CEN335-01: COMPUTER NETWORKS
Midterm Exam Sample Questions and Selected Solutions

1- True-False questions:

F	Radio signal can be considered as an example of guided media.
T	In packet-switching hosts break application-layer messages into packets
T	In Internet structure, connecting each access ISP to every other access ISP would make the Internet very fast.
T	In Internet structure, connecting each access ISP to every other access ISP is almost impossible.
F	FDM and TDM are the terms used for packet switching.
F	Store and forward mechanisms are used for circuit switching.
T	The formula for transmission delay is given as L/R.
F	Propagation delay and transmission delays are very similar to each other.
T	While sharing a single file from server to N users, the method of using P2P is faster than Client-Server method.
F	In interactive games, there should not be any data loss during data transmission.
T	UDP does not support reliability during transmission
T	The definition of RTT (Round-Trip-Time): time for a small packet to travel from client to server and back
F	2*RTT is required to initiate a TCP connection
T	non-persistent HTTP requires 2 RTTs per object
T	Web caching is used to reduce response time for client request
F	FTP default server port is 33
F	The main purpose of a DNS is IP address to hostname translation
F	There are about 1300 DNS servers all around the world
T	BitTorrent is an example of P2P architecture

F	In UDP transmitted data will never lost and received data is always in the correct order
T	In rdt3.0 ACK loss can be resolved by timeout operation

2- How many types of delays in packet switched network? What are these?

ANSWER:

There are four types of delays in packet switched networks:

- $d_{proc}: nodal\ processing\ delay$
- $d_{queue}: queueing\ delay$
- $d_{trans}: transmission\ \ delay$
- $d_{prop}: propagation\ delay$

3- What are the name of internet/network protocol layers? Give them in order! Give one example for each of one.

ANSWER:

- Application (e.g. FTP, HTTP)
- Transport (e.g. TCP, UDP)
- Network (e.g. IP)
- Link (e.g. Ethernet)
- Physical (e.g. bits on the wire)

4- What are the main components of an electronic mail? Give example or make the definition of each of them

ANSWER:

a. user agents (e.g. Outlook)
b. mail servers (def: physical servers as mail receivers or senders)
c. simple mail transfer protocol: SMTP (def: network protocol between mail servers)

5- Suppose within your Web browser you click on a link to obtain a Web page. The IP address for the associated URL is not cached in your local host, so a DNS lookup is necessary to obtain the IP address. Suppose that n'DNS servers are visited before your host receives the IP address from DNS; the successive visits incur an RTT of RTT1, …, RTTn. Further suppose that

the Web page associated with the link contains exactly one object, consisting of a small amount of HTML text. Let RTT0 denote the RTT between the local host and the server containing the object.

a. Assuming zero transmission time of the object, how much time elapses from

when the client clicks on the link until the client receives the object?

Now suppose the HTML file references eight very small objects on the same server.

Neglecting transmission times, how much time elapses with

b. Non.persistent HTTP with no parallel TCP connections?

c. Non.persistent HTTP with browser configured for 5 parallel connections?

d. Persistent HTTP?

ANSWER:

a- The total amount of time to get the IP address is $RTT_1 + RTT_2 + \dots + RTT_n$
Once the IP address is known RTT_0 elapses to set up the TCP connection
and another RTT_0 elapses to request and receive the small object. The total
response time is $2RTT_0 + RTT_1 + RTT_2 + \dots + RTT_n$

b- $RTT_1 + RTT_2 + \dots + RTT_n + 2RTT_0 + 8x2RTT_0$

c- $RTT_1 + RTT_2 + \dots + RTT_n + 2RTT_0 + 2x2RTT_0$

d- $RTT_1 + RTT_2 + \dots + RTT_n + 2RTT_0 + RTT_0$

2- Consider distributing a file of F'= 15 Gbits to N'peers. The s.. Consider distributing a file of F = 15 Gbits to N peers. The server has an upload rate of u_s = 30 Mbps, and each peer has a download rate of d_i = 2 Mbps and an uplod rate of u. For N = 10, 100, and 1,000 and u = 300 Kbps, 700 Kbps, and 2 Mbps, prepare a chart giving the minimum

distribution time for each of the combination of N and u for both client-server distribution and P2P distribution.

ANSWER:

For calculating the minimum distribution time for client-server distribution, we use the following formula:

$D_{cs} = \max\{{}^{NF}/_{u_s}, {}^{F}/_{d_{min}}\}$, here we already know that $d_{min} = d_i$

Similarly, for calculating the minimum distribution time for P2P distribution, we use the following formula:

$D_{P2P} = \max\{{}^{F}/_{u_s}, {}^{F}/_{d_{min}}, {}^{NF}/_{(u_s + \sum_{i=1}^{N} u_i)}\}$,

As they are given clearly in the question, we already know that

File Size, F = 15Gbits; Server upload rate $u_s = 30Mbps$;

Each Peer download rate: $d_{min} = d_i =$ 2Mbps. Putting all together:

CLIENT-SERVER			
	N		
Client Upload Rate	**10**	**100**	**1000**
u=300Kbps	7680	51200	51200
u=700Kbps	7680	51200	51200
u=2Mbps	7680	51200	51200
P2P			
	N		
Client Upload Rate	**10**	**100**	**1000**
u=300Kbps	7680	25904	47559
u=700Kbps	7680	15616	21525
u=2Mbps	7680	7680	7680

3- Server A runs a web server on port 80 and an FTP server on port 21. Client 1 opens local port 5001 to establish a TCP session to the web server on Server A. What are the numbers of the destination and source ports in the TCP segments send to the server? Client 2 opens local port 5002 to establish a TCP session to the FTP server on Server A. What are the numbers of the destination and source ports in the TCP segments send to the server?

ANSWER:

Client 1 D=80, S=5001, Client 2 D=21, S=5002

4- How many TCP connections are established between FTP client and sever while the client is downloading a file from the server? If your answer is larger than one, explain what each connection is used for.

ANSWER:

2 connections will be open. One for control the other for the data download

5- By comparing HTTP and SMTP it is often noted that HTTP is a pull protocol and SMTP is a push protocol. a) Based on a client server interaction in the HTTP case, explain why it is described as a pull protocol. b) Based on a mail server to mail server interaction describe why SMTP is described as a push protocol.

ANSWER:

a) In the HTTP case the client downloads (pulls) data from the server.

b) In the SMTP case the sending mail server pushes the mail to the receiving mail server.

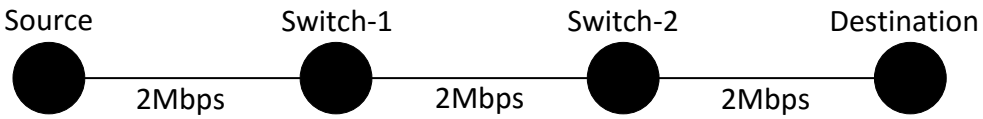
6- Cable and DSL are two residential Internet access technologies. Which one can be described as dedicated and which one as shared?

ANSWER:

Cable, shared, one coax cable shared between clients and head end.

DLS, dedicated, each client is connected by a separate pair of wires.

7- In this problem, assume that source segments, splits messages into smaller packets and sends the packets into the network. The receiver then reassembles the packet back into the original message. Consider a message that is $8*10^6$ bits long that is to be sent from source to destination. Suppose each link has a maximum capacity of 2Mbps. Ignore propagation, queuing, and processing delays. (Hint: Use ony Transmission Delay)



a. Consider sending the message from source to destination without message segmentation. How long does it take to move the message from the source host to the first packet switch? Keeping in mind that each switch uses store---and---forward packet switching, what is the total time to move the message from source host to destination host?

b. Now suppose that the message is segmented into 4,000 packets, with each packet being 2,000 bits long. How long does it take to move the first packet from source host to the first switch? When the first packet is being sent from the first switch to the second switch, the second packet is being sent from the source to the first switch. At what time will the second packet be fully received at the first switch?

c. How long does it take to move the file from source host to destination host

when message segmentation is used? Compare this result with your answer in part (a) and comment.

d. Discuss the drawbacks of message segmentation.

ANSWER:

The solution of this question is already given in the class. Remember that this was the first problem that we solved in the class!

a- 4 sec, 12 sec

b- 1msec, 2msec

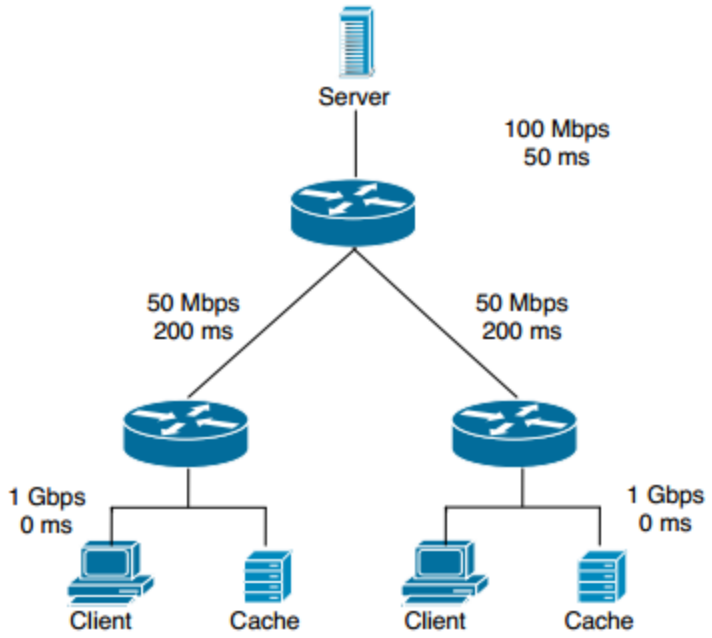
c- 4.002 sec

d- Drawbacks:

i. Packets have to be put in sequence at the destination.

ii. Message segmentation results in many smaller packets. Since header size is usually the same for all packets regardless of their size, with message segmentation the total amount of header bytes is more.

8- Consider the scenario shown in the following figure in which a server is connected to a router by a 100Mbps link with a 50ms propagation delay. Initially this router is also connected to two routers, each over a 50Mbps link with a 200ms propagation delay. A 1Gbps link connects a host and a cache (if present) to each of these routers and we assume that this link has 0 propagation delay. All packets in the network are 20,000 bits long.



a- What is the end-to-end delay from when a packet is transmitted by the server to when it is received by the client? In this case, we assume there are no caches, there's no queuing delay at the routers, and the packet processing delays at routers and nodes are all 0.

b- Here we assume that client hosts send requests for files directly to the server (caches are not used or off in this case). What is the maximum rate at which the server can deliver data to a single client if we assume no other clients are making requests?

c- Now assume that the client on the left-hand side and the client of the right-hand sight are part of a peer-to-peer network. What is the end-toend delay from when a packet is transmitted by the right-hand client to when it is received by the left-hand client? In this case, we assume there are no caches, there's no queuing delay at the routers, and the packet processing delays at routers and nodes are all 0.

d- Again we assume only one active client but in this case the caches are on and behave like HTTP caches. A client's HTTP GET is always first directed to its local cache. 70% of the requests can be satisfied by the local cache. What is the average rate at which the client can receive data in this case?

ANSWER:

The solution of this question is already given in the class. Remember that this was the last (if I remember correctly?) problem that we solved in the class!

a- 250.62 msec

b- 50 Mbps

c- 400.084 msec

d- 715 Mbps