National University of Computer & Emerging Sciences, Karachi
FAST School of Computing
Midterm I Examination SOLUTION, Spring 2023
27th February 2023, 11:30 am – 12:30 pm

Course Code: CS-3001	Course Name: Computer Networks
Instructor Names: Dr. Sufian Hameed, Dr. Farrukh Salim, Mr. Shoaib Raza, Ms. Yusra Kaleem	
Student Roll No:	Section No:

Instructions:

- Return the question paper.
- **All questions must be answered in answer script and according to the sequence given in the question paper.**
- In case of any ambiguity, you may make an assumption. But your assumption should not contradict any statement in the question paper.

Time: 60 minutes. **Max Marks**: 50 Points

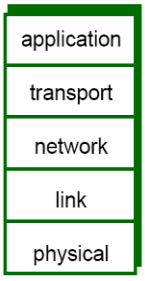
Question 1: Briefly discuss the following:

a) What are the four different sources of packet delays? How does packet loss occur? **CLO#: 01 [05 Points]**

1. **Nodal processing: Error checks and link determination.**
2. **Queuing: Congestion at router? Time wait at output link (e.g. when shared channel is busy)**
3. **Transmission delay: Writing data to the link**
4. **Propagation delay: Typically the speed of light and level 1 processing.**

b) List five layers, from top to bottom, in the Internet protocol stack? How many layers are implemented in a switch? **CLO#: 01 [05 Points]**

- A switch processes up to layer 2. It uses the physical and the link layer.
- Advantages: Isolation, transparent to changes in other layers
- Disadvantages: Isolation ;), cannot optimize across layers



Question 2: Consider the scenario shown in figure 1, with four different servers connected to four different clients over four three-hop paths. The four pairs share a common middle hop with a transmission capacity of R = 100 Mbps. The four links from the servers to the shared link have a transmission capacity of R_S = 20 Mbps. Each of the four links from the shared middle link to a client has a transmission capacity of R_C = 90 Mbps per second. **CLO#: 01 [10 Points]**

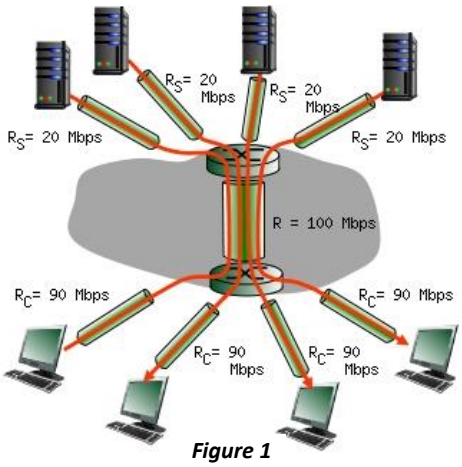


Figure 1

a) What is the maximum achievable end-end throughput (in Mbps) for each of four client-to-server pairs, assuming that the middle link is fair-shared (i.e., divides its transmission rate equally among the four pairs)?

b) Which link is the bottleneck link for each session?
c) Assuming that the senders are sending at the maximum rate possible, what are the link utilizations for the sender links (R_S), client links (R_C), and the middle link (R)?

Answer:

a) The maximum achievable end-end-throughput is 20 Mbps.
b) This is the transmission capacity of the first hop, which is the bottleneck link, since the first-hop transmission capacity of 20 Mbps is less than one quarter of the shared-link transmission capacity (100/4 = 25 Mbps) and less than the third-hop transmission capacity of 90 Mbps.
c) The utilization of sender links is 100% . The utilization of receiver links is 22.22% . The utilization of the middle link is 80% .

Question 3: The text below shows the reply sent from the server in response to the HTTP GET message. Answer the following questions, indicating where in the message you find the answer. **CLO#: 02 [10 Points]**

HTTP/1.1 200 OK<*cr*><*lf*>Date: Tue, 07 Mar 2008 12:39:45GMT<*cr*><*lf*>Server: Apache/2.0.52 (Fedora)
<cr><lf>Last-Modified: Sat, 10 Dec2005 18:27:46 GMT<*cr*><*lf*>ETag: "526c3-f228a4c80"<*cr*><*lf*>Accept-Ranges: bytes<*cr*><*lf*>Content-Length: 3874<*cr*><*lf*>Keep-Alive: timeout=max=100<*cr*><*lf*>Connection: Keep-Alive<*cr*><*lf*>Content-Type: text/html; charset=ISO-8859-1<*cr*><*lf*><*cr*><*lf*><!doctype html public "-//w3c//dtd html 4.0 transitional//en"><*lf*><html><*lf*><head><*lf*> <meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1"><*lf*> <metaname="GENERATOR" content="Mozilla/4.79 [en] (Windows NT5.0; U) Netscape]"><*lf*> <title>CMPSCI 453 / 591 / NTU-ST550A Spring 2005 homepage</title><*lf*></head><*lf*><*much more document text following here (not shown)*>

a) Was the server able to successfully find the document or not? What time was the document reply provided?
b) When the document was last modified?
c) How many bytes are there in the document being returned?
d) What are the first 5 bytes of the document being returned? Did the server agree to a persistent connection?

ANSWERS

a) The status code of 200 and the phrase OK indicate that the server was able to locate the document successfully. The reply was provided on Tuesday, 07 Mar 2008 12:39:45 Greenwich Mean Time.
b) The document index.html was last modified on Saturday 10 Dec 2005 18:27:46 GMT.
c) There are 3874 bytes in the document being returned.
d) The first five bytes of the returned document are : <!doc. The server agreed to a persistent connection, as indicated by the Connection: Keep-Alive field

Question 4: **nu.edu.pk** is registered and hosted with Dreamhost. Both the webserver and mailserver of **nu.edu.pk** are associated with 111.112.113.114 and 111.112.113.115 respectively. The primary authoritative name serve of Dreamhost is dns1.dreamhost.com which is mapped to 192.1.1.4. List down all the resource records (RRs) that will be inserted into the authoritative name server and .com's TLD (top level domain) server. **CLO#: 02 [10 Points]**

RR Inserted in Authoritative NS

- **(nu.edu.pk, 111.112.113.114, A)**
- **(nu.edu.pk, 111.112.113.115, MX)**

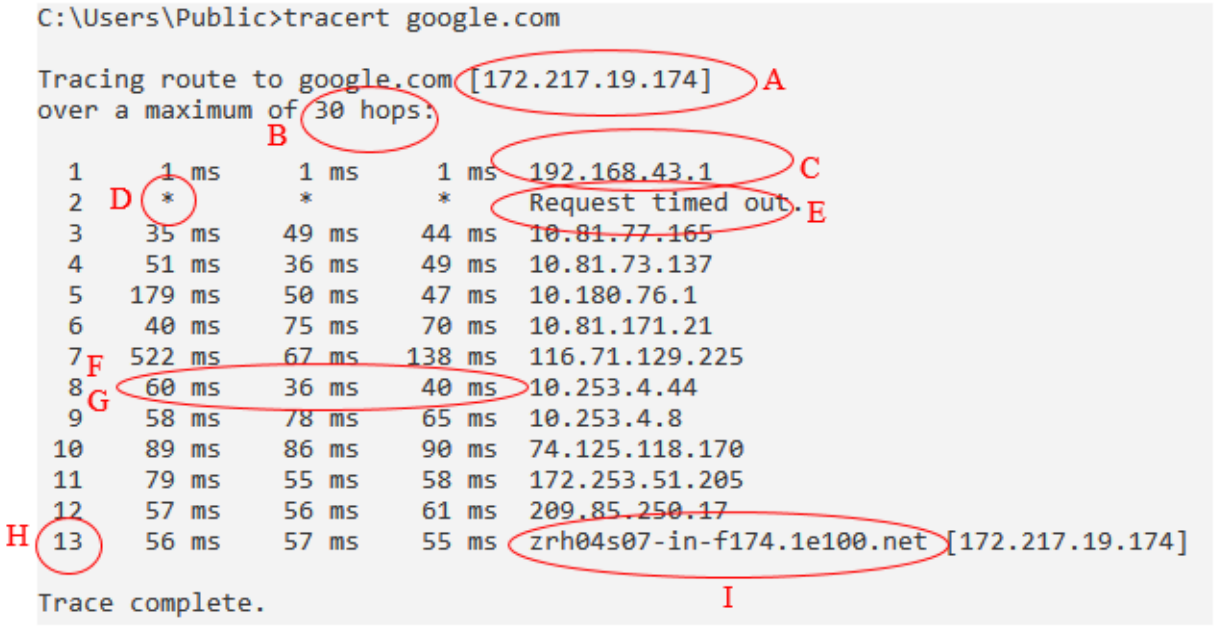
RR Inserted in TLD

- **(nu.edu.pk, dns1.dreamhost.com, NS)**
- **(dns1.dreamhost.com, 192.1.1.4, A)**

Question 5: For the result of the traceroute command shown below in Figure 1, give answers for below questions:

CLO#: 01 [10 Points]

A. If traceroute command runs again, will the IP address shown by point A will be always this same for google.com? If no, and any other IP address is also possible, then why?
B. What this '30 hops' represents?
C. Which device is represented by the IP address of Point C in the network?
D. What * represents, as shown by point E?
E. On running traceroute command, the result for this line shown by point E is always 'Request timed out'. What could be the possible reason behind this?
F. What these three different values represents, as shown by point F or G, and why these three values are mostly not same? and why not only one value suffices?
G. Why the values of F (hop 7) are mostly smaller than values of G (hop 8)? Give reason.
H. What is the importance of this number 13 shown by point H?
I. What this URL is, as shown by point I?



Solution:

A. No, because google.com runs on many servers, so any one IP address will be used from the pool of the IP address, which will not necessarily be the same as previous IP address. Moreover, anycast routing is used, in which any one google server will reply to the request.
B. This represents that if the number of hops with destination node is more than 30 number of hops, then this traceroute command or the connection will not run.
C. The first router or the gateway address.
D. * means the reply has not received within timeout.
E. Because the second device has restricted to reply to ping commands.
F. These represent the Round Trip Time (RTT). Three values are taken to measure average behavior. The variation is mostly due to queuing delay. The average delay cannot be estimated by one measurement only.
G. Every router RTT varies mostly due to the variable queuing delays.
H. This represent the last hop. Because it is the maximum number of total hops encountered with the server.
I. This is the real URL name of the server, called canonical name.

Best of Luck!!!