Assignments #1

Last Date of Submission: March 30, 2023

Subject: Computer Networks (CS44113)
Semester: B.Tech (IV CSE)

1) What are the key benefits of layered network?
2) Explain the functionalities of different OSI layers?
3) List two advantages and two disadvantages of having international standards for network protocols?
4) A system has an n-layer protocol hierarchy. Applications generate messages of length M bytes. At each of the layers, an h-byte header is added. What fraction of the network bandwidth is filled with headers?
5) How two adjacent layers communicate in a layered network? (or What do you mean by Service Access Point?)
6) Discuss the design issues for the layers?
7) List two ways in which the OSI reference model and the TCP/IP reference model are the same. Now list two ways in which they differ.
8) When a file is transferred between two computers, two acknowledgement strategies are possible. In the first one, the file is chopped up into packets, which are individually acknowledged by the receiver, but the file transfer as a whole is not acknowledged. In the second one, the packets are not acknowledged individually, but the entire file is acknowledged when it arrives. Discuss these two approaches.
9) What is the principal difference between connectionless communication and connection-oriented communication?
10) Two networks each provide reliable connection-oriented service. One of them offers a reliable byte stream and the other offers a reliable message stream. Are these identical? If so, why is the distinction made? If not, give an example of how they differ.

11) Distinguish between attenuation distortion and delay distortion.

12) Distinguish between time domain and frequency domain representation of a signal.

13) This elementary problem begins to explore propagation delay and transmission delay, two central concepts in data networking. Consider two hosts, Hosts A and B, connected by a single link of rate *R* bps. Suppose that the two hosts are separated by *m* meters, and suppose the propagation speed along the link is *s* meters/sec. Host A is to send a packet of size *L* bits to Host B.

(a.) Express the propagation delay, d_{prop} in terms of *m*and *s*.

(b.) Determine the transmission time of the packet, d_{trans} in terms of *L*and *R*. (c.) Ignoring processing and queing delays, obtain an expression for the end-

i. to-end delay.

(c.) Suppose Host A begins to transmit the packet at time *t=0*. At time *t*= d_{trans}, where is the last bit of the packet?

(d.) Suppose d_{prop} is greater than d_{trans} . At time *t*= d_{trans} , where is the first bit of the packet?

(e.) (f.) Suppose d_{prop} is less than d_{trans} . At time *t*= d_{trans} , where is the first bit ofthe packet?

(f.) Suppose *s=2.5*108*, *L=100*bits and *R=28* kbps. Find the distance *m* so that

i. d_{prop} equals d_{trans} .

14) Why analog-to-analog modulation technique is required? Explain the possible analog-to-analog modulation techniques?

15) Discuss Nyquist for a noiseless channel and Shannon for a noisy channel. We have a channel with a 1-MHz bandwidth. The SNR for this channel is 63. What are the appropriate bit rate and signal level?

16) Explain the possible digital-to-analog modulation techniques? Out of the three digital-to-analog modulation techniques, which one requires higher bandwidth?

17) Distinguish between the two basic multiplexing techniques? Why guard bands are used in FDM and why sync pulse is required in TDM?

18) How is the wastage of bandwidth in TDM overcome by statistical-TDM?

19) What is the difference between Frequency Division Multiplexing and Wave Division Multiplexing?

20) What is the essential difference between message switching and packet switching?

21) What are the key differences between datagram and virtual circuit packet switching?

22) How the drawback of circuit switching is overcome in message switching?

23) What are the key differences between circuit switching and virtual circuit packet switching?

24) How packet size affects the transmission time in a packet switching network?

25) Design a three stage 200×200 switch (N=200) with k=4 and n=20.

26) Redesign the previous three stages, 200*200 switches, using the Clos criteria with minimum number of cross points?

27) Explain the Public switch telephone networks?

28) Suppose users share a 1 Mbps link. Also suppose each user requires 100 Kbps when transmitting, but each user only transmits 10% of the time.

(a.) When circuit-switching is used, how many users can be supported?

29) For the remainder of this problem, suppose packet-switching is used. Find the probability that a given user is transmitting.

30) How does Manchester encoding differ from differential Manchester encoding? Sketch the Manchester encoding, differential Manchester and NRZ encoding for the bit stream: 0001110101.

31) Distinguish between PAM and PCM signals?

32) What is quantization error? How can it be reduced?

33) Data link protocols almost always put the CRC in a trailer rather than in a header. Why?

34) What is the remainder obtained by dividing $x^7 + x^5 + 1$ by the generator polynomial $x^3 + 1$?

35) A bit string, 0111101111101111110, needs to be transmitted at the data link layer. What is the string actually transmitted after bit stuffing?

36) Sixteen-bit messages are transmitted using a Hamming code. How many check bits are needed to ensure that the receiver can detect and correct single bit errors? Show the bit pattern transmitted for the message 1101001100110101. Assume that even parity is used in the Hamming code.

37)A bit stream 10011101 is transmitted using the standard CRC method described in the text. The generator polynomial is $x^3 + 1$. Show the actual bit string transmitted. Suppose the third bit from the left is inverted during transmission. Show that this error is detected at the receiver's end.

38)A CRC is constructed to generate a 4-bit FCS for an 11-bit message. The generator polynomial is $X^4 + X^3 + 1$.

a.) Encode the data bit sequence 10011011100 using the generator polynomial and give the codeword

b.) Now assume that bit 7 (counting from the leftmost bit) In codeword is in error and show that the detection algorithm detects the error?

39)An 8-bit byte with binary value 10101111 is to be encoded using an even-parity Hamming code. What is the binary value after encoding?

40)How the inefficiency of Stop-and-Wait protocol is overcome in sliding window protocol?

41)What is piggybacking? What is its advantage?

42)Using 5 -bit sequence numbers, what is the maximum size of the send and the receive windows for each of the following protocols?

(a.) Stop -and-Wait ARQ

(b.) Go-Back-N ARQ

(c.) Selective-Repeat ARQ

43)Design two simple algorithms for byte-stuffing. The first adds bytes at the sender; the second removes bytes at the receiver.

44)Consider a half-duplex point-to-point link using a stop-and-wait scheme.

A) What is the effect on line utilization of increasing the message size so that fewer messages will be required? Other factors remain constant.

B)What is the effect on line utilization of increasing the number of frames for a constant message size?

C)What is the effect on line utilization of increasing frame size?

45)A channel has a data rate of 4 kbps and a propagation delay of 20 ms. For what range of frame sizes does stop-and-wait give an efficiency of at least 50%?

46)Consider the use of 1000-bit frames on a 1-Mbps satellite channel with a 270-ms delay. What is the maximum link utilization for

Stop-and-wait flow control?

Continuous flow control with a window size of 7?

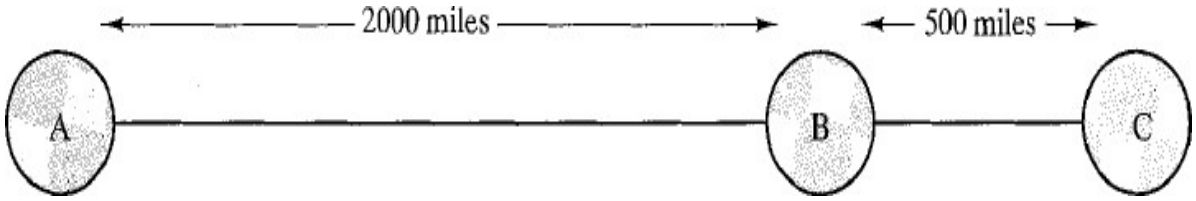
Continuous flow control with a window size of 127?

Continuous flow control with a window size of 255?

47) Frames of 1000 bits are sent over a 1-Mbps channel using a geostationary satellite whose propagation time from the earth is 270 msec. Acknowledgements are always piggybacked onto data frames. The headers are very short. Three-bit sequence numbers are used. What is the maximum achievable channel utilization for **(a) Stop-and-wait (b) Go back-N (c) Selective Repeat**

48) Consider an error-free 64-kbps satellite channel used to send 512-byte data frames in one direction, with very short acknowledgements coming back the other way. What is the maximum throughput for window sizes of 1, 7, 15, and 127? The earth-satellite propagation time is 270 msec.

49) A channel has a data rate of R bps and a propagation delay of *t* seconds per kilometer. The distance between the sending and receiving nodes is L kilometers. Nodes exchange fixed-size frames of B bits. Find a formula that gives the minimum sequence field size of the frame as a function of R, *t,* B, and *L* (considering maximum utilization). Assume that ACK frames are negligible in size and the processing at the nodes is instantaneous.



50) Explain the following (a) Transmission Media(b) Bit-oriented (HDLC) and Byte-oriented Protocol(PPP)