

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. Circuit 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?

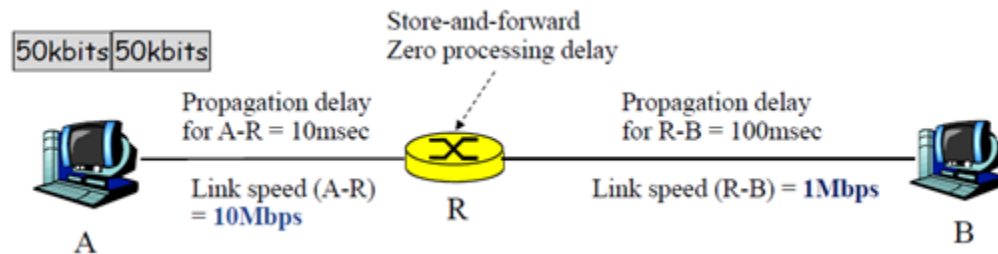
4. Bandwidth, Data rate, and Capacity (15 points)

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.

- If circuit switching is used, how many users can be hosted on this link?
- If packet switching is used, what is the probability that the link is overloaded?
- 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.