



CS3201 midtern qs - Midterm paper

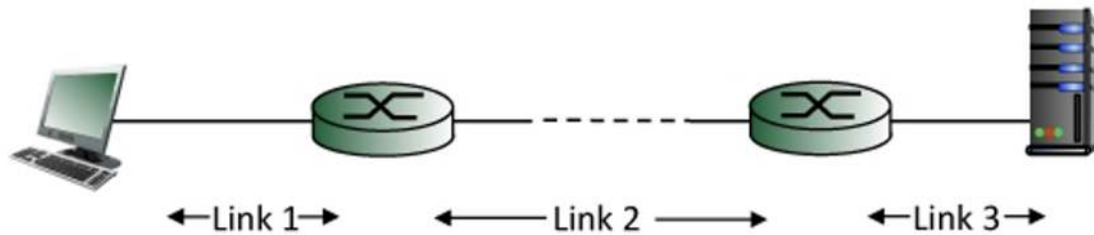
Computer Networks (City University of Hong Kong)



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Mid Quiz Question

1. Consider the connection between the following two hosts.



Suppose that we upgrade the bandwidth of Link 3 but do not change any other parameters of the connection (i.e., the routers and Links 1 and 2 remain unchanged).

Mark the delay(s) that will be affected by this upgrade:

- ☐ Queueing delay
- ☐ Nodal processing delay
- ☐ Transmission delay
- ☐ Singal propagation delay

2. What is DNS used for?

Mark all answers that apply:

- ☐ To resolve the IP address of hostnames
- ☐ To access a remote file in a server with an IP address
- ☐ To provide multiple names to the same machine.
- ☐ To distribute a file among a group of peers.
- ☐ To transfer messages from one mail server to another.

3. (1) Give an application example that it may prefer to use UDP instead of TCP and why?

Multi-media data such as skype communication (UDP), lose data or lower resolution is acceptable

- (2) Give an application example that it may perfer to use TCP instead of UDP and why?

bank account transactions, ftp files (TCP), reliable, and in order data transfer, no loss is allowed

Mid Quiz Question

4. In the context of web caches, mark all **true** statements:

- ☐ The local web proxy is a client, and it is also a server.
- ☐ Web caches may reduce the traffic intensity on a network's access link.
- ☐ After sending the requested object to the client, the web cache will immediately delete the object.
- ☐ Whenever an object is updated, the origin server of the object will automatically inform the web cache to update its stale copy.
- ☐ Web caches can significantly reduce the response time during web browsing.

5. (a) In the context of email protocols, explain the difference between SMTP and a mail-access protocol such as IMAP. (2-3 sentences suffice.)

SMTP is used to push mails from the client to the mail server and communicate between email servers, while IMAP is used to fetch mails from a user mailbox on the mail server.

(b) If a person sends an email to someone else, will which protocol (SMTP/IMAP) be used for the message transfer of that email in the Internet?

SMTP.

(c) If a person wants to read emails from his/her mailbox, should which protocol (SMTP/IMAP) be adopted for this purpose?

IMAP.

6. Consider the following two arrival patterns of packets at a router:

- (A) $3N$ packets arrive periodically. That is, the first N packets arrive simultaneously in the 1st timestep and no other packets arrive during the $N-1$ following timesteps, then after the N timesteps, the next N packets arrive simultaneously, and after $2N$ timesteps, the last N packets arrive simultaneously again.
- (B) There is a sequence of $3N$ packets with one packet arriving every second timestep, where forwarding (or relaying) each packet at the router takes one timestep.

Mark all correct statements:

- ☐ (B) will incur a larger average queuing delay compared to (A).
- ☐ The traffic intensity is exactly 1 for (B).
- ☐ The queuing delay for both (A) and (B) will be roughly the same.
- ☐ (A) will incur a larger average queuing delay compared to (B).
- ☐ The traffic intensity is exactly 1 for (A).

7. In the context of HTTP protocol, mark all **false** statements:

- ☐ The HTTP protocol requires both the client and the server to keep track of several variables such as `rcv_base`.
- ☐ The server-side of the HTTP protocol does not need to remember the previous exchange with the client.
- ☐ Persistent HTTP can achieve a speedup by bypassing the transport layer protocol.
- ☐ A client can establish parallel TCP connections to the same web server.
- ☐ When pipelining is used, a server will can pack multiple objects into the same HTTP response message.

Mid Quiz Question

8. Suppose that we use 8-bit sums instead of 16-bit sums to compute the UDP checksum. Consider the following scenario of a segment transfer between a sender and a receiver:

Transmitted by the sender	Received by the receiver
11011011 (byte 1)	11011 <u>10</u> 1 (byte 1)
11011101 (byte 2)	11011 <u>01</u> 1 (byte 2)
10111001 (checksum)	10110101 (checksum)

Can the receiver detect an error in the segment transmission? Justify your answer.

No, as the receiver cannot detect the error because 2 bits flipped in the same column, and the sum will be the same as the one without the 2 bits flipping.

9. What is the difference between the Go-back-N protocol and Repeat-Selective protocol?

GBN: there is only one timer for each sliding window, the ack is always the last successful one without out of the order. All received packets need to be retransmitted if some packet prior to these packets is missed, wasting lots of bandwidth and resulting in longer delays.

SR: there is a timer for each packet in the sliding window, acknowledge each successful received packet. Only failed packets are retransmitted, but all out of order packets received in the receiver must be buffered, the protocol needs more timer in the sender side and more storage resource in the receiver side.

10. Suppose that 3 bits are used to represent sequence numbers in the **Go-Back-N** protocol.

(a) What is the maximum sender window size such that the protocol works correctly? Justify your answer.

Since the space of sequence numbers is $2^3=8$, the maximum sender window size is no larger than 8, otherwise, the sequence number of a packet sent from the sender cannot be distinguished in the receiver side.

(b) List all sequence numbers in the sender window.

{ 0, 1, 2, 3, 4, 5, 6, 7 }

11. Assume that there are three routers R1, R2 and R3 between Alice's host and Bob's host. The bandwidth of the first link, i.e., from Alice's host to router R1, is B_1 bits/sec. The second link connecting router R1 to router R2 has a bandwidth B_2 bits/sec, the third link connecting router R2 to router R3 has a bandwidth of B_3 bits/sec Bob, and the last link connecting router R3 to Bob has a bandwidth of B_4 bits/sec.

A. What is the end-to-end delay for a packet of L bits that is sent from Alice's host to Bob's host? assuming that queueing, nodal, and propagation delays are ignored.

the end-to-end throughput is $L/B_1 + L/B_2 + L/B_3 + L/B_4$.

B. Give a formula to calculate the throughput of the connection between the two hosts.

the throughput is $\min\{B_1, B_2, B_3, B_4\}$

12. Suppose that hosts A and B communicate with each other using the TCP protocol. What is the size of the TCP send window for host A if the value of *rwnd* (receiver window) advertised by host B is 1500 bytes, the value of *cwnd* (congestion window) is 2500 bytes, and assuming the link between A and B has a bandwidth of 4500 bytes/sec?

As the TCP sender window is determined by the receiver window through its ACK advertises *rwnd* size, in this case, it is 1500, thus, the send window size is 1500, otherwise, the packets will be lost due to exceeding the buffer size in the receiver side B.

Mid Quiz Question

13. Suppose that there are six packets arrived at a receiver, which contain the following address information, respectively

1. Source: 221.177.0.7, port: 8158;
Destination: 183.168.20.5, port: 1000
2. Source: 221.177.0.12, port: 9600;
Destination: 183.168.20.5, port: 1000
3. Source: 221.177.0.7, port: 9600;
Destination: 183.168.20.5, port: 1000
4. Source: 221.177.0.12 port: 9600;
Destination: 183.168.20.5, port: 1300
5. Source: 220.177.0.12 port: 9600;
Destination: 183.168.20.5, port: 1200
6. Source: 221.177.0.12, port: 9600;
Destination: 183.168.20.5, port: 1000

Which of the six packets will be delivered to the same socket?

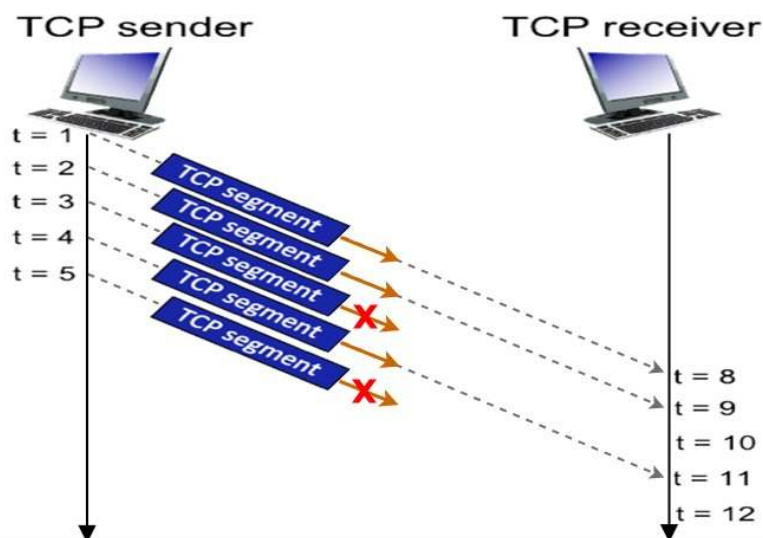
(a) Assume UDP is used.

UDP is used: 1, 2, 3, 6

(b) Assume TCP is used.

TCP is used: 2, 6

14. Consider the figure below in which a TCP sender and receiver communicate over a connection in which the sender-to-receiver segments may be lost. The TCP sender sends an initial window of 5 segments. Suppose the initial value of the sender-to-receiver sequence number is 20, and the number of bytes contained in the first 5 segments are 125, 19, 231, 1200 and 53, respectively. The delay between the sender and receiver is 7 time units, and so the first segment arrives at the receiver at $t=8$. As shown in the figure below, 2 of the 5 segment(s) are lost between the sender and the receiver, i.e., segments 3 and 5 are lost.



- A. Give the ACK number the receiver sends in response to each of the segments.

ACK01: 145

ACK02: 164

ACK04: 164

- B. Give the sequence number associated with each of the 5 segments sent by the sender.

segment 1: 20

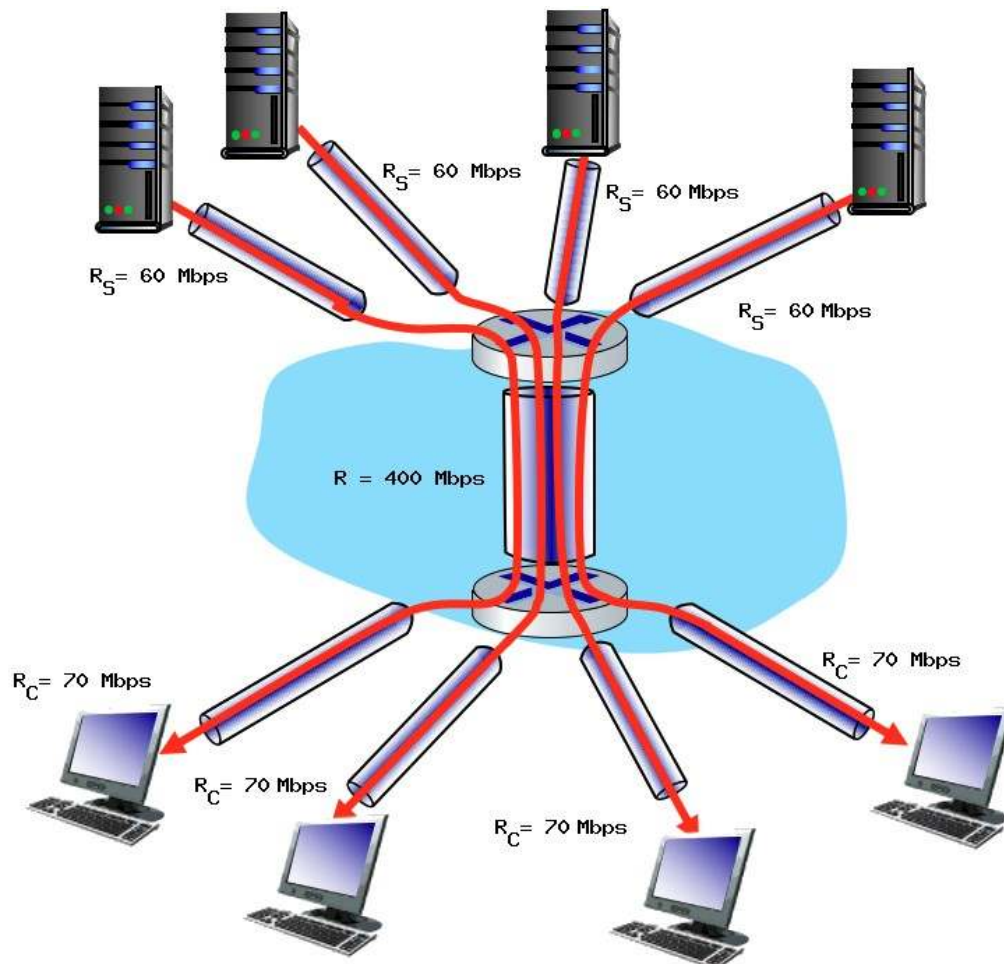
segment2: $20+125=145$

segment3: $145+19=164$

segment4: $164+231=395$

segment5: $395+1200=1595$

15. Consider the scenario shown below, there are four different servers connected to four different clients over four three-hop paths, where the four pairs share a common middle hop with a transmission capacity of $R = 400$ Mbps. Each of the four links from the servers to the shared link has a transmission capacity of $R_S = 60$ Mbps, while each of the four links from the shared middle link to each client has a transmission capacity of $R_C = 70$ Mbps.



- Which link is the bottleneck link in any routing path between a server and a client?

Each of the four routing paths from the shared middle link has a transmission capacity of $R_C = 40$ Mbps is the bottleneck link.

- What is the maximum throughput (in Mbps) for each of four client-to-server pairs, assuming that the transmission rate of the middle link is fairly shared (divides its transmission rate equally) among 4 routing paths?

The maximum throughput is $\min\{85, 280/4, 40\}=40$ Mbps