CMPE 412 - Fall 2024

Review Problems #2

These are review problems

Problem 1: Asynchronous and synchronous communication

Suppose a file of 10000 bytes is to be sent over a line at 2400 bps.

1. Calculate the overhead in bits and time in using asynchronous communication. Assume one start bit and a stop element of length one bit and eight bits for data with no parity bit

2. Calculate the overhead in bits and time using synchronous communication. Assume that the data are sent in frames each frame consists of 1000 characters (8000 bits) and overhead of 48 control bits per frame.

Problem 2: Error detection

Suppose we want to transmit the message 1011 0010 0100 1011 and protect it from errors using the CRC8 polynomial $x^8 + x^2 + x + 1$. Determine the message that should be transmitted. You can use polynomial long division or binary division. Feel free to use online CRC calculators.

Problem 3: Maximum data rate

1. A noiseless 8-kHz channel is sampled every 1 msec. Each sample (S) is 16 bits. What is the maximum data rate?
   Note: the number of levels (M) is related to the number of samples (S) as follows: $M = 2^S$.

2. How does the maximum data rate change if the channel is noisy, with a signal-to-noise ratio of 30 dB?

Problem 4: Maximum data rate

1. Assuming television channels are 5 MHz wide. How many bits/sec can be sent if eight-level digital signals are used? Assume a noiseless channel.

2. If a binary signal is sent over a 3-kHz channel whose signal-to-noise ratio is 20 dB, what is the maximum achievable data rate?

3. What is the channel capacity for a teleprinter channel with a 300 Hz bandwidth and a signal-to-noise ratio of 3 dB?

Problem 5: Multiplexing

1. What type of multiplexing is shown in figure 1?
2. What is the purpose of guard time?

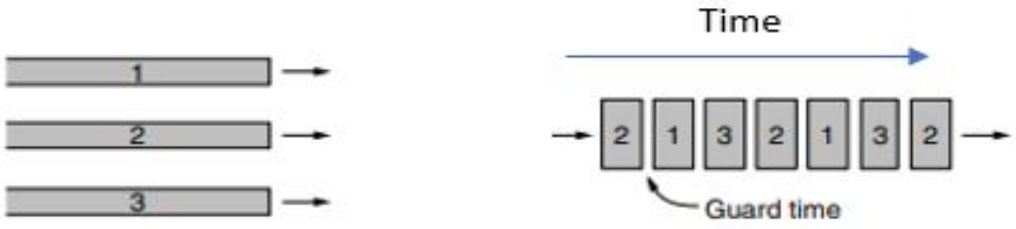

Figure 1: Multiplexing

Problem 6: Frequency division multiplexing

Ten signals, each requiring 4000 Hz, are multiplexed onto a single channel using FDM. To accommodate the successful transmission of multiple signals over a single line, FDM separates assigned bands by strips of unused frequencies called guard bands. What is the minimum bandwidth required for the multiplexed channel? Assume that the guard bands between channels are 400 Hz wide.

Problem 7: CDMA

Suppose that A, B, and C are simultaneously transmitting 0 bits, using a CDMA system with the chip sequences of Figure 2. What is the resulting chips sequence?

Figure 2: Chip sequences for four stations.

1. Assuming the receiver receives the sequence (–2 –2 0 –2 0 –2 +4 0), what did channel B transmit?

Problem 9: SNR

Given a channel with an intended capacity of 20 Mbps, the bandwidth of the channel is 3 MHz. What SNR is required to achieve this capacity?

Problem 10: Data rate and levels

A digital signaling system is required to operate at 9600 bps.

1. If a signal element encodes a 4-bit word, what is the minimum required bandwidth for the channel? Note that 4-bit word corresponds to 16 levels.
2. Repeat for the case of 8-bit. Note that 8-bit word corresponds to 256 levels.

Problem 11: Transmission media

Figure 3 shows three transmission media.

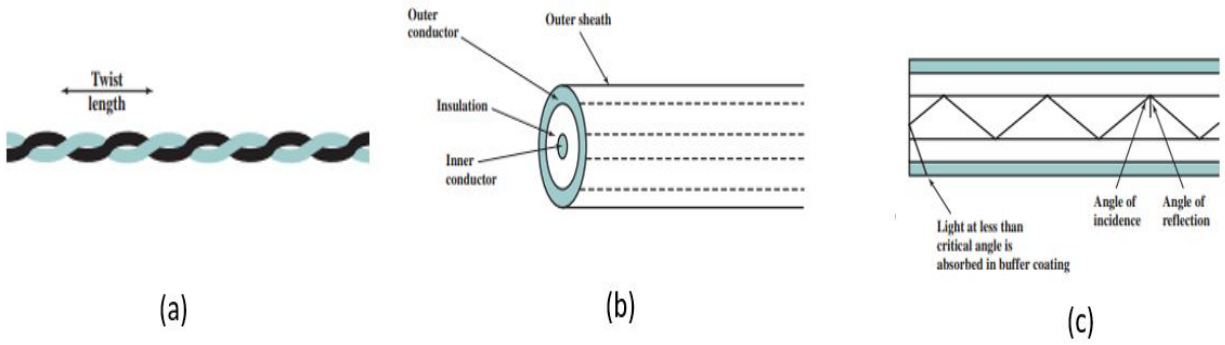

Figure 3: Transmission media

1. Which one corresponds to guided transmission and which corresponds to unguided transmission
2. Name each type

Problem 13: Signaling 4B/5B

Show the 4B/5B encoding for the following bit sequence: 1110 0101 0000 0011

4-Bit Data Symbol	5-Bit Code
0000	11110
0001	01001
0010	10100
0011	10101
0100	01010
0101	01011
0110	01110
0111	01111
1000	10010
1001	10011
1010	10110
1011	10111
1100	11010
1101	11011
1110	11100
1111	11101

Figure 5: 4B/5B table

Problem 14: Simplex, full duplex, half duplex

Which type of communication is shown in figure 6 (simplex, full duplex, half duplex)?

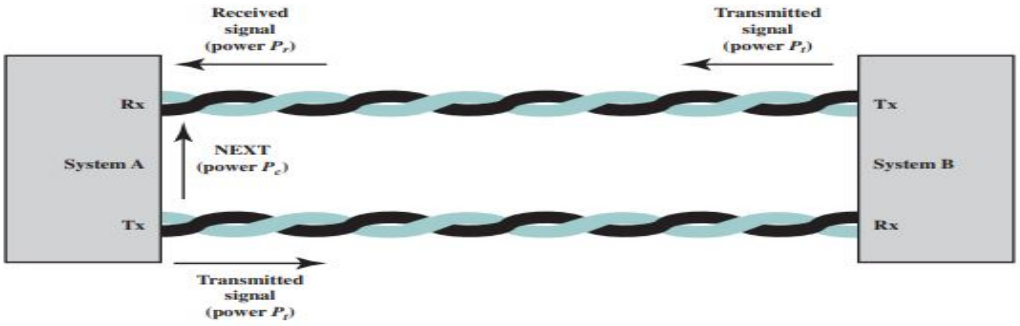

Figure 6: Simplex, full duplex, half duplex

Problem 15: ASK, FSK APSK, and PSK

Figure 7 shows four different methods for shift keying modulation.

1. Label the figures with the name of the modulation method.
2. What is the number of levels for each one.

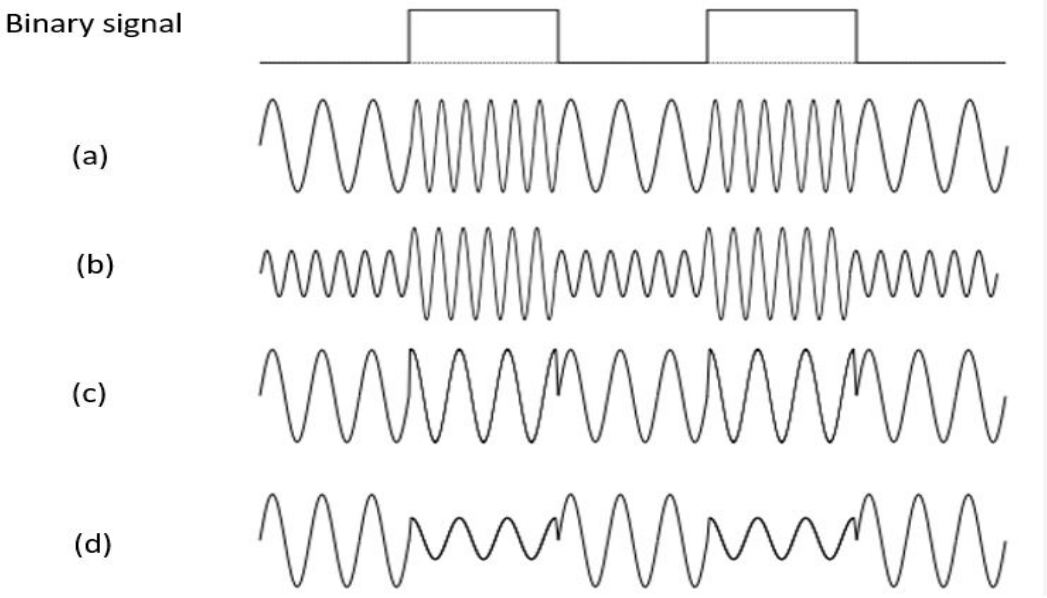

Figure 7: Shift keying modulation

Problem 16: Internet checksum

Compute the Internet checksum for the data block E3 4F 23 96 44 27 99 F3. Then perform the verification calculation.

Problem 17: IPv4

Consider figure 8 below.

1. What does the figure represent?
2. Discuss three fields in the header.
3. What is the maximum total length of a datagram (Header+ Data) in IPv4?

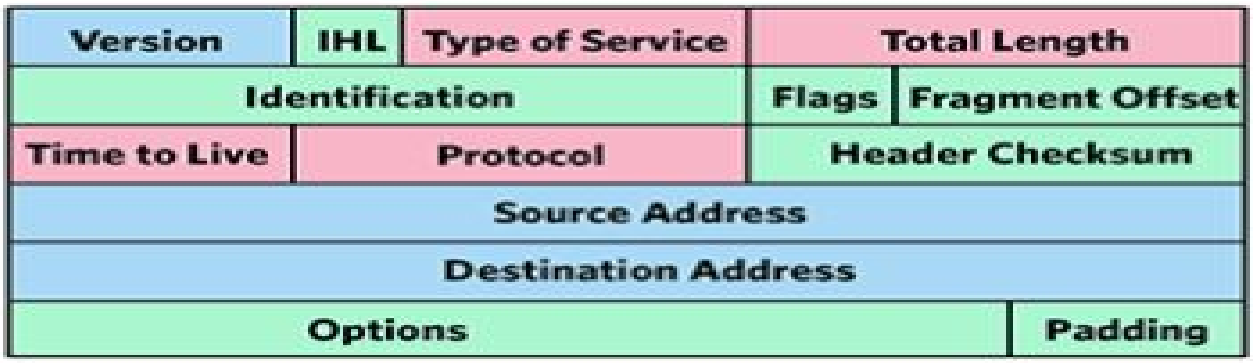

Figure 8: IPv4 Header.

Problem 18: IPv4 and IPv6

What are the main differences between IPv4 and IPv6. Use table format to explain.

Problem 19: IP address

Consider the IP address given by:

11000000.11100100.00010001.00111001

1. Find the dotted decimal representation.
2. To which class does this address belong?

Problem 20: Address classes

Consider the three IP address classes: A, B and C. Which class is better for

- Few networks, each with many hosts
- Medium number of networks, each with a medium number of hosts
- Many networks, each with a few hosts

Problem 21

Consider figure 9. Discuss the figure.

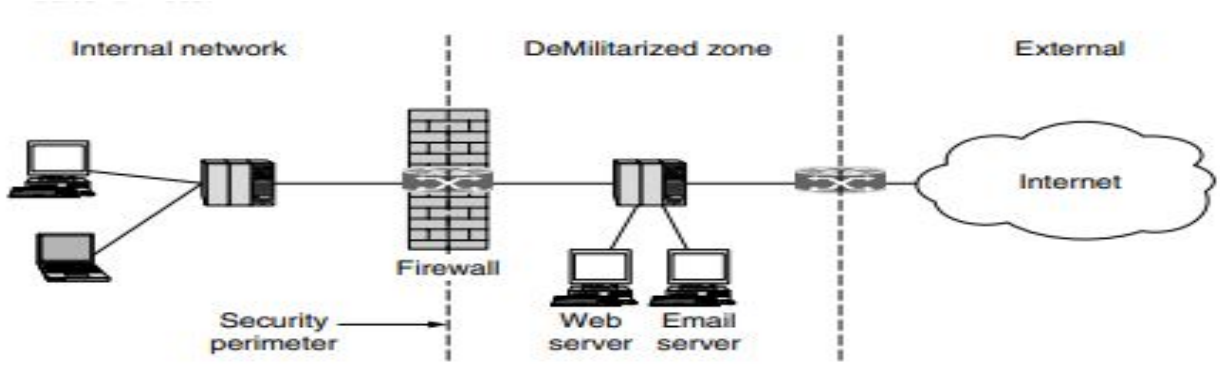

Figure 9: A firewall protecting an internal network.

Problem 22

1. What is the length in bits of the addresses in IPv4 and IPv6?
2. How many addresses does each one of them have?
3. What is the main limitation of IPv4?
4. What is the header size in IPv4?

Problem 23

Convert the IP address whose hexadecimal representation is C22F1582 to dotted decimal notation.

Problem 23

1. How many host addresses does class C have?
2. How many host addresses does class B have?

Problem 24

IPv6 uses 16-byte addresses. If a block of 1 million addresses is allocated every picosecond, how long will the addresses last?

Problem 25

Consider the network shown in figure 10.

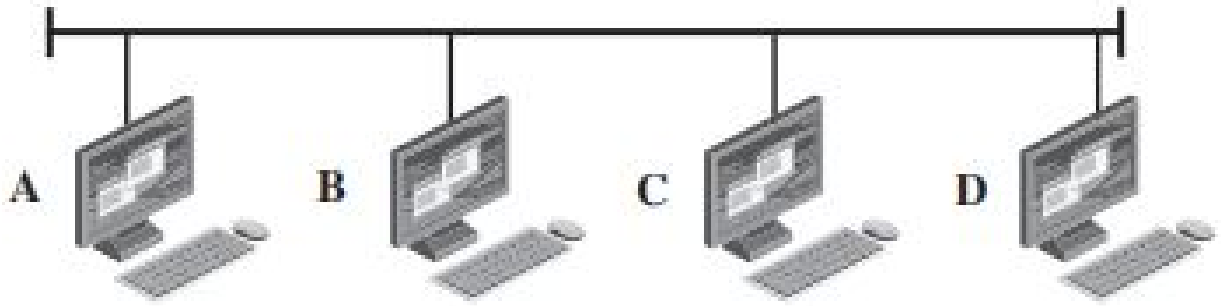

Figure 10: A network of computers

1. What is the possible problem with this type of configuration?
2. Describe a method to address this problem.

Problem 26

1. What is the method used to solve collision problem in the Ethernet?

Problem 27

1. What is fixed routing?
2. What is flooding?

Problem 28

1. What are the advantages and disadvantages of adaptive routing?
2. What is a least-cost routing algorithm?
3. What is the difference between an interior router protocol and an exterior router protocol?
4. What is a Choke Packet in the context of congestion?

Problem 29

We consider IPv4 header.

1. What is the size of the Total Length filed in bits?
2. What is the minimum size of the datagram (if you have no data)?
3. What is the maximum size of the datagram? Show your answer. Hint: This corresponds to the highest value in the Total Length field.
4. What is size of the datagram (in decimal) when the Total Length field is 0xABCD?. Hint: $ABCD_{16} = 43981_{10}$.

Problem 30

Consider address notation 192.168.5.85/24. How many bits are used for the network and how many bits are used for the hosts?

Problem 31

1. What are the difference between datagrams and virtual circuits.
2. What are the other names for these two approaches?
3. Give practical analogies for datagrams and virtual circuits.