

THE UNIVERSITY OF AUCKLAND

SECOND SEMESTER, 2010
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 page 16).
- 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	8		7	10	
2	4		8	10	
3	8		9	10	
4	10		10	10	
5	10		11	10	
6	10				
Total	50		Total	100	

Student ID:

1. Security

[8 marks]

The following questions refer to the series of three messages (M1, M2, M3) described below.

In this protocol, a , b , and c are public keys for Alice, Bob, and Charles (respectively), with private keys a' , b' , and c' . E is a public-key encryption function, and D is the corresponding decryption function. t_a is a timestamp.

M1. Alice \rightarrow Bob: $E_b(\text{"Hi Bob, please deduct \$10 from my account and send it to Charles } c.\text{"}, a, t_a)$

M2. Bob \rightarrow Alice: $E_a(\text{"Hi Alice, no worries, I have sent \$10 to Charles } c.\text{"}, b, t_a)$

M3. Alice \rightarrow Bob: $E_b(\text{"Thanks!"}, a, t_a)$

- (a) If Eve is able to intercept messages, will she know that Alice has asked Bob to send \$10 to Charles? Explain briefly. [4 marks]

- (b) If Eve is able to fabricate messages, will she be able to persuade Bob to send her some money from Alice's account? Explain briefly. [4 marks]

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Student ID:

2. Shannon limit

[4 marks]

Digital satellite TV in New Zealand is transmitted on a channel with bandwidth of approximately 30 MHz. If the signal to noise ratio is about 6 dB, what is the Shannon limit on the data rate for this channel? Show your work. [4 marks]

3. Coding

[8 marks]

The following questions refer to the following code.

0		01100
1		11000
2		10100
3		10010
4		01010
5		00110
6		10001
7		01001
8		00101
9		00011

- (a) What is the Hamming distance between the code for '0' and the code for '1'? Show your work. [4 marks]

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Student ID:

- (b) Does this code have any error-detecting or error-correcting properties? Explain briefly. [4 marks]

4. Protocol Layers

[10 marks]

- (a) What is the purpose of splitting protocols into separate layers?

[2 marks]

- (b) Give two examples of one protocol making use of another one. In each case, say which one is in the higher layer. [2 marks]

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Student ID:

(c) Are hardware addresses used by the transport layer? Explain your answer. [2 marks]

(d) Briefly describe how protocol layers can be observed in packet traces obtained with Wireshark. [4 marks]

5. Transmission [10 marks]

(a) What is the difference between serial and parallel transmission of data? [2 marks]

Student ID:

(b) Why is serial transmission normally used for long distance links? [2 marks]

(c) What is the difference between synchronous and asynchronous transmission? [2 marks]

(d) What is the simplest technique that can be used if several synchronous data links, all running at the same bit rate, need to be combined on a single long distance link with a greater bit rate, to save money? [2 marks]

(e) What would be a better technique if the links were asynchronous and each was running at a different bit rate? [2 marks]

Student ID:

6. Flow Control

[10 marks]

(a) What is the main reason why flow control is needed on a data link?

[2 marks]

(b) Why is a simple stop-and-wait flow control sometimes very inefficient?

[2 marks]

(c) What is the purpose of the 'window' in a sliding window protocol? When does it 'slide'?

[2 marks]

(d) In a 'go-back-N' sliding window protocol, what causes a 'go-back' event?

[2 marks]

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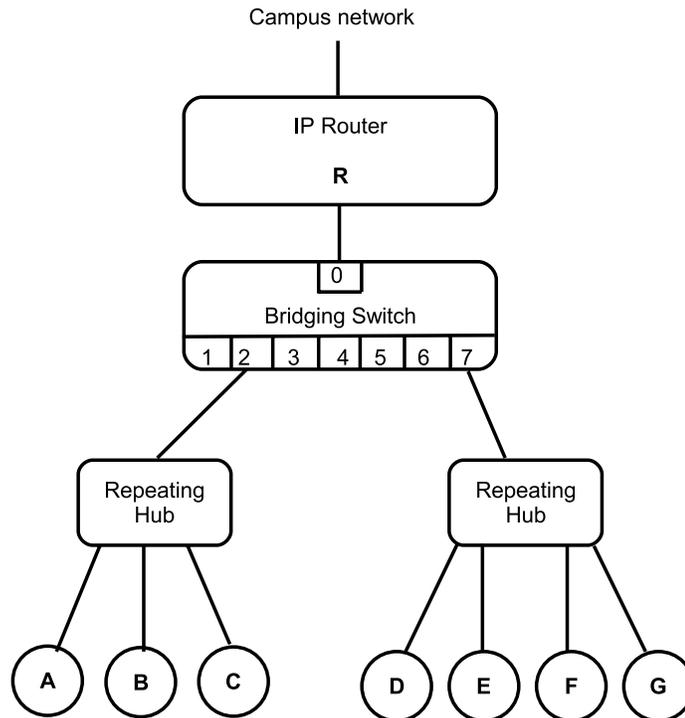
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- (e) In a 'go-back-N' sliding window protocol, what aspect of the protocol sets the value of N? [2 marks]

7. Switching and Routing

[10 marks]

Consider the network in the figure. Assume that all the links are Ethernet over UTP twisted pair cable. A, B,...G are the MAC addresses of various computers, and R is the MAC address of the IP router. The ports of the switch are numbered from 0 to 7.



The switch needs to contain a routing table showing which MAC addresses are reached from which port number, with entries like

$R \rightarrow 0$

$C \rightarrow 2$

$F \rightarrow 7$

etc.

Initially this table is empty.

Student ID:

- (a) If A sends a packet to B and then A sends a packet to G, what will be added to the routing table in the switch? Use the format $x \rightarrow y$. [2 marks]

- (b) When complete, the table will contain the entry
 $G \rightarrow 7$
What will cause the switch to add this entry? [2 marks]

- (c) Does the switch need to run the spanning tree algorithm? Explain your answer. [2 marks]

- (d) Do the computers A, B, C etc. need to know the MAC address R? If so, why? [2 marks]

Student ID:

- (e) Does the routing table in the *IP router* contain port numbers 0 to 7 or the MAC addresses A, B, C, etc.? Explain your answer. [2 marks]

8. IP Addresses

[10 marks]

- (a) How does an IP address differ from a MAC address? What is the main difference between IPv4 and IPv6 addresses? [2 marks]

- (b) What are the two component parts of an IP address? What is each of those parts used for? [2 marks]

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Student ID:

- (c) What is meant by 'Private' IP Addresses? Describe briefly how 'Private' addresses might be used in a small network. [3 marks]

- (d) What would happen if a host in a distant network sent packets over the Internet to the private IP address of one of the hosts in your small network? How could an Internet Service Provider prevent such packets being sent out of their network? [3 marks]

9. Finding Addresses

[10 marks]

- (a) What is the ARP protocol used for? [2 marks]

- (b) How are ARP packets carried over a network? [2 marks]

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Student ID:

- (c) A host stores ARP responses in its ARP Cache. How is an ARP Cache maintained, i.e. how does a host decide when an entry should be timed out? [3 marks]

- (d) What would it mean if we received two different responses to a single ARP request? What should we do if that happens? [3 marks]

Student ID:

10. Transport Protocols

[10 marks]

The most common IP Transport Protocols are (a) TCP and (b) UDP. Compare and contrast them by writing some brief notes about each, considering

- What kind of service does it provide for the data?
- Does it respond to network congestion or packet loss?
- How much overhead does it incur for short transactions?
- Give two examples of common applications that use it.

(a) TCP

[4 marks]

(b) UDP

[4 marks]

(c) How does TCP compute the checksum in a TCP packet?

[2 marks]

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Student ID:

11. Hypertext Transfer Protocol (HTTP)

[10 marks]

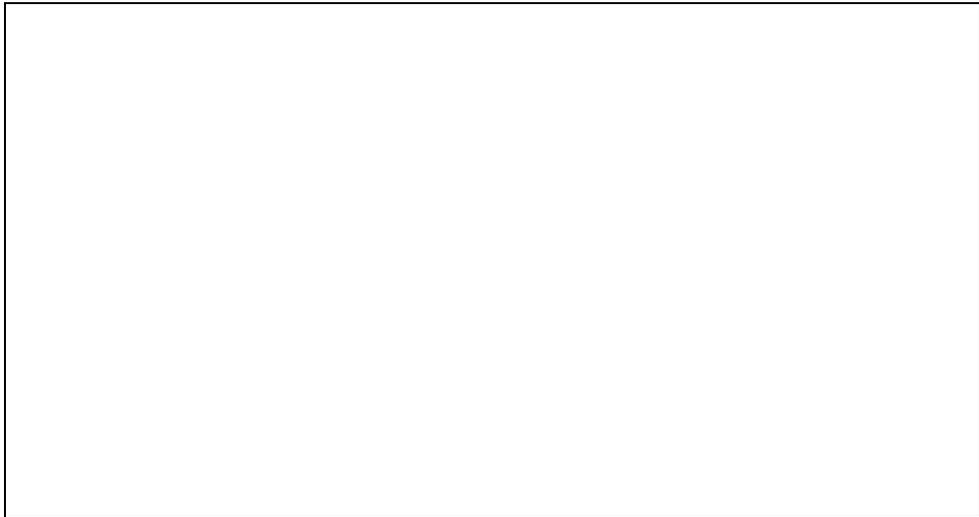
- (a) What is a URL? Give an example of a URL, and explain the purpose of its various component parts. [2 marks]

- (b) How are hyperlinks written in HTML? What must a browser do when it encounters a hyperlink in a page? [3 marks]

- (c) HTML and XML can both be used to create web pages. Why must XML web pages be syntactically correct and conform to their specified DTD? Is this also true for HTML web pages? Explain your answer. [3 marks]

Student ID:

- (d) What is an HTTP Proxy? Draw a simple diagram showing how a user would connect to a client via an HTTP proxy. Why might a large company network want to use an HTTP Proxy?
[2 marks]



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.

