



**EXAMINATIONS — 2007**  
**MID-YEAR**

**COMP306**  
**COMPUTER NETWORKS**

**Time allowed:** THREE HOURS

**Instructions:** The examination contains 5 questions, you must answer all questions

Question 1 is worth 40 marks

The other four questions are worth 30 marks each.

The exam consists of 160 marks in total.

The number of marks assigned to each part of a question are shown.

Paper foreign to English language dictionaries are allowed.

Electronic dictionaries and programmable calculators are not allowed.

## Question 1 Assorted Short Questions

[40 marks]

- (a) [2 Marks] What is a network “protocol”?
- (b) [3 marks] Show, in the correct order, the layers of the TCP/IP protocol stack that are implemented on the following network components:
- i. End System (host)
  - ii. Router
  - iii Switch
- (c) [4 marks] State the primary differences between the link-state and distance vector routing algorithms.
- (d) [5 Marks] Briefly explain how the Domain Name Service (DNS) is implemented and how DNS queries are resolved in the DNS system.
- (e) [3 marks] What is ICMP and for what is it used? Give one example of its use.
- (f) [5 marks] Explain why datagram fragmentation is an issue in IPv4 and how it can be dealt with in the Internet?
- (g) [2 marks] Why is datagram fragmentation not an issue in IPv6? How is this achieved?
- (h) [6 marks] Describe how Network Address Translation (NAT) works. In your answer indicate the data structure required to maintain the mapping between the private (internal) IP addresses and the public IP address. You may illustrate the operation using a diagram.
- (i) [10 marks] Discuss the issues and solutions related to the interworking of IPv6 and IPv4 and how IPv6 can be transported over IPv4. You may illustrate the operation of the techniques using diagrams.

## Question 2 Security

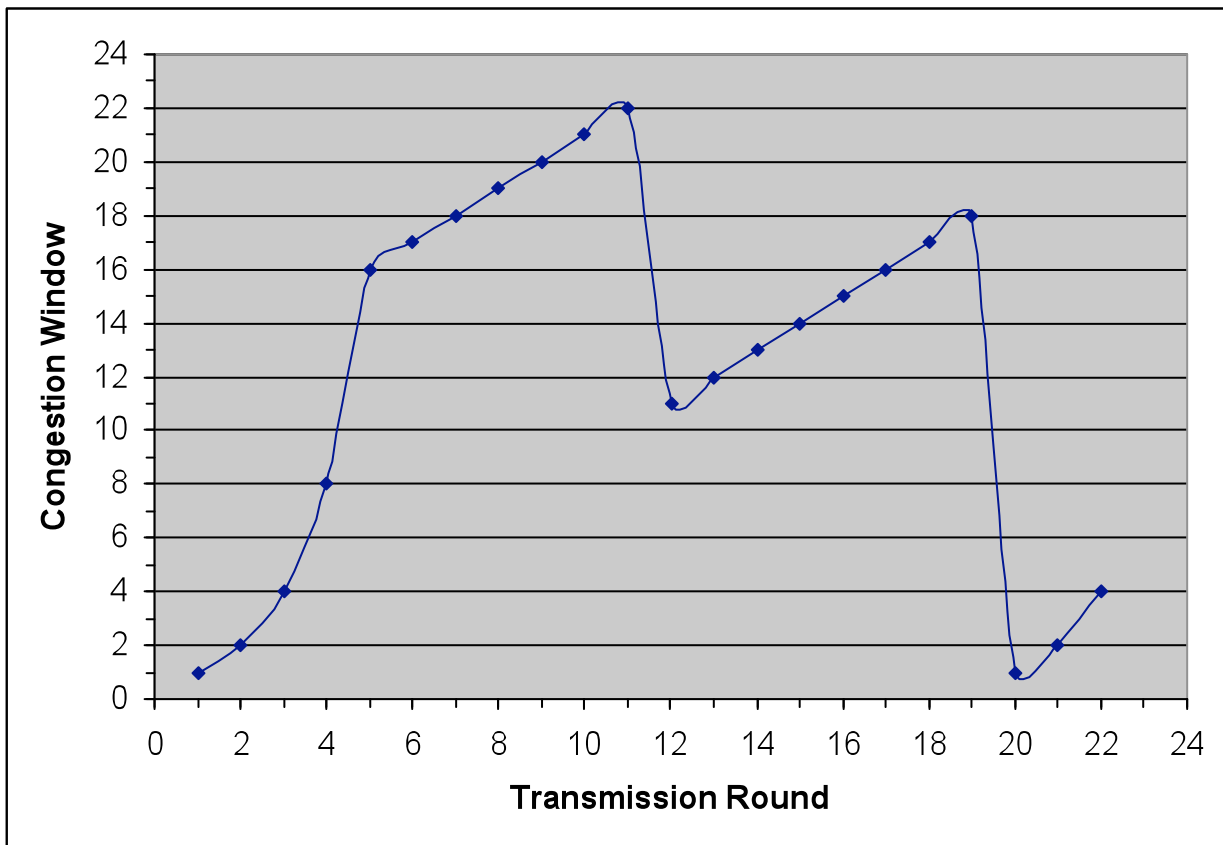
[30 marks]

- (a) [3 marks] Explain briefly what is meant by confidentiality, integrity and authentication.
- (b) [10 marks] Compare and contrast symmetric key cryptography (typified by the use of the DES algorithm), with public key cryptography (typified by the use of the RSA algorithm). In your answer you should list the major features of these approaches, but not discuss the details of DES or RSA.
- (c) There are a number of techniques that can be used to attack communicating entities during the authentication phase of a communication session. Using diagrams where appropriate, describe and discuss the following:
- i. [4 marks] A replay attack (also known as a playback attack).
  - ii. [8 marks] A man in the middle attack. In your answer, discuss whether the use of public key cryptography would overcome the attack.
  - iii. [5 marks] A reflection attack.

**Question 3 Transport Layer**

**[30 marks]**

- (a) [3 marks] What is the role of the transport layer in the five layer TCP/IP protocol stack?
- (b) [3 marks] Describe the functionality provided by the Transmission Control Protocol (TCP)
- (c) Consider the TCP connection mechanism.
  - i. [1 marks] What is the name of the mechanism used to set up a TCP connection?
  - ii. [2 marks] Why is this mechanism needed?
  - iii. [3 marks] Outline how the mechanism works.
- (d) [5 marks] What is flow control and how is it achieved in TCP?
- (e) [5 marks] What is congestion control and how is it achieved in TCP?
- (f) [8 marks] Consider the graph shown in Figure 1, which shows the TCP congestion window against transmission round for a TCP connection.



**Figure 1** Congestion window vs. Transmission Round

Determine how the key parameters associated with this TCP transmission sequence change from round 1 through to round 22, indicate in your answer what events have occurred. You should identify values of key variables and events by reference to their transmission round number.

**Question 4 Peer to Peer and the Application Layer**

**[30 marks]**

(a) [10 marks] Compare and contrast the application protocols SMTP and HTTP. You may illustrate the operation of these application protocols using diagrams.

(b) [14 marks] Compare and contrast the architecture of peer to peer applications, such as Napster, Gnutella, and KaZaA studied in the course. In your answer, discuss the mechanisms for managing the peer to peer network, locating content and how control and data transmission is accomplished. You may illustrate the operation of these applications using diagrams.

(c) [6 marks] Explain how Chord enables effective content location discovery in a peer-to-peer network. You may illustrate the operation using a diagram.

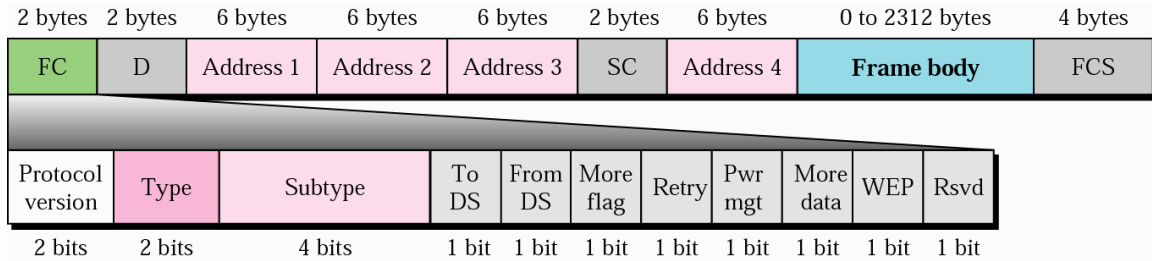
**Question 5 Wireless and Ad Hoc Routing**

**[30 marks]**

(a) [4 marks] What is the hidden station and exposed station problem in wireless networking?

(b) [6 marks] Describe the mechanism by which the wireless LAN protocol CSMA/CA is able to control the hidden station problem. You may illustrate the operation using a diagram.

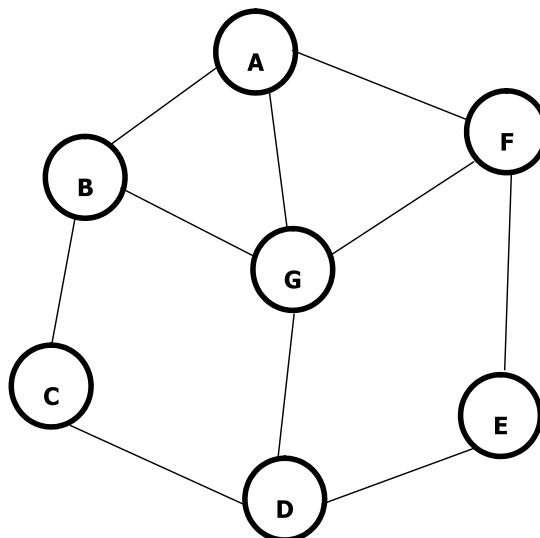
(c) [10 marks] The IEEE 802.11 frame format is shown in Figure 2, which shows the four address fields and the details of the frame control field. Explain why the 802.11 frame format requires four address fields. In your explanations identify the other two control fields that would be used in determining the use of the address fields. You may illustrate the operation using a diagram.



**Figure 2 IEEE 802.11 wireless LAN frame format**

(d) The ad hoc on-demand distance vector (AODV) protocol is used to route datagrams in ad hoc networks. For the topology given in Figure 3 determine the following, using diagrams as required:

- i. [4 marks] The sequence of route request packets transmitted when creating a path from A to D (assume that the route to D is not known by the intermediate nodes).
- ii. [3 marks] The route reply that is delivered to A and the route table at A.
- iii. [3 marks] Briefly describe what will occur if node G ceases to operate.



**Figure 3 Wireless network topology**

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