Student Number | **SAMPLE EXAM ONLY**

THE UNIVERSITY OF MELBOURNE

SCHOOL OF COMPUTING AND INFORMATION SYSTEMS

SAMPLE FINAL EXAM – Semester 1, 2019

COMP90007 Internet Technologies

Exam Duration: ABC hours
Reading Time: IJK minutes

Total marks for this Exam: KLM

Length: This paper has XYZ 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:

- Any unreadable answers will be considered wrong.
- …

Multiple choice questions [choose only one answer for each question]:

Q1. The Internet Protocol (IP) address of the sending and receiving hosts is identified at which layer of the OSI model?

A) Layer 7
B) Layer 2
C) Layer 4
D) Layer 3
E) All of the above

Q2. Which of the following statements is correct regarding Services and Protocols?

A) Service is a set of primitives that a layer provides to a layer above it
B) Service defines what operations the layer is prepared to perform on behalf of the it's users
C) Protocol is a set of rules governing the format and meaning of packets exchanged by peers within a layer
D) All of the above
E) None of the above

Q3. Message latency, which is the time delay associated with sending a message over a link is made up of ___

A) Jitter
B) Transmission delay (message in bits / transmission rate)
C) Propagation delay (length of channel / signal speed)
D) Both transmission delay and propagation delay
E) All of the above

Q4. Which of the following statements is correct?

A) Attenuation is the loss of reduction in amplitude of a signal as it passes through a medium

B) Time division multiplexing is used to give access to users with a fixed schedule

C) Frequency multiplexing allocates specific frequency range for each user to send their data

D) All of the above

E) None of the above

Q5. In Data Link layer, which framing methods can be used?

A) Character (Byte) count

B) Flag bytes with byte stuffing

C) Start and end flags with bit stuffing

D) All of the above

E) None of the above

Q6. Hamming distance, *d*, is the minimum bit flips to turn a valid codeword into any other valid one. Therefore, a Hamming distance of 4 can correct how many errors?

A) 1

B) 2

C) 3

D) 4

E) All of the above

Q7. In MAC Sublayer, which of the following protocols could provide greater throughput under high network traffic load?

A) Pure ALOHA
B) Slotted ALOHA
C) 1-persistent CSMA
D) 0.1-persistent CSMA
E) All of the above

Q8. Which one of the following is not a MAC Layer protocol?

A) Binary Countdown protocol
B) Bit Map protocol
C) Carrier Sense Multiple Access
D) Adaptive Tree Walk Protocol
E) Carrier Sense Fast Reverse Access

Q9. In Network layer, which of the following statements is correct?

A) Services provided by a Network layer protocol depend on the router technology
B) Routing is left to one layer up
C) IP Protocol is located inbetween Network Layer and Transport Layer
D) All of the above
E) None of the above

Q10. What are the approaches used in establishing a reliable connection?

A) Don't reuse sequence numbers within a max segment lifetime
B) 3-way handshake for establishing connection
C) Use a sequence number space large enough that it will not wrap even when packets are sent at a high transmission rate
D) All of the above
E) None of the above

Q11. Which of the following statements is correct?

A) UDP is a connection-oriented protocol
B) TCP is a connectionless protocol
C) UDP and TCP has to be used together at Transport Layer
D) All of the above
E) None of the above

Q12. Which of the following techniques can be used for supporting good quality-of-service (QoS)?

A) Over-provisioning
B) Traffic shaping
C) Resource reservation
D) Packet scheduling
E) All of the above

Q13. In the lectures, we learnt that the Domain Name System is a distributed database implemented in a hierarchy of many name servers. Which of the following reasons is correct regarding why DNS is not centralised?

A) Single point of failure
B) Huge traffic volume will be going to a centralised location
C) Distant centralized database for many users
D) Difficult or hard to maintain a centralised system
E) All of the above

Q14. In security, which of the following statements is correct?

A) Symmetric Key Algorithms uses the same key for both encryption and decryption
B) Asymmetric Key Algorithms allow different keys to be used for encryption and decryption
C) A Public Key Infrastructure is important to ensure safe distribution of public keys
D) All of the above

Q15. Which of the following statements is correct about MD?

A) MD uses a one-way hash function to take an arbitrary length of plaintext and compute a fixed-length bit string
B) A MD from plaintext is much faster than encrypting plaintext
C) MD could be used to speed up the derivation of a digital signature
D) All of the above

SHORT ANSWER QUESTIONS

Q16. Describe the key OSI layer division principles.

A layer should be created where a different abstraction is needed. Each layer should perform a well-defined function. The function of each layer should be chosen with a view toward defining internationally standardised protocols. The layer boundaries should be chosen to minimise the information flow across the interfaces. The number of layers should be large enough that distinct functions need not to be thrown together in the same layer out of necessity, and small enough that the architecture does not become unwieldy.

Q17. a. Give three key characteristics that affect the performance of applications on networks.

Bandwidth
Latency
Jitter

b. Give an example of application that has stringent requirements on each of the three main characteristics you have given in Q17.a.

Bandwidth – HD video
Latency – Interactive gaming
Jitter – Real-time video

Q18. Briefly explain key relative advantages and disadvantages of using Fibre Optics versus Copper Wire.

Fibre is efficient to run over longer distances, higher bandwidth, low noise, however it is expensive, requires specialists to deploy, is difficult to tape, is fragile.

Copper is cheaper, lower bandwidth, no specialist skill required, more receptive to noise.

Q19. a. How can you increase the bit rate of a 1200KHz line from X bit/s to 3X bit/s with out changing the frequency?

Increase the number of bits per symbol from A bit/symbol to 3xA bits/symbol, for example, by increasing from a two-level code to a 8-level code basically.

b. Consider a telephone line that is bandwidth limited to 4kHz. If we use 32 levels, what is the bit rate achieved to transmit data?

2 x 4 x log 2 of 32 gives 40kbps

Q20. a. 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.

A B ESC ESC D ESC FLAG ESC FLAG ESC ESC C

b. What is the maximum overhead in the byte-stuffing algorithm in general and when does it occur?

100% when the payload consists of only ESC and FLAG bytes.

Q21. a. Briefly explain the difference in operation and philosophy of two approaches to error handling on the data link layer; error-correcting and error-detecting.

Include enough information in frames to allow reconstruction/deduction of original content (error-correcting). Include enough redundancy to allow receiver to determine an error occurred and request retransmission (error-detecting).

b. Data link protocols almost always put the CRC in a trailer rather than in a header. Why do we want to do this?

The CRC is computed during transmission and appended to the output stream as soon as the last bit goes out onto the wire. If the CRC were in the header, it would be necessary to make a pass over the frame to compute the CRC before transmitting. This would require each byte to be handled twice. Using the trailer cuts the work in half.

Q22. 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.

Under high load a contention protocol would cause many collisions and not be effective, where a collision free protocol allows each source to use the network in turn. Therefore a collision free protocol should be used.

Q23. Consider a client program that needs to run the following operations on a remote file server:

a. List the contents of a directory
b. Open a file
c. Read a text file
d. Display the attributes of a file

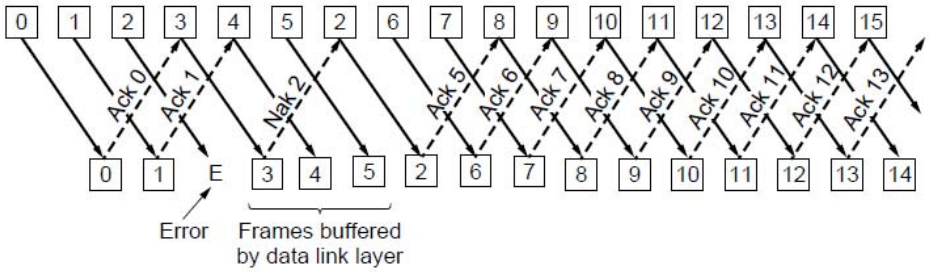
For each of the above operations, indicate whether they are more likely to be delay sensitive or bandwidth sensitive. Justify your answer?

a. Delay-sensitive; directories are typically of modest size.
b. Delay-sensitive; the messages exchanged are short.
c. Bandwidth-sensitive, particularly for large files.
d. Delay-sensitive; a file's attributes are typically much smaller than the file itself.

Q24. Give the name of one sliding window protocols and briefly explain how that protocol works at Data Link Layer using an example figure where a transmission error occurs.

For example: Selective Repeat

Briefly explain the following diagram as your answer



…

Q25. 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	R2
196.4.153.0	255.255.255.192	R3
Default		R4

Describe what the router does if a packet addressed to each of the following destinations is received.
(a) 148.96.40.12
(b) 148.96.39.193

item(a) 148.96.40.12 -forwards to R2;

item(b) 148.96.39.193
Matches to 1) and 2) entries, chooses the longest match; forwards it to Interface 1

Q26. With respect to routing packets in the Network Layer, explain the difference between a connectionless and connection-oriented service?

Connectionless: packets are injected into the network individually and routed independently of each other. No advance setup is needed

Connection-oriented: If connection-oriented service is used, a path from the source router all the way to the destination router must be established before any data packets can be sent. This connection is called a VC (virtual circuit).

Q27. Explain the purpose of subnetting.

Subnetting allows networks to be split into several parts for internal uses whilst acting like a single network for external use.

Q28. Give an example for policy choice at the Transport layer that can affect network congestion.

E.g. Flow control policy – small congestion windows reduce the data rate and avoid congestion.

Q29. a. A common approach to removing jitter in streaming audio is to buffer incoming packets at the receiver. Briefly explain a key problem using this approach for video conferencing.

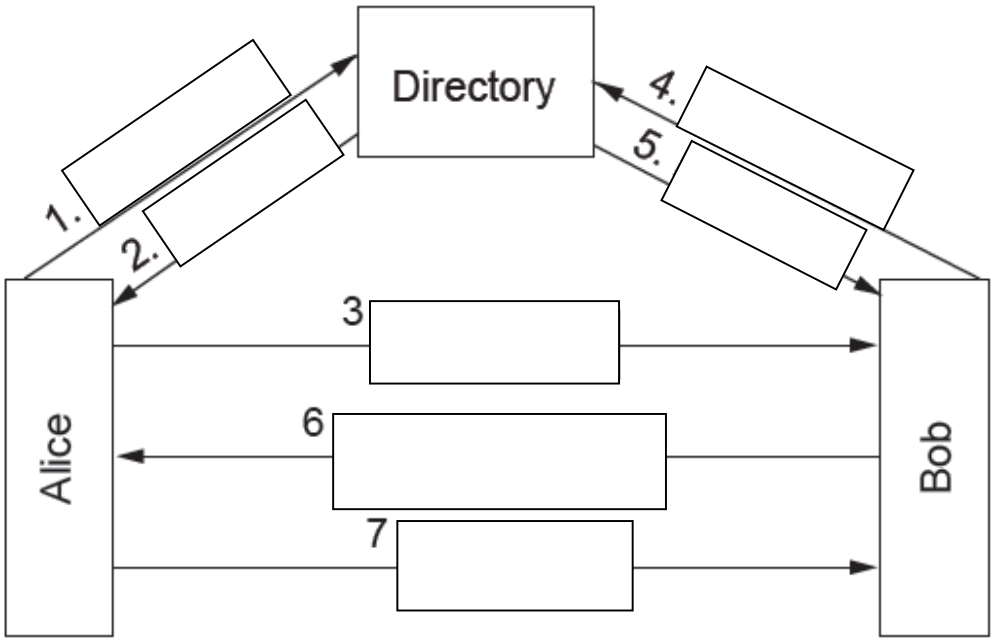
Videoconferencing is a 2-way interactive service. Buffering introduces delay into the service, which is a nuisance for interactive services.

b. Briefly explain what do we need low water mark and high water mark in media player buffer management?

Low water mark: Safety margin, to avoid a stall. When this threshold is reached, media player requests media server to resume data transmission.

High water mark: Can pause server (or go ahead and save to disk). When this threshold is reached, media player requests media server to stop data transmission temporarily to avoid buffer overflow.

Q30. Given the following protocol for authentication using Public Key Cryptography, fill in the numbered boxes.



1 Get EB
2 Send EB
3 EB (A, RA)
4 Get EA
5 Send EA
6 EA (RA, RB, KS)
7 KS (RB)
Where EB is the public key of Bob and EA is for Alice
KS is the shared key
RA and RB two numbers created by the associated owners A (Alice) and B (Bob)

Q31. a. Name two services that DNS provides.

Services:
Hostname to IP address translation
Load Balancing

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

Both, since it can act as a server if the requested domain name is in its database, or as a client if it needs to ask another server to resolve the name.

Q32. a. 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.

Counter mode is the best option, since each block can be encrypted or decrypted based on its location in the files using a counter. Other techniques required decryption of all preceding blocks in the file.

a. Give at least three key properties of a message digest.

easy to compute MD(P) given P
impractical to compute P given MD(P)
given P, impractical to find P' such that MD(P') = MD(P)
also, a single bit change in P creates a very different message digest

Q33. Briefly explain Dijkstra's algorithm in computing the set of optimal routes to all destinations from a given source.

Dijkstra's algorithm can be use to compute a sink tree on the graph
Each link is assigned a non-negative weight/distance
Shortest path is the one with lowest total weight from the source to a destination
(Using weights of 1 gives paths with fewest hops)

Algorithm:
Start with the source, set distance at other nodes to infinity
Relax distance to other nodes
Pick the lowest distance node, add it to sink tree
Repeat until all nodes are in the sink tree