THE UNIVERSITY OF MELBOURNE
DEPARTMENT OF COMPUTING AND INFORMATION SYSTEMS

Practice Examination – Semester 1, 2015

COMP90007: Internet Technologies

Exam Duration: 3 hours   **Total marks for this Exam: 60**
Reading Time: 15 minutes
This exam has 2 pages.

Authorised materials:
The following items are authorized: writing materials (e.g. pens, pencils)
and non-electronic dictionaries are allowed.
Calculators and all other books are *not* allowed.

Instructions to Invigilators:
Supply students with standard script book.

**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 worth 3 marks. Attempt all
  questions.
- Answer questions in the script book(s) provided. Do not write your
  answers on this paper.
- Clearly number your answers.
- Bullet points are acceptable in answering descriptive questions.
- 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.*

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Q1. 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 destination?

b. Explain how Traceroute uses ICMP (Internet Control Message Protocol) in its operation.

Q2. Briefly explain the relative advantages and disadvantages of the OSI Reference Model versus the TCP/IP Reference Model. [3 marks]

Q3. The bandwidth and latency are the main characteristics of the networks affecting the performance of applications on networks. Define bandwidth and latency as discussed in lectures. Give an example of a network that exhibits high bandwidth but also high latency. Then give an example of a network that has both low bandwidth and low latency. [3 marks]

Q4. How can you increase the bit rate of a 1200 baud line from 1200 bit/s to 3600 bit/s? [3 marks]

Q5. Briefly explain the relative advantages and disadvantages of using Fibre Optics versus Copper Wire. [3 marks]

Q6. Consider a telephone signal that is bandwidth limited to 4 kHz. [3 marks]

a. At what rate should you sample the signal so that you can completely reconstruct the signal?

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

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

Q7. a. The following binary data fragment occurs in the middle of a data stream for which the bit-stuffing algorithm described in the lectures is to be applied:

0001111101111111111001

Show the output binary data stream after the bit-stuffing algorithm has been applied. (Note that you do **not** need to add any flag bytes)

b. The following data fragment occurs in the middle of a data stream for which the byte-stuffing algorithm described in the lectures is to be applied:

A B ESC D FLAG FLAG ESC C

Show the output data stream after the byte-stuffing algorithm has been applied.

c. What is the maximum overhead in the byte-stuffing algorithm in general? [3 marks]

Q8. Briefly explain the difference in operation and philosophy of two approaches to error handling on the data link layer; error-correcting and error-detecting. [3 marks]

Q9. Data link protocols almost always put the CRC in a trailer rather than in a header. Why? [3 marks]

Q10. If a LAN is under high load, would it be more efficient to use a contention protocol or a collision free protocol in the MAC Sub-layer? Briefly explain your answer. [3 marks]

Q11. Explain the operational benefits of Switched Ethernet in terms of handling increased traffic loads and avoiding collisions. [3 marks]

Q12. A router has built the following routing table. The router can directly deliver packets over Interface 0 and Interface 1 or it can forward to routers R2, R3 and R4.

Subnet Number	Subnet Mask	Next Hop
148.96.39.0	255.255.255.0	Interface 0
148.96.39.128	255.255.255.128	Interface 1
148.96.40.0	255.255.255.128	Router 2
196.4.153.0	255.255.255.192	Router 3
Default		Router 4

Describe what the router does if a packet addressed to each of the following destinations is received. [3 marks]

a. 148.96.40.12

b. 148.96.39.193

c. 196.4.153.90

Q13. Explain the purpose of subnetting and Classless Inter-Domain Routing (CIDR) for logically partitioning the IP Address space. [3 marks]

Q14. The following round-trip times (RTT) were measured by connecting from a host in Melbourne to one residing in the Netherlands.

Trial i	x_i RTT (ms)
1	0
2	1000
3	2000

a. Determine the jitter in milliseconds. The jitter is defined as the square root of the variance of a normal distribution, as shown below:

$$\sigma = \sqrt{\frac{1}{N-1} \sum_{i=1}^{N} (x_i - \bar{x})^2}$$

where $\bar{x}$ is the mean of the samples.

b. Explain how the value of jitter obtained above can be detrimental to certain network applications running on the host.

c. How can this problem be alleviated and what are the corresponding trade-offs involved? [3 marks]

Q15. Give three types of policy choices at the Transport layer that can affect network congestion. In each case, briefly explain why the policy choice affects network congestion. [3 marks]

Q16. A common approach to removing jitter in streaming audio is to buffer incoming packets at the receiver. Briefly explain the main problem with using this approach for video conferencing. [3 marks]

Q17. Briefly explain the architecture of the email system by describing key components and services. What are the basic steps of SMTP protocol? [3 marks]

Q18. Give 3 reasons for the emergence of Voice-over-IP telephony as an alternative to the PSTN. [3 marks]

Q19. a. Is a DNS server a client, a server, or both? Briefly justify your answer.

b. Give three important properties of a message digest. [3 marks]

Q20. Briefly summarize the relative strengths and weaknesses of using UDP to implement remote procedure calls (RPC). [3 marks]

End of exam

Additional Practice Questions

Q1. The following data is the output of traceroute on a computer in the EDS laboratory. [3 marks]

```
traceroute to cis.unimelb.edu.au (128.250.37.164), 64 hops
max, 52 byte packets

1 10.0.0.254 33.100 ms 33.100 ms 33.100 ms
2 58.96.2.205 27.800 ms 27.800 ms 27.800 ms
3 58.96.2.129 28.000 ms 28.000 ms 28.000 ms
4 218.100.78.33 28.299 ms 28.469 ms 28.332 ms
5 202.158.200.9 29.626 ms 28.871 ms 29.841 ms
6 202.158.210.26 31.320 ms 28.722 ms 29.135 ms
7 202.158.200.250 29.668 ms 29.096 ms 28.660 ms
8 * * *
9 * * *
10 * * *
11 128.250.37.130 957.521 ms 33.475 ms 29.891 ms
12 128.250.37.164 29.940 ms 29.260 ms 30.020 ms
```

a. Describe two techniques that can be used in traceroute to speed up determining the number of hops to a host. Assume that all other information aside from the final hop count is irrelevant in the traceroute output for this particular application.

b. Why is the eighth, ninth and tenth hops shown as stars?

c. What is the round trip delay between the source and the router with IP address 58.96.2.129?

Q2. With respect to routing packets in the Network Layer, explain the difference between a connectionless and connection-oriented service? [3 marks]

Q3. An encrypted file needs to be accessed in non-sequential order. Which cipher mode is best suited to encrypting this file, and briefly explain why. [3 marks]

Q4. Give three requirements that are needed to ensure reliable connection establishment in the transport layer. [3 marks]