# Beijing-Dublin International College

**SEMESTER 2 FINAL EXAMINATION - (2017/2018)**

**School of Computer Science**

# COMP2001J Computer Networks

**Prof. Pádraig Cunningham**
**Dr. Seán Russell***
**Dr Shen Wang***

## 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. Computer networks are organised as a stack of layers. Explain how communication between two applications on different computers functions in this design. Draw a diagram to aid your explanation.

**(5%)**

b. List the layers in the TCP/IP communications model. Explain briefly the functions of each layer.

**(5%)**

c. Consider a 2400 Km optical fiber cable with a transmitter operating at 2 Gbps. The signal propagation speed in optical fiber is approximately 300 000 000 m/sec. The packets being sent are 1000 bits each. How many packets have been transmitted and are propagating over the connection when the first bit reaches the destination?

**(5%)**

d. Describe the difference between an Ethernet switch and an Ethernet hub. What are the advantages and disadvantages of each?

**(5%)**

e. In computer networks what is multiplexing? Briefly explain the frequency division multiplexing (FDM) and time division multiplexing (TDM).

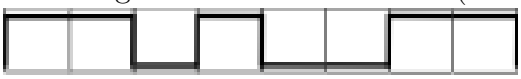
**(5%)**

**(Question Total 25%)**

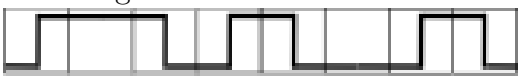
## Question 2:

a. For each of the following signals, calculate the binary number being transmitted.

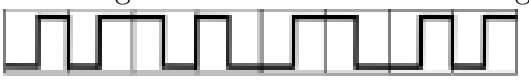
(a) Encoding is Non Return to Zero (NRZ)



(b) Encoding is Non Return to Zero Invert (NRZI)



(c) Encoding is Manchester with clock high to low



**(5%)**

b. Explain how a two dimensional parity check works. How many errors can it detect? How many errors can it correct? Correct the error in the following received data:
0 0 1 1 0 1 0 1
1 0 0 1 0 1 1 1
1 1 0 0 1 1 1 1
0 1 0 0 1 1 0 1

**(5%)**

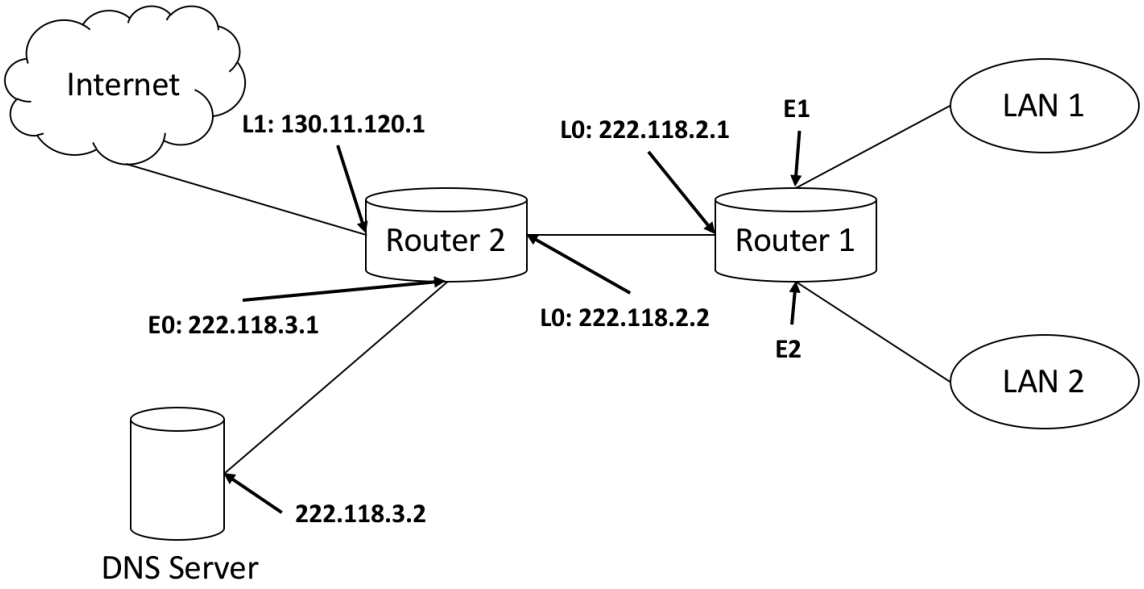



Figure 1: The network topology of a company.

c. With the aid of a diagram, explain the hidden node problem. How does CSMA/CA solve this problem?

**(5%)**

d. Explain how digital modulation is achieved using passband modulation. Briefly describe amplitude shift keying (ASK) and frequency shift keying (FSK).

**(5%)**

e. Why is flow control necessary in computer networks? Explain the stop and wait flow control scheme. Is stop and wait an efficient scheme? Why?

**(5%)**

**(Question Total 25%)**

## Question 3:

a. Briefly explain what are MAC address, IPv4 address, and Port numbers? How many bits are used to represent each? Explain how each can be used for addressing in the existing computer network layered stack?

**(6%)**

b. The available pool of IPv4 addresses have already been allocated, but IPv4 is still widely used now, explain why NAT can make this happen.
Although IPv6 supports a lot more addresses than IPv4, it is still not broadly configured. State how tunnelling technology keep both IPv4 and IPv6 working in the existing network.

**(4%)**

c. The network topology of a company is shown in Figure 1:

The structure of routing table for each router is as follows:

| Destination Network IP address | Subnet Mask | Nexthop IP address | Interface |
|---|---|---|---|

- Divide the IP address range 202.118.1.0/24 efficiently into 2 subnets for LAN 1 and LAN 2 respectively, the number of supported hosts in each LAN is 120. State your results for each LAN with your explanations and justifications.
- Determine the routing table for router 1. It should contain routing entry to LAN1, LAN2, DNS server, and Internet (IP address and mask all "0").
- Determine routing entries on router 2 to LAN1 and LAN2 using route aggregation.

**(10%)**

d. Referring to their key characteristics, compare two dynamic routing algorithms in computer network, distance vector and link state. Explain what is meant by "count-to-infinity" problem for distance vector algorithm and why it can be avoided in link state algorithm.

**(5%)**

**(Question Total 25%)**

## Question 4:

a. Draw a diagram to show the process of TCP 3-way handshake with the values of key flags, sequence number, and acknowledgement number. Also explain why 3-way handshake can establish a relatively more reliable connection.

**(5%)**

b. What is network congestion? Explain the role of receiving window in congestion control. What is silly window problem? How this problem can be solved?

**(5%)**

c. Figure 2 shows the evolution of the congestion window size in a TCP host. Suppose the maximum segment size is 1024 bytes, answer the following questions:

- What is the initial threshold for this TCP version? Why?
- Explain what type of packet loss happened at 13th RTT round?
- What is the updated threshold for 14th RTT round?
- What kind of TCP congestion control algorithm is used? Why?

**(6%)**

d. Let's find out what will happen when enter www.ucd.ie into your browser:

- Firstly, ARP is used to find your gateway MAC address, briefly explain this process.
- Then, DNS is used to find the IP address of www.ucd.ie, briefly explain this process.
- Finally, your computer can get desired information from the www.ucd.ie server using HTTP protocol. In this process, what type of HTTP request your PC sent to the server? What technology used in HTTP to implement stateful connection?

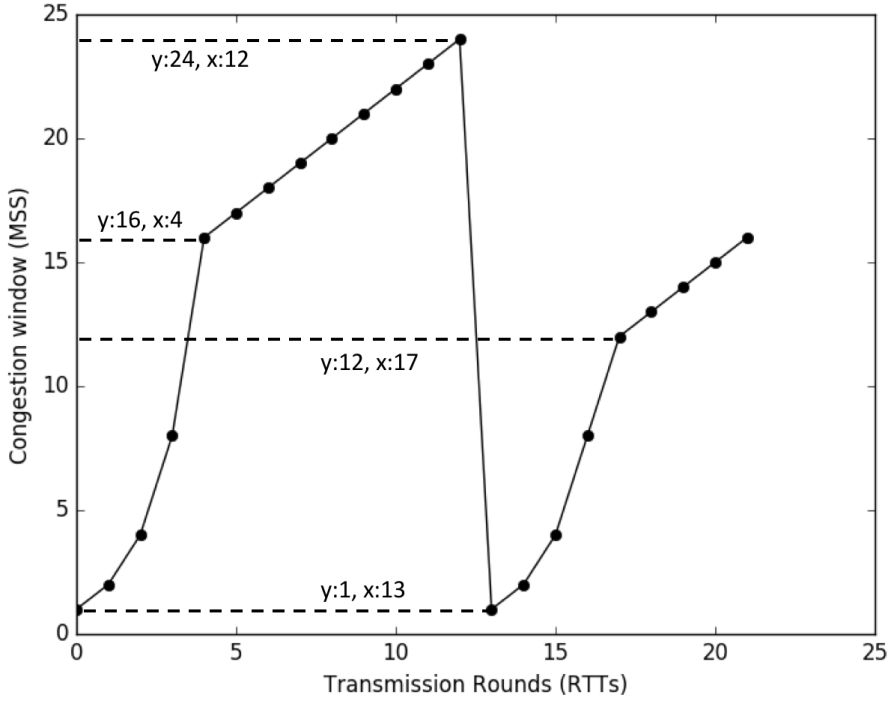



Figure 2: Congestion window evolution along a TCP transmission

- This is a typical Client/Server mode application, what are its main advantage and disadvantage compared with Peer-to-Peer mode?

**(9%)**

**(Question Total 25%)**

**Total Marks (100%)**