

THE UNIVERSITY OF AUCKLAND

SECOND SEMESTER, 2011
Campus: City

COMPUTER SCIENCE

Modern Data Communications

(Time allowed: TWO hours)

NOTE:

- Attempt *all* questions. Calculators are NOT permitted.
- Write *short* answers in the space provided (extra space for answers is available on pages 13 and 14).
- No marks will be awarded if you merely state a “yes” or “no” answer. To obtain full credit, your script must clearly explain *why* your answer is correct.
- If you require additional information in order to answer a question, you should make a reasonable assumption as required for your answer, and you should explain your assumption on your script.

Surname: Forenames:

Student ID:

Departmental Use Only					
Question	Marks allocated	Marks gained	Question	Marks allocated	Marks gained
1	12		5	12	
2	12		6	12	
3	12		7	12	
4	14		8	14	
Sub-total	50		Sub-total	50	
-	-	-	Total	100	

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Student ID:

1. Coding and Transmission

[12 marks]

(a) Consider this simple code:

Symbol	A	B	C	D	E	F
Codeword	0	1	10	11	110	111

Is it a prefix code? Explain your answer.

[2 marks]

(b) Using the code in part (a), try to decode the string "11101110". What do you notice?
[4 marks](c) What is the difference between the *bandwidth* and the *bit rate* of a communications channel?
[2 marks]

(d) Given the bandwidth of a channel, what other quantity do you need to know to calculate the maximum theoretically possible bit rate? What units is this quantity measured in? [2 marks]

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Student ID:

- (e) Consider this statement: "NRZI or Manchester encoding allows one to exceed the Shannon limit for a channel." True or false? Briefly explain your answer. [2 marks]

2. Security

[12 marks]

- (a) Is Manchester encoding suitable for cryptography? Explain your answer. [2 marks]

- (b) If somebody tells you their public key, are they using symmetric cryptography? Explain your answer. [2 marks]

- (c) Alice says to Bob "I'll send you the password encrypted with my public RSA key." Does this make sense? Explain your answer. [2 marks]

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Student ID:

- (d) Suggest a better method for Alice to send the password to Bob. [2 marks]

- (e) Bank A wants to send a file of secret credit records safely to Bank B. The method is for A to encrypt the file and then upload it to a cloud computing server, where B can download it. Each bank has a private RSA key, and each publishes its own public key. The cloud computing server provides SSH login, but it's important that the credit records cannot be "stolen" from the cloud by any other bank.

Explain the main steps followed by each bank. Start by stating which key Bank A uses to encrypt the file. [4 marks]

Student ID:

3. Protocol layers

[12 marks]

(a) List three advantages of separating network protocols into layers.

[3 marks]

(b) The Open Systems Interconnection model includes layers called 'Session' and 'Presentation'. How does the Internet deal with those layers?

[2 marks]

(c) If you can observe the bits of a packet travelling along a wire, which bits will come first?

[2 marks]

(d) Assume you have stored a TCP packet in memory. If you do **not** have a convenient tool like Wireshark, what are the main steps you would use to find the TCP port numbers in the packet? (You are not expected to remember exact details of the packet format.)

[3 marks]

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- (e) In question (d), will the port numbers be in the same place for IPv4 and IPv6? Explain your answer. [2 marks]

4. Routing protocols

[14 marks]

- (a) The Internet uses distributed and dynamic routing protocols. Explain why it does not use static routes that are defined in a central office. [4 marks]

- (b) Ordinary computers such as desktops and servers normally do not run a routing protocol. How do they route non-local packets? [2 marks]

- (c) How do these computers know whether a packet is local or non-local? [2 marks]

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- (d) List two differences between a Distance Vector (DV) routing protocol and a Link State (LS) routing protocol. [4 marks]

- (e) "OSPF is a Distance Vector EGP?" True or false? Explain your answer. [2 marks]

5. Finding IP host information [12 marks]

When starting up, a host must find out information about itself and the network it is connected to; it does that using the Dynamic Host Configuration Protocol, DHCP, and Address Resolution Protocol, ARP.

- (a) When an IP host boots up, what four things does it need to know? [2 marks]

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- (b) Explain briefly how a rebooting host finds the above information. [3 marks]

- (c) How would a host get other information (e.g. its Time Zone) from its DHCP server? [2 marks]

- (d) How can a host find a hardware address for another host on the same LAN? [2 marks]

- (e) What would it mean if a host gets two different replies to an ARP request? What should a host do if that happens? [3 marks]

Student ID:

6. Transport Control Protocol (TCP)

[12 marks]

TCP uses 32-bit unsigned sequence numbers to keep track of the bytes sent and received between the two hosts (*initiator* and *listener*) of a TCP connection.

- (a) Explain briefly how the two hosts find out each other's starting sequence numbers. [2 marks]

- (b) How is a TCP host's sequence number updated during the life of a TCP connection? [2 marks]

- (c) How does a TCP host know when it needs to resend some bytes?

[2 marks]

- (d) What is the TCP header's checksum field used for? How is that checksum calculated?

[3 marks]

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Student ID:

- (e) When and how is the TCP checksum verified? What should a host do if it receives a TCP packet with an incorrect checksum? [3 marks]

7. World Wide Web: Markup Languages and HTTP [12 marks]

Markup languages provide a way to describe elements within a document, so that software (e.g. a web browser) may display that document.

- (a) What is a Document Type Definition? What should an XML parser do with an XML file that doesn't cite a specific DTD? [2 marks]

- (b) What are *hyperlinks*? How are they expressed in HTML? [2 marks]

- (c) How does a browser request a web page using HTTP? What does the browser need to do to display a page that contains images? [3 marks]

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- (d) What advantages does a browser obtain by caching web content? How long should objects remain in a web cache? [2 marks]

- (e) What protection does a URL beginning with *https:* provide? Is the use of *https:* sufficient to provide secure browsing? [3 marks]

8. **Skype: Peer-To-Peer Voice-over-IP telephony** [14 marks]
A Peer-To-Peer network is one with many participating nodes, most of which have similar roles.

- (a) What are the three types of host used by Skype? Your answer should say what each is used for. [6 marks]

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- (b) What service does Skype's *global indexing* system provide? Comment on how this service provides resilience to the Skype system. [3 marks]

- (c) How does Skype transport a conversation between two nodes when both have globally routable IP addresses? In what way does that change when one of the nodes does not have a globally routable IP address? [3 marks]

- (d) What is meant by a Peer-To-Peer *application*? Is Skype purely a Peer-To-Peer application? Explain your answer. [2 marks]

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Student ID:

SPARE PAGE FOR EXTRA ANSWERS

Cross out rough working that you do not want marked.
Specify the question number for work that you do want marked.

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