Lancaster University

Part II

COMPUTING AND COMMUNICATIONS – On-line Assessment

Available Time [23 Hours]

Recommended Completion Time [3 Hours]

SCC.203 COMPUTER NETWORKS

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

Question 1

1.a Error detection can be used to determine the integrity of transmitted data.

   i. Two-dimensional Parity bits are a rudimentary way of achieving this. Consider the following data. What would be the parity bit for each row and column?

```
0 0 0 1 1 0 1
1 1 1 1 1 0 1
0 0 1 1 0 1 0
```

[3 marks]

   ii. The Cyclic Redundancy Check is a more advanced method doing so. Given a generator polynomial of $x^5 + x^3 + x^2$ and data of `1 0 0 1 0 1 1 1 0 0`, calculate the CRC value to append to the data. Show all of your working.

[5 marks]

1.b In the context of the network transport layer, compare *connectionless* to *connection-orientated* demultiplexing. What resources are more likely to be used in the case of *connection-orientated*, and how can this be overcome? **[6 Marks]**

1.c Consider a single DHCP server providing IP addresses to a large corporate local area network. As a security tester, you have been tasked with attacking the existing DHCP server and establishing your own within the network.

   i. Describe the process to achieve this. Be clear on what conditions are required to achieve success. How would you establish precedence for your DHCP server over the existing server?

[5 marks]

   ii. Once established, what would this allow the tester/attacker to do? List two of these, explaining in each case how this may impact the other network clients.

[4 marks]

   iii. Why is this type of attack possible with DHCP?

[2 marks]

[Total 25 marks]

Question 2

2.a TCP Error Control

    i.   Host A sends two 20-byte packets to host B. Packet 1 has sequence number 100. Host B acknowledges the receipt of both packets, but the first ACK is lost while the second arrives successfully at host A. What will be the sequence number of the next packet that host A will send to host B? Explain your answer.

[4 marks]

    ii.   Explain how TCP fast retransmission improves the performance of TCP. Why does it use three duplicate ACKs instead of one or two duplicate ACKs to retransmit a segment?

[4 marks]

2.b HTTP

    i. Explain HTTP pipelining and the Head-of-Line (HOL) blocking problem.

[4 marks]

    ii. Does HTTP pipelining solve the issue of HOL blocking?

[3 marks]

2.c Random Access Protocols

    i. Is CSMA/CD appropriate for wireless networks? Explain your answer.

[4 marks]

    ii. 500 users are competing for the use of a single slotted ALOHA channel. The average user makes 72 requests per hour. A slot is 100 μsec. What is the approximate total channel load?

[6 marks]

[Total 25 marks]

Question 3

3.a You have been given the task of establishing a new top-level domain for a new nation state.

    i.   Describe the process for doing so. Consider the other organisations/entities that need to hold new data.

[3 marks]

    ii.   A business operating in the new nation station has contacted you to register a new domain. What changes do you have to make on your own infrastructure? What do they also have to provide to enable the resolution of a request?

[3 marks]

3.b As a software developer, you have been tasked with creating a new application by a customer.

    i.   One of the required features is a messaging function between users. What would be the most appropriate transport-layer protocol for achieving this? Justify your answer.

[4 marks]

    ii.   An additional requirement includes live video calling. Again, what would be the most appropriate transport-layer protocol for achieving this? Justify your answer.

[4 marks]

3.c TCP has a dedicated congestion control mechanism.

    i.   Why is congestion control necessary?

[2 marks]

    ii.   State and describe the two general phases used by TCP to control congestion using the *congestion window*. Using a diagram, illustrate how this usually manifests itself over a fixed period of time.

[3 marks]

    iii.   Over time, TCP aims to offer fairness between clients. How does it achieve this fairness when TCP is the only protocol in use? What happens when a client leaves the network?

[3 marks]

    iv.   How is this different when UDP applications are also operating in the network? What impact does it have on the TCP clients?

[3 marks]

Total 25 marks

Question 4

4.a Do you agree or disagree with the following statements? Explain your answer.

    i. BGP guarantees that the shortest path in terms of IP hops will be selected to route traffic between two Autonomous Systems

                [2 marks]

    ii. BGP guarantees that the shortest path in terms of AS hops will be selected to route traffic between two Autonomous Systems

                [2 marks]

    iii. The number of hosts that can communicate over the Internet cannot be larger than the number of available IP addresses.

                [2 marks]

    iv. There are mainstream protocols that do not strictly follow the protocol layers of the TCP/IP or OSI models to solve issues with protocols that belong to specific layers.

                [2 marks]

4.b Explain the role of the following types of networks in the Internet topology:
    i. Regional ISPs
    ii. Tier-1 ISPs
    iii. Internet eXchange Points (IXPs)
    iv. Content Distribution Networks (CDNs)

                [8 marks]

4.c You work as a network administrator for SCC, and you have to troubleshoot why Matt's computer cannot connect to the Internet. The network configuration of that computer is the following:
- Host IPv4 Address: 10.254.254.1
- Subnet Mask: 255.255.255.0
- Default Gateway: 10.254.254.255

Select the correct answer as to why the problem occurs, and explain your choice:
    i. The subnet mask is incorrect.
    ii. The host IPv4 address is incorrect.
    iii. The default gateway is incorrect.
    iv. The subnet mask and the IP address are incorrect

                [4 marks]

4.d Consider the topology below. Autonomous System 4 (AS 4) hosts a web server, with IP address 94.66.223.5 and a database server with IP address 94.66.220.1. AS 4 uses BGP to advertise to AS 2 that the prefix 94.66.220.0/24 is reachable through its network. AS 4 also advertises to AS 3 through BGP that the prefix 94.66.220.0/20 is reachable through its network. Answer the following questions:

provider ⟵——— customer

peer - - - - - peer
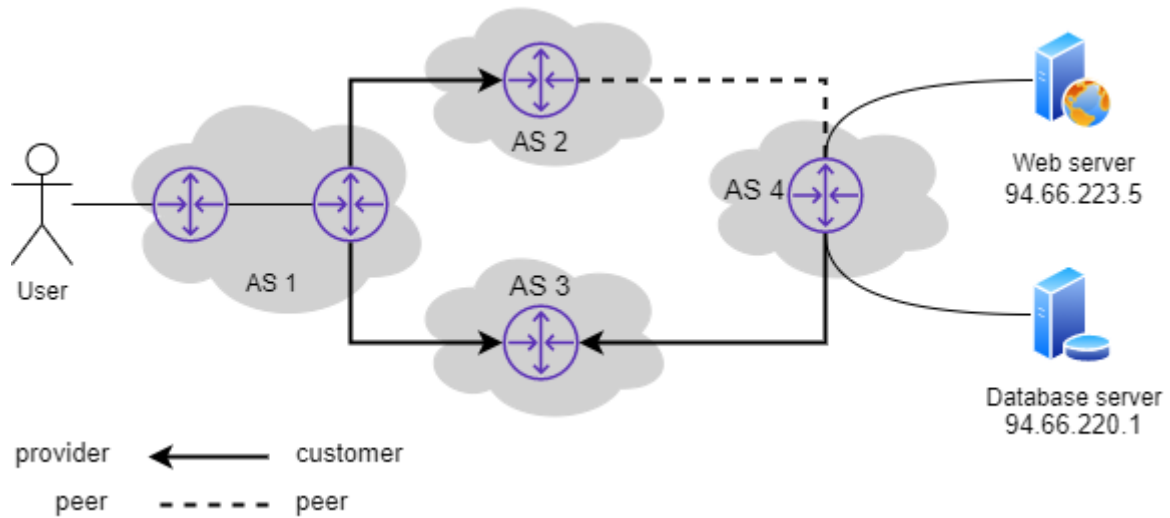
   i.   What will be the AS paths at AS 1 for prefixes 94.66.220.0/24 and 94.66.220.0/20?

[2 marks]

  ii.   A user that connects to AS1 starts a new session with the database server. What AS path will the user's traffic follow?

[3 marks]

[Total 25 marks]

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