

1. The message is divided into 16-bit words.
2. The value of the checksum word is set to 0.
3. All words including the checksum are added using one's complement addition.
4. The sum is complemented and becomes the checksum.
5. The checksum is sent with the data.

The receiver uses the following steps for error detection.

Receiver site:

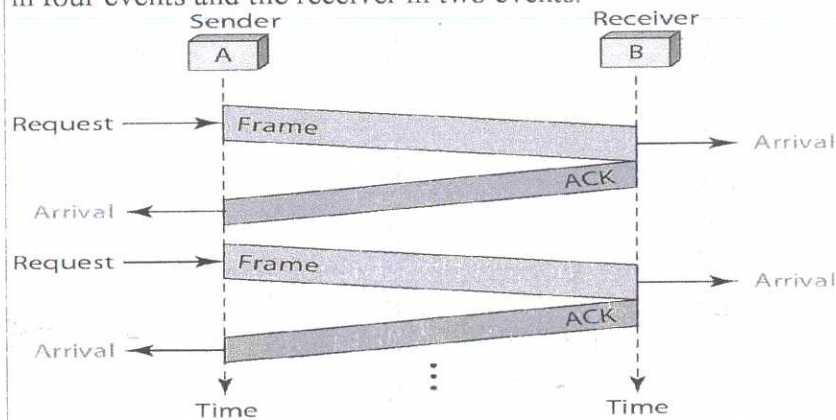
1. The message (including checksum) is divided into 16-bit words.
2. All words are added using one's complement addition.
3. The sum is complemented and becomes the new checksum.
4. If the value of checksum is 0, the message is accepted; otherwise, it is rejected.

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X(b) **Stop-and-Wait Protocol**

The sender sends one frame and waits for feedback from the receiver. When the ACK arrives, the sender sends the next frame. Note that sending two frames in the protocol involves the sender in four events and the receiver in two events.



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2

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explanation

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