Instruction

Homework 1 covers Chapter 1 to Chapter 3. Total 100 points.
Due by 23:59 Oct, 29th, 2023.
Submit your homework (**in a single PDF file**) here.
Grading. Please briefly explain your answer. Answer without explanation will only receive half credit. **Plagiarism is strictly forbidden, and will receive zero credit for the entire homework (20% of this course) section.**

Questions

1. Reference Model (8 points)

Which of the OSI layers execute the following function?

a) Providing reliable, connection-oriented path between the source and the destination.

b) Determining which user may have access to the wireless channel.

c) Framing.

d) Determining which interface should an IP datagram go out.

2. Transmission Medium and Modulation (12 points)

Enumerate all the types of ... that we discussed in class.

a) Modulation schemes

b) Communication satellites

c) Guided Medium

d) Multiplexing schemes

3. Packet Switching v.s. Curcuit Switching (10 points)

Is the end-to-end delay in a packet switching system always smaller than the same system with circuit switching? Why or why not?

4. Bandwidth, Data rate, and Capacity (15 points)

There is a link of data rate 6 Mbps, to be shared by 30 users. Suppose each user, when active, needs a 500 Kbps data rate. Each user is active with a probability of 0.3.

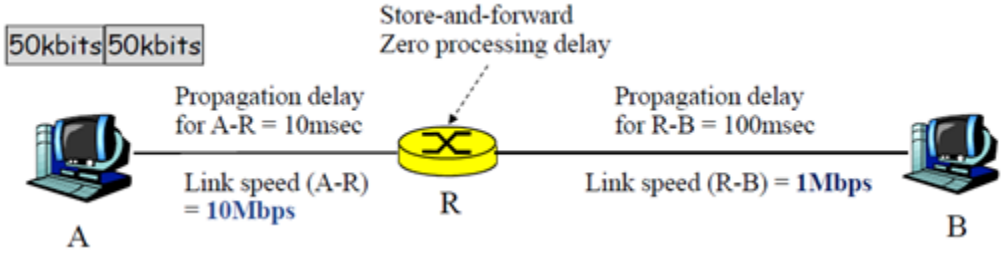
a) If circuit switching is used, how many users can be hosted on this link?

b) If packet switching is used, what is the probability that the link is overloaded?

c) What is the minimum signal-to-noise ratio (SNR) to provide for the required 6 Mbps data rate on a channel of bandwidth 30 MHz?

5. Store-and-Forward, Delay (10 points)

Suppose host A has 3 packets to send to host B, who is joined to A by a router with zero processing delay. Each packet is 50 Kb. The network configuration is as follows. What is the queuing delay of the third packet at the router R?



6. CDMA (10 points)

Consider 4 stations with the following chip sequences.
A: (-1 -1 -1 +1 +1 -1 +1 +1)
B: (-1 -1 +1 -1 +1 +1 +1 -1)
C: (-1 +1 -1 +1 +1 +1 -1 -1)
D: (-1 +1 -1 -1 -1 -1 +1 -1)
The received sequence S = (-1 +1 -3 +1 -1 -3 +1 +1).
Which station transmitted, and what are the transmitted bits?

7. Hamming Distance (10 points)

What is the Hamming distance of the horizontal-vertical parity check code for the 7×7 block we discussed in class? Show correctness of your answer by considering the detection and correction capability of this coding scheme.

8. Hamming Code (10 points)

A 9-bit (m=9) message with binary value 100101011 is to be encoded using a even-parity Hamming code.

a) How many check bits are needed?

b) What is the encoded Hamming codeword. Show your steps.

9. CRC (15 points)

Data stream 10010011101 is to be encoded using the standard CRC method. The generator polynomial is $G(x) = x^3 + 1$.

a) What is the bit string $T(x)$ that is to be transmitted?

b) Suppose the first three bits from the left are inverted/flipped during the transmission. Can the errors be detected? Show your steps.