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DT066A	T101	2024-08-22
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Re-Exam

DT052A / DT066A TCP/IP Internetworking

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Instructions

Carefully read the questions before you start answering them. Note the time limit of the exam and plan your answers accordingly. Only answer the question, do not write about subjects remotely related to the question. The questions are *not* sorted by difficulty. Clearly show which answer you are giving your solution to, *Always motivate your answers and show your calculations.*.

Time 5 hours.

Exam Aids Non-programmable calculator.

Maximum points 30

Questions 10

Preliminary grades

The following grading criteria applies: E $\geq$ 50%, D $\geq$ 60%, C $\geq$ 70%, B $\geq$ 80%, A $\geq$ 90%.

Questions

(3p) 1. Answer the following questions while motivating your answer.

- Why do we need error detection and error correction at the link layer? List two basic link layer error detection techniques.
- Link layer error detection is 100% reliable (True/False)
- What is the difference between a switch and a router?

(3p) 2. Answer the following questions.

- A handoff occurs when a mobile station changes its association from one base station (BS) to another during a call. List two reasons for the need for a handoff.
- What is the hidden node problem in WLANs, and how to overcome it?

(3p) 3. In rdt protocols,

- Why did we need to introduce sequence numbers?
- Why did we need to introduce timers?

(3p) 4. What is congestion at the transport layer, and how does it impact network performance? What are the congestion control techniques employed by TCP, and could you explain each of them in detail?

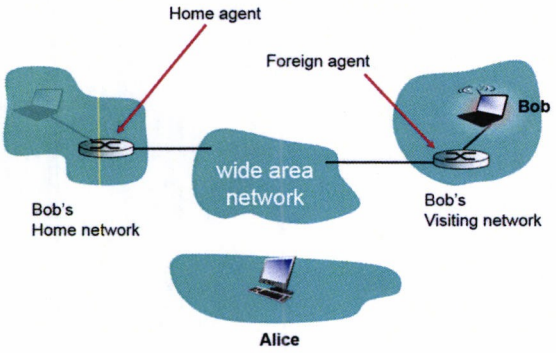

Figure 1: Mobility management: direct routing

(3p) 5. Answer the following questions.

- What are cookies, and how do they work in the context of web browsing?
- Why are cookies needed and important for websites and web applications?
- Please explain the process of how a cookie is created, stored, and transmitted between a web server and a client's browser.
- What are the advantages of using cookies in web development? How do they enhance the user experience?
- What are some potential weaknesses or vulnerabilities associated with cookies?
- Elaborate on benefits and drawbacks using examples and illustrations.

(3p) 6. What is Software Defined Networking (SDN)? Discuss the control plane and data plane concepts related to SDN architecture. Provide the basic SDN architecture figure. Describe the benefits and advantages of SDN compared to traditional networking.

(3p) 7. Answer the following questions.

- How does packet loss impact a transport layer protocol that aims to achieve reliable delivery over an unreliable channel? What mechanisms are employed to manage packet loss in such protocols?
- What is the effect of duplicate acknowledgements on a transport layer protocol striving for reliable delivery over an unreliable channel? How does the protocol handle duplicate acknowledgements to ensure proper management of the issue?
- Explain how congestion affects a transport layer protocol designed for reliable delivery over an unreliable channel. What mechanisms and algorithms are utilized to manage congestion in such protocols and maintain reliable communication?

(3p) 8. Assume that Alice wants to communicate with Bob while Bob is currently residing in a network that is not his home network (see Figure 1). How Alice can communicate with Bob in the visiting network using **direct and indirect routing**? List and clearly state all the steps needed to connect Alice to Bob.

(3p) 9. In an M/M/1 queue, customers arrive at the rate of $\lambda = 20$ customers per hour. What is the minimum server rate to ensure that:

- the server is idle at least 30% of the time.
- the expected value of the customer in the system does not exceed 10.

Note that for M/M/1 queue, the average number of customers in the system is $N = \frac{\rho}{1-\rho}$, where $\rho = \frac{\lambda}{\mu}$ is the utilization factor.

(3p) 10. Consider that only a single TCP (Reno) connection uses one 54 Mbps wireless 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 536 bytes; the two-way propagation delay of this connection is 6 msec; and this TCP connection is always in the congestion avoidance phase, that is, ignore slow start.

- What is the maximum window size (in segments) that this TCP connection can achieve?
- What is the average window size (in segments) and average throughput (in bps) of this TCP connection?
- How long would it take for this TCP connection to reach its maximum window again after recovering from a packet loss?

Hints:

$$W \cdot \frac{\text{MSS} \cdot 8}{\text{RTT}} = \text{Throughput (bits per second)}$$

- W is the window size in segments.
- MSS is the Maximum Segment Size in bytes.
- 8 is the number of bits in a byte.
- RTT is the Round-Trip Time.

Average Window Size (W) (Section 3.7 page 303)

The congestion window size varies from $\frac{W}{2}$ to W (assuming TCP congestion avoidance phase, ignoring slow start). The average window size is given as $0.75W$.

$$\text{Average Window Size} = 0.75W$$

Packet Loss

- After detecting a packet loss, TCP Reno enters a "fast recovery" phase.
- The window size W is reduced to half of its current value $W/2$.

$$W' = \frac{W}{2}$$

Time to Recover

- The time it takes to recover the window size from $W/2$ to W is determined by the number of round-trip times (RTTs).
- Each round-trip time allows the window size to increase by one MSS (Maximum Segment Size).

$$\text{Time to Recover} = (W - W') \times \text{RTT}$$