Exam June 2017, questions

Internet Technologies (University of Melbourne)

Student Number

THE UNIVERSITY OF MELBOURNE

DEPARTMENT OF COMPUTING AND INFORMATION SYSTEMS

Examination – Semester 2, 2017

COMP90007 Internet Technologies

Exam Duration: 3 hours
Reading Time: 15 minutes

Total marks for this Exam: 60

Length: This paper has 41 pages including this cover page.

Authorized materials: Writing materials (e.g. pens, pencils). Calculators and all other books are not allowed.

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 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 within the given space 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.
- Bullet points are acceptable in answering descriptive questions.
- *Any unreadable answers will be considered wrong*.

1	2	3	4	5	6	7	8	9	10

Q1. The performance of a network application is influenced by two major network characteristics: 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).

Give:

a. an example of a network that exhibits high bandwidth as well as high latency. [1 mark]

b. an example of a network that exhibits low bandwidth as well as low latency. [1 mark]

c. an example of a network that exhibits high bandwidth as well as low latency. [1 mark]

Q2. Consider the layered model for networks in Fig Q2.

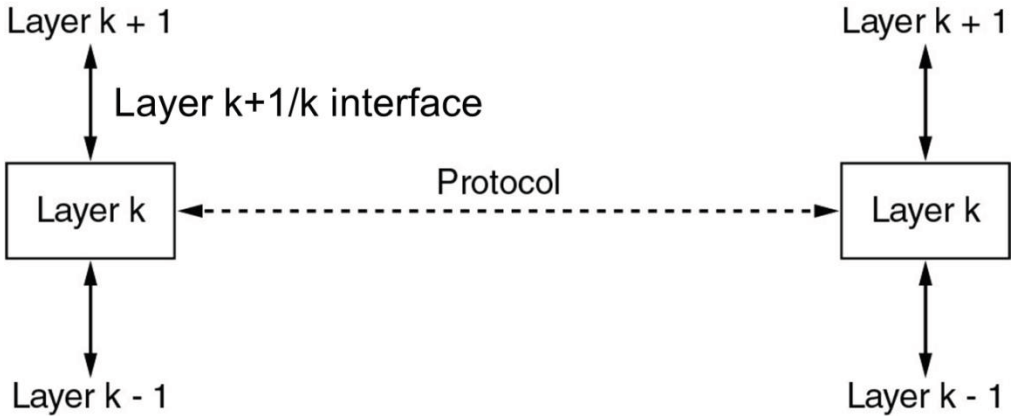


Fig Q2.

a. Briefly explain the difference between a protocol and a service in a layered protocol hierarchy. [1 mark]

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? [1 mark]

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? [1 mark]

Q3. Consider a television signal that is bandwidth limited to 2 MHz.

a. What is the minimum sampling rate such that the signal can be completely reconstructed? [1 mark]

b. If each sample of the signal is to be encoded using 1024 levels, how many bits/symbol are required for each sample? [1 mark]

c. What is the minimum bit rate required to transmit this signal? [1 mark]

Q4. Frames of 1000 bits are sent over a 4-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.

a. What is the maximum channel utilization for the stop-and-wait protocol? [2 marks]

b. What is the effect of decreasing the bandwidth on channel utilization in the above protocol? [1 mark]

Q5. Consider a 2-Mbps satellite communication link established between a station in The University of Melbourne and a station in Stanford University through a geo-stationary satellite having equal distance of 12,000 Km to the two stations.

a. Find the 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. [1.5 marks]

b. What is the round trip bandwidth delay product of the link? [1.5 marks]

Q6. On the topic of error detection and correction:

a. Given the following 4 codewords of 8 bits (number of data bits=2, number of parity bits=6),

00000000;
00001111;
11110000;
11111111;

What is the Hamming distance of this code? [1 mark]

b. How many bit errors can this code correct? How many can it detect? [2 marks]

Q7. Suppose that a message 00110 10101 10010 11011 is transmitted using Checksum (4-bit word). What is the value of the checksum? [3 marks]

Q8. Considering sliding window protocols in Data Link layer:
a. Briefly explain the main differences between Go-Back-N and Selective Repeat when dealing with a missing frame. [2 marks]

b. Which of the protocols Go-Back-N or Selective Repeat requires increased buffer space at the receiver compared to the other? [1 mark]

Q9. Briefly explain how the Binary Countdown Protocol works and describe the relative advantages over the Bit Map Protocol. [3 marks]

Q10. a. What is the main reason for packet fragmentation in routers? Provide one advantage of non-transparent fragmentation compared to transparent fragmentation. [1.5 marks]

b. What fields in the IPv4 packet header are needed in IP fragmentation for the destination host to resemble fragmented packets? [1.5 marks]

Q11. A large number of consecutive IP addresses are available starting at 212.40.0.0/18. Suppose that 3 organisations: A, B, and C request 2000, 500, 2000 addresses respectively, and in that order (A gets the smallest IP values in the range then B and C). For each of these, give the first IP address assigned, the last IP address assigned, and the mask in the w.x.y.z/s notation [3 marks]
Note:

Binary base 2	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
Decimal	2048	1024	512	256	128	64	32	16	8	4	2	1

Q12. On the topic of routing protocols: [3 marks]

a. Briefly explain the algorithm used in link state routing (LSR) protocol. [2 marks]

c. Describe one of the key differences between distance vector routing and LSR. [1 mark]

Q13. Consider connection establishment and release in the transport layer, [3 marks]

a. List the steps in a successful 3-way handshake for connection establishment (assuming no error in transmission) by completing Fig. Q12. [1 mark]

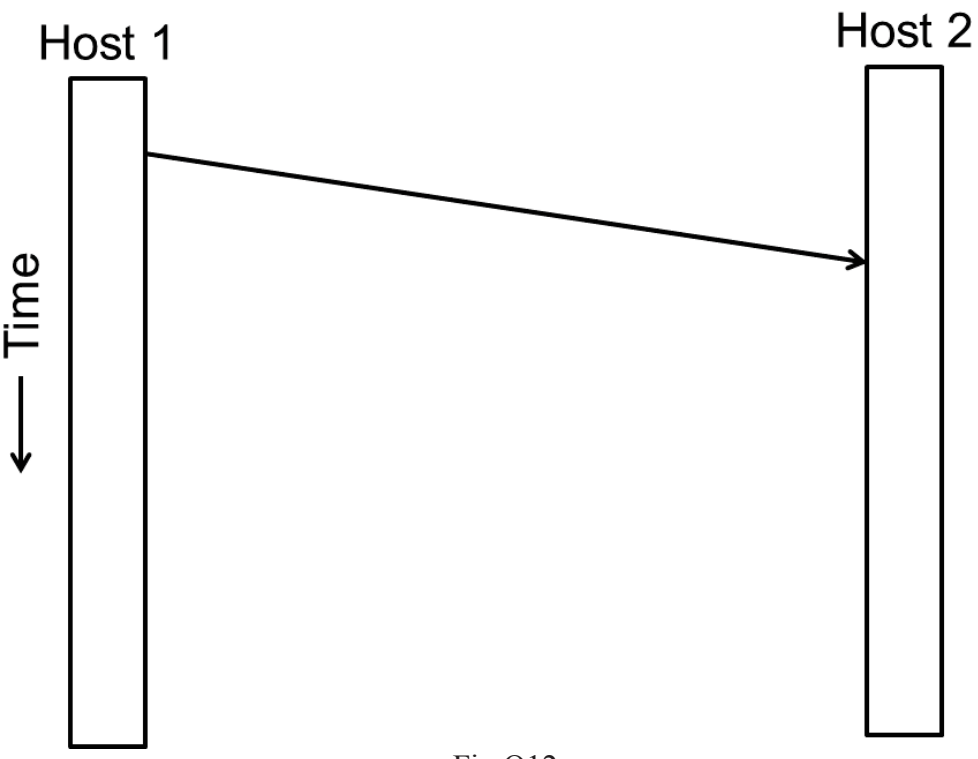
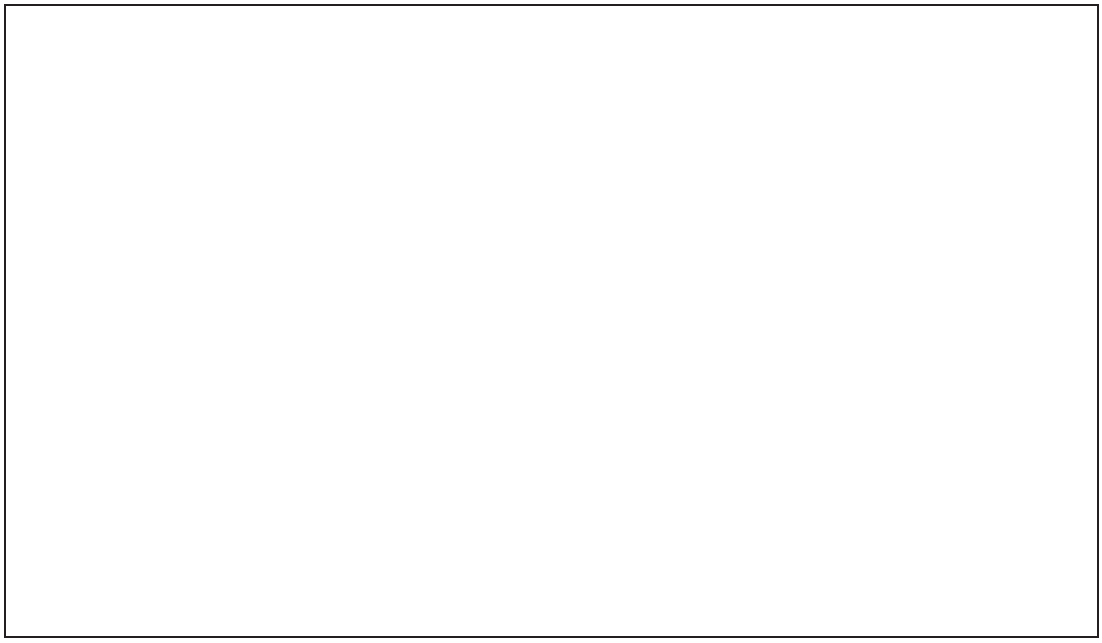
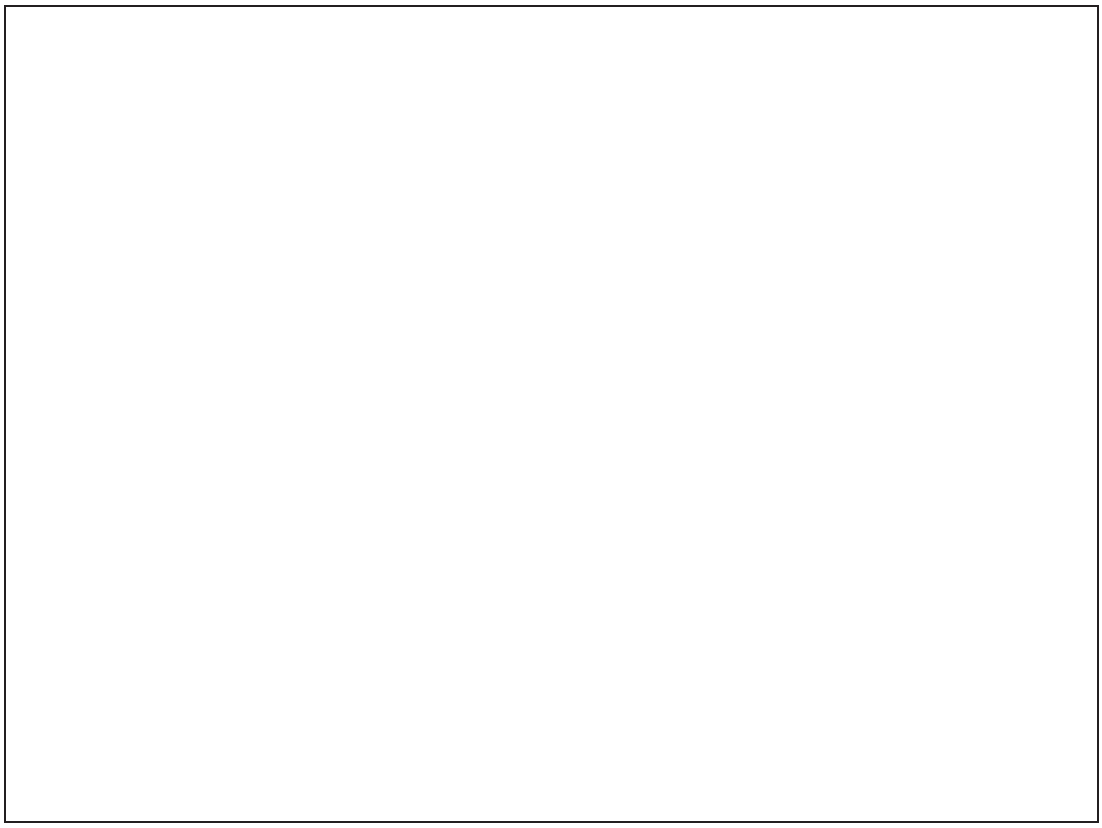


Fig Q12.

b. Compare the symmetric and asymmetric connection release. [1 mark]



c. How does TCP deal with two Army problem in connection release? [1 mark]



Q14. a. Explain why it is necessary to have both the Transport layer and the Network layer for end-to-end connectivity. [1.5 Mark]

b. Explain why it is necessary to have both the Transport layer and the Network layer in the case of a host running multiple application processes at the same time. [1.5 Mark]

Q15. a. Considering the transport layer, network layer and datalink layer, what is the difference between congestion control and flow control? [1 mark]

b. Considering the slow-start method in the transport layer, where the sender *starts* with *one segment*, indicate the maximum number of unacknowledged segments that the sender can have in the network after receiving 4 ACKs (Assume there is no packet loss). [1 mark]

c. Considering the additive increase method in the transport layer, where the sender *starts* with *one segment*, indicate the maximum number of unacknowledged segments that the sender can have in the network after receiving 4 ACKs (Assume there is no packet loss). [1 mark]

Q16. a. Explain how caching improves the performance of DNS resolution. [1 Mark]

b. What is the difference between persistent and non-persistent connections in the context of HTTP protocol? [1 Mark]

c. Name two benefits of voice over IP (VoIP) over public switched telephone network (PSTN). [1 mark]

Q17. A media player is connected to an audio streaming server with a one-way "distance" (propagation delay) of 200 milliseconds. It's outputs at 1 Mbps. The server sends the data at fix rate of 2 Mbps. If the media player has a 4 MB buffer, what can you say about the position of the low-water mark and the high-water mark? [2 marks]

b. Why do we need buffer in media player? [1 mark]

Q18. a. Explain the difference between symmetric key and public key encryption. [1.5 Marks]

b. 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 in Fig. Q16 for your reference. [1.5 marks]

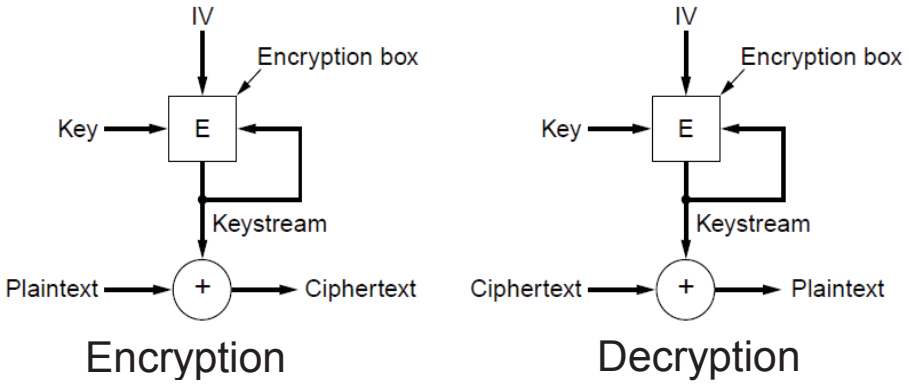


Fig. Q16.

Q19. Consider the TCP transmission policy shown in Fig. Q19, fill in the missing information in boxes (i), (ii), (iii), (iv), (v), and (vi). [3 marks]

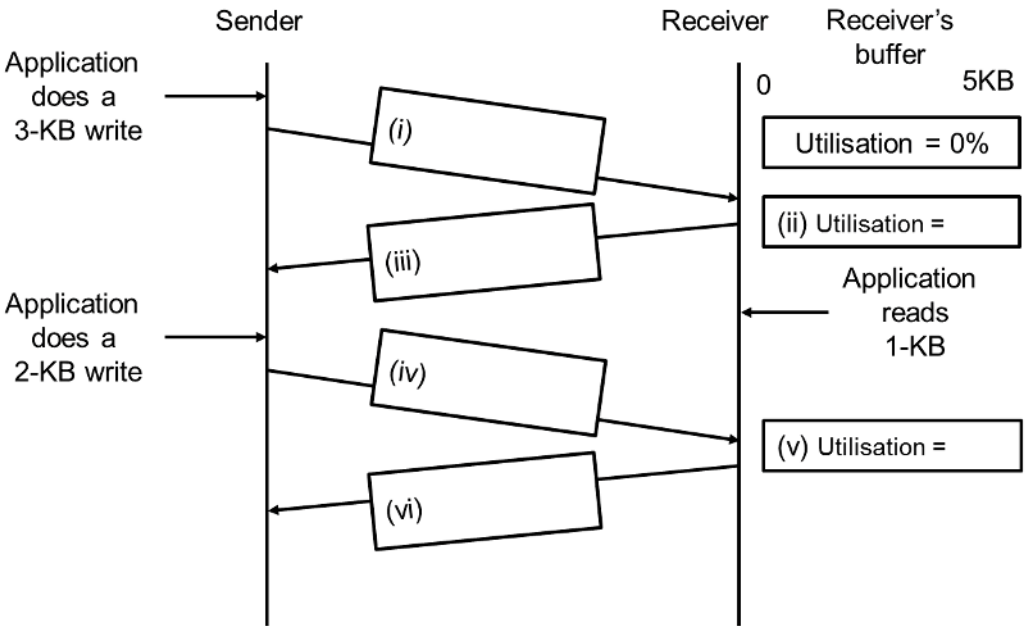


Fig. Q19.

Q20. Refer to the weighted, undirected graph of Fig. Q20, where the weights represent the distance between two router nodes. Determine the shortest path from Node A to Nodes B, C, D, E, F, G, and H by labelling each node (in parentheses) with its distance from Node A along the best-known path. For example, B (4,A) indicates the distance from Node A is 4 and the best known path is from Node A. Note: use blank even pages for your calculations and only write your answers in the space given below Fig. Q20. [3 marks]

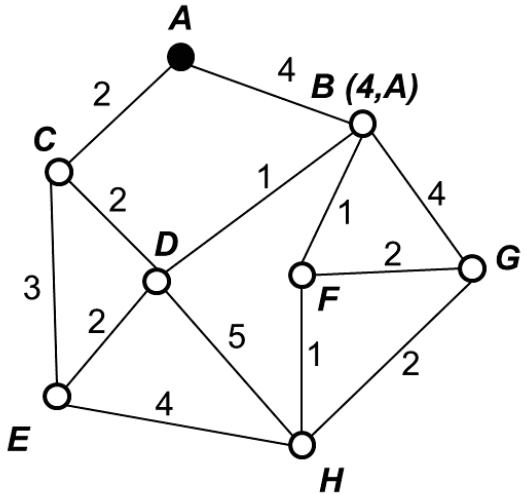


Fig. Q20.