國立雲林科技大學資訊管理系
110 學年度第 1 學期博士班資格考
科目：資訊網路
時間：4 小時 (Closed book)
作答時，請注意各題之比例配分，並清楚標示題號

【第一部分】

- 必選題：30 分(共 3 題，每題 10 分)

1. Consider Figure 2.12, for which there is an institutional network connected to the Internet. Suppose that the average object size is 1,000,000 bits and that the average request rate from the institution's browsers to the origin servers is 16 requests per second. Also suppose that the amount of time it takes from when the router on the Internet side of the access link forwards an HTTP request until it receives the response is three seconds on average (see Section 2.2.5). Model the total average response time as the sum of the average access delay (that is, the delay from Internet router to institution router) and the average Internet delay. For the average access delay, use Δ/(1 - Δb), where Δ is the average time required to send an object over the access link and b is the arrival rate of objects to the access link.

   a. Find the total average response time. (5%)

   b. Now suppose a cache is installed in the institutional LAN. Suppose the miss rate is 0.4. Find the total response time. (5%)

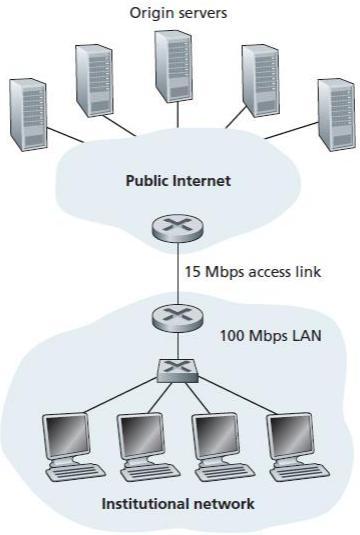
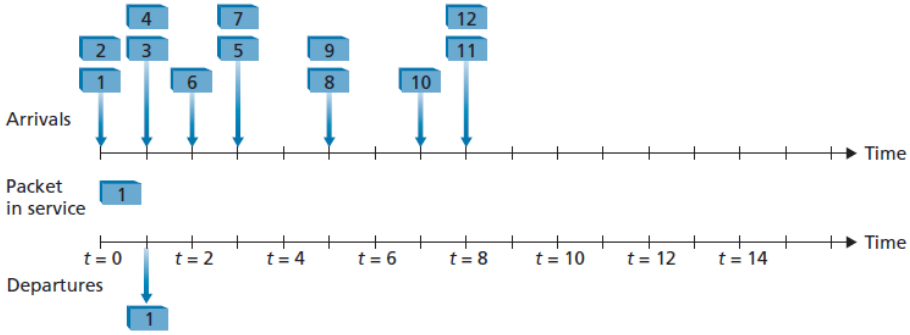


Figure 2.12 ♦ Bottleneck between an institutional network and the Internet

2. In the discussion of TCP splitting in the sidebar in Section 3.7, it was claimed that the response time with TCP splitting is approximately 4*RTT_{FE} + RTT_{BE} + processing time. Justify this claim. (10%)

3. Consider the figure below. Answer the following questions:



a. Assuming FIFO service, indicate the time at which packets 2 through 12 each leave the queue. For each packet, what is the delay between its arrival and the beginning of the slot in which it is transmitted? What is the average of this delay over all 12 packets? (2%)

b. Now assume a priority service, and assume that odd-numbered packets are high priority, and even-numbered packets are low priority. Indicate the time at which packets 2 through 12 each leave the queue. For each packet, what is the delay between its arrival and the beginning of the slot in which it is transmitted? What is the average of this delay over all 12 packets? (2%)

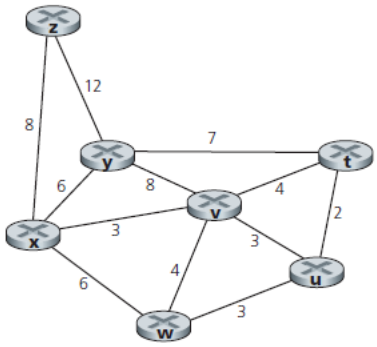
c. Now assume round robin service. Assume that packets 1, 2, 3, 6, 11, and 12 are from class 1, and packets 4, 5, 7, 8, 9, and 10 are from class 2. Indicate the time at which packets 2 through 12 each leave the queue. For each packet, what is the delay between its arrival and its departure? What is the average delay over all 12 packets? (2%)

d. Now assume weighted fair queueing (WFQ) service. Assume that oddnumbered packets are from class 1, and even-numbered packets are from class 2. Class 1 has a WFQ weight of 2, while class 2 has a WFQ weight of 1. Note that it may not be possible to achieve an idealized WFQ schedule as described in the text, so indicate why you have chosen the particular packet to go into service at each time slot. For each packet what is the delay between its arrival and its departure? What is the average delay over all 12 packets? (2%)

e. What do you notice about the average delay in all four cases (FIFO, RR, priority, and WFQ)? (2%)

- **自選題：20 分(2 選 1，每題 20 分)**

4. Consider the following network. With the indicated link costs, use Bellman-Ford Distance vector algorithm to do the following:
   a. Compute the shortest path from z to all network nodes. (10%)
   b. Compute the shortest path from w to all network nodes. (10%)



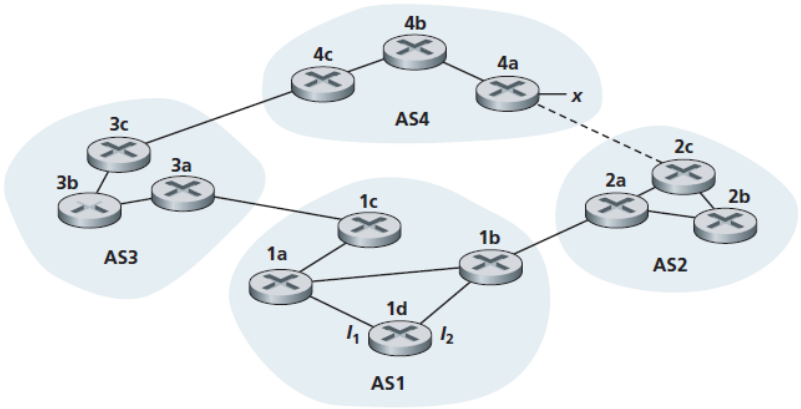
5. Consider the network shown below. Suppose AS3 and AS2 are running OSPF for their intra-AS routing protocol. Suppose AS1 and AS4 are running RIP for their intra-AS routing protocol. Suppose eBGP and iBGP are used for the inter-AS routing protocol. Initially suppose there is *no* physical link between AS2 and AS4.

a. Router 3c learns about prefix *x* from which routing protocol: OSPF, RIP, eBGP, or iBGP? (5%)

b. Router 3a learns about *x* from which routing protocol? (5%)

c. Router 1c learns about *x* from which routing protocol? (5%)

d. Router 1d learns about *x* from which routing protocol? (5%)



【第二部分】

- 自選題：50 分(7 選 5，每題 10 分)

6. How long does it take a packet of length 1,000 bytes to propagate over a link of distance 2,500 km, propagation speed $2.5 \cdot 10^8$ m/s, and transmission rate 2 Mbps? More generally, how long does it take a packet of length L to propagate over a link of distance d, propagation speed s, and transmission rate R bps? Does this delay depend on packet length? Does this delay depend on transmission rate?

7. Suppose nodes A, B, and C each attach to the same broadcast LAN (through their adapters). If A sends thousands of IP datagrams to B with each encapsulating frame addressed to the MAC address of B, will C's adapter process these frames? If so, will C's adapter pass the IP datagrams in these frames to the network layer C? How would your answers change if A sends frames with the MAC broadcast address?

8. Suppose nodes A and B are on the same 10 Mbps broadcast channel, and the propagation delay between the two nodes is 325 bit times. Suppose CSMA/CD and Ethernet packets are used for this broadcast channel. Suppose node A begins transmitting a frame and, before it finishes, node B begins transmitting a frame. Can A finish transmitting before it detects that B has transmitted? Why or why not? If the answer is yes, then A incorrectly believes that its frame was successfully transmitted without a collision. ***Hint:*** Suppose at time t = 0 bits, A begins transmitting a frame. In the worst case, A transmits a minimum-sized frame of 512 + 64 bit times. So A would finish transmitting the frame at t = 512 + 64 bit times. Thus, the answer is no, if B's signal reaches A before bit time t = 512 + 64 bits. In the worst case, when does B's signal reach A?

9. a) Suppose n = 10,000, a = 10,023, and b = 10,004. Use an identity of modular arithmetic to calculate in your head (a • b) mod n.
   b) Suppose you want to encrypt the message 10101111 by encrypting the decimal number that corresponds to the message. What is the decimal number?

10. Consider the Wireshark output below for a portion of an SSL session.

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a. Is Wireshark packet 112 sent by the client or server?

b. What is the server's IP address and port number?

c. Assuming no loss and no retransmissions, what will be the sequence number of the next TCP segment sent by the client?

d. How many SSL records does Wireshark packet 112 contain?

e. Does packet 112 contain a Master Secret or an Encrypted Master Secret or neither?

11. a) What is the role of the SMI in network management?

b) What is an important difference between a request-response message and a trap message in SNMP?

c) What are the seven message types used in SNMP?

d) What is meant by an "SNMP engine"?

12. Consider a virtual-circuit network. Suppose the VC number is an 8-bit field.

a. What is the maximum number of virtual circuits that can be carried over a link?

b. Suppose a central node determines paths and VC numbers at connection setup. Suppose the same VC number is used on each link along the VC's path. Describe how the central node might determine the VC number at connection setup. Is it possible that there are fewer VCs in progress than the maximum as determined in part (a) yet there is no common free VC number?

c. Suppose that different VC numbers are permitted in each link along a VC's path. During connection setup, after an end-to-end path is determined, describe how the links can choose their VC numbers and configure their forwarding tables in a decentralized manner, without reliance on a central node.