TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI

VICTORIA
UNIVERSITY OF WELLINGTON

EXAMINATIONS — 2005

END OF YEAR

COMP 306

DATA COMMUNICATIONS

Time Allowed: 3 Hours

Instructions: 100 marks in total.
There are five questions, each worth 20 marks.
Answer all questions.

Paper foreign to English language dictionaries are allowed.
Nonprogrammable calculators are permitted.

Electronic dictionaries and programmable calculators are not allowed.

Question 1. Warmup

(a) [2 marks] Identify the 4 components of the following URL:

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http://www.mcs.vuw.ac.nz:80/courses/COMP306/2005T2/
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(b) [2 marks] Indicate the layers of the TCP/IP protocol stack that are implemented on the following network entities:

   i. End System

  ii. Router

(c) [2 marks] Why do some applications use the UDP transport protocol.

(d) [2 marks] Why does the DNS have *zones*?

(e) [2 marks] Briefly outline the differences between: *request-response* and *messaging* communication architectures.

(f) [2 marks] What is the function of ICMP in the Internet? At what layer does ICMP reside in the protocol stack?

(g) [2 marks] If an IP packet of size 1500 bytes leaves a subnet with $MTU = 1500$ bytes through a router for a subnet with $MTU = 576$ bytes, how many fragments will be created and what will be the size of each packet? Assume the IP header has a fixed size of 20 bytes.

(h) [2 marks] List the key aspects of RTP (Real Time Protocol) that make it good for real time communications.

(i) [4 marks] The average TCP bandwidth B in bytes per second is given approximately by the following equation:

$$B = \frac{1.22 * MSS}{RTT * \sqrt{L}}$$

Where:

MSS = Maximum Segment Size
RTT = Round Trip Time
L = packet loss rate

For a TCP connection with mean RTT of 200ms, an MSS of 1024 bytes and a packet loss rate L of 0.05, what is the average bandwidth achieved by the TCP connection?

Question 2. Networks and Protocols [20 marks]

(a) [4 marks] What are headers used for in the TCP/IP protocol stack? Illustrate this use with an example of your choice.

(b) [4 marks] There are a variety of protocols used for email, including SMTP, POP3 and IMAP. Consider the simplest case with just SMTP and POP3 protocols. Describe how an email is passed through the network from the sender's user agent to the recipient's user agent.

(c) [6 marks] Socket Multiplexing

    i. In what situation are sockets multiplexed over ports.

    ii. Describe the process by which multiplexing of sockets over ports is achieved and state all of the information needed to perform the multiplexing.

(d) [6 marks] Write C-style pseudo code for a short client application that connects to a server, writes a request and reads the reply. Do not worry about exact syntax, although you should make sure that your intention is clear.

Question 3. Authentication [20 marks]

(a) [5 marks] Authentication Attacks

There are a number of techniques that can be used to attack communicating entities during the authentication phase. Using diagrams describe:

    i. A *replay* attack.

    ii. A *reflection* attack.

    iii. A *man in the middle* attack.

(b) [10 marks] Authentication Authorities

    i. Describe the process by which a Certification Authority (CA) authenticates communicating entities by giving a time ordered sequence diagram, that shows all messages exchanged between each of the communicating entities.

    ii. Describe the process by which a Key Distribution Centre (KDC) authenticates communicating entities by giving a time ordered sequence diagram, that shows all messages exchanged between each of the communicating entities.

(c) [5 marks] Authentication with Disconnection

State, with justification, which parties can continue to communicate during:

    i. Disconnection of the CA from the network.

    ii. Disconnection of the KDC from the network.

Question 4. Flow control and congestion control [20 marks]

(a) [6 marks] Briefly explain flow control and congestion control in TCP. Your answer should include a list of the key techniques used to provide flow control and congestion control in TCP.

(b) [4 marks] Briefly compare and contrast TCP congestion control with a network based congestion control mechanism.

(c) [6 marks] TCP is a very flexible protocol able to adapt to network conditions. Explain how timeout values are related to the RTT (Round Trip Time) measurements.

(d) [4 marks] If a TCP connection were to achieve a throughput of 1Gbytes per second with a MSS (Maximum Segment Size) of 1500 bytes and a 100ms RTT (Round Trip Time), what would need to be the required size of the Congestion Window? How would you determine whether a throughput of 1Gbytes per second is achievable in TCP?

Question 5. Routing and Mobility [20 marks]

(a) [5 marks] Briefly explain the need for hierarchical routing in the Internet? What are the main limitations of hierarchical routing in this context?

(b) [5 marks] The Border Gateway Protocol (BGP) is used as the Internet standard for inter domain routing:

    i. How are routing loops detected in BGP?

    ii. Briefly discuss *policy* in the context of BGP.

(c) [10 marks] Consider the two solutions to mobile forwarding of a mobile node: (i) indirect routing and (ii) direct routing. Identify the key components of the solutions. Compare and contrast the solutions identifying their strengths and weaknesses

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