Tutorial 1 (Week 5)

Note: Some questions are from past exams.

Section I - Multiple Choice, Fill-in Questions

1. List the four different types of delays encountered in packet switched networks:
   a. Transmission
   b. Propagation
   c. Queueing
   d. Processing

2. Consider the operation of downloading a Web page consisting of an index page that references 3 JPEG objects located on the same server. Ignoring latency involved in transferring the objects themselves, fill in the blanks below with the correct values: http1.0 no persistent connection
   a. Utilizing HTTP/1.0 with no parallel connection capability, the number of RTTs required to download the page is 8 rtt, index first then 3 obj.
   b. Utilizing the HTTP/1.1 with pipelining, 3 RTTs are required to download the page.

3. DNS responses have a TTL field. Why is this necessary?

   Answer is (d)

   a. The TTL field is decremented at each DNS server that the response passes through on its way to the client, and servers drop responses with a TTL of 0, so the TTL field prevents responses from looping indefinitely.
   b. The TTL field allows DNS servers to prevent cache poisoning.
   c. The TTL field is necessary for tracking the number of DNS servers involved in resolving the query.
   d. The TTL field causes DNS servers to delete entries after some time, so that if the host moves and the underlying address changes, the server will eventually get the correct address.

4. Transport layer may be able to provide reliability by using its own mechanisms, despite working over an unreliable network layer.
   a. True.
   b. False.

   Answer MAYBE is (a)

5. UDP has which of the following characteristics:

   Answer is (d)

   a. Three-way hand shake for connection establishment.
   b. Connection state at the server.
   c. Regulated send rate.
   d. None of the above.

   UDP
   - is stateless
   -use available bandwidth

   (a), (b), (c) - characteristics TCP

Section II – Problem Solving

Instructions: For numerical questions, calculate the values requested and provide a *numeric answer* for each question. *Show your work* for each problem. Select the numeric result of your calculations from the choices provide, or fill in the blanks where requested.

1. Calculate the *end-to-end delay*, *dend-end*, between the source host and the destination host in a network with 4 routers between source and destination? Assume that the network is NOT congested (i.e. *dqueue* is insignificant), and that:

   d,endtoend = d,proce + d,trans + d,propa
   = 10ms + L/R(trasnmission rate) + (distance)d/Speed
   = 10ms + 10000/1x10^6 + 5x10^3/2.5x10^8
   =20.02ms

   b = bits
   B = bytes

   i. all packets are 10,000 bits in length,
   ii. each link between source and destination is 5 kilometers long,
   iii. the processing time is 10msec at the source host and at each router,
   iv. the transmission rate from the source host and each router is 1Mbps,
   v. the propagation speed of each link is 2.5×10^8 meters/second.

   total = 5 x 20.02
   = 100.1ms

2. UDP and TCP use 1s complement for their checksums. Suppose you have the following three 8-bit bytes: 01010101, 01110000, 01001100. What is the 1's complement of the sum of these 8-bit bytes? (Note although TCP and UDP use 16-bit words in computing the checksum, for this problem we will only consider 8-bit summands). Show all work. Is it possible that a 1-bit error will go undetected by the checksum? How about a two-bit error?

   01010101 -> 11000101 -> 00010001 1's complement
   01110000 01001100 1 11101101
   00010010

   yes for most 1 - bit, yes for most 2-bit

3. Answer these questions in a concise manner. A few sentences (2-3) should suffice.
   a. List one advantage and one disadvantage of using a text-based header (as in HTTP) instead of a binary format (as in IP and TCP).
      adv - easy to read, extensible
      dis - size, parsing
   b. Web caches and content distribution networks (CDNs) both reduce the time for a client to download Web pages by moving content closer to the users. Give two reasons why CDNs have been more widely deployed (and successful) than Web caching?
      1. performance
      2. availability (load balancing)
      3. can save dynamic content
      4. cost

      cost money and maintenance
      doesn't not support dynamic

4. Salil wants to watch a live stream of a UEFA soccer game using the VLC video player. He opens VLC and points it to vid1.streaming.uefa.com. The local DNS client in Salil's machine contacts his local DNS server to translate the host name to an IP address. The local DNS server performs an **iterative lookup**. The table below contains the DNS entries with each row corresponding to a DNS record. The entries are grouped by the DNS server in which they are stored. For example, R1 and R2 are stored in the local DNS server (localdns.localdomain.com), R3 and R4 are stored in the E root server, and so on.

Record #	Name	TTL (sec)	IN	Type	Value
localdns.localdomain.com					
R1	.	262542	IN	NS	e.root-servers.net
R2	e.root-servers.net	348942	IN	A	192.203.230.10
e.root-servers.net					
R3	com.	172800	IN	NS	f.gtld-servers.net
R4	f.gtld-servers.net	172800	IN	A	192.35.51.30
f.gtld-servers.net					
R5	uefa.com.	172800	IN	NS	4klinsmann.uefa.com.
R6	4klinsmann.uefa.com.	172800	IN	A	205.153.37.175
4klinsmann.uefa.com.					
R7	streaming.uefa.com.	10	IN	NS	ns.streaming.uefa.com.
R8	ns.streaming.uefa.com.	10	IN	A	205.153.36.175
ns.streaming.uefa.com.					
R9	video.streaming.uefa.com.	10	IN	CNAME	vidl.streaming.uefa.com
R10	vidl.streaming.uefa.com.	10	IN	A	205.153.36.221

(a) Copy the figure below (Figure 1) to the answer booklet. Draw arrows to indicate the sequence of queries and responses exchanged among the different name servers. Label each arrow with a sequence number. Copy the table below to the answer booklet and fill in the table to indicate the following information:

- Sequence number indicating the ordering of the message exchanges.
- Message Type: use Q for query and R for response.
- Data: For queries use the value of the question data. For responses, specify the record ID(s) returned, if any, from the first column in the table above (e.g. R1, R2, ...).

Seq	Type	Data
1	Q	vidl.streaming.uefa.org (A)
2	Q	vidl.streaming.uefa.org(A)
3	R	R3(NS), R4(A)
4	Q	vidl.streaming.uefa.org(A)
5	R	R5(NS), R6(A)
		Add rows as necessary
6	Q	vidl.streaming.uefa.org(A)
7	R	R7(NS), R8(A)
8	Q	vidl.streaming.uefa.org(A)
9	R	R9(CNAME), R10(A)
10	R	R9(CNAME), R10(A)

Figure 1 already contains an arrow indicating the first message from the DNS client on Salil's machine to his local DNS server. The sequence number is 1 (first message), type = Q (query) and the data is the host name that the application wants to resolve (vid1.streaming.uefa.com). To make your sequence as simple as possible, assume that the server includes both the A and NS records when applicable.

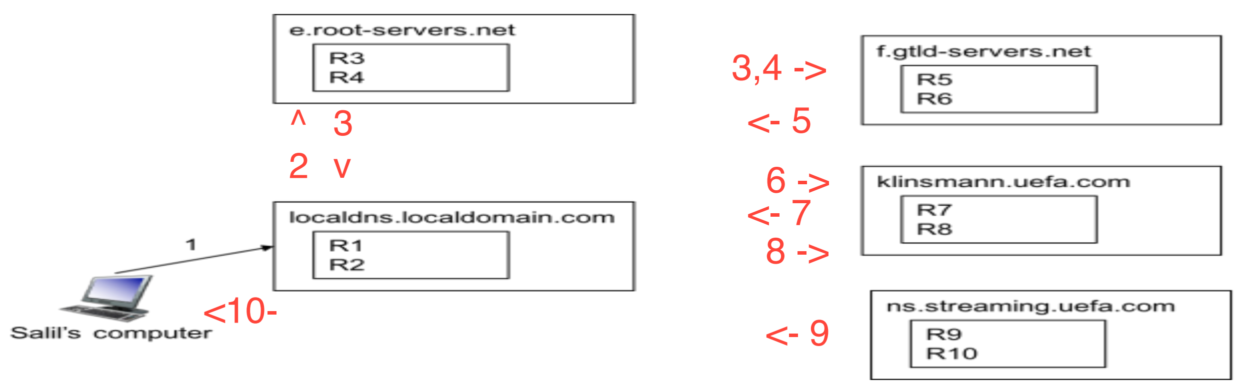


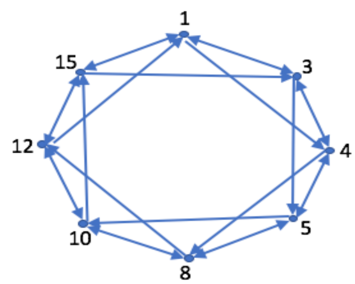
Figure 1: Figure for Question 4

(b) Salil repeats his query two minutes later. Show what happens for this subsequent query. Draw a new picture (Figure 1) showing the interactions between the various name servers and provide a new table showing the details of the DNS messages as in part (a). just R7, R8 - R9, R10

5. Two hosts located at two ends of a continent are trying to transfer data using a window based reliable transport protocol (for pipelining). Suppose that the one-way propagation delay between the hosts is 15 milliseconds. If the hosts are using packets of length 1500 bytes over a 1 Gbps transmission link, how big the window size must be for the channel utilization to be greater than 98%?

$0.98 = (X * L/R)/(L/R + 30 \text{ ms})$ $\quad$ $0.98 = (X * 1500/10^9)/(30*10^{-3} + 1500/10^9)$

6. Consider the circular DHT with shortcuts in Figure below, where each node in the DHT also keeps track of (i) its immediate predecessor, (ii) its immediate successor, and (iii) its second successor (i.e., the successor of the node's immediate successor).



a. Suppose that peer 1 wants to learn where file with content ID 9 is stored. Write down the sequence of DHT protocol messages that the nodes exchange until peer 1 discovers the location of the file. 1 -> 4 -> 8 -> 10

b. Suppose that peer 3 learns that peer 5 has left. How does peer 3 update its successor state information? 3 ask 4 sends either (1) = 5 (2) = 8 or (1) = 8 (2) = 10

Now consider that the DHT nodes do not keep track of their second successor (the figure should look like lecture notes with a simple circular DHT). Suppose that a new peer 6 wants to join the DHT and peer 6 initially only knows the IP address of peer 15. What steps are taken?

1 -> 3 -> 4 -> 5, 5 will tell 8 and it send to 6 then 5 will point to 6

7. Consider a TCP connection between sender A and receiver B. Sender A sends a 900 byte TCP segment with sequence number 3100 and header length 20 bytes. What acknowledgement number will receiver B reply with to inform sender A that it has received this segment correctly and in order? (Ignore the possibility of a cumulative ack for this question.)

data = 900 - 20   seq + data = 3100 + 880

8. Given that the previously calculated values for Estimated RTT and RTT Deviation are as shown below, and that the new sample RTT shown has just been measured, what Timeout interval will TCP use for the next transmitted segment? DevRTT = (1-B) * DevRtt + B | sampleRtt - Est Rtt |

i. EstimatedRTT (k) = 4 msec
ii. DevRTT (k) = 2 msec
iii. new SampleRTT = 8 msec
iv. $\alpha = .125$
v. $\beta = .25$

= (1-0.25)*2 + 0.25(8-4)
= 2.5ms

est RTT = (1 - a) * k + a sample Rtt
= (1-.125) * 4 + .125 * 8
= 4.5ms

timeout = Est Rtt + 4 DevRtt
= 4.5 + 4*2.5
=14.5ms

9. Two hosts A and B establishes a TCP connection. Host A transfer 200 Bytes to Host B in a single TCP segment that is successfully received and acknowledged by B. Host B then transfers 1000 Bytes to Host A in a single segment that A acknowledges. Host B then closes the connection by issuing a FIN that is acknowledged by Host A. Host A now issues a FIN segment that is acknowledged by B. Assume that the Initial Sequence Numbers (ISN) used by Host A and B are 33000 and 55000, what are the sequence numbers used by A and B in their final ACK send in response to the FIN segment from the other side?

seg | type | sender | receiver | seq | ackno | data

1 | syn | A | B | 33000 | NA | 1
2 | syn/ack | B | A | 55000 | 33001 | 1
3 | ack | A | B | 33001 | 55001 | 0
4 | data | A | B | 33001 | 55001 | 200
5 | ack | B | A | 55001 | 33201 | 0
6 | data | B | A | 55001 | 33201 | 1000
7 | ack | A | B | 33201 | 56001 | 0
8 | fin | B | A | 56001 | 33201 | 1

9 | ack | A | B | 33201 | 56002 | 0
10 | fin | A | B | 33201 | 56002 | 1
11 | ack | B | A | 56002 | 33202 | 0