THE UNIVERSITY OF ADELAIDE
AUSTRALIA

Primary Examination, Semester 1, 2012

Computer Networks and Applications COMPSCI 3001,

Official Reading Time:	10 mins
Writing Time:	120 mins
Total Duration:	130 mins

Questions	Time	Marks
Answer all 6 questions	120 mins	120 marks 120 Total

Instructions

- Begin each answer on a new page in the answer book.
- Examination material must not be removed from the examination room.

Materials

- Calculator without alphanumeric memory or remote communications capability permitted.
- Foreign language paper dictionaries permitted.

DO NOT COMMENCE WRITING UNTIL INSTRUCTED TO DO SO

Application Layer

Question 1

(a) Consider how e-mail is sent in the Internet.

i. Why is it difficult to stop "spam" (unsolicited e-mails) by tracking down the sender (both the host/network they used and the sender themselves)?

[2 marks]

ii. Why do not SMTP servers just require all senders to be authenticated before accepting mail?

[3 marks]

(b) i. Explain the steps involved in translating the hostname (`www.google.com`) into the IP address of the Web server (`64.233.167.99`) using DNS (base your answer on an iterative query). Assume that initially there are no cached hostname/IP mappings available in the DNS related to this address. List all of the HTTP and DNS requests that will occur while retrieving this page.

[5 marks]

ii. Assume the IP address of the Web server is now cached at the client, so no network traffic relating to DNS is required in answering the following. Furthermore, assume the client is downloading an html resource containing three images each referring to a small image. Lastly, assume transmission times for each of the four Web resources is insignificant in comparison to the round-trip-time (RTT) between client and server. How many RTT's does it take after the IP address of the server has been cached at the client until when the html resource and all three images are received, in each of the following cases (be sure to explain how you arrive at your answer in each case):

- The browser and server are interacting using HTTP 1.0
- The browser and server are interacting using HTTP 1.1 without pipelining
- The browser and server are interacting using HTTP 1.1 with pipelining,

[6 marks]

(c) Calculate the *minimum* time needed to complete the distribution of a 10 Gigabit file to 10 hosts under the following conditions (you can assume negligible delays due to processing, queuing at routers and propagation for this question). Express all your answers in seconds.

i. A client server system with a server upload speed of 1 Gb/s and a client download speed of 20 Mb/s.

[4 marks]

ii. A peer to peer system where the entire file is initially at a seeder with an upload bandwidth of 100 Mb/sec and each peer has a download bandwidth of 20 Mb/s and an upload bandwidth of 1 Mb/sec. Assume that as soon as a part of a file is downloaded it is available for sharing with other peers.

[4 marks]

[Total for Question 1: 24 marks]

Transport Layer

Question 2

(a) Reliable transport protocols

i. Given the average round trip time measured over a period is 20 ms for a 1 Gb/s network connection, calculate the buffer space required in Mbits to ensure 80% link utilization of the network?

[4 marks]

ii. In your Go-Back-N sender implementation in the second practical you were recommended to use a sequence number space that is twice the window size. Why was this recommended for Go-Back-N?

[3 marks]

(b) Explain how demultiplexing differs between UDP and TCP (it may help to consider the use of sockets, to which messages are demultiplexed, in the case of UDP vs TCP).

[3 marks]

(c) Assuming a TCP protocol engine receives a segment with $< SYN = 1, ACK = 1, SEQNUM = 1234, ACKNUM = 5432 >$, explain what this segment means to the recipient and provide details of the previous segment sent by this recipient (be sure to include all relevant fields of the segment).

[4 marks]

(d) Figure 1 is a diagrammatical depiction of the headers for TCP in which a subset of the fields have been identified.

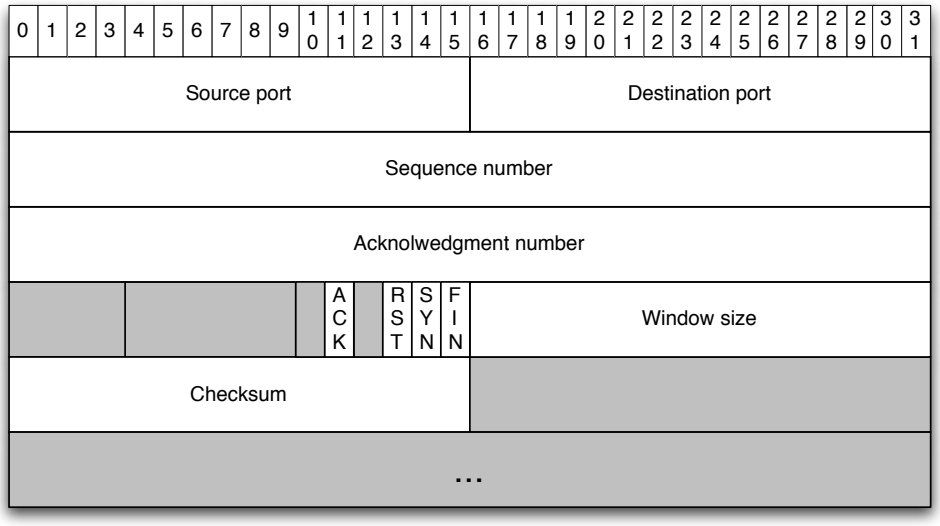


Figure 1: TCP headers.

In the case of TCP's provisioning of each of the following, identify all relevant fields from within the Figure and briefly explain their use:

i. Error detection,

[2 marks]

ii. Reliable data transmission,

[3 marks]

iii. Connection-oriented communication, and

[3 marks]

iv. Flow control.

[2 marks]

[Total for Question 2: 24 marks]

Question 3

Network Layer

(a) Consider the Internet Protocol.

i. Is the Internet Protocol a datagram or virtual circuit protocol?

[1 mark]

ii. What is the main limitation of the choice?

[2 marks]

(b) The following questions all refer to the IP address: 129.127.8.1/23

i. What is the binary representation of the host bits of this address?

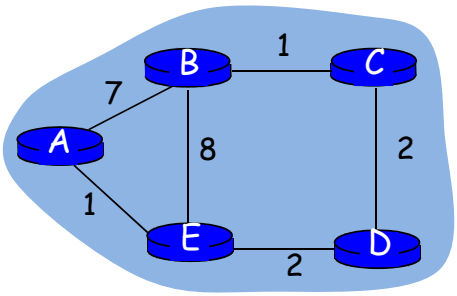
[2 marks]

ii. What is the network address of this IP address (in dotted notation or binary)?

[2 marks]

iii. How many hosts can you have in this network?

[2 marks]



$D^E()$

destination \ cost to destination via	A	B	D
A			
B			
C			
D			

Figure 2: Distance Vector Routing.

(c) Figure 2 is a diagrammatical depiction of a network of routers with link costs. Copy the table given in the figure and complete the distance table using the Distance Vector routing algorithm executed at node E. Finally indicate in a table the resulting routing table.

[10 marks]

(d) One problem with routing protocols is that they can be subject to route oscillations. Would this happen in a routing protocol that used number of hops as its cost metric? Why or why not?

[5 marks]

[Total for Question 3: 24 marks]

Question 4

Data Link Layer

(a) Ethernet efficiency is strongly influenced by the probability of collisions, as the time and network capacity spent sending a frame that collides is effectively wasted. With this in mind, state whether the following might increase or decrease efficiency and why.

1. reducing the maximum distance between hosts in the network
2. increasing the bandwidth (assuming the maximum frame size is not changed).

[6 marks]

(b) Explain why the Cyclic Redundancy Check is commonly used at Layer 2.

[2 marks]

(c) Evaluate the CRC bits for the following:

- message (16 bits): 1001 0110 1001 1110
- generator: 1101

and write down the message transmitted by the sender as well as the error detecting capability of this CRC.

[7 marks]

(d) What is the role of the Address Resolution Protocol (ARP)? Briefly explain how ARP works.

[6 marks]

(e) Give four advantages of MPLS when compared to ATM?

[4 marks]

[Total for Question 4: 25 marks]

Security

Question 5

(a) What is the "key distribution problem". How can we solve this problem in an insecure communication network?

[5 marks]

(b) The following scenario applies to this question. There are two correspondants, Bob and Alice, who are using a computer network to communicate. There is a third party, Trudy, who would like to disrupt their communications, or at the very least be able to copy their communications. Both Bob and Alice have X.509 certificates and a large collection of cryptographic software written in Java that runs on their low power (as in low *performance*) mobile phone handsets.

i. Alice has tried to send Bob messages in the past by using Bob's public key (from his certificate) and encrypting the message. Unfortunately, this is far too slow on her phone, and Bob is unable to tell if the message came from Alice. Alice is taking a Computer Networks course and has learnt that it is possible to send an un-encrypted message to Bob and have Bob be able to check that both: the message came from Alice and the message has not been tampered with. Explain what Alice must do, and what Bob must do to complete this message transfer.

[5 marks]

ii. Alice and Bob have been using the scheme from part (i) above for some time, and have discovered that Trudy has been recording messages from Alice and playing them to Bob at a later date. Bob is unable to tell that this is an already-received message that is being replayed. Assuming all Alice's messages to Bob are in response to a message he first sent, explain how Bob can ensure a response from Alice is not a replay.

[5 marks]

[Total for Question 5: 15 marks]

Other Topics

Question 6

(a) ICMP is used to communicate network layer information between routers and hosts. Explain how the traceroute program uses ICMP to trace the path taken by a packet over the network.

[5 marks]

(b) You want to use SNMP to detect when a link interface goes down or comes up. Would a request-response mode or a trap mode be appropriate for this? Explain your choice.

[3 marks]

[Total for Question 6: 8 marks]

End of exam