Beijing-Dublin International College

SEMESTER 2 FINAL EXAMINATION - (2018/2019)

School of Computer Science

COMP2009J Computer Networks

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Time Allowed: 120 minutes

Instructions for Candidates:

All questions carry equal marks.
Answer all questions.

BJUT Student ID:_____ **UCD Student ID:**_____

I have read and clearly understand the Examination Rules of both Beijing University of Technology and University College Dublin. I am aware of the Punishment for Violating the Rules of Beijing University of Technology and/or University College Dublin. I hereby promise to abide by the relevant rules and regulations by not giving or receiving any help during the exam. If caught violating the rules, I accept the punishment thereof.

Honesty Pledge:_____ **(Signature)**

Instructions for Invigilators

Non-programmable calculators are permitted.
No rough-work paper is to be provided for candidates.

Question 1:

a. Most communication networks are organised as a stack of layered structures. How are the layers generally implemented? What are the advantages of using a layered stack?

(6%)

b. Explain the difference between Circuit Switching and Packet Switching. Which one of them is ideal for "bursty" communications and why?

(7%)

c. 500 nodes are connected to a 150 meter length of coaxial cable. Using some protocol, each node can transmit 50 packet/s, where each packet is 2000 bits long. The transmission rate at each node is 100 Mbit/s.

What is the total throughput? What is the efficiency of this protocol?

(7%)

d. The Internet enables computer devices to communicate worldwide by interconnecting a large number of autonomous networks. In your opinion, why is the Internet not made of a single Local Area Network (LAN)?

(5%)

(Question Total 25%)

Question 2:

a. Explain how digital modulation is achieved using both Non-Return to Zero (NRZ) and Non-Return to Zero Invert (NRZI).

Provide the digital modulation for 10001100_2 with each of them.

(6%)

b. Explain the single-bit parity error detection.

How many bit errors can the single-bit parity code detect and how many bits can it correct?

(6%)

c. In Carrier Sense Multiple Access/Collision Detection (CSMA/CD) a node must sense if the channel is busy before sending a message. In CSMA/CD describe with the aid of a diagram what a node will do if the channel is busy if it is:

- 1-Persistent CSMA/CD
- Non-Persistent CSMA/CD
- P-Persistent CSMA/CD

(7%)

d. Let's consider a communications channel with continuous frequencies between 21MHz and 24MHz:

- Use the Nyquist Limit to calculate the number of signal levels (V) that is required to achieve an intended bit rate R of 24 Mbit/s.

- Use Shannon limit for capacity to measure the Signal to Noise ratio (S/N) that would allow us to have a maximum information carrying rate of 15 Mbit/s.

Note that $\log_2(2^x) = x$

(6%)

(Question Total 25%)

Question 3:

a. How many IP addresses are contained in the network 192.168.1.0 if the used subnet mask is 255.255.255.252? How many valid Host IP addresses are contained in the same network?

(5%)

b. University College Dublin (UCD) created a new school with 3 departments D_1, D_2 and D_3 such that:

- Department D_1 has 60 machines
- Department D_2 has 120 machines
- Department D_3 has 30 machines

Knowing that the new school has been granted the IPv4 prefix address 137.43.1.0/24, assign a subnet to every department.

Let's assume that UCD wishes to create another department D_4 with 110 machines. Explain why it is not possible for UCD to accommodate department D_4 and briefly discuss a solution that could help UCD assign a subnet to each of its 4 departments.

(8%)

c. Consider that three LANs in UCD are connected to the Sisweb server as shown in Figure 1. For each router, the Name:IP_Address of every interface is provided.

Fill the routing tables for both routers R1 and R2 and aggregate route entries whenever possible. For each entry, report the following information: (1) Destination Network IP address, (2) NetMask, (3) Nexthop IP address, and (4) Interface.

(6%)

d. Consider a network composed of four devices as shown in Figure 2.

Provide the distance-vector routing table for each device at the initial phase (each device only knows the distance to itself and to its immediate neighbours).

Using the Distance Vector Algorithm, show the updates on the distance-vector routing tables until its convergence.

(6%)

(Question Total 25%)

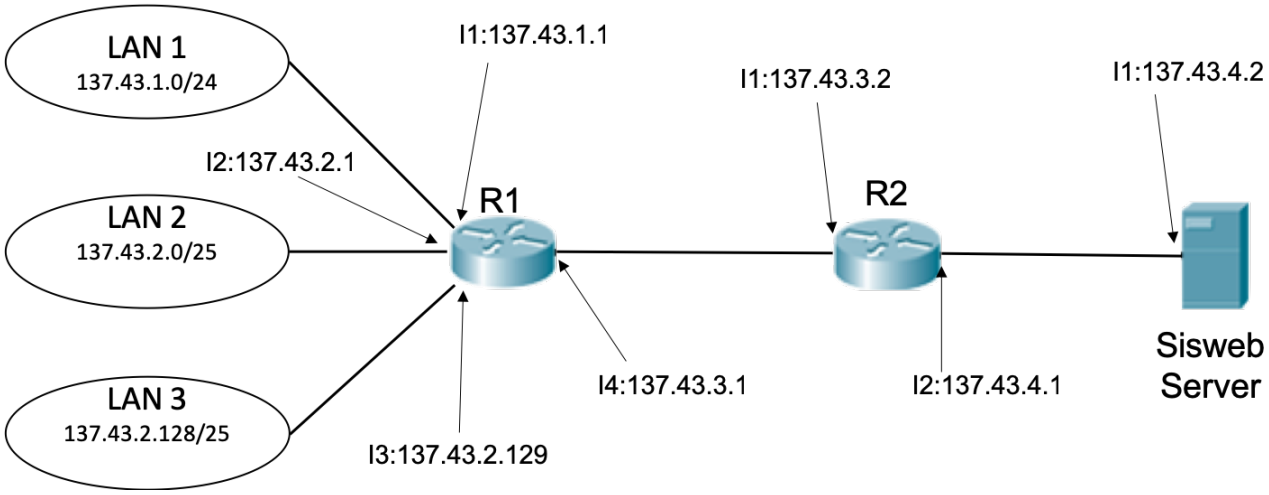

Figure 1: The network topology

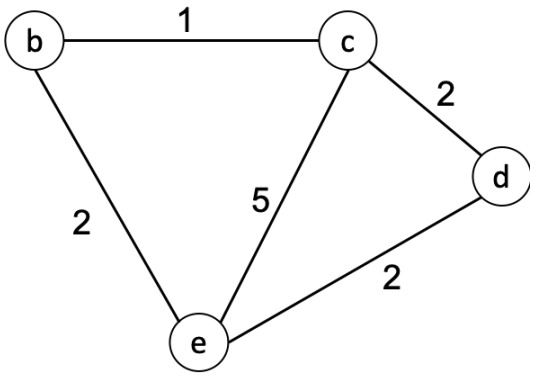

Figure 2: Network topology with distance between routers.

Question 4:

a. What are the main responsibilities of the Transmission Control Protocol (TCP)? Briefly explain the mechanisms that allow TCP to achieve them.

(7%)

b. While both TCP and Layer 2 use a windowing mechanism, TCP dynamically updates the window size. Why is it essential for TCP to dynamically update the window size?

What mechanism is used for this? Name two different algorithms that implement this mechanism and indicate how does each of them react in the event of a packet loss.

(8%)

c. What is the purpose of Domain Name System (DNS)?

Using a diagram, describe the mechanism of finding records in a recursive Domain Name Server.

(10%)

(Question Total 25%)

Total Marks (100%)