Department of Computer Science and Engineering, National Sun Yat-Sen University
First Semester of 2005 PhD Qualifying Exam
Computer Networks

Problem 1. (Totally, 15 points)

(1) What are the major differences between TCP and UDP in terms of services provided for the upper layer?

(2) Explain what is "three-way handshaking" in the context of TCP connection setup. Why not use "two-way handshaking" or "four-way handshaking"?

(3) Explain the congestion control algorithm that is used in TCP. Why it might be a good solution for congestion control? Why don't we simply use a window of constant size?

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, 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 proba-

bility.

(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 the jitter problem that arises in multimedia transmissions over the Internet. List two techniques that are widely used to mitigate the jitter problem.

Problem 4. (Totally, 20 points)

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

(2) List the advantages and the disadvantages of layer-3 multicast and layer-7 multicast.

(3) In IGMP, is it necessary for multicast router to know how many hosts join in a multicast group? Please justify your answer.

(4) Briefly explain two multicast routing algorithms.

Problem 5. (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 6. (Totally, 10 points)

(1) IPv6 and NAT (Network Address Translation) are two ways to solve the shortage problem of IP addresses. List the advantages and the disadvantages of these two ways.

(2) The original TCP does not work well over a wireless link. Explain why. (Hint: The error probability of a wireless link is much larger than that of a wired link. Start from the congestion control algorithm.)

Problem 7. (Totally, 10 points)

Consider a M/M/1 queueing system. Let $a(t) = \lambda e^{-\lambda t}$ be the probability density function for the interarrival times and $b(t) = \mu e^{-\mu t}$ be the probability density function of the service times. Let $X(t)$ be the system size of the queueing system at time t. In addition, $X(0) = 0$.

(1) Let $p_n = \lim_{t\to\infty} P\{X(t) = n\}$, $\forall n \geq 0$. Derive p_n's, where $n \geq 0$.

(2) Derive the average system delay W and the average queueing delay W_q.