Assignment 1 (individual assignment)

Course Name: COMPUTER NETWORK Course Code: CMNT5330

Semester: March 2016 Lecturer: Dr. Mohammed Awadh Ben Mubarak

First Assignment Questions (%20 of the carry mark)

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1. What advantage does a circuit-switched network have over a packet-switched network? What advantages does TDM have over FDM in a circuit-switched network?

2. Consider sending a packet from a source host to a destination host over a fixed route. List the delay components in the end-to-end delay. Which of these delays are constant and which are variable?

3. Suppose Host A wants to send a large file to Host B. The path from Host A to Host B has three Jinks, of rates R 1 = 500 kbps, R2 = 2 Mbps, and R3 = I Mbps.
   a. Assuming no other traffic in the network, what is the throughput for the file transfer.
   b. Suppose the file is 4 million bytes. Dividing the file size by the through put, roughly how long will it take to transfer the file to Host B?
   c. Repeat (a) and (b), but now with R2 reduced to 100 kbps.

4. Consider an application that transmits data at a steady rate (for example, the sender generates an N-bit unit of data every k time units, where k is small and fixed). Also, when such an application starts, it will continue running for a relatively long period of time. Answer the following questions, briefly justifying your answer:
   a. Would a packet-switched network or a circuit-switched network be more appropriate for this application? Why?
   b. Suppose that a packet-switched network is used and the only traffic in this network comes from such applications as described above. Furthermore, assume that the sum of the application data rates is less than the capacities of each and every link. Is some form of congestion control needed? Why?

5. Suppose you would like to urgently deliver 40 terabytes data from Boston to Los Angeles. You have available a 100 Mbps dedicated link for data transfer. Would you prefer to transmit the data via this link or instead use FedEx overnight delivery? Explain

6. For a communication session between two hosts, which host is the client and which is the server?

7. What information is used by a process running on one host to identify a process running on another host?

8. Suppose you wanted to do a transaction from a remote client to a server as fast as possible. Would you use UDP or TCP? Why?

9. Describe how Web caching can reduce the delay in receiving a requested object. Will Web caching reduce the delay for all objects requested by a user or for only some of the objects? Why?

10. What is an overlay network? Does it include routers? What are the edges in the overlay network? How is the query-flooding overlay network created and maintained?

11. For the client-server application over TCP, why must the server program be executed before the client program? For the client server application over UDP, why may the client program be executed before the server program?

12. Consider an HTTP client that wants to retrieve a Web document at a given URL. The IP address of the HTTP server is initially unknown. What transport and application-layer protocols besides HTTP are needed in this scenario?

13. Suppose the network layer provides the following service. The network layer in the source host accepts a segment of maximum size 1,200 bytes and a destination host address from the transport layer. The network layer then guarantees to deliver the segment to the transport layer at the destination host. Suppose many network application processes can be running at the destination host.
    a. Design the simplest possible transport-layer protocol that will get application data to the desired process at the destination host. Assume the operating system in the destination host has assigned a 4-byte port number to each running application process.
    b. Modify this protocol so that it provides a "return address" to the destination process.
    c. In your protocols, does the transport layer "have to do anything" in the core of the computer network?

14. Consider a TCP connection between Host A and Host B. Suppose that the TCP segments traveling from Host A to Host B have source port number x and destination port number y. What are the source and destination port numbers for the segments traveling from Host B to Host A?

15. Describe why an application developer might choose to run an application over UDP rather than TCP.

16. Is it possible for an application to enjoy reliable data transfer even when the application runs over UDP? If so, how?

17. Suppose that a Web server runs in Host C on port 80. Suppose this Web server uses persistent connections, and is currently receiving requests from two different Hosts, A and B. Are all of the requests being sent through the same socket at Host C? If they are being passed through different sockets, do both of the sockets have port 80? Discuss and explain.

18. Suppose Host A sends two TCP segments back to back to Host B over a TCP connection. The first segment has sequence number 90; the second has sequence number 110.
    a. How much data is in the first segment?
    b. Suppose that the first segment is lost but the second segment arrives at B. In the acknowledgment that Host B sends to Host A, what will be the acknowledgment number?
    c. Suppose that the first segment is lost but the second segment arrives at B. In the acknowledgment that Host B sends to Host A, what will be the acknowledgment number?

19. Suppose Client A initiates a Telnet session with Server S. At about the same time. Client B also initiates a Telnet session with Server S. Provide possible source and destination port numbers for

a. The segments sent from A to S.
b. The segments sent from B to S.
c. The segments sent from S to A.
d. The segments sent from S to B.
e. If A and B are different hosts, is it possible that the source port number in the segments from A to S is the same as that from B to S!
f. How about if they are the same host?

20. UDP and TCP use 1's complement for their checksums. Suppose you have the following three 8-bit bytes: 01010011, 01010100, 01110100. What is the 1's complement of the sum of these 8-bit bytes?

21. Consider transferring an enormous file of L bytes from Host A to Host B. Assume an MSS of 536 bytes.
    a. What is the maximum value of L such that TCP sequence numbers are not exhausted? Recall that the TCP sequence number field has 4 bytes.
    b. For the L you obtain in (a), Find how long it takes to transmit .the file. Assume that a total of 66 bytes of transport, network, and data-link header are added to each segment before the resulting packet is sent out over a 155 Mbps link. Ignore flow control and congestion control so A can pump out the segments back to back and continuously.

22. Host A and B are communicating over a TCP connection, and Host B has already received from A all bytes up through byte 126. Suppose Host A then sends two segments to Host B back-to-back. The first and second segments contain 70 and 50 bytes of data, respectively. In the first segment, the sequence number is 127, the source port number is 302, and the destination port number is 80. Host B sends an acknowledgement whenever it receives a segment from Host A.
    a. In the second segment sent from Host A to B, what are the sequence number, source port number, and destination port number?
    b. If the first segment arrives before the second segment, in the acknowledgement of the first arriving segment, what is the acknowledgment number, the source port number, and the destination port number?
    c. If the second segment arrives before the first segment, in the acknowledgement of the first arriving segment, what is the acknowledgment number?
    d. Suppose the two segments sent by A arrive in order at B. The first acknowledgement is lost and the second acknowledgement arrives after the first timeout interval. Draw a timing diagram, showing these segments and all other segments and acknowledgements sent. (Assume there is no additional packet loss.) For each segment in your figure, provide the sequence number and the number of bytes of data; for each acknowledgement that you add, provide the acknowledgement number.

23. Host A and B are directly connected with a 100 Mbps link. There is one TCP connection between the two hosts, and Host A is sending to Host B an enormous file over this connection. Host A can send its application data into its TCP socket at a rate as high as 120 Mbps but Host B can read out of its TCP receive buffer at a maximum rate of 60 Mbps. Describe the effect of TCP flow control.

24. Consider that only a single TCP (Reno) connection uses one 10 Mbps link which does not buffer any data. Suppose that this link is the only congested link between the sending and receiving hosts. Assume that the TCP sender has a huge file to send to the receiver, and the receiver's receive buffer is much larger than the congestion window. We also make the following

assumptions: each TCP segment size is 1,500 bytes; the two-way propagation delay of this connection is I 00 msec; and this TCP connection is always in congestion avoidance phase, that is, ignore slow start.

a. What is the maximum window size (in segments ;) that this TCP connection can achieve'?

b. What is the average window size (in segments) and average throughput (in bps) of this TCP connection?

c. How long would it take for this TCP connection to reach its maximum window again after recovering from a packet loss?

25. Do the routers in both datagram networks and virtual-circuit networks use forwarding tables? If so, describe the forwarding tables for both classes of networks.

26. Three types of switching fabrics are discussed in course. List and briefly describe each type.

27. Suppose there are three routers between a source host and a destination host. Ignoring fragmentation, an IP datagram sent from the source host to the destination host will travel over how many interfaces? How many forwarding tables will be indexed to move the datagram from the source to the destination?

28. Explain 4 types of DNS Resource Record (RR).

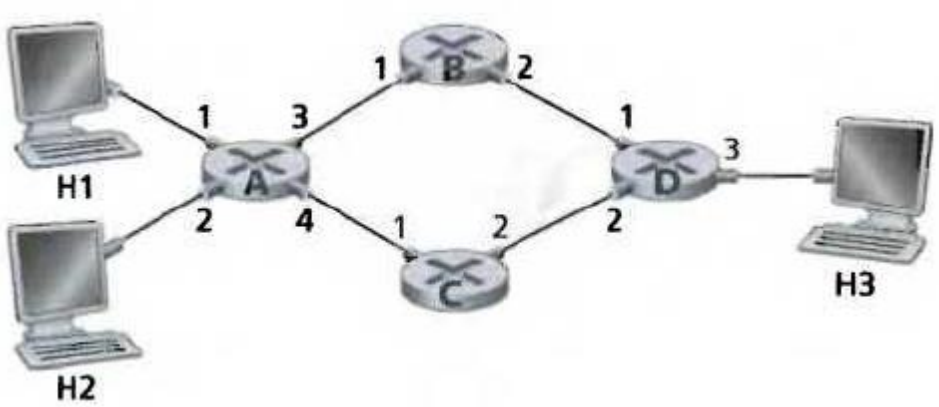
29. Compare and contrast link-state and distance-vector routing algorithms.

30. Discuss how a hierarchical organization of the Internet has made it possible to scale to millions of users.

31. Compare and contrast the advertisements used by RIP and OSPF.

32. What is the difference between a group-shared tree and a source-based tree in the context of multicast routing?

33. Consider the network below.



a. Suppose that this network is a datagram network. Show the forwarding table in router A, such that all traffic destined to host H3 is forwarded through interface 3.

b. Suppose that this network is a datagram network. Can you write down a forwarding table in router A, such that all traffic from HI destined to host H3 is forwarded through interface 3, while all traffic from H2 destined to host H3 is forwarded through interface 4? (Hint: this is a trick question.)

c. Now suppose that this network is a virtual circuit network and that there is one ongoing call between HI and H3, and another ongoing call between H2 and H3. Write down a forwarding

table in router A, such that all traffic from HI destined to host H3 is forwarded through interface 3, while all traffic from H2 destined to host H3 is forwarded through interface 4.
d. Assuming the same scenario as (c), write down the forwarding tables in nodes B, C, and D.

34. Consider a router that interconnects three subnets: Subnet I. Subnet 2, and Subnet 3. Suppose all of the interfaces in each of these three subnets are required to have the prefix 223.1.17/24. Also suppose that Subnet I is required to support up to 63 interfaces, Subnet 2 is to support up to 95 interfaces, and Subnet 3 is to support up to 16 interfaces. Provide three ne twork addresses (of the form a.b.c.dlx) that satisfy these constraints.

35. Suppose datagrams are limited to 1,500 bytes (including header) betweensource Host A and destination Host B. Assuming a 20-byte IP header, howmany datagrams would be required to send an MP3 consisting of 5 millionbytes? Explain how you computed your answer. (Assume the data is carried in TCP segment, with eachTCP segment also having 20 bytes of header)

36. Are companies today providing a video-on-demand service over the Internet using a P2P architecture?.

1. Suppose Alice, with a Web-based e-mail account (such as Hotmail or gmail), sends a message to Bob, who accesses his mail from his mail server using POP3. Discuss how the message gets from Alice's host to Bob's host. Be sure to list the series of application-layer protocols that are used to move the message between the two hosts.

1. Why would the token-ring protocol be inefficient if a LAN had a very large perimeter?

2. How big is the MAC address space? The IPv4 address space? The 1Pv6 address space?

3. Why is an ARP query sent within a broadcast frame? Why is an ARP response sent within a frame with a specific destination MAC address?