STUDENT'S SURNAME: .....

OTHER NAMES: .....

STUDENT ID: .....

This question paper must be returned.
Candidates are not permitted to remove
any part of it from the examination room.

Macquarie University

MID-YEAR EXAMINATION 2002

Unit:	**Comp341 and Comp831 – Computer Networks**
Date:	July 2, 2002 at 9:20 am
Time Allowed:	THREE (3) hours, plus 10 minutes reading time.
Number of Questions:	EIGHTEEN (18)
Total Marks:	180
Instructions:	Answer ALL questions.
	The questions are *not* of equal value.
	Use separate books for each part.
	Indicate the section clearly on the outside of each book.
	Write your name and student number clearly on each book.
	Calculators are not permitted.
	The marks allocated to a question are written next to the question.
	If you wish to spread your time evenly, you should spend approximately one minute for each mark.

.

PART A (Use a separate book)

The following formulas may be useful in this examination:

Nyquists's formula: $R = 2H \log_2 V$

Shannon's formula: $C = H \log_2 (1 + S/N)$

$SNR_{dB} = 10 \log_{10} S/N$

1. [20 marks]

Multiple choice. Each question is worth 1 mark for a correct answer, negative ¼ mark for an incorrect answer and 0 for a question that is not attempted. For each question, choose the most appropriate answer and write it in your answer book.. If you believe that options A-D are inappropriate, choose option E and provide your own answer.

(a) A connectionless network-layer protocol:

A. Transmits frames over an EtherNet LAN.
B. Transmits packets that are independently routed through a network.
C. Transmits frames ensuring that they arrive in correct sequence at the other end.
D. Transmits packets ensuring that they arrive in the correct sequence at the other end.
E. None of the above – the correct answer is…

(b) Which of the following is **NOT** an Internet protocol:

A. IP
B. TCP
C. DNS
D. ATM
E. All of the above are Internet protocols.

(c) An example of an application protocol is:

A. ATM
B. IP
C. SMTP
D. UDP
E. None of the above – the correct answer is…

(d) A file transfer application protocol has the following characteristics:

A. It can tolerate data loss and requires a minimum of 10Kbps data rate.
B. It cannot tolerate data loss and requires a minimum of 10Kbps data rate.
C. It can tolerate data loss and requires response times within a few seconds.
D. It cannot tolerate data loss and is not time sensitive.
E. None of the above – the correct answer is…

(e) When using the socket interface, a client program establishes a TCP connection to a server using the system call:

A. connect
B. listen
C. accept
D. socket
E. None of the above – the correct answer is…

(f) When using the socket interface, a server program waits for a connection request from a client using the system call:

A. connect
B. listen
C. accept
D. socket
E. None of the above – the correct answer is…

(g) The telnet protocol defines a new line as:

A. The ASCII linefeed character
B. The ASCII carriage-return character
C. The ASCII NUL character
D. The sequence ASCII carriage-return followed by NUL
E. None of the above – the correct answer is…

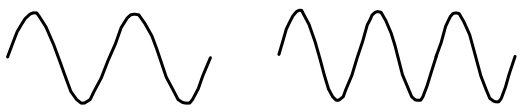
(h) The HTTP protocol:

A. Is stateless but allows the client to access server state through cookies.
B. Has state and supports both persistent and non-persistent connections.
C. Is stateless and requires the client to reconnect for each transfer.
D. Has state and requires the client to remain connected for the duration of a session.
E. None of the above – the correct answer is…

(i) A Web cache (proxy server):

A. Stores the IP addresses of Web hosts that you have accessed recently.
B. Stores copies of recently accessed Web pages for the local area network.
C. Stores copies of Web pages recently accessed by a single user.
D. Stores authorization credentials so that the user does not have to retype their password.
E. None of the above – the correct answer is…

(j) The following pair of periodic signals differ in:



A. Frequency
B. Amplitude
C. Phase
D. Amplitude and phase
E. None of the above – the correct answer is…

(k) A signal introduced on one wire due to the signal on another wire is called:
   A. Thermal noise
   B. Attenuation
   C. Delay distortion
   D. Crosstalk
   E. None of the above – the answer is…

(l) The cheapest suitable transmission medium for 100Mbps baseband signalling over 100m distance is:
   A. Category 3 UTP
   B. Category 5 UTP
   C. Category 7 SSTP
   D. Thin coaxial cable (RG58)
   E. None of the above – the answer is…

(m) GSM uses the following techniques:
   A. TDM and FDM
   B. FDM and WDM
   C. WDM and TDM
   D. TDM, WDM and FDM
   E. None of the above – the answer is…

(n) The 8-bit message 01101000 is received in a system that uses even parity to check transmissions. The receiver knows that:
   A. This message has been received correctly.
   B. The first bit of the message received is incorrect.
   C. The last bit of the message received is incorrect.
   D. An unknown bit of the message received is incorrect.
   E. None of the above – the answer is…

(o) A well designed 16-bit CRC can detect:
   A. All burst errors of at least 16 bits and all double bit errors.
   B. All burst errors of no more than 16 bits and all double bit errors.
   C. All burst errors of at least 16 bits but not all double bit errors.
   D. All burst errors of no more than 16 bits but not all double bit errors.
   E. None of the above – the answer is…

(p) The efficiency of a channel using stop-and-wait protocol **increases** if:
   A. The length of data frames is reduced.
   B. The round trip time is reduced.
   C. The data rate is increased.
   D. The channel bandwidth is increased.
   E. None of the above – the answer is…

(q) The token in IEEE 802.4 Token bus is:

A. A special data frame that circulates on the ring when the ring is idle.
B. A special bit pattern that circulates on the ring when the ring is idle.
C. Permission to transmit that is passed from one station to another in a logical ring.
D. A data frame that is periodically broadcast by a master station to allow other stations to transmit on the network.
E. None of the above – the answer is…

(r) A medium access protocol that can detect when another station is transmitting and wait until it is complete before attempting to transmit is called:

A. Aloha
B. Slotted Aloha
C. CSMA
D. A collision-free protocol
E. None of the above – the correct answer is…

(s) Aloha was first used for

A. Packet radio
B. Wired LAN
C. Satellite network
D. Internet
E. None of the above – the correct answer is…

(t) Consider a sliding window go-back-N protocol with an initial sender's window of [0,3] and frames numbered between 0 and 7. Suppose that, after a number of frames have been transmitted successfully, a frame does not arrive correctly. The sender transmits all the frames allowed by its window, then times out and starts retransmitting. The last acknowledgement received from the receiver was 6. What frames are retransmitted?

A. Frame 6 only
B. Frame 7 only
C. Frames 6, 7, and 0
D. Frames 6, 7, 0 and 1
E. None of the above – the correct answer is…

2. [6 marks]

Consider a communication cable with 10,000Hz bandwidth and SNR of 30dB.

(a) [2 marks] Suppose that the communication cable is to be used to transmit data with direct binary signalling. What is the maximum data carrying capacity of the cable? Show your working.

(b) [1 marks] Suppose that the cable is to be used to transmit data using Manchester coding. What is the maximum data capacity of the cable? Show your working.

(c) [1 marks] Suppose that the cable is to be used to transmit data using QAM with 4 bits per baud. What is the maximum data capacity of the cable? Show your working.

(d) [2 marks] Suppose that the cable is to be used to transmit data using sophisticated modulation techniques. What is the maximum possible data capacity of the cable? Show your working.

3. [10 marks]

Diagram 1 is a Petri Net representation of the stop-and-wait ARQ protocol. Suppose that, at a given point in time, the Petri Net has tokens on the states labelled "A0?", "A0" and "F0?".

(a) [1 mark] Briefly describe what it means that the Petri Net has a token on "A0?".

(b) [1 mark] Briefly describe what it means that the Petri Net has a token on "A0".

(c) [1 mark] Briefly describe what it means that the Petri Net has a token on "F0?".

(d) [1 mark] What action(s) are possible in this situation? List all possible actions.

(e) [2 marks] Assume that the sender emits frame 0, and that it is correctly received and the receiver emits the acknowledgement. List the actions that occur in the Petri Net, one by one, and after each action list the states that have tokens on them in the Petri Net.

(f) [1 mark] Suppose that the acknowledgement is lost in the network. What action represents this loss? What states have tokens on them after this action?

(g) [3 marks] What sequence of actions occurs for the protocol to recover from the loss of the acknowledgement? List the actions that occur until the sender has received and processed the acknowledgement and after each action list the states that have tokens on them

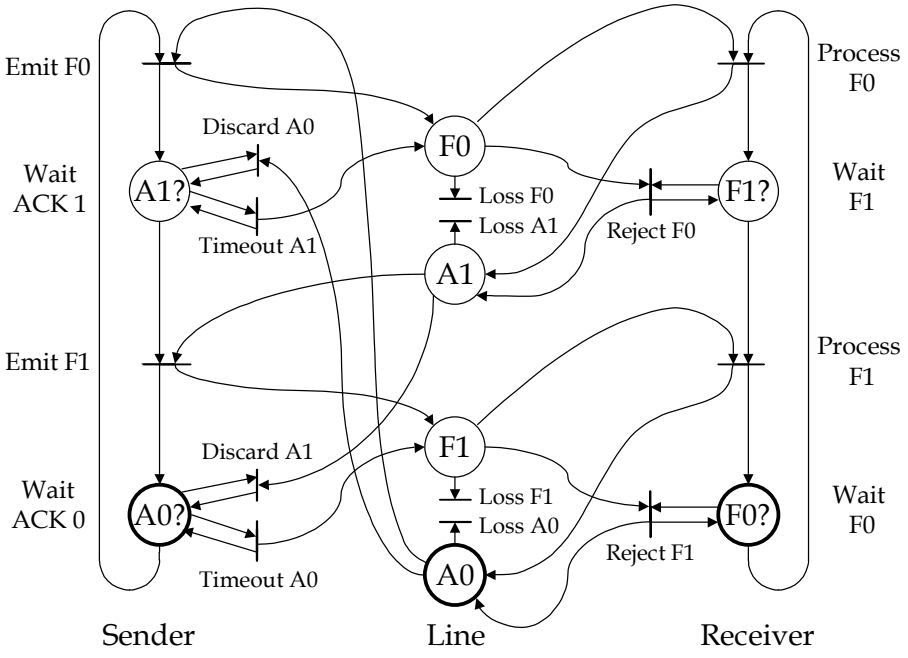
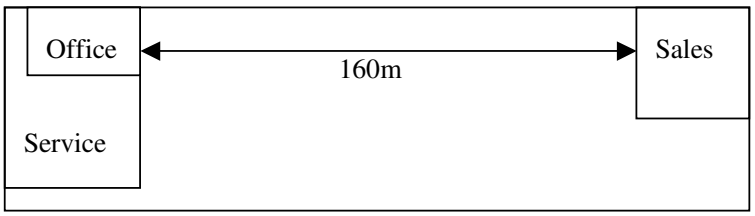


Diagram 1: Petri Net.

4. [12 marks]

A car sale yard runs a sales centre and a service centre. The sales centre has 5 PCs while the service centre has 10 PCs. Each centre has its own file server. Sales staff occasionally need to access service data and service staff occasionally need to access sales data, but most access is within the centre. Occasionally, service staff would like to access the InterNet to locate parts. The service centre occupies a workshop 30m by 10m with an office 3m by 5m in one corner. The sales centre is 160m away at the other end of the yard. It occupies an office 8m by 10m. A conduit is already available connecting the two buildings. Both centres are equipped with telephone service.

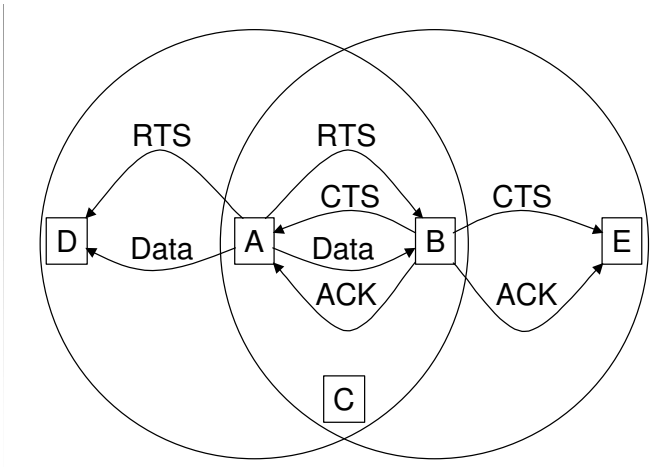
The following sketch is *not* to scale.



Suggest suitable network cabling and components, and design a network to meet the needs of this car sale yard. Sketch your network design and clearly label the components. Explain the reasons for your particular choices of cabling and components, and your design decisions.

5. [5 marks]

The following diagram represents transmission of a data frame in IEEE 802.11. In the diagram, station D hears RTS and the data frame while station E hears CTS and the acknowledgment frame. Briefly explain how stations D and E respond to the frames they hear and how RTS and CTS are used to help avoid collisions in IEEE 802.11.



6. [12 marks]

Design a protocol for a TCP/IP server application whose task is to provide system information to client processes. Your protocol should be stateless and use non-persistent connections. Clients may request the following types of information:

- CPU load statistic – server will return a CPU load percentage value.
- User count – server will return the number of users currently logged in to the machine.
- Login count – for a specified user name, the server will return the number of times that user has logged into the machine and whether or not they are currently logged in.
- Disk utilisation statistics – server will return the disk name(s) and disk usage data as disk capacity in bytes, disk bytes used, and percentage used values.

In your answer, describe clearly the interaction between the client and the server – the sequence of steps performed by each process and how they interact to perform the various tasks listed above. Also describe in some detail the syntax of messages that the client can send to the server and the server send to the client. Your descriptions should be detailed enough that a programmer who was skilled in writing TCP/IP applications could implement either the client or server process correctly. Consider also that the client and server may be running on different hardware and different operating systems.

7. [25 marks]

Write an essay discussing the social impact of the InterNet. In your answer, identify one or two areas where the InterNet has significantly impacted society. In your discussion, refer to views recently expressed in at least 2 articles in newspapers or popular/trade magazines. Critique the articles from a technical perspective based upon your understanding of computer networks.

Your answer should be approximately 3-4 pages in length.

PART B (Use a separate book)

8. [6 marks]

You have been assigned one class A address of 124.0.0.0 by the InterNIC. Your private internet currently has 5 subnets. Each subnet has approximately 500,000 hosts. In the near future, you'd like to divide the 5 subnets into 25 smaller, more manageable subnets. The number of hosts on the 25 new subnets could eventually increase to 300,000.

(a) How many bits did you use for the subnet mask?

(b) How much growth did you allow for additional subnets?

(c) How much growth did you allow for additional hosts?

9. [2 marks]

The university where you work has been allocated a class C address. It has six administrative offices, each on its own subnet and each requiring between 15 to 25 hosts. You create a subnet mask 255.255.255.240. How well does this solution address the problem? Choose an answer and explain your choice.

A. Meets the requirement and is an outstanding solution.
B. Meets the requirement and is an adequate solution.
C. Meets the requirement and is not a desirable solution.
D. Does not meet the requirement although it appears to work.
E. Does not meet the requirement and does not work

10. [6 marks]

An organization has a network ID 130.145.0.0. It decides to have six subnets and therefore uses a mask of 255.255.224.0. This results in six valid subnets.

One of the hosts H1 (IP: 135.140.32.1) in the subnet 135.140.32.0 has an invalid subnet mask of 255.255.0.0. Explain what would happen in each of the following cases?

(a) H1 sends a packet to host H2 (IP: 135.140.60.4).

(b) H1 sends a packet to host H4 (IP: 135.140.96.4).

(c) H1 sends a packet to a host in a remote network 200.10.10.0

11. [7 marks]

An organization has been assigned the network number 135.120.0.0/16 and it plans to deploy subnet masks of variable length. The requirement calls for dividing this base network into eight equal-sized address blocks (6 subnets). Then subnet #4 is to be divided into 4 equal-sized address blocks.

Note:

i. In your count of subnet ids include the all 0s and the all 1s subnet ids.

ii. **To determine subnet id X**: Determine subnet #0 and subnet #1. Increase the subnet ids in the increasing order in multiples of subnet #1 address till you reach all 1s subnet id.

(a) Specify the 8 subnets for 135.120.0.0/16.

(b) List some of the host addresses (identify the first three and the last three host addresses) that can be assigned to subnet #2.

(c) Identify the broadcast address for subnet #1.

(d) Specify the 4 subnets of subnet #4.

(e) Define the subnet mask at each level of subnetting.

(f) List some of the host addresses and the range of host addresses that can be assigned subnet #4-3. (Identify the first three and the last three host addresses)

(g) Identify the broadcast address for subnet #4-3. What do you observe?

12. [5 marks]

What do you understand by the term "proxy ARP"? Identify some scenarios where this technique can be deployed.

13. [8 marks]

Explain "the count to infinity" problem. Identify and describe some remedial solutions to fix this problem.

14. [6 marks]

(a) [4 marks] A TCP connection is in the ESTABLISHED state. The following events occur one after another:

i) The application sends a "close" message.

ii) A FIN segment is received.

What is the state of the connection after each event? What is the action after each event?

(b) [2 marks] Lost TCP acknowledgements do not necessarily force retransmissions. Why?

15. [6 marks]

A router has R1 has the following routing table:

Mask	Destination	Next Hop	Flag	Reference Count	Use	Interface
255.0.0.0	111.0.0.0		U	0	0	M0
255.255.255.224	193.14.5.160		U	0	0	M2
255.255.255.224	193.14.5.192		U	0	0	M1
255.255.255.0	192.16.7.1	111.20.18.14	UGH	0	0	M0
255.255.255.0	194.17.21.0	111.20.18.14	UG	0	0	M0

(a) The first three entries do not have the G flag set indicating the destination is local. How can we have three different destination addresses for the local network?

(b) The last two entries indicate that the destination addresses are not local. What is the fundamental difference between the two addresses specified?

(c) Suppose that the flag field "U" entry was not present for the first entry. What would this mean?

16. [12 marks]

(a) [3 marks] How does multicast routing differ from conventional routing techniques?

(b) [3 marks] Consider a network consisting of three hosts H1, H2, and H3. The network uses a multicast router R running IGMP version1. The list of currently active groups and the associated delay timers is as follows:

H1	Group A (timer t1)	Group B (timer t2)	Group C (timer t3)
H2		Group B(timer t4)	Group C (timer t5)
H3	Group A (timer t6)		

Note:

- $t1 < t6$
- $t4 < t2$
- $t3 < t5$.

Describe the sequence of responses that will occur in response to router R's query message.

(c) [2 marks] In IGMP, a host need not send a report when processes leave a group. Assuming the last process belonging to a group G decides to leave G. How does the router know that there are no members for G in the subnet? How does IGMP version 2 address this problem?

(d) [4 marks] How is the DVMRP forwarding table different from the DVMRP routing table? Why is there a need for these two different tables?

17. [5 marks]

Define the term "quality of service" (QoS). Highlight some of the advantages of differentiated services architecture over Integrated services model of QoS.

18. [27 marks]

(a) [8 marks] Explain the rationale for placing the security mechanisms between MAC and LLC layers to secure local area networks.

(b) [4 marks] What do you understand by the terms "link encryption" and "end-to-end encryption"? Describe the advantages and disadvantages of each of these approaches.

(c) [5 marks] Two users Alice and Bob wish to engage in a secure communication. The secure communication must take place via a trusted third party called a key distribution centre (KDC). Describe the sequence of steps that you need to follow to establish the secret session key between Alice and Bob with appropriate authentication. It is assumed that each user has a single unique key shared with the KDC. It is a requirement for authentication and session key management procedures to go through the KDC. Once you design this secure communication model, identify some attacks that can occur in this scheme.

(d) [10 marks] Both Alice and Bob have public-key capability. They have respectively obtained their own public key certificates from a trusted certificate authority. Alice now wants to send a message to Bob. Upon receiving the message, Bob knows that

(1) the message was definitely sent by Alice, and

(2) the message can be decrypted only by Alice and himself.

Describe the sequence of protocols steps to achieve this objective.

-- That's all! Now check your answers --