National University of Computer and Emerging Sciences, Lahore Campus

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| Course Name: | Computer Networks | Course Code: | CS307 | |
| Degree Program: | BS (CS) | Semester: | Fall 2019 | |
| Exam Duration: | 150 Minutes | Total Marks: | 70 | |
| Paper Date: | 12-Dec-2019 | Weight | 40 | 15 |
| Section: | ALL | Page(s): | 6 | |
| Exam Type: | Final Exam | | | |

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Instruction/Notes:
- Attempt all questions on the provided question paper.
- Even if you use rough sheets, they should NOT be attached with final paper.
- No need to ask questions. If you have confusions, take assumptions where needed.

**Question 01: Answer the multiple-choice questions by choosing one option. Fill the provided table with answers. Any answers outside the table will NOT be marked.**

| | | | |
|---|---|---|---|
| 1 | c ~ | 6 | d x |
| 2 | c ~ | 7 | a ~ |
| 3 | a ~ | 8 | c x |
| 4 | c + | 9 | d x |
| 5 | b x | 10 | c ~ |

6 − 1 = 5 / 10

1 Which of the following mapping does Address Resolution Protocol (ARP) provide to the host:
- a. IPv4 to IPv6
- b. Hostname to IP address
- c. IP address to MAC address ✓
- d. MAC address to interface ID

2 Which of the following is NOT an algorithm used to determine the best routing path in computer networks.
- a. Bellman-Ford Algorithm
- b. Dijkstra's Algorithm
- c. Brent's Algorithm ✓
- d. None of the above

3 Which is the following header fields does a router modify while fragmenting an IPv4 packet.
- a. Flag, Identifier, and offset ✓
- b. Header length, offset, and flag
- c. Protocol, header length, and identifier
- d. Destination IP, Source IP, and flag

4 It is possible to detect and correct multiple bit errors on link layer using
- a. CRC
- b. Ethernet
- c. 2-D parity scheme ✓
- d. None of the above

5 Which of the following is NOT a server-side connection state?
- a. SYN_RCVD
- b. ESTABLISHED ✓
- c. TIME_WAIT

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**[20 points] Question 2.** A certain organization has been assigned a network address block 201.180.128.0/23.

It has been determined that the organization needs:

201.180.128.0

7 bits reserved.

128 = 10000000

- 1 network with at least 240 hosts
- 1 network with at least 55 hosts
- 1 network with at least 28 hosts
- 2 networks with at least 15 hosts

a) Design the complete IP addressing scheme for this organization and **fill in the table below.** Show all your work with appropriate comments (if any). **[15 points]** // As we can not use the broadcast address as the last hope that's why increment it.

5/15

| Network | Network Address | Subnet mask | First available host address | Last available host address | # of available host addresses |
|---|---|---|---|---|---|
| 1 → | 201.180.128.0 | /24 | 201.180.128.1 | 201.180.128.240 | 240 |
| Network 1 | 201.180.128.242 | /23 | 201.180.128.243 | 201.180.129.41 | 55 |
| Network 2 | 201.180.129.43 | /25 | 201.180.129.44 | 201.180.129.71 | 28 |
| Network 3 | 201.180.129.73 | /27 | 201.180.129.74 | 201.180.129.88 | 15 ✗ |
| Network 4 | 201.180.129.90 | /26 | 201.180.129.91 | 201.180.129.105 | 15 ✗ |
| Network 5 | ✗ | | | | |

R.W

b) An internet user wants to examine the path that their data packets follow while accessing www.google.com, for which they use *traceroute* network tool. **[5 points]**

| | |
|---|---|
| A T | 1 |
| I N | |
| D P | 5 |

0/2 ✗

i. What layer-3 *protocol* does *traceroute* use?

Network Layer Protocol = SMTP

ii. Explain (in detail) how *traceroute* uses the available network infrastructure to achieve the desired goal?

2/3 → First of all it depends upon the host which we are using. i-e laptop, PC, etc.
→ From Host it will get the IP of ~~router~~ switch
→ Then router
→ Local ISP
→ Global ISP (Internet Service Provider)

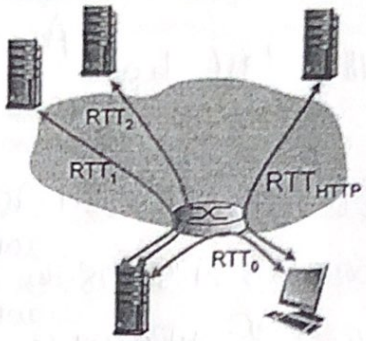


→ From Global ISP it will find out the IP address of google.com, soin this way the Trace route of google.com will be examined.

3/

**[20 points] Question 3:** Suppose within your Web browser you click on a link to obtain a Web page. The IP for the associated URL is not cached in your localhost, so a DNS lookup is necessary to obtain the IP address. that three DNS servers are visited before your host receives the IP address from DNS. The first DNS server visit the local DNS cache, with an RTT delay of $RTT_0 = 3$ msecs. The second and third DNS servers contacted have R of 27 and 49 msecs, respectively. Initially, let's suppose that the Web page associated with the link contains exactly one object, consisting of a small amount of HTML text. Suppose the RTT between the local host and the Web server containing the object is $RTT_{HTTP} = 37$ msecs.

Host → Resolver → Root → TLD → Appropriate




1. Assuming zero transmission time for the HTML object, how much time elapses from when the client clicks on the link until the client receives the object?

2. Now suppose the HTML object references 10 very small objects on the same web server. Neglecting transmission times, how much time elapses from when the client clicks on the link until the base object and all 10 additional objects are received from web server at the client, assuming non-persistent HTTP and no parallel TCP connections?

3. Repeat 2. above but assume that the client is configured to support a maximum of 5 parallel TCP connections, with non-persistent HTTP.

4. Repeat 2. above but assume that the client is configured to support a maximum of 5 parallel TCP connections, with persistent HTTP.

*Answers:*

1. First it went to local DNS Then. 1 and 2 respectively

Host → Local DNS → 1 → Local → 2 → Local → Main (Found)



Total Time elapses = $2RTT_0 + 2RTT_1 + 2RTT_2 + RTT$

$= 6 + 54 + 98 + 37 = 195$ sec

~~5335 msec~~

e. The IP
e IP address
's server visit
ted have R
s exactly
h server

Total Time Elapse = =935 msec

2/5

3. ~~(195 + 10(37))~~ ∴ (195 + 10(37))

0/5 Total Time Elapse = 307 msecs

4.

0/5 Total Time elapse = 264 msec.

**[20 points] Question 4:** Suppose Node A (sender) and B (receiver) have a TCP connection between them. Assume that a single segment seg (x-1) is timed out. Consider the size of the TCP receiver buffer is 300 bytes. Assuming all packets of equal size i.e. 64 bytes, if *ssthreshold* = 6, then **answer the following questions in table given below** by looking at the provided figure:

1) Provide
   a. Sequence number of seg (x+2)
   b. Acknowledgement of seg (x+2)
2) Sequence number of bytes of seg (x+4)
3) *Receiver window* field value in acknowledgment of seg (x+3)
4) *Receiver window* field value in acknowledgement of seg (x+4)
5) Value of *window size* and *ssthreshold* after acknowledgement of seg (x+6) is received?
6) TCP receiver sometimes waits for 500ms before sending an acknowledgement of a newly arrived segment. For how long will receiver wait before sending ack for seg (x+4)?
7) Assuming seg (x) to be sent in the first transmission round, how many segments will be sent in the third transmission round?
8) Assume no loss occurs, what will be the last segment that will be sent in the *slow start* phase starting from seg(x)?
9) What is the link utilization during the *slow start* phase if the link capacity is 10 Mbps and the RTT between node A and B is 15ms?
10) Suppose after receiving 50 segments from the source, node B lost synchronization with A. Write the name and value of the field used by destination B to notify source node A.

**NOTE: Answer all numbers in decimal number system ONLY (where applies). For segment numbers, use the notation of seg(x) where *x* is the number of a segment.**