Student Number

The University of Melbourne

School of Computing and Information Systems

Examination Semester 1, 2017
COMP90007 - Internet Technologies

June, 2017

Exam Duration: 180 minutes. **Reading Time:** 15 minutes.

Length: This paper has 27 pages including this cover page.

Authorised Materials: Writing Materials (e.g. pens, pencils).

Calculators: No Calculators are permitted.
The exam paper must remain in the exam room and be returned to the subject coordinator.

Instructions to Students:

- This paper contains 20 questions, each question is worth 3 marks.
- Answer all questions in this exam booklet using pen only in the space provided after the questions. All even pages are intentionally left blank which you can use for rough work. Note that only your answers on odd numbered pages will be marked.
- As a guide, two or three sentences should be sufficient to answer each question. Marks may be deducted for overly long answers or irrelevant information.
- *Any unreadable answers will be considered wrong.*

Library: This paper must be returned and not taken out of the exam hall.

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1. We defined computer networks as a collection of autonomous computers interconnected by a single technology. The performance of any client server application running on such a network is primarily influenced by these two network characteristics, i.e bandwidth and delay. Give:

   (a) an example of a network that exhibits high bandwidth but also high latency.

   (b) an example of a network that exhibits high bandwidth and low latency.

   (c) an example of a network that exhibits low bandwidth and low latency.

2. The performance of a network application is influenced by two major network parameters: the bandwidth of the *network* (number of bits per second that the network can transport) and the *latency* (the delay experienced by each bit transported). In each of the following scenarios, what **other** parameter is required to characterize the quality of service offered by a network used for:

   (a) Transmission of Digitized Voice?

   (b) Transmission of Video?

   (c) Transmission of Financial Data?

3. Consider the layered model for networks.

   (a) Briefly explain the difference between a *protocol* and a *service* in a layered protocol hierarchy

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(b) Suppose the algorithms used to implement the operations at layer k are changed. How do these impact operations at layers k-1 and k+1?

(c) Suppose there is a change in the set of operations provided by layer k. How do these impact operations at layers k-1 and k+1?

4. Briefly explain the design principles of the layered approach in the Open Systems Interconnection (OSI) model.

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5. Consider a television signal that is bandwidth limited to 2 MHz.

   (a) What is the minimum sampling rate required such that the signal can be completely reconstructed?

   (b) If each sample of the signal is to be encoded using 256 levels, how many bits/symbol are required for each sample?

   (c) What is the minimum bit rate required to transmit this signal?

6. Frames of 1000 bits are sent over a 2-Mbps communication channel which has a propagation delay of 500 microseconds. Channel utilization is normally calculated by dividing the time to transmit a frame by the total time required for a successful transfer.What is the maximum channel utilization for the stop-and-wait protocol?

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7. Consider a 2-Mbps communication link established between a station on Earth and a station on the Moon. The shortest and longest distances between the stations on Earth and the Moon are 363,000 and 402,000 kilometers respectively.

   (a) Find the minimum and maximum propagation delay between the end points of the communication link assuming that the signals travel at the speed of light, given by 3×10^8 meters per second

   (b) What is the bandwidth delay product of the link when the Moon is at the closest point to the station on Earth?

   (c) Among the basic datalink protocols studied in the subject, which protocol would you suggest for establishing networking using this link? Give your reasons.

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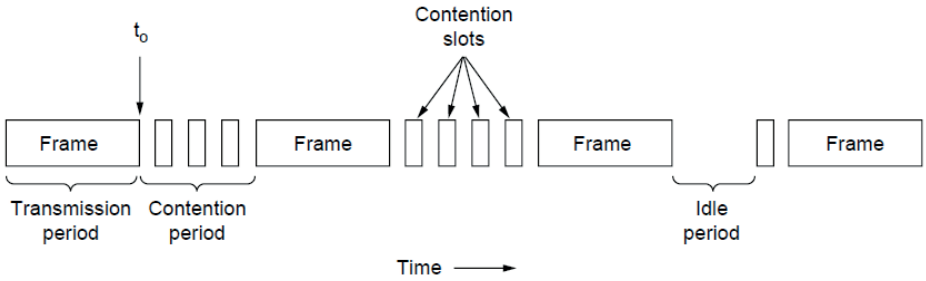
8. Consider the CSMA/CD model shown below for collision free protocols.



Now consider the Binary Countdown protocol involving stations 0 to $N-1$ with each station represented by equal length binary digits. Stations with data ready to send broadcast their addresses during a contention period simultaneously. An arbitration rule is applied so that only one station wins the right to send the frame after the contention period.

(a) Now consider the situation when N is 8. What is the length of the contention period in bits for this protocol?

(b) Briefly explain the arbitration rule that facilitates stations to earn the right to send their data frames?

(c) Suppose at time t_0, stations 3, 5, and 11 and 14 became ready to transmit. Which station will win the right to transmit after the contention period?

(d) If d is the size of the frame and there are N stations, what is the channel efficiency of the method when all users are using the channel?

(e) What is the main advantage of this method over the Bit-Map protocol?

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9. The following data is the output of traceroute on a computer in the EDS laboratory.

traceroute to cis.unimelb.edu.au (128.250.37.164), 64 hops max, 52 byte packets
1 10.9.152.1 3.304 ms 3.304 ms 3.304 ms
2 172.18.68.81 1.146 ms 1.099 ms 1.076 ms
3 172.18.68.83 1.133 ms 1.144 ms 1.115 ms
4 172.18.68.33 2.175 ms 1.931 ms 2.149 ms
5 172.18.66.133 9.724 ms 1.688 ms 1.989 ms
6 128.250.37.130 1.246 ms 1.205 ms 1.381 ms
7 128.250.37.164 1.988 ms 2.035 ms 1.848 ms

(a) What is the IP address of the router connected to the source?

(b) Based on this traceroute output, how many routers are in the path between the source and the destination?

(c) What IP-based protocol is used by traceroute in the network layer?

(d) What is the round trip delay between the source and the third router in the path?

10. On the Data Link layer, what is the function of the flag Byte and how does Bit Stuffing ensure that boundaries between frames are unambiguous?

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11. What is the main reason for packet fragmentation in routers? Explain the relative advantages and disadvantages of transparent and non-transparent fragmentation.

12. A router has built the following CIDR entries in its routing table. The router can directly deliver packets over Interface 0 or it can forward to routers R2 and R3.

Address/mask	Next Hop
148.46.96.0 / 21	Interface 0
148.46.104.0 / 21	R2
148.46.112.0 / 21	R2
148.46.120.0 / 21	R2
Default	R3

Can you simplify the routing table by aggregating addresses having the same outgoing lines? Briefly explain your answer. If you are able to simplify the table, include the simplified routing table in your answer.

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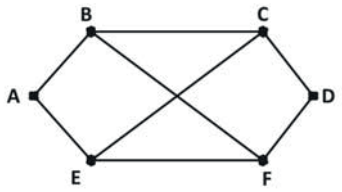
13. Consider the following network of routers. Distance vector (DV) routing is used, and the following vectors have just been received by router C as shown in the table below from routers B, C and E, respectively. What is Cs new routing table? Give both the outgoing line to use and the cost. Print your answer in the table below.



DVs Received by C				Your Answer	
From B	From C	From E		Routing Table for C	Out Going Line
5	16	7			
0	12	6			
8	6	3			
12	0	9			
6	9	0			
2	10	4			

14. A large number of consecutive IP addresses are available starting at 192.80.0.0. Suppose that four organizations A, B, C and D request 2000, 500, 2000 and 4000 addresses respectively, and in that order. For each of these, give the first IP address assigned, the last IP address assigned, and the prefix in the w.x.y.z/s notation. Please print directly into the following table:

Organi zations	First address	Last Address	Prefix
A			
B			
C			
D			

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15. Consider connection establishment and release in the transport layer,

    (a) Compare the symmetric and asymmetric connection release.

    (b) Describe the steps in a successful 3-way handshake for connection establishment.

16. Considering the transport layer, network layer and datalink layer,

    (a) What is the difference between congestion control and flow control?

    (b) Which layer has the biggest role in controlling these two issues?

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17. (a) Is a DNS server a client, a server, or both? Briefly justify your answer.

(b) What is the transport layer protocol that DNS uses?

18. A media player is connected to an audio streaming server with a one-way distance (propagation delay) of 100 milliseconds. It outputs at 1 Mbps. If the media player has a 2-Mega Bytes buffer, what can you say about the position of the low-water mark and the high-water mark?

19. (a) What is Kerckhoffs principle in the context of cryptographic algorithms?

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(b) Alice and Bob had previously agreed on the following one-time pad for exchanging a message, which was inadvertently got exposed to Trudy.

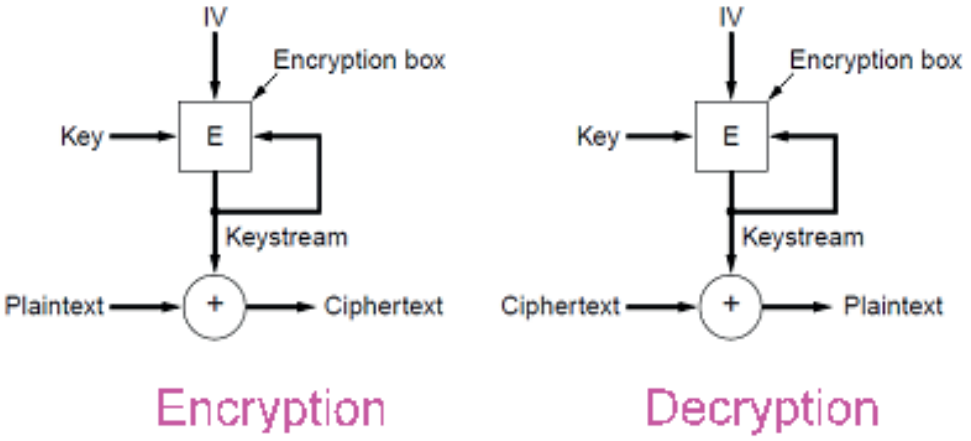
1011001110

Further trudy observes the following ciphertext encrypted using the one-time pad.

1100110011

What was the message sent by Alice to Bob?

(c) How many bits of decrypted plaintext will be corrupted due to a single bit error in the transmitted ciphertext using stream cipher mode? Briefly justify your answer. A schematic diagram of Encryption and Decryption functions in the stream cipher mode is given below for your reference.



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20. This question is about the wireshark experiment and general knowledge about TCP/IP model. The figure below shows a Wireshark trace of a "200 OK" status being received by a client.

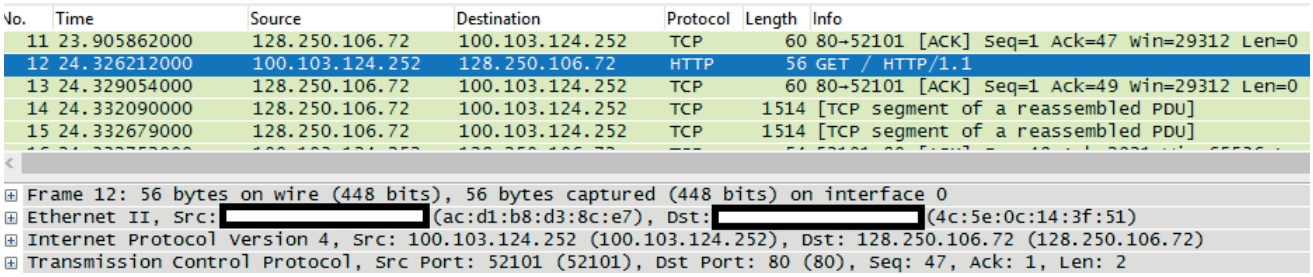

Figure 1: An example Wireshark Trace

(a) What is the IP address of the client computer?

(b) What is the IP address of the server?

(c) What is the MAC address of the client computer?

(d) Which layer in the TCP/IP stack uses IP addresses? Which layer uses MAC addresses?

(e) Can we determine the MAC address of the server computer by using this trace? Explain why or why not.

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An extra blank additional page for your answers if required.

End of exam