

Department of Computer Science and Engineering,
National Sun Yat-Sen University
Second Semester of 2006 PhD Qualifying Exam
Computer Networks

Problem 1. (20 points)

- (1) What is Link-State routing? List a Link-State routing protocol in the Internet.
- (2) What is Distance-Vector routing. List a Distance-Vector routing protocol in the Internet.
- (3) RIP, OSPF, and BGP are three major routing protocols in the Internet. Draw a protocol stack and place the protocols at the right layer. You should also show major TCP/IP protocols and their relations to the above three routing protocol.
- (4) What are the differences between class A, B, C, D IP addresses in IPv4?

Problem 2. (Totally, 15 points)

In addition to IPv6, CIDR (Classless Interdomain Routing) and NAT (Network Address Translation) are two methods to combat the shortage of IP addresses.

- (1) Use an example to briefly explain CIDR.
- (2) Use an example to briefly explain NAT.
- (3) What is the the longest prefix matching rule? Use an example to explain your answer.

Problem 3. (Totally, 15 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) What is the main function of the IGMP (Internet Group Management Protocol)? Is it necessary for a multicast router to know which hosts in a Ethernet local area network are in a multicast group? Please justify your answer.

Problem 4. (Totally, 20 points)

- (1) What are the major differences between TCP and UDP?

- (2) Explain the additive-increase, multiplicative-decrease (AIMD) algorithm used in TCP congestion control. Draw a figure that shows the typical evolution of TCP's congestion control window size. You can select either TCP-Tahoe or TCP-Reno.

- (3) Which Transport-Layer Protocol (TCP or UDP) is more suitable for multimedia networking? Justify your answer.

- (4) Explain how the Leaky-Bucket works for multimedia networking.

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 Mary to George over an insecure Internet.

Problem 6. (Totally, 10 points)

Let G be the total network traffic load. Typically, the network throughput is a function of G .

- (1) When the ALOHA is used, the network throughput equals $f_1(G) = G \cdot e^{-2G}$. Draw the function $f_1(G)$ and use Calculus to find the maximum value of $f_1(G)$.

- (2) When the slotted ALOHA is used, the network throughput equals $f_2(G) = G \cdot e^{-G}$. Draw the function $f_2(G)$ and use Calculus to find the maximum value of $f_2(G)$.

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 inter-arrival 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 $p_n = \lim_{t \rightarrow \infty} P\{X(t) = n\}$, $\forall n \geq 0$. Derive p_n 's, where $n \geq 0$.

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