Lancaster University

Part II

COMPUTING AND COMMUNICATIONS – On-line Assessment   [150 Minutes]

SCC.203   COMPUTER NETWORKS

*Candidates are asked to answer **THREE** questions from **FOUR**; each question is worth a total of 25 marks.*

[Please turn over]

Question 1

1.a Explain why subnetting improves routing scalability compared to flat IP addressing.

[3 marks]

1.b Why is Classless Interdomain Routing (CIDR) a more efficient way of splitting the IP address space compared to classful routing?

[3 marks]

1.c The figure below gives a network topology of hosts and routers, and their corresponding MAC and IP addresses. Each LAN has a network mask of 255.255.255.0.
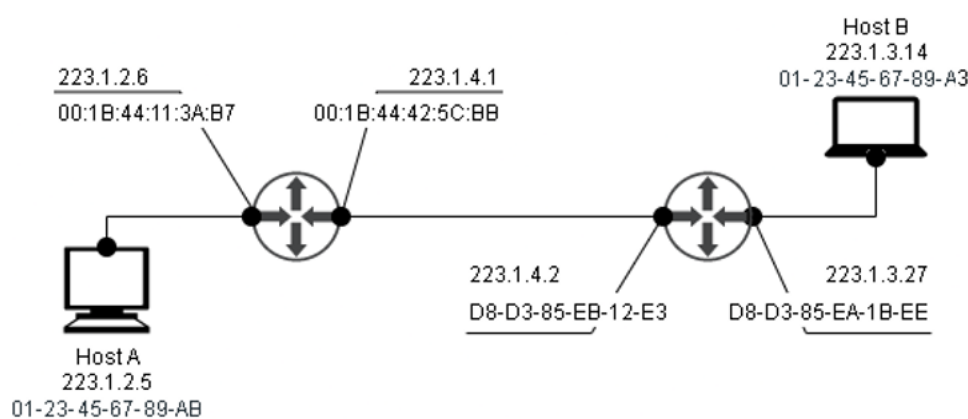
In the topology above, assume that host A sends a packet to host B, using the path that is shown in the above topology. For each hop which packet traverses, indicate the source and destination MAC and IP addresses that are used in the link layer and network layer packets.

[6 marks]

1.d Let the following be addresses of destination IP networks:
- Network 1: 131.21.0.0/16
- Network 2: 131.22.0.0/16
- Network 3: 133.22.12.0/24

Also, consider the following hosts with IP addresses:
- Host A: 131.21.12.19
- Host B: 133.21.12.19
- Host C: 133.22.11.19
- Host D: 131.21.21.21
- Host E: 133.22.21.21

  To which (destination) network do the different hosts belong? Are there any hosts that do not belong to any of the above networks?

[Please turn over] **[5 marks]**

1.e. For each of the items below, say if it increases, decreases, or doesn't affect the number of entries in an BGP routing table of an AS, and briefly explain why: (Assume that any announcements generated will eventually be reflected in that routing table.)

    i.   An organization with a spare /8 IP address allocation decides to sell blocks of this space to anyone that wants IP addresses.

[2 marks]

    ii.   An organization that has a single transit provider in the BGP graph (single-homed), becomes a customer of another transit provider (becomes multi-homed to two transit providers)

[3 marks]

    iii.   An organization which had already had IP prefix 15.81.128/17 manages to buy 15.81.0/17

[3 marks]

[8 marks]

[Total: 25 marks]

Question 2

2.a Below there is a series of seven 7-bit data segments, with an additional parity bit each and an additional parity byte to enable bit error detection.

							Parity bit
1	0	1	0	1	1	0	
1	1	0	1	0	1	0	
0	1	1	1	1	1	0	
0	1	1	0	1	0	0	
1	1	0	0	0	1	0	
0	0	1	0	1	0	1	
1	1	0	0	0	0	0	
Parity byte							

i.   Fill in the parity bit for each blank, assuming odd parity is followed.

[2 marks]

ii.   Will this 2-D parity catch all 3-bit errors? Explain why and provide an example.

[2 marks]

iii.   Will this 2-D parity catch all 4-bit errors? Explain why and provide an example.

[2 marks]

[6 marks]

2.b Assume that a network host wants to send the following bit stream, which we want to encode with the help of the CRC-8 polynomial:
1011 0011 0101 0110

i.   What does the CRC-8 polynomial look like? Write it down using the standard polynomial notation.

[Please turn over]   [2 marks]

4

ii.   What does the transmitted bit-sequence look like? Highlight your steps in the calculation.

[4 marks]

[6 marks]

2.c Assume a network with two hosts, host A and host B, that try to share the same channel using the slotted ALOHA protocol. At each slot, host A transmits with a probability of p_A, while host B transmits with a probability of p_B.

i.   Derive the formula of the average throughput of host A and host B

[2 marks]

ii.   What is the formula of the average throughput of the system with these two hosts?

[1 mark]

iii.   Assume that $p_A = 2 p_B$, namely host A transmits with twice as large probability as host B. Is average throughput of host A twice as large as the average throughput of host B? Explain your answer.

[3 marks]

[6 marks]

2.d. Assume a 100 Mbps CSMA/CD protocol in which the maximum one-way propagation delay between any two hosts is 100×10^{-6} sec. What should be the minimum size of a packet so that the host that transmits the packet is able to detect a collision before the hosts finishes the transmission of the packet?

[4 marks]

2.e. A host using CSMA/CD detects the 5th collision. What is the probability that this host chooses K=4? How many seconds on a 10Mbps Ethernet is the corresponding delay for K=4?

[3 marks]

[Total: 25 marks]

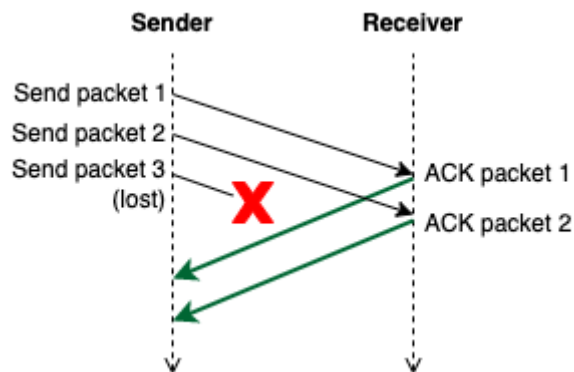**[Please turn over]**

Question 3

3.a. Consider a TCP connection between two processes running on two hosts A and B.

    i.   Draw a TCP sequence diagram to show the sequence of packets exchanged between A and B required to initiate a TCP connection, and explain the role of each packet
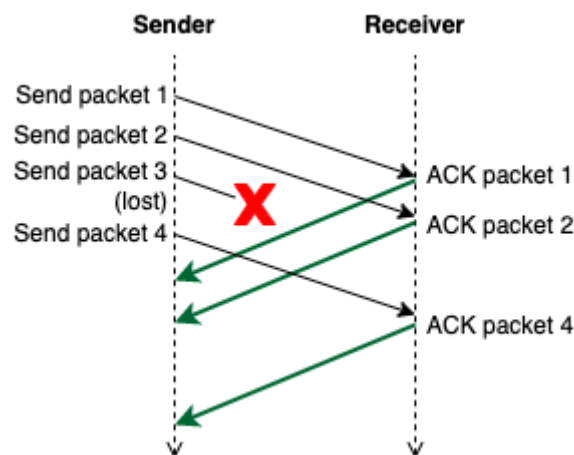
                [3 marks]

    ii.   Consider the TCP sequence diagram below. Does this diagram indicate if the TCP version used is Go-Back--N, Selective Repeat, or there is not enough information to tell? Explain your answer.

                [3 marks]

    iii.   Consider the TCP sequence diagram below. Does this diagram indicate if the TCP version used is Go--Back--N i, Selective Repeat, or there is not enough information to tell? Explain your answer.
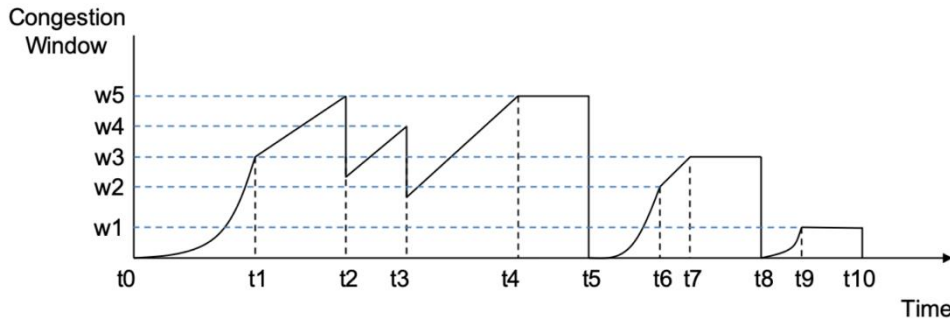

                [3 marks]

                [9 marks]

[Please turn over]

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

[2 marks]

3.c. The plot below shows the change of the congestion window size of a TCP connection over time.

i. Which are the time periods when the TCP connection is in the slow start phase, and which are the time periods in the congestion avoidance phase. Explain your answer.

[5 marks]

ii. Is the TCP version used Tahoe or Reno. Explain your answer.

[2 marks]

[7 marks]

3.d. Nic is implementing a file transfer application using UDP as the transport-layer protocol. According to Nic's design, the application sends all blocks of data to the remote host, and it waits for the remote host to send a file checksum (checksum computed on the entire contents of the file). If the checksum is incorrect, the sender retransmits the whole file.

i. Assuming that the network guarantees there are no packets lost, and the client handle correctly packet reordering. Also, remember that UDP has its own checksum. With these guarantees, is the checksum in Nic's application necessary? Why or why not?

[4 marks]

ii. While receiving a large file over the Internet using Nic's application, a user notices that her existing HTTP download from the same source slows down considerably. She finds out that the transfer using Nic's protocol uses more bandwidth than the HTTP download. What might be happening?

[3 marks]

[7 marks]

[Please turn over]   **[Total: 25 marks]**

Question 4

4.a. You type the following URL into your web browser:
http://print.lancaster.ac.uk/app?service=page/UserSummary

Assuming that

- The address of the DNS resolver is 1.1.1.1
- Neither your host nor your DNS resolver have any cached DNS entries
- DNS never needs to fail over to TCP
- The HTML response returns 200 OK with a web page
- The HTML request and response each fit in a single segment
- The web page requires loading no additional resources

Write down the series of packets exchanged that will occur for your host to receive the web page. Include packets sent by your DNS server, and control packets for TCP connection setup and teardown. You need not include any ARP packets, and you do not need to write down message formats. Simple descriptions such as "X sends a UDP segment to the HTML server on the HTTP port Y" are sufficient. In the case of the HTTP request, clearly state the path of the file requested in the GET.

[12 marks]

4.b. Consider the topology below as part of the Internet map. Circles represent Autonomous Systems (ASes) that connect to other networks using the Border Gateway Protocol (BGP). A single-ended arrow indicates a "customer-to-provider" relationship, while dashed lines indicate "peer-to-peer" relationships. For example, network B is a customer of ASes 5 and 2, while AS1 and AS2 are peers. Paths are selected at each AS based on the normal customer/provider/peer policies, and no other policy is applied.
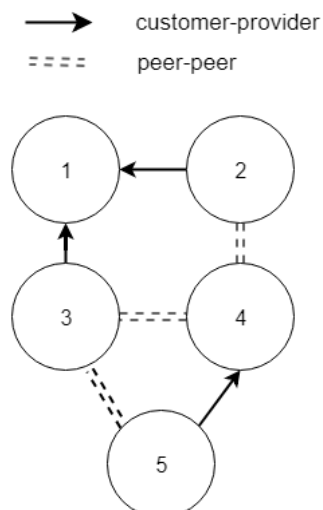
AS 5 received some reports from its users that they cannot access every other AS in graph. You are a renowned BGP expert and they ask you to help them resolve this issue.

i. Which ASes are not reachable from AS 5 and why?

[4 marks]

ii. How can AS 5 change its existing relationships to make sure that it can get routes to every other AS? Explain why.

[4 marks]

[8 marks]

4.c Select which one of the following actions CANNOT be executed by a layer-4 firewall (a device that can look at all protocol headers up to the transport layer) and explain why.

(A) block HTTP traffic during 9:00PM and 5:00AM

(B) block all ICMP traffic

(C) stop incoming traffic from a specific IP address but allow outgoing traffic to same IP

(D) block TCP traffic from a specific user on a specific IP address on multi-user system during 9:00PM and 5:00AM

[2 marks]

4.d HTTP supports conditional GET requests. Explain how these can be used by the client when interacting with caches, with specific reference to how the HTTP response codes are used.

[3 marks]

[Total: 25 Marks]

---End of paper---