
UNSW

SYDNEY

CANDIDATE

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TEST

# Mid-Term Exam T2 2021

| | |
|---|---|
| Subject code | -- |
| Evaluation type | -- |
| Test opening time | 13.07.2021 16:10 |
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**Front Page**

| Question | Question title | Status | Marks | Question type |
|---|---|---|---|---|
| ℹ | COMP3331/9331 T2 Mid-term Front Page | | | Document |

**Throughput**

| Question | Question title | Status | Marks | Question type |
|---|---|---|---|---|
| 1 | Throughput (1.5 marks) | Partially Correct | 1/1.5 | Multiple Choice |

**HTTP MCQ**

| Question | Question title | Status | Marks | Question type |
|---|---|---|---|---|
| 2 | HTTP (1 mark) | Correct | 1/1 | Multiple Choice |

**Packet Switching**

| Question | Question title | Status | Marks | Question type |
|---|---|---|---|---|
| 3 | Packet Switching Q1 (0.6 marks) | Answered | 0.6/0.6 | Text area |
| 4 | Packet Switching Q2 (0.9 marks) | Answered | 0/0.9 | Text area |
| 5 | Packet Switching Q3 (1.25 mark) | Answered | 0/1.25 | Text area |
| 6 | Packet Switching Q4 (1.5 marks) | Answered | 1.5/1.5 | Essay |

**DNS**

| Question | Question title | Status | Marks | Question type |
|---|---|---|---|---|
| 7 | DNS (2.25 marks) | Correct | 2.25/2.25 | Text Entry |

**DHT**

| Question | Question title | Status | Marks | Question type |
|---|---|---|---|---|
| 8 | DHT (1 mark) | Answered | 1/1 | Text area |

**Caching**

| Question | Question title | Status | Marks | Question type |
|---|---|---|---|---|
| 9 | Caching (2 marks) | Answered | 2/2 | Essay |

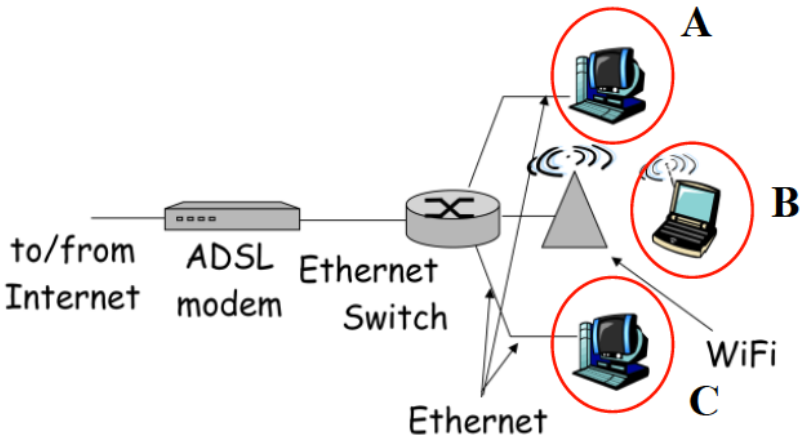
**Reliable Data Transfer**

| Question | Question title | Status | Marks | Question type |
|---|---|---|---|---|
| 10 | GBN and SR (4 marks) | Answered | 3/4 | Essay |

**TCP Sequence Numbers**

| Question | Question title | Status | Marks | Question type |
|---|---|---|---|---|
| 11 | TCP Sequence Numbers (4 marks) | Correct | 4/4 | Numeric Entry |

# 1 Throughput (1.5 marks)




Consider the home network shown in the figure above comprised of 3 hosts. Suppose that the ADSL model has a **8 Mbps** downlink and **1Mbps** uplink connection to the Internet. Suppose that the Ethernet network has capacity of **10Gbps** (both upstream and downstream) and the WiFi network has a capacity of **54Mbps** (both upstream and downstream). Assume that the rest of the Internet (not shown in the figure) has ample capacity. Hosts A and C are connected through Ethernet while Host B is connected through WiFi.

Answer the following three questions (0.5 mark for each)

1) What is the maximum throughput that any host in this home network can experience when downloading a large file from the Internet?

**Select one alternative:**

- 54Mbps
- 9Mbps
- 8Mbps
- 10Gbps
- 1Mbps

2) What is the maximum throughput that any host in this home network can experience when downloading a large file from any other host in the same home network?

**Select one alternative:**

- 8Mbps
- 10Gbps ✔
- 54Mbps ✖
- 9Mbps
- 1Mbps

3) If all hosts in the home network are downloading large files from the Internet simultaneously and each host gets an equal share of the available bandwidth, what is the maximum throughput that any host in the home network can experience?

**Select one alternative:**

- 3.33Gbps
- 18Mbps
- 0.33Mbps
- 2.67Mbps ✔
- 3Mbps

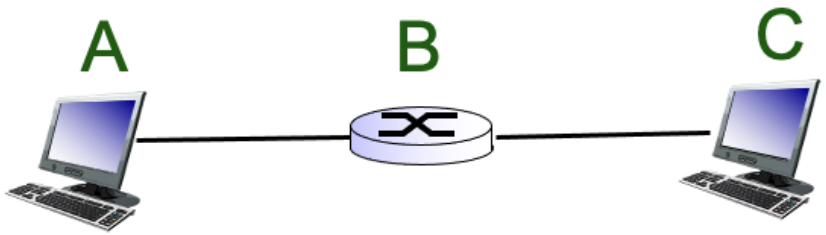
## 2 HTTP (1 mark)

You access a web page that consists of 1 HTML file and 4 images, all stored on the same server. Suppose your browser uses a single non-persistent TCP connection at any given time, and that DNS resolution for the IP address of the server has already been completed. Let RTT denote the round-trip time between your machine and the server. What is the minimum number of RTTs needed to display the entire web page? Ignore all transmission delays.

**Select one alternative:**

- 6RTTs
- 10RTTs ✓
- 5RTTs
- 8RTTs
- 3RTTs
- 4RTTs

Suppose host A has **M** bytes to send to host C along the path through packet switch B which employs store and forwarding switching.




Assume that there is no processing delay and no queuing delay at any node. The propagation delay is **T** seconds for both link A-B and link B-C. The transmission rate is **R** bits per second for both link A-B and link B-C. Suppose that the header added to each packet (irrespective of the size of the packet) is always **N** bytes. Assume that there is no other traffic on the network. No acknowledgements are sent.

Answer the following four questions.

## 3 Packet Switching Q1 (0.6 marks)

How much time does it take to send all M bytes of data as one packet from Host A to Host C? Write the final expression in the space provided. You are not required to provide a justification.

**Fill in your answer here**

(8(M+N)/R + T) * 2

## 4 Packet Switching Q2 (0.9 marks)

Divide the M bytes into two equal parts, assuming M is exactly divisible by 2. How much time does it take to send all the data as two packets from Host A to Host C? The packets are sent back-to-back (i.e. immediately after each other). Write the final expression in the space provided. You are not required to provide any justification.

**Fill in your answer here**

2 * (8(M/2+N)/R + T) * 2

## 5 Packet Switching Q3 (1.25 mark)

Divide the M bytes into K equal parts, assuming M is exactly divisible by K. How much time does it take to send all the data as K packets from Host A to Host C? The packets are sent back-to-back (i.e. immediately after each other). Write the final expression in the space provided. You are not required to provide any justification.

**Fill in your answer here**

K * (8(M/K+N)/R + T) * 2

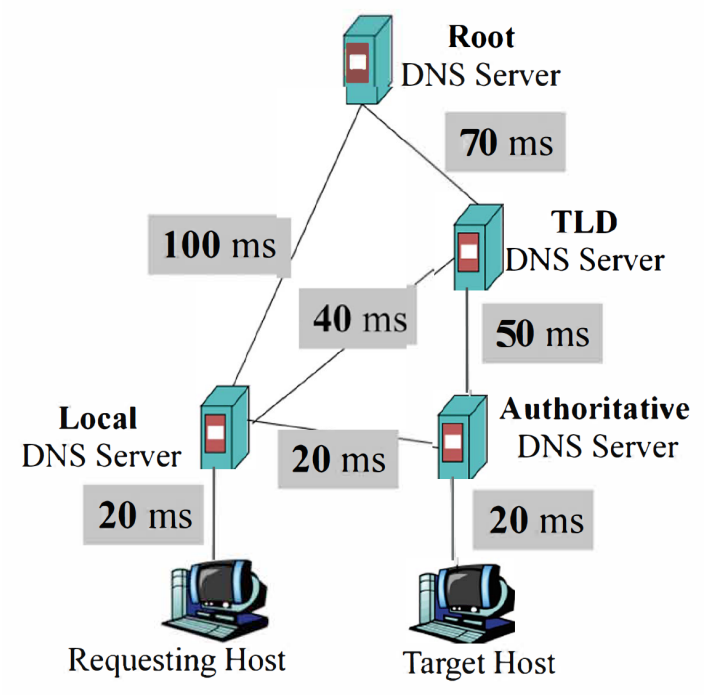
## 6 Packet Switching Q4 (1.5 marks)

Based on the result of the previous question, find K such that the total data delivery delay is the minimum. Explain your answer. Answers without justification will not receive marks.

**Fill in your answer here**

$\sqrt{\frac{M}{N}}$

## 7 DNS (2.25 marks)




Consider the network shown above. The delays shown indicate the one way propagation delays on the respective links. The requesting host issues a query to obtain the hostname to IP address mapping for a web server hosted on the target host. You may assume that the size of the DNS request and response messages are small and thus disregard transmission delays for the DNS messages. You may assume there is no other traffic on the links.

Answer the following three questions (0.75 mark for each question)

1) If the requested DNS record is cached in the local DNS server, how long does it take for the requesting host to receive the corresponding DNS reply? Simply note down the final numeric answer in ms in the space provided. You do not need to provide any justification.

40

2) Now assume that all DNS server caches are empty. Assume that all DNS servers use iterated queries. How long does it take for the requesting host to receive the corresponding DNS reply? Simply note down the final numeric answer in ms in the space provided. You do not need to provide any justification.

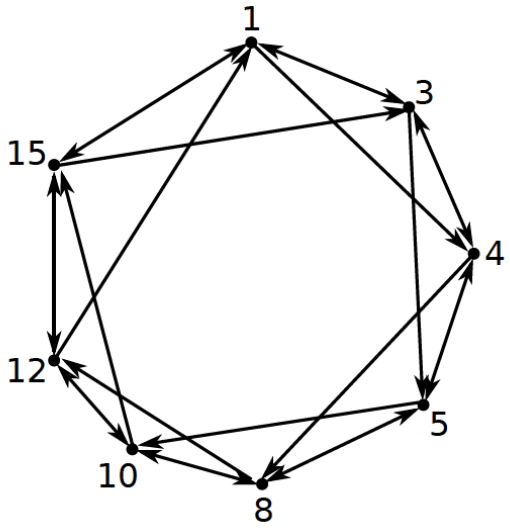
360

3) Assume that all DNS server caches are empty. Assume that all DNS servers use recursive queries. How long does it take for the requesting host to receive the DNS reply? Simply note down the final answers in ms in the space provided. You do not need to provide any justification.

480

## 8 DHT (1 mark)

Consider a circular DHT (Distributed Hash Table) network that is used for storing files where both the node IDs and file content IDs are mapped to the integer range of 0 to 15. Assume that the network is constructed as shown in the figure below where each node in the DHT keeps track of its (i) immediate predecessor (ii) immediate successor and (iii) its second successor (i.e., the successor of the node's immediate successor).




Suppose that **peer 1** wants to learn where file with **content ID 14** is stored. Write down the sequence of nodes that are queried for peer 1 to discover the location of the file. Note that, queries can only be forwarded in the **clockwise** direction. Your answer could simply be a sequence like Peer X -> Peer Y -> Peer Z and so on.

**Fill in your answer here:**

Peer 1 -> Peer 4 -> Peer 8 -> Peer 12 -> Peer 15

# 9 Caching (2 marks)

Web caches uses a conditional request to the origin servers in order to verify the freshness of data. In contrast. DNS uses a time-to-live (TTL): each record is accompanied by a time after which its entry in the cache is invalidated.

Would it make sense for web caches to use the mechanism used by DNS to ensure freshness of data and vice-versa (i.e. for DNS to use the mechanism used by web caches) ? Justify each answer in a few sentences.

**Fill in your answer here**

Web caching is the activity of storing data in local cache for reuse, such as a copy of web page served by a web server, it is cached or stored the first time a user visit the page and the next time a user request the same page, which helps keep the origin server from getting overloaded.

If web caches uses the notion of time to live (TTL), then we a user visit a page after TTL, he or she has to go through every step again to fetch the web page. And this time to visit is not really predictable by the user. So if web caches uses this notion, it will create a lot of load to the server. And for some pages, they don't get uploaded too often, so it is wasting bandwidth to handle such cache mechanism.

Also, if a page gets updated frequently, say within the time of TTL, using DNS cache doesn't really know whether the page has been updated or not.

## 10 GBN and SR (4 marks)

There is a pair of nodes transferring data unidirectionally using a pipelined reliable data transfer protocol. i.e., either Go-Back-N (GBN) or Selective Repeat (SR). Suppose the window size is **4** and the timeout interval is substantially longer than the round-trip time + the time to transmit multiple packets.

To find out exactly which pipelined reliable protocol the connection is using, you install a packet sniffer at the sender side and record the sequence number of data packets coming out of the sender over time. Note that packets may be lost on the underlying channel.

Can you determine if either GBN or SR is being used by the node pair if the recorded pattern of sequence numbers is the following? Justify your answers for both patterns in the space provided. Answers without justifications will not receive any marks (2 mark for each pattern).

1) 1, 2, 3, 4, 5, 2, 3, 4, 5, 6, 7, 8, 9, ...

2) 1, 2, 3, 4, 5, 2, 3, 6, 7, 8, 9, ....

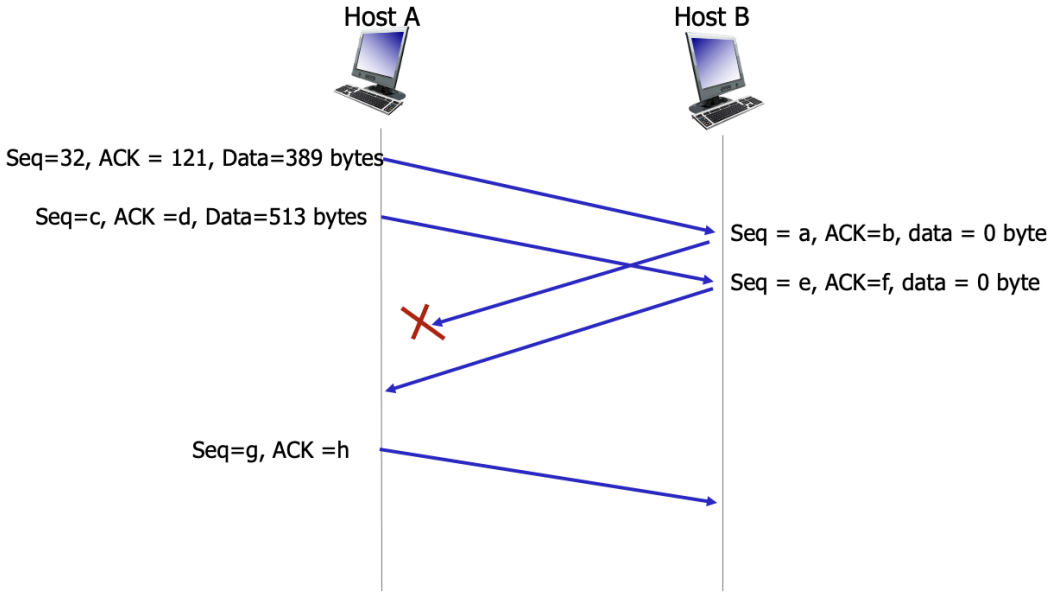
**Fill in your answer for both patterns below:**

The first one is GBN and the second one is SR.

The reason is simple, GBN doesn't have a buffer available at receiver, out of order packets are discarded. in sequence 1), packet 2,3,4,5 are retransmitted. Compared to sequence 2), packet 2 and 3 are retransmitted, but 4 and 5 are not transmitted. This means sequence 2) stores packet 4 and 5 in the buffer and it accepts out of order packets. Therefore sequence 1 is GBN and sequence 2 is SR

# 11 TCP Sequence Numbers (4 marks)

Consider the exchange of TCP segments between Hosts A and B shown in the figure below. The TCP connection establishment process is not shown. The figure depicts all segments exchanged between the two hosts (i.e. no other segments beyond those shown are exchanged). Host A sends two back-to-back data segments (with sequence numbers **32** and **c**, respectively). Host B responds with an ACK for each segment (with sequence numbers **a** and **e**, respectively). The first ACK is lost, the second ACK is received by Host A.




Answer the following questions. Simply note the numeric answers in the space provided. No explanations are required.

What is a? 121

What is b? 421

What is c? 421

What is d? 121

What is e? 121

What is f? 934

Host A transmits a third segment (with sequence number **g**) a few moments after receiving the ACK from Host B. You will need to figure out whether this segment is a retransmission of either of the two previously transmitted data segments or a fresh segment containing new data. Based on this, answer the following questions. Simply note the numeric answers in the space provided. No explanations are required.

What is g? 934

What is h? 121