Coláiste na Tríonóide, Baile Átha Cliath
Trinity College Dublin
Ollscoil Átha Cliath | The University of Dublin

Faculty of Engineering, Mathematics & Science

School of Computer Science and Statistics

Integrated Computer Science Programme **Trinity Term 2018**
Year 2 Annual Examinations
BA (Mod) Computer Science and Business
Year 3 Annual Examinations

Telecommunications II

Tuesday 1st May 2018 **Sports Centre** **14.00-16.00**

Prof. Stefan Weber

Instructions to Candidates:
Answer 2 questions.
All questions carry equal marks (50 marks).
Answer each question in a separate answer book.
Exam paper is not to be removed from the venue

Materials permitted for this examination:
Calculator (non-programmable)

Question 1)

a) Connections using the Point-to-Point Protocol (PPP) follow the lifecycle shown in the state diagram in figure 1.

i) Describe the progress of a station through the lifecycle in your own words.

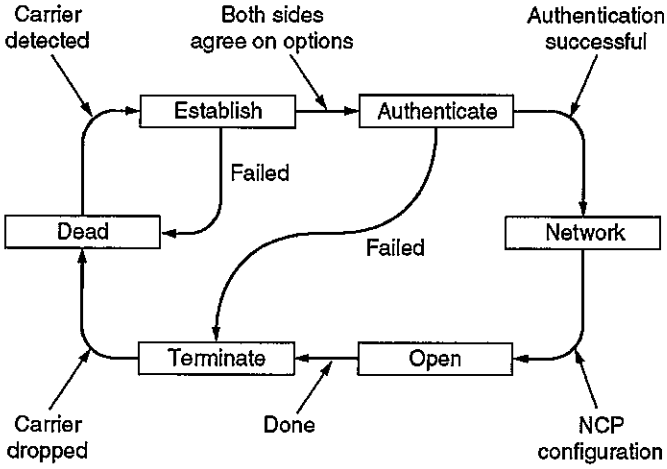

Figure 1: PPP State diagram

ii) Describe the frames that are being exchanged between two stations for every step in the lifecycle. Figure 2 provides the general layout of these frames and default values for some of the fields.

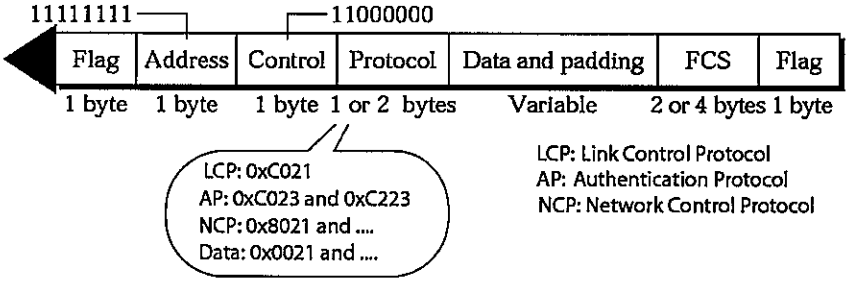

Figure 2: PPP Frame Layout

iii) Draw a diagram that demonstrates the chronological exchange of the frames that you have explained in your answer to ii).

[25 marks]

b) A variety of mechanisms are used in telecommunication to provide error detection.

i) Discuss the difference between Checksums and Hamming Code. As part of this discussions, explain the suitability of Checksums for IP headers and the suitability of Hamming Code for link layer bit-sequences.

ii) Demonstrate the use of a Checksum and of Hamming Code on the following bit-sequence "1011011 0101110 1000011".

iii) Discuss the difference of CRC to Checksums and Hamming Code and why CRC is suitable for the Ethernet frames while Checksums and Hamming Code would be less suitable in the context of Ethernet frames.

[25 marks]

[Total 50 marks]

Question 2)

a) Code Division Multiple Access (CDMA) and Carrier Sense Multiple Access (CSMA) with Collision Detection (CD) provide two mechanisms for medium access control.

i) Assume that CDMA is used in a network with three stations 1, 2 and 4, and a base station, station 3. The three mobile phones want to send the following bit sequences 011, 101 and 100 respectively; the base station is silent. A 0 is encoded as -1, a 1 is encoded as +1 and silence is represented by 0. Give the signals that the base station receives and discuss how the base station will decode these signals.

The chip sequences of the stations are as follows:
Station 1: +1 +1 -1 -1
Station 2: +1 -1 +1 -1
Station 3: +1 +1 +1 +1
Station 4: +1 -1 -1 +1

ii) Contrast the allocation of the medium using CDMA in i) against using CSMA/CD for a similar communication. Use diagrams to visualize the chronological exchange of the information in both cases.

iii) Discuss the effect of a large number of nodes competing for a medium using CSMA/CD and the effect that a binary exponential backoff as reaction to collisions.

[25 marks]

b) IEEE 802.11 defines two methods for medium access control, the Distributed Coordination Function (DCF) and the Point Coordination Function (PCF).

i) Assume that 6 laptops use 802.11 in two phases to communicate. In the first phase, an access point uses the Point Coordination Function (PCF) to coordinate the communication between the laptops. In the second phase, the laptops can communicate directly with each other using the Distributed Coordination Function (DCF). Describe the frames that will be exchanged in each phase by the laptops and the inter frame spaces that are involved in these exchanges. Use diagrams to visualise the chronological exchange of the frames and the inter-frame spaces that are involved in these exchanges.

ii) Explain the terms "hidden terminal problem" and "exposed terminal problem". The explanations should be accompanied by diagrams that visualise the terms.

[25 marks]
[Total 50 marks]

Question 3)

a) An Internet Service Provider (ISP) has bought the right to use the IP addresses in the range from 213.49.0.0 to 214.57.255.255. It uses Classless Inter-Domain Routing (CIDR) to route traffic to these addresses. It receives a number of requests from companies. First company A buys a block of 14,000 addresses, then company B requests 6,000, followed by company C with 850 addresses and company D requests 350 addresses. The ISP processes these requests in the order it receives them.

i) What is the address range allocated for each client? Give the first and last address of the range, the number of significant bits and the subnet mask.

ii) If CIDR wasn't used, what classes of network addresses would be allocated to each client? How many addresses would be allocated in total? What would be the fraction of addresses actually used by each client? Compare this to the use of CIDR.

iii) Describe a structured approach to the allocation of IP addresses that the ISP could employ in comparison to allocating IP addresses from the available address range as request arrive.

[25 marks]

b) Link State Routing is a widely used routing concept for routing within Autonomous Systems.

i) Describe the process that router C in figure 3 will follow in order to establish a routing table using Link State Routing and the information that this router will exchange with other nodes in the topology in figure 3.

ii) Describe Dijkstra's Shortest Path algorithm in your own words and demonstrate it with the help of the topology in figure 3 for router C.

iii) Discuss the differences between Distance Vector Routing and Link State Routing.

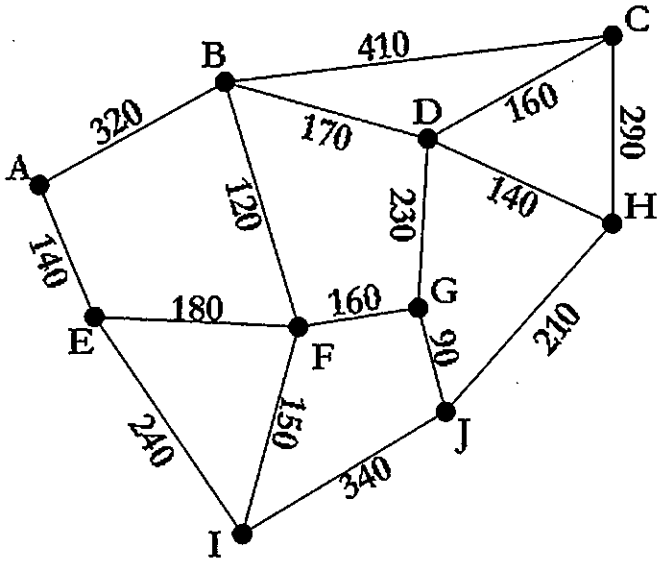

Figure 3: Topology with nodes and weights on connections

[25 marks]

[Total 50 marks]