CANDIDATE

TEST

Question	Question title	Status	Marks	Question type
i	COMP3331 Exam Cover sheet for T2 2021			Information or resources
1	RDT Q1	Correct	1/1	Multiple Response
2	RDT Q2	Correct	1/1	Multiple Response
3	RDT Q3	Correct	1/1	Multiple Response
4	RDT Q4	Partially Correct	0.6700000166893005/1	Multiple Response
5	RDT Q5	Partially Correct	0.6700000166893005/1	Multiple Response
6	TCP Congestion Control and File Transfer	Answered	3/3	Essay
7	Congestion Control and Queue Sizes	Answered	1/2	Essay
8	Link State MCQ	Wrong	0/1	Multiple Choice
9	Fragmentation	Correct	1.5/1.5	Numeric Entry
10	IP Addressing	Answered	5/5	Essay
11	Longest Prefix	Correct	1/1	Multiple Choice
12	NAT	Correct	1/1	Composite
13	Distance Vector MCQ	Correct	1/1	Multiple Choice

14	Distance Vector Routing	Partially Correct	4/4	Composite
15	Ethernet Switches	Correct	6/6	Multiple Response
16	ARP	Correct	0.75/0.75	Text Entry
17	Headers	Correct	1/1	Multiple Response
18	Switch Forwarding	Wrong	0/0.75	Multiple Response
19	WiFi	Correct	0.5/1	Composite
20	Authentication Switch Network	Answered	3/3	Essay
21	Security MCQ	Correct	1/1	Multiple Choice
22	Authentication	Answered	2/2	Essay

The table below describes 5 different network channels between a sender A and a receiver B. E.g., in channel (3), there may be packet corruption only on the path from A to B, and pipelining must be used. There is no packet reordering in any of the channels. Note that, data only flows in one direction from A to B.

channel ID	errors in $A \to B$	errors in $B \to A$	support for pipelining?
(1)	none	none	yes
(2)	corruption	none	no
(3)	corruption	none	yes
(4)	corruption &loss	none	yes
(5)	corruption & loss	corruption & loss	yes

For each channel specify which mechanisms are necessary for providing reliable data delivery (no data loss, no data corruption and no data duplication).
You have the following constraints:

- Specify a mechanism only if it is necessary. E.g., if one can provide reliable data delivery over a given channel without checksums, you should not specify checksums for that channel.
- Do not specify timeout-based retransmissions if NACK-based retransmissions are sufficient.

Note that NACK-based retransmissions means that receiver B will ONLY send negative acknowledgements to sender A when it receives a corrupted data packet.

Answer the following five questions.

1 RDT Q1

For Channel (1), which of the following mechanisms are strictly necessary to ensure reliable data delivery?

Select one or more alternatives:

- [x] no mechanisms are needed ✔
- [ ] checksum
- [ ] NACK-based retransmissions
- [ ] timeout-based retransmissions
- [ ] sequence numbers

Maximum marks: 1

2 RDT Q2

For Channel (2), which of the following mechanisms are strictly necessary to ensure reliable data delivery?

Select one or more alternatives:

- [ ] no mechanisms are needed
- [x] NACK-based retransmissions
- [x] checksum
- [ ] sequence numbers
- [ ] timeout-based retransmissions

Maximum marks: 1

3 RDT Q3

For Channel (3), which of the following mechanisms are strictly necessary to ensure reliable data delivery?

Select one or more alternatives:

- [ ] timeout-based retransmissions
- [x] NACK-based retransmissions
- [ ] no mechanisms are needed
- [x] sequence numbers
- [x] checksum

Maximum marks: 1

4 RDT Q4

For Channel (4), which of the following mechanisms are strictly necessary to ensure reliable data delivery?

Select one or more alternatives:

- [ ] no mechanisms are needed
- [x] timeout-based retransmissions ✓
- [x] sequence numbers ✓
- [x] checksum ✓
- [x] NACK-based retransmissions ✗

Maximum marks: 1

5 RDT Q5

For Channel (5), which of the following mechanisms are strictly necessary to ensure reliable data delivery?

Select one or more alternatives:

- [x] sequence numbers ✓
- [x] NACK-based retransmissions ✗
- [x] timeout-based retransmissions ✓
- [ ] no mechanisms are needed
- [x] checksum ✓

Maximum marks: 1

6 TCP Congestion Control and File Transfer

Assume that a sender wishes to transfer a file of size 19KB to a receiver over a TCP Reno connection. Assume that the slow start phase begins with a window size of 1KB, and that the initial value of ssthresh is set at 8KB. Assume that all TCP segments contain MSS bytes and that the MSS is 1KB. Assume that a time-out always occurs during the RTT in which the window size is 8KB and none of the data sent during this RTT is successfully received. How many RTTs does it take before all segments of the file are successfully transmitted and acknowledged? Ignore connection setup and teardown. Justify your answer with an explanation.

Fill in your answer here

8

1RTT: CWND = 1, ssthread = 8,

2RTT:CWND = 2, ssthread = 8, 1packets transmitted

3RTT,CWND = 4, ssthread = 8, 3packets transmitted

4RTT,CWND = 8, ssthread = 8, 7packets transmitted

Timeout， cwnd = 1, ssthread = CWND/2

5RTT,CWND = 1, ssthread = 4, 7packets transmitted

6RTT,CWND = 2, ssthread = 4, 8packets transmitted

7RTT,CWND = 4, ssthread = 4, 10packets transmitted

8RTT,CWND = 5, ssthread = 4, 14packets transmitted

After 8 RTT, send 19 packets

Maximum marks: 3

7 Congestion Control and Queue Sizes

A network architect proposes to make the packet queues of all packet switches/routers very very large, in order to ensure almost zero packet loss. How would this affect TCP's congestion control algorithm? Do you think it would do its job better or worse? Justify your answer.

Fill in your answer here

Worse.

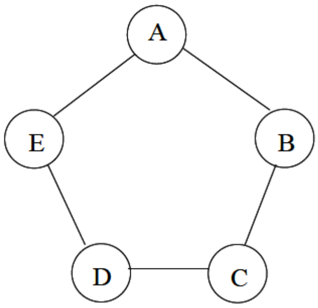
Because a packet loss means the network congestion has happened, in this case the receiver would take a long time receive the packet, like yesterday's request will be responded on today, so that will be meaningless.

Once you have a very long queue with a short timeout time, soon the network will full with same packet because they timed out. But if you set the timeout time too long, which means there is no packet loss, then you can't judge if there is a network congestion which leads to a overtime response.

Maximum marks: 2

8 Link State MCQ

Consider a 5-node ring network as in the figure below. The link costs are all the same and are equal to 1. Suppose each node sends its link state advertisement (LSA) to all the outgoing links and then the LSAs are further propagated using the algorithm in the figure below to reach the entire network. Suppose each LSA is of size 20 bytes. In order for all nodes to receive LSAs from all other nodes, how much cumulative LSA traffic (in bytes) is transmitted over the entire network?



if (LSA received on incoming link && the LSA has not been received before)

then flood LSA onto all but the incoming link

Select one alternative:

- 600 ✔
- 800
- 200
- 500 ✖
- 400

Maximum marks: 1

9 Fragmentation

An IP datagram which is itself a fragment (of a larger datagram) is of size 460 bytes (inclusive of the IP header) and has an offset field of 1240. It arrives at a router which has to forward it on an outgoing link with MTU of 300 bytes, and thus needs to create two fragments. What are offset fields of these two fragments (fill in the values in the provided spaces)?. Assume that IP headers are always 20 bytes (i.e. no options are used).

Offset for first fragment: 1240 ✔

Offset for second fragment: 1275 ✔

Maximum marks: 1.5

10 IP Addressing

Suppose UNSW is allocated a block of public IP addresses: 217.125.112.0/20. Based on your knowledge on IP addressing, address the following questions.

1) Suppose there are 6 Faculties (A, B, C, D, E and F) that UNSW needs to distribute the IP addresses to. Two of the Faculties (A and B) request twice as much IP addresses as the other 4. What will be the block of IP addresses allocated to each Faculty? You MUST use up the entire block of IP addresses available to UNSW in your allocation. Faculties A and B should be allocated addresses first (i.e. must receive the smallest IP addresses in the block allocated to UNSW). Simply represent the block allocated to each Faculty in the CIDR (a.b.c.d/x) notation. (3 marks)

2) How many hosts can each Faculty supply with public IP addresses? (1 mark)

3) What is the subnet mask for each Faculty (represent in a.c.b.d format)? (1 mark)

Fill your answer for all 3 questions here. No explanations are necessary.

ip addresses	number of hosts	subnet mask
A:217.125.112.0~217.125.115.255	2^10 = 1024	255.255.252.0
B:217.125.116.0~217.125.119.255	2^10 = 1024	255.255.252.0
C:217.125.120.0~217.125.121.255	2^9 = 512	255.255.254.0
D:217.125.122.0~217.125.123.255	2^9 = 512	255.255.254.0
C:217.125.124.0~217.125.125.255	2^9 = 512	255.255.254.0
D:217.125.126.0~217.125.127.255	2^9 = 512	255.255.254.0

Maximum marks: 5

11 Longest Prefix

Consider a router with the following forwarding table.

Destination	Interface
128.8.16.0/20	Port 1
128.8.24.0/21	Port 2
128.8.128.0/24	Port 3
128.8.128.0/28	Port 4
Default	Port 5

Which interface would an IP datagram with destination address 128.8.25.223 be forwarded to?

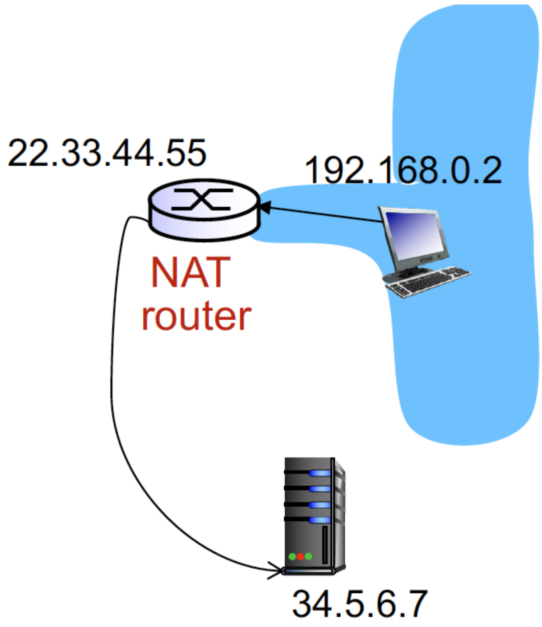
Select one alternative:

- Port 2
- Port 4
- Port 5
- Port 1
- Port 3

Maximum marks: 1

12 NAT

Consider the network topology shown in the figure below. A host with a private IP address 192.168.0.2 opens a TCP socket on its local port 6700 and connects to a web server at 34.5.6.7. The NAT Router's public IP address is 22.33.44.55. Suppose the NAT router creates the following mapping (WAN -> LAN): [22.33.44.55, 4001] -> [192.168.0.2, 6700].



In the IP datagram encapsulating the SYN-ACK response sent from the web server what is the destination IP address and the destination port number (in the TCP header)? Note down the answers in the spaces provided below. No explanation is required.

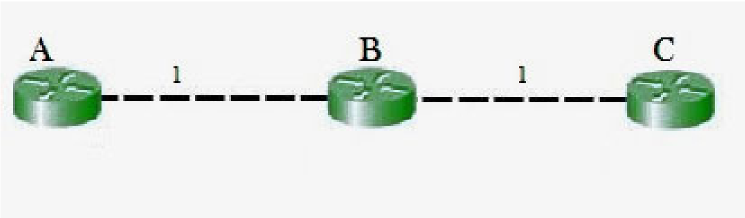
Destination IP Address: 22.33.44.55

Destination Port Number: 4001

Maximum marks: 1

13 Distance Vector MCQ

Consider the following network comprised of 3 routers. The link costs of both links are 1 as shown and do not change. Assume that the network uses Distance Vector routing protocol with Poisoned Reverse enabled. In the final distance vector update sent by router B to router C, (i.e. just before it achieves convergence), what is the cost to router A advertised by router B?



Select one alternative:

- infinity
- 2
- 1
- none of the provided choices
- 3

Maximum marks: 1

14 Distance Vector Routing

In a certain 5-node network with nodes A through E, assume that we are using distance-vector routing. Node D receives the following vectors simultaneously from its two neighbours - from B: (1, 0, 1, 4, 1) and from E: (4, 1, 2, 2, 0), where the elements of the vectors corresponds to the current estimated costs to get to nodes A through E in that order. For example, the estimated cost from B to A is 1, from B to C is 1 and from E to A is 4. The cost of the links D-B and D-E are 4 and 2, respectively.

Assume that node D executes the distance vector algorithm using these two new vectors. What is current estimated cost from node D to each of the other nodes (A, B, C and E) and the what is the next hop node for node D to get to that node. Fill in the cost in the first space provided and the id of the node in the second space, for each destination.

Cost to A: 6 (5) Next hop node (from D) to get to A: B

Cost to B: 3 Next hop node (from D) to get to B: E

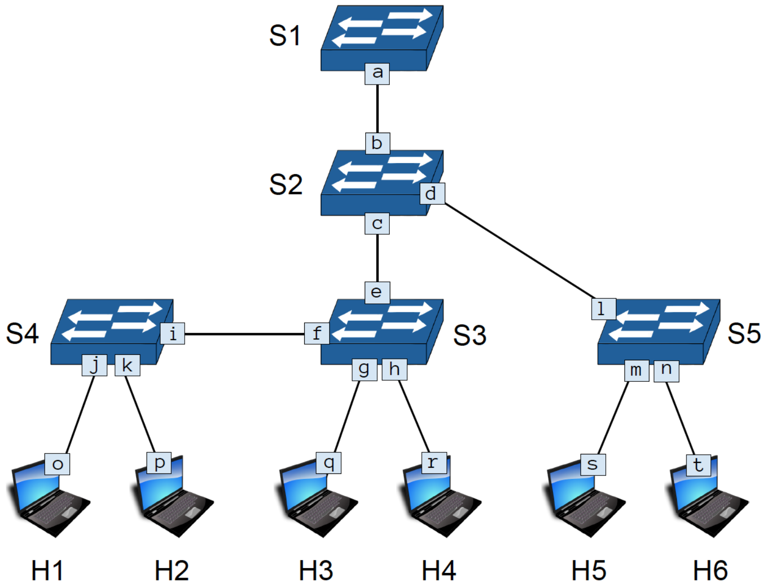
Cost to C: 4 Next hop node (from D) to get to C: E

Cost to E: 2 Next hop node (from D) to get to E: E

Maximum marks: 4

15 Ethernet Switches

Consider the network in the figure below. The switch table of all the switches are initially empty. Any switch table entries created for any of the interactions described below remain till the end of the questions. Each question is worth 1 mark.



Host H1 sends Ethernet frame f1 to host H6. Frame f1 has source MAC address *o* and destination MAC address *t*. Answer the two questions below.

1) Which hosts other than H6 will receive frame f1?

Select one or more alternatives:

- [x] H2
- [ ] none of other hosts
- [x] H5
- [x] H4
- [x] H3

2) Which switches will receive frame f1?

Select one or more alternatives

- [x] S4 ✔
- [x] S5 ✔
- [x] S2 ✔
- [x] S3 ✔
- [x] S1 ✔

Immediately after this, Host H4 sends Ethernet frame f2 to host H1. Frame f2 has source MAC address *r* and destination MAC address *o*. Answer the two questions below.

3) Which hosts other than H1 will receive frame f2?

Select one or more alternatives

- [ ] H5
- [ ] H3
- [x] None of the other hosts ✔
- [ ] H2
- [ ] H6

4) Which switches will receive frame f2?

Select one or more alternatives

- [x] S3 ✔
- [ ] S2
- [ ] S1
- [ ] S5
- [x] S4 ✔

Immediately after this, Host H6 sends Ethernet frame f3 to host H4. Frame f3 has source MAC address *t* and destination MAC address *r*. Answer the two questions below.

5) Which hosts other than H4 will receive frame f3?

Select one or more alternatives

- [x] H5
- [ ] H3
- [ ] None of the other hosts
- [ ] H2
- [ ] H1

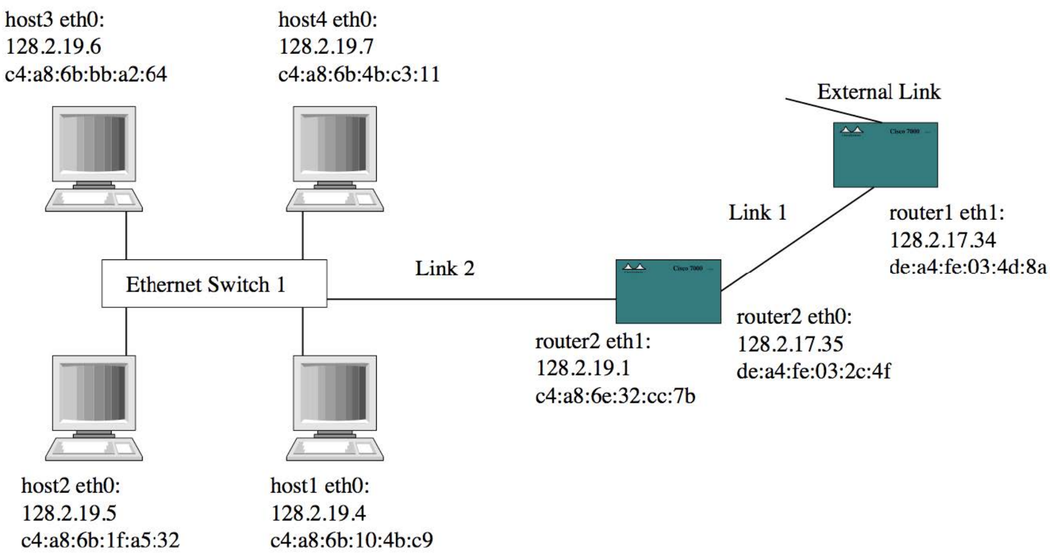
6) Which switches receive frame f3?

Select one or more alternatives

- [x] S5
- [x] S2
- [x] S1
- [ ] S4
- [x] S3

Maximum marks: 6

The figure below shows a partial network topology. The hosts (host1 through host4) and router2 are connected to the Ethernet switch in a star topology. Assume that a well-formed (i.e. error free) IP datagram with a destination IP address of 128.2.19.5 arrives at router 1 on the external link. Router 1 will look up the destination address in its forwarding table which will indicate to forward this IP datagram on Link 1 to router 2. Assume that the ARP tables at all devices in the network are empty.



Answer the following 3 questions.

16 ARP

What is the IP address for which router 1 will initiate an ARP query on link 1 (i.e. the IP address for which the corresponding MAC address is requested)?

Note down the address in the a.b.c.d format in the space provide:

128.2.17.35

Maximum marks: 0.75

17 Headers

Which of the Ethernet header fields in the following list will router2 change between when it receives the Ethernet frame encapsulating the IP datagram on eth0 and when it forwards the Ethernet frame encapsulating the same IP datagram on eth1?

Select one or more alternatives:

- [x] Source MAC address ✔
- [x] Destination MAC address ✔
- [ ] Type
- [ ] None of the headers
- [x] CRC ✔

Maximum marks: 1

18 Switch Forwarding

The Ethernet frame transmitted by router 2 will be forwarded by Ethernet switch 1 to the destination host. Which of the header fields in the following list will change from when the Ethernet switch receives the frame on the link connected to router2 and when it transmits the frame on an outgoing link?

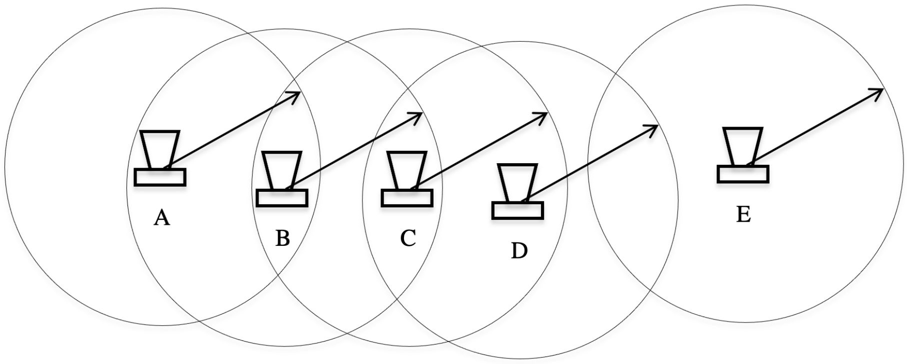
Select one or more alternatives:

- [ ] Source MAC address
- [ ] Destination MAC address
- [x] CRC ✖
- [ ] Type
- [ ] None of the headers ✔

Maximum marks: 0.75

19 WiFi

Consider the wireless topology shown below comprised of 5 nodes (A-E). Circles around each node illustrate their transmission range. Assume that all nodes use the 802.11 MAC protocol and that RTS/CTS is always enabled for all transmissions referenced in the questions below.



Answer the following questions:

1) When node E transmits which other nodes can hear node E's transmission?
Select one or more alternatives

- [x] no other node
- [ ] D
- [ ] C
- [ ] B
- [ ] A

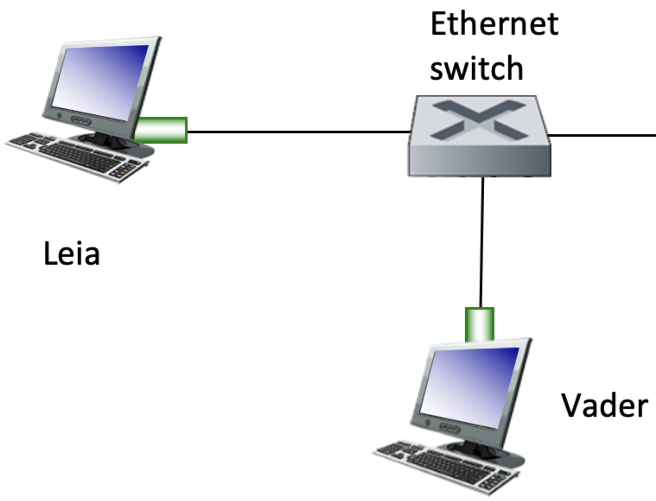
2) It is possible for node A to be transmitting to node B at the same time that node D is transmitting to node C?
Select one alternative

- (•) Yes
- ( ) No

Maximum marks: 1

20 Authentication Switch Network

Consider the network depicted below where Leia, Yoda and Vader are connected through an Ethernet switch. The switch is assumed to be functioning correctly (i.e. it is not compromised) and only forwards the frames to the intended destination as per the destination MAC address (i.e., it has learnt of the network topology and its switch table is correctly populated).



Leia sends a message to Yoda. Yoda knows Leia's true IP address. In each scenario, explain why or why not authenticity is guaranteed - i.e., Yoda can tell for sure that the the message is indeed coming from Leia and not from Vader.

Scenario 1: Leia sends the message to Yoda over UDP

Scenario 2: Leia sends the message to Yoda over TCP: Leia establishes a TCP connection with Yoda, sends the message and then closes the TCP connection.

Fill in your answer for both scenarios here:

1.

No, Vader can claiming to Leia, so Yoda can't make sure if it is Leia

2.

Yes, if Vader establish TCP connection to Yoda, the syn ack message will send to Leia, but Leia doesn't want to establish connections to Yoda, so it will fail. At the same time Vader can't receive syn ack message so he can't establish connections to Yoda too.

Maximum marks: 3

21 Security MCQ

Alice wants to send a message *m* to Bob and prove that the message is from her. Appending which of the following to *m* would achieve this goal?

Select one alternative:

- *m* encrypted with Alice's public key
- *m* encrypted with some random number only known to Alice
- *m* encrypted with Bob's public key
- *m* encrypted with Alice's private key
- *m* encrypted with a Certificate Authorities public key

Maximum marks: 1

22 Authentication

Consider a setting where Vader, an adversary has full access to the communication channel between Yoda and Leia. Yoda wants to send a message to Leia.

In each scenario below, explain whether or not Leia can always verify the authenticity of the received message *m*, i.e., verify that the message *m* is indeed sent by Yoda (and not by Vader claiming to be Yoda).

K^+_L and K^+_Y are the public keys of Leia and Yoda, respectively. H is a cryptographic hash function which is known to everyone, i.e., Leia, Yoda and Vader.

Scenario 1: Leia receives a message [m, $K^+_Y(H(m))$]

Scenario 2: Leia receives a message [m, $K^+_L(H(m))$]

You must provide justifications for your answers for both scenarios.

Fill in your answer here for both scenarios:

1.

No, K^+_Y is a public key, Vader can use it with H to send the message.

2.

No, K^+_L is a public key, Vader can use it with H to send the message.

Maximum marks: 2