Department of Computer Science and Engineering, National Sun Yat-Sen University
Second Semester of 2004 PhD Qualifying Exam
Computer Networks

Problem 1. (Totally, 10 points)

(1) Identify two major differences between circuit switching and packet switching.

(2) Identify two major differences between the IEEE 802.3 standard and the IEEE 802.11 standard.

Problem 2. (Totally, 15 points)

In a shared-medium CSMA/CD LAN, we assume that each station will try to transmit a frame during an available time slot with probability p. Suppose there are only 5 stations on the LAN. In addition, each station has frames in the buffer.

(1) Calculate the probability of a successful frame transmission.

(2) Calculate the optimal value of p that maximizes the probability of a successful frame transmission.

(3) Calculate the probability that at least two stations simultaneously transmit frames, when $p = 0.4$. You have to explicitly derive the number.

Problem 3. (Totally, 10 points)

(1) What are the major differences between flow control and congestion control?

(2) Explain the congestion control algorithm that is used in TCP. Why it might be a good solution for congestion control?

Problem 4. (Totally, 10 points)

You are an Internet service provider; your client hosts connect directly to your routers. You know some hosts are using experimental TCPs and suspect some may be using a "greedy" TCP with no congestion control. What measurements might you take at your router to establish that a client was not using slow start at all? If a client use slow start on startup but not after a timeout, could you detect that?

Problem 5. (Totally, 20 points)

Video applications typically run over UDP rather than TCP.

(1) Could you explain why TCP is not suitable for video applications?

Therefore, video applications are not constrained by TCP's congestion control algorithm.

(2) What impact does this have on TCP traffic? Be specific about the consequences.

Fortunately, these video applications often use RTP, which results in RTCP "receiver reports" being sent back from the sink back to the source. These reports are sent periodically and include the packet loss probability.

(3) Describe how the source might use this information to adjust its rate in a TCP-compatible way.

Timestamps are usually used in multimedia transmissions.

(4) Explain what is the jitter problem that arises in multimedia transmissions and why timestamps could be used to solve the jitter problem.

Problem 6. (Totally, 10 points)

IP currently uses 32-bit addresses. If we could redesign IP to use the 6-byte MAC address instead of the 32-bit address, would we be able to eliminate the need for ARP? Explain why or why not.

Problem 7. (Totally, 10 points)

What is multicast? Explain how multicast is used to reduce bandwidth consumption in the Internet backbone and the Ethernet-based local area networks.

Problem 8. (Totally, 10 points)

(1) What are the major differences between the symmetric key encryption scheme and the public key encryption scheme?

(2) Use public key encryptions to design a scheme that assures privacy and integrity for a communication session from Alice to Bob over an insecure Internet.

Problem 9. (Totally, 5 points)

Explain the shortest path problem in terms of graph theory. How the shortest path problem is related to network routing?