

PRIFYSGOL ABERYSTWYTH - ABERYSTWYTH UNIVERSITY

DEGREE EXAMINATIONS 2011-2012 SEMESTER 1

FACULTY OF SCIENCE

Computer Science, CHM5720: The Internet And How It Really Works

Time allowed: 2 hours

Calculators are not allowed in this examination.

*Answer **THREE** from **FIVE** questions.*

All questions carry equal marks.

1. This question concerns the technology commonly referred to as WiFi and specified by the IEEE 802.11 family of standards.
 - a) The IEEE 802.11 standard defines a number of services that need to be provided by a wireless LAN to provide functionality equivalent to that which is inherent to wired LANs. Explain what is meant by each of the following major services:
 - (i) Association [2 marks]
 - (ii) Reassociation [2]
 - (iii) Disassociation [2]
 - (iv) Authentication [2]
 - b) The IEEE 802.11 wireless working group considered two types of media access control. *Distributed access* was one approach and *centralised access* the other.
 - (i) Outline the advantages and disadvantages of each type of media access control mentioned above. [4]
 - (ii) What solution was chosen for the IEEE 802.11 protocol and what are the advantages of this solution? Mention in your answer the role of the Point Coordination Function and the Distributed Coordination Function defined by IEEE 802.11. [5]
 - (iii) How might the solution described in your answer to part ii) help when a variety of types of traffic are to be transported over a wireless network? [4]
 - (iv) WiFi uses 2.4Ghz radio frequency (RF) transmission as the physical media and this leads to a number of significant problems that do not occur (or are less significant) in a wired network. Discuss the major issues associated with using RF media and provide a brief outline of the ways that IEEE 802.11 addresses them. [12]

2. You should answer this question with reference to your experience of the IEEE 802 technologies commonly referred to as Traditional (10Mbps) and Fast Ethernet (100Mbps).

a) Describe the function of each of the following networking devices:

- Repeater
- Hub
- Bridge
- Switch

[12]

b) Explain why it might be possible to improve the performance of a network by replacing a hub with a switch. [7]

c) What were the major physical level changes made to the traditional 10Mbps Ethernet to support fast (100Mbps) Ethernet, and what is meant by half duplex and full duplex transmission in this context. [7]

d) Explain the concept of a Virtual Local Area Network (VLAN) including a discussion of the networking device capabilities that make it possible and the benefits to be gained. [7]

3. This question is about the Transmission Control Protocol (TCP).

a) Describe with the aid of diagrams the TCP/IP connection establishment and connection tear down processes, and explain how the initial sequence number (ISN) is exchanged between two nodes in the connection establishment.

Label the diagrams with the TCP connection states at each stage. [12]

b) Describe, with the aid of diagrams, the sliding window flow control mechanism. What elements of the TCP header are used to support this mechanism? [9]

c) Describe, with the aid of a diagram, the slow start / congestion avoidance flow control mechanism, including fast retransmit and fast recovery as understood in TCP Reno. [10]

d) Why does TCP employ both these flow control mechanisms? [2]

4. This question is about the layered model of the TCP/IP Protocol Suite, IPv4 Address Exhaustion, IPv6 and Path MTU Discovery.
- a) The TCP/IP protocol is built up in layers.
 - (i) Briefly describe the layered model and the extent to which the layered model will help the transition from IPv4 to IPv6. [6]
 - (ii) How does the structure of IPv6 attempt to simplify routing decisions on the Internet over the method used by IPv4? [6]
 - (iii) Consider the Transport Layer and describe the benefits of TCP's connection oriented approach over UDP datagrams, explaining how this allows TCP to implement a reliable stream of data over an unreliable network layer. You should discuss the purpose of TCP acknowledgements in your answer. [6]
 - b) What is meant by packet fragmentation? Why is fragmentation best avoided? [5]
 - c) TCP avoids fragmentation by employing Path MTU Discovery. Describe how this process works. [6]
 - d) How do UDP applications usually avoid fragmentation? [4]

5. This question is about multicast IP and multicast IP Routing.

a) Briefly describe the overall concept of multicast IP and how it differs from both unicast IP and IP broadcasting. [6]

b) Within a single local area network, hosts and routers exchange information relating to multicast IP using the Internet Group Management Protocol (IGMP).

Explain how IGMP operates and include discussion of the changes between IGMPv1, IGMPv2 and IGMPv3. [9]

c) Within a large network containing multiple routers, the flow of multicast IP traffic is normally controlled using Protocol Independent Multicast - Sparse Mode (PIM-SM).

Briefly explain how PIM-SM operates and the crucial role of the items called Rendezvous Points (RP). [6]

d) Imagine you are managing a multicast enabled network containing five routers connected in a ring. The network uses PIM-SM. One router acts as an RP, two connect to Local Area Networks (LANs) and the final two each directly connect to servers that are the potential source of multicast traffic flows. The two LANs have large numbers of host computers which sometimes wish to receive certain multicast traffic.

(i) Produce an annotated diagram to show this network and the packet flow that will take place when one of the servers starts to source multicast traffic. [6]

(ii) Produce an annotated diagram to show this network and the packet flow that will take place when one of the hosts attached to the local area networks expresses a request to receive the multicast traffic which is available from one of the active servers. [6]