Ve489 Computer Networks

Prof. Xudong Wang

Homework Set 1

1. What is the key working mechanism of telegraph?

2. What is the key working mechanism of telephone?

3. Comparing telephone and telegraph, which one is closer to computer networks? Why?

4. Is the mechanism of telephone useful for computer networks? If yes, in what sense?

5. Read the textbook and find out the basic idea of congestion control, flow control, and error control?

6. What is a protocol in computer networks? Why is it necessary?

7. Why do we need a protocol reference model? What are the commonly used protocol reference models? Which model is most frequently used in today's computer networks?

8. Why do we need a layered protocol stack? Please explain the key advantages. Also list the possible shortcomings.

9. Provide a possible reason for popularity of Internet protocol stack?

10. Why does an IP address include NetID and HostID?

11. What are the key differences between TCP and UDP?

12. Draw a diagram showing the example of end-to-end networking between one PC on one end with another PC on the other end, across the Internet. Please also show the protocol stack on each node. Hint: refer to the example shown in class notes.

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Homework Set 2

1. Considering an analog audio signal has a bandwidth of 10KHz, what is the minimum sampling rate that is needed for digitization?

2. For samples in problem 1, if we need to quantize them with a requirement of 50dB signal to quantization noise ratio, then how many bits are needed to quantize each sample?

3. What is the process of digital modulation? Explain it.

4. If the number of bits per symbol increases in modulation, then the bit rate could keep increasing. However, the bit rate is actually limited in a communication channel. Why?

5. Given a channel bandwidth (baseband) of 20 MHz, if the SNR of the channel is 30 dB, then what is the maximum transmission rate that can be achieved in this channel for reliable communications?

6. If the bandwidth in problem 5 is passband, then what is the maximum transmission rate?

7. Consider a Hamming code with m = 3, k = 4. It can be designed in different ways. Suppose the parity check is done as follows:

$$b_5 = b_2 + b_3 + b_4$$
$$b_6 = b_1 + b_3 + b_4$$
$$b_7 = b_1 + b_2 + b_3$$

What is the parity check matrix of this (7,4) Hamming coding?

8. Explain the reason for framing in the logical link control layer? Also, list the key approaches for framing?

9. Considering an example of bit stuffing,

1) If the bit stream of a service data unit (SDU) is 01101111 11101011 10110100 00101111 11011011 10111111 11010111 11111110 (totally 64 bits, i.e., 8 bytes). If bit stuffing is used, and the flag is 01111110, what would be the bit stream after stuffing? Mark the stuffed bits.

2) Explain the procedures of how to de-stuff the stuffed bit stream and get the original bit stream at the receiver? If the bit stuffed bit stream is 0111111001111100011111110101001101111110

(totally 40 bits). In this problem, there is at most one bit error and the bit error can only occur at a stuffed bit.

10. Study the key mechanisms of three ARQ protocols.

    1) Use a table to list the key elements of these ARQ protocols (e.g., timeout, ack/nak, sequence number, receiving window, sending windows, etc.), and also explain the relationship of these elements (if there is any).

    2) Derive the efficiency of these three ARQ protocols considering both error-free and erroneous environments.

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Homework Set 3

1. Explain the differences and relationship between multiple access and medium access control.

2. What is static channelization? Why do we need guard time for TDMA?

3. Why random access protocol is useful for TDMA base MAC protocol? Use slotted Aloha as an example.

4. Answer following questions about random access protocols:

    1) What is the vulnerable period for Aloha? How about slotted Aloha? Explain it.
    2) What is vulnerable period of CSMA? How can we make sure the performance of CSMA is better than Aloha?
    3) Why collision detection (CD) can improve performance of CSMA?

5. Considering the CSMA/CA based DCF in IEEE 802.11, answer the following questions:

    1) What is virtual carrier sensing? Why is it helpful for IEEE 802.11 MAC?
    2) What does hidden node mean? How about exposed node?
    3) Why does DCF need DIFS and SIFS?
    4) What is collision avoidance in IEEE 802.11? What key mechanisms are needed?