# **SEHH2238 Computer Networking**

# **Assignment 1 (Individual)**

Due Date: 11-March-2022 (Week 6, Friday) 18:00

## **Expected Learning Outcomes**

- Grasp the key principles of data communications, the operation and protocols of computer networks.
- Analyze communication systems from the perspectives of communication architectures, transmission techniques, network organization, security, implementation techniques.
- Explore technical and practical issues of communicating data between computers over networks.

#### **Instructions**

- a) This assignment should be completed individually and neatly.
- b) Plagiarism will be penalized severely. Marks will be deducted for assignments that are plagiarized in whole or in part, regardless of the sources.
- c) Submit soft copy of your assignment via Moodle before the due date.
- d) Late submission is NOT accepted. You will get ZERO mark.
- e) Answer ALL questions. Correct your answer to 4 decimal places.
- f) You may assume 1K = 1000, 1M = 1000K and 1G = 1000M.
- g) Please state clearly your source of references.
- h) You can attach your reference materials.

#### **Submission**

#### Softcopy

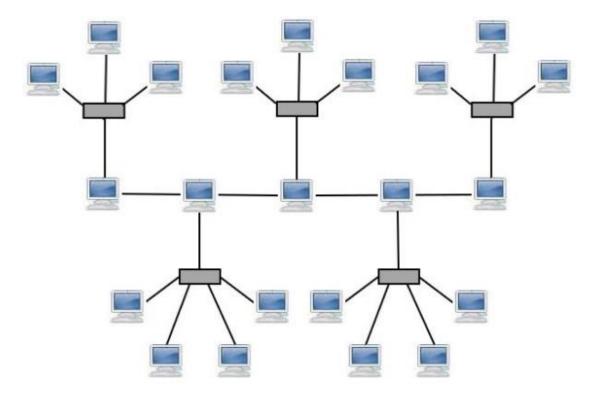
Save your work, or scan your handwritten work, into a **PDF file**. Use the file name *yourname\_StudentID.pdf* and submit it via Moodle.

# **Grading Aspects**

- Marks are given to the accuracy of both steps and answer. **Detailed steps** should be provided.
- No mark would be given if your work is not readable (especially for handwritten work) and/or the steps cannot be followed.

## **Question 1 (20%)**

(a) Describe the advantages and disadvantages of the TWO topologies used in the following hybrid network, and provide ONE real life example of using them: (12%)



- (b) Design a network of a company that consists of two offices in different physical locations: (8%)
  - Hong Kong office
    - (a) Customer Service department (2 x PCs)
    - (b) Marketing department (2 x laptops)
    - (c) Network printer for staff x 1
    - (d) Wifi network for customers only
  - US office
    - (a) Finance department (3 x PCs)
    - (b) Human Resource department (3 x PCs)
    - (c) Research and Development department (3 x laptops)
    - (d) Administration department (3 x PCs)
    - (e) Wifi network for staffs
    - (f) Internal server x 1
    - (g) Network printer for staff x 1

Indicate clearly the devices in the network (e.g. PC, server, router, switch, hub, etc.), and you should avoid single point of failure problem in your design. Justify your answer.

## **Question 2 (25%)**

Consider a composite signal with initial power 65W and has the following three components:

Amplitude: 12V, Frequency: 5 Hz, Phase: 0 degree
Amplitude: 5V, Frequency: 10 Hz, Phase: 60 degrees
Amplitude: 1V, Frequency: (35+x) Hz, Phase: 135 degrees

where x is the  $3^{rd}$  digit of your student ID number.

- (a) Plot the composite signal in frequency domain graph. (6%)
- (b) Plot the composite signal in time domain graph for 1 second. (7%) Hint: A sine wave can be represented as  $f(t) = A \sin(2\pi f t + \theta)$ .
- (c) If the signal travels through a medium with attenuation -3dB, what is the signal power at the receiver? (6%)
- (d) Suppose the signal lasts for 20 seconds and is digitized by PCM using 127 levels. What is the minimum size of the resulted digital data? Express your answers in bits. (6%)

# **Question 3 (25%)**

Consider that you are going to send the message "Hi!", where each character is encoded by 7-bit ASCII.

- (a) What is the bit stream of your message? (3%)
- (b) Suppose **two-dimensional odd-parity check** is used, with each character is considered as a block. Derive the bit stream to be transmitted. Show your steps. (8%)

Now, your friend replies a message "HA", where each character is encoded by <u>7-bit</u> **ASCII.** The message is protected by CRC using a polynomial below:

Check the **4**<sup>th</sup> **digit** of your student ID if it is odd or even, and use the corresponding CRC polynomial as divisor (see table 1).

Table 1

4 <sup>th</sup> digit of your student ID number	CRC polynomial
Odd	$X^4 + X^3 + 1$
Even	$X^4 + X^2$

- (c) Calculate the CRC. Show your steps. (8%)
- (d) What is the bit stream to be transmitted? (2%)
- (e) Can CRC be used for error correction in data transmission? Justify your answer. (4%)

### **Question 4 (30%)**

Suppose you send a 180 Mb file to your friend at 8 km away. The channel data rate is 50 Mbps and the propagation speed is 4 x  $10^8$  ms<sup>-1</sup>. Stop-and-Wait ARQ is used in the transmission. Each frame carries 1700 bits of data plus 32 bits of overhead (header + trailer). ACK frame has a fixed size of 60 bits. The queuing and processing delay along the path can be neglected.

Note: Use 1K = 1000, 1M = 1000K and 1G = 1000M.

- (a) How many data frames will be sent? What are the sizes of data frames (fully filled with data) and last data frame (partly filled with data)? (5%)
- (b) What is the time to confirm the first frame is correctly received by the receiver? (8%)
- (c) Continued from (b), how long does it take to complete the file transmission? (5%)
- (d) If any ACK frame is delayed, how the transmission can be resumed? (4%)
- (e) Assume there are 3 frames lost in every 200 frames sent, no frame lost if less than 200 frames sent, and the last frame is not lost. By using a timeout value of (10 \* x) millisecond (ms), where x is the  $4^{th}$  digit of your student ID number, for example, set x = 7 if the  $4^{th}$  digit is 7, set x = 10 if the  $4^{th}$  digit is 0. Calculate the total time required for the process to complete. (8%)

- End of Assignment -