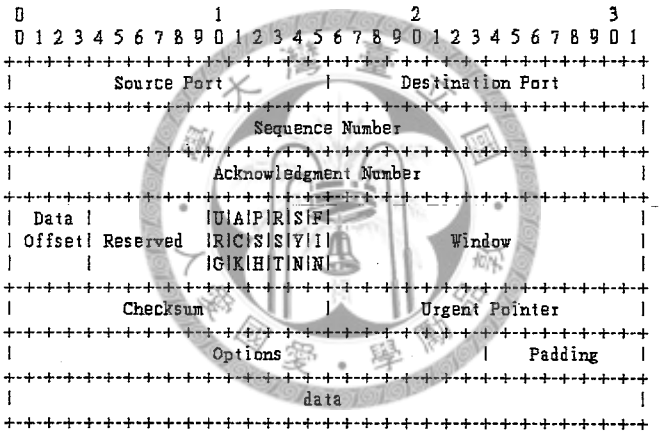
一、選擇題 (第 1 題爲單選題，佔 10%；第 2-7 題爲複選題，每題佔 5%，全對才給分；答案須寫於答案卷「**選擇題作答區**」對應位置)

1. Suppose a router has built up the routing table shown in Figure 1. The router can deliver packets to the directly connected networks, or it can forward packets via other routers. Assume the router does the longest prefix match. To which interface does the router forward with a packet addressed to 140.252.13.45? (A) le0 (B) lo0 (C) emd0 (D) sl0 (E) viv0.

Destination	Gateway	Flags	Refcnt	Use	Interface
140.252.13.65	140.252.13.35	UGH	0	171	le0
127.0.0.1	127.0.0.1	UH	1	766	lo0
140.252.1.183	140.252.1.29	UH	0	0	emd0
140.252.13.32	140.252.13.33	U	8	99551	sl0
default	140.252.1.183	UG	1	2955	viv0

Figure 1: Routing Table

TCP is the transport layer protocol used predominantly in the Internet. For answering Questions 2-4, consider the TCP protocol header as shown in Figure 2.



TCP Header Format

Note that one tick mark represents one bit position.

Figure 2: TCP Protocol Header

2. The UDP header contains which of the following field(s) in the TCP header?
   (A) Source Port
   (B) Sequence Number
   (C) Acknowledgment Number
   (D) Window
   (E) Checksum

3. Choose one or more correct statements from the following regarding the use of TCP header fields:
   (A) The following fields are used by TCP in providing reliable data transfer service: Sequence Number, Acknowledgment Number, and Checksum.
   (B) TCP's error recovery mechanism is a hybrid of Go-Back-N (GBN) and Selective-Repeat (SR) protocols since Acknowledgment Number can be used to carry cumulative acknowledgment or selective acknowledgment.
   (C) Window can be used by TCP to keep track of the congestion window.
   (D) TCP's three-way handshake for connection establishment involves the use of SYN (bit 110), ACK (bit 107), and FIN (bit 111).
   (E) None of the above.

接背面

4. Choose one or more correct statements from the following regarding the congestion control mechanism in TCP:
   (A) TCP's congestion control is to avoid the sender from overflowing the receiver's buffer.
   (B) TCP is said to be self-clocking since it maintains a timer for automatic retransmissions of lost segments.
   (C) TCP uses an additive-increase, multiplicative-decrease algorithm for performing congestion control.
   (D) In the congestion avoidance phase, TCP uses slow start to have a slower sending rate.
   (E) None of the above.

Ethernet was invented by Bob Metcalfe and David Boggs in the mid-1970s. For answering Questions 5-7, refer to the composite sketches of Ethernet (Figure 3) drawn by Bob Metcalfe in 1973 while he was a researcher at Xerox PARC.

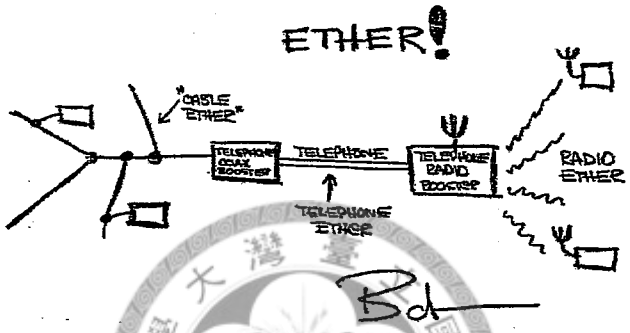


Figure 3: Ethernet Sketch by B. Metcalfe

5. CSMA is a random access protocol used by Ethernet for multiple access control. Which of the following multiple access protocol(s) belongs to the same category as CSMA?
   (A) Slotted ALOHA
   (B) CDMA
   (C) Polling
   (D) Token ring
   (E) None of the above.

6. As shown in Figure 3, the principles of CSMA are not limited to using the coaxial cable ("Cable Ether") as the only transmission medium. In your opinion, however, which of the following mechanism(s) in CSMA/CD is medium-specific that needs to be modified for use in a different broadcast medium (e.g. "Radio Ether")?
   (A) Carrier sensing
   (B) Collision detection
   (C) Backoff
   (D) Persistence
   (E) None of the above.

7. Point-to-point links such as telephone lines ("Telephone Ether") are very different from broadcast links. Choose one or more correct statements from the following regarding networking over telephone lines:
   (A) PPP is a link layer protocol for connecting host computers to the Internet over a dial-up modem.
   (B) PPP uses byte stuffing to ensure data frames have fixed length.
   (C) Link layer can use sliding window protocols such as Go-Back-N (GBN) and Selective-Repeat (SR) for reliable data transfer.
   (D) ADSL modem uses PPP over Ethernet, so host computers can still use Ethernet technology for connecting through the telephone line.
   (E) None of the above.

接次頁

二、非選擇題 (答案須寫於答案卷非選擇題作答區，並標明題號; 每題佔 10%)

1. Compare the delay in sending an x-bit data file over a k-hop path in a circuit-switched network and in a lightly loaded packet switched network. The circuit setup time is t_s sec, virtual circuit setup time is t_c, the propagation delay is t_d sec per hop, the packet size is p bits, and the data rate is b bps. Under what conditions does the virtual circuit packet switched network have a lower end-to-end delay for sending the data file?
2. Suppose that x-bits of data file is sent over a k-hop path in a datagram packet switched network as a series of packets, each containing p data bits and h header bits, with $x >> p + h$. The bit rate of the lines is b bps and the propagation delay is negligible. What value of p minimizes the total delay (in terms of x, k, b, and h)?
3. Suppose we have the forwarding tables shown in Figure 4 for nodes A and D in a network where all links have cost 1. Give a diagram of the smallest network consistent with these tables.
4. For the network given in Figure 5, give the forwarding table for node B. The links are labeled with relative costs; your table should forward each packet via the lowest-cost path to its destination.
5. One of the most actively pursued research topic in networking is the modeling of TCP congestion control behavior. For starters, consider the simplified window evolution of TCP under periodic segment loss as shown in Figure 6. Assume that the round trip time is T, the loss probability is p, and the maximum segment size is S. Derive the average TCP throughput in steady state in terms of S, T, and p. Based on the formula obtained, discuss techniques that can be used to improve the throughput of a TCP connection.
6. To derive the maximum efficiency for slotted ALOHA, consider a snapshot of node operations as shown in Figure 7. A slot is called successful (S) if and only if there is one frame transmitted therein. Otherwise, it is called collision slot (C) or empty slot (E) where the efficiency is sacrificed. Assume that there are N nodes in the network, and each node transmits with probability p. Derive the efficiency of slotted ALOHA in terms of N and p, and find the optimal value of p that maximizes the efficiency. What is the maximum efficiency of slotted ALOHA as N approaches infinity? Discuss the implication of the results obtained.

Node	Cost	Next hop
B	1	B
C	2	B
D	3	B
E	2	B
F	1	F

Node A

Node	Cost	Next hop
A	3	E
B	2	C
C	1	C
E	1	E
F	2	E

Node D

Figure 4: Forwarding Tables of Nodes A and D

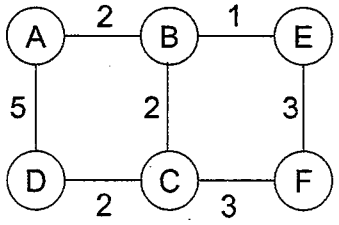


Figure 5: Network Topology

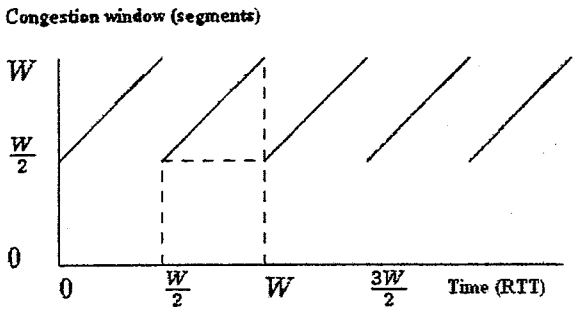


Figure 6: TCP Congestion Window Evolution

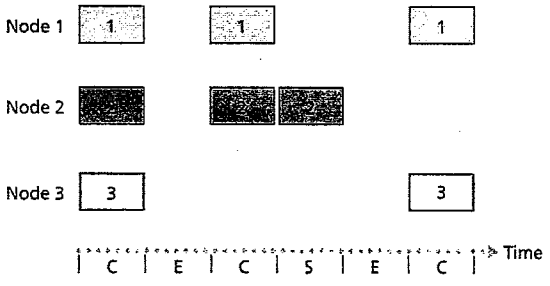


Figure 7: Slotted ALOHA Operation

試題隨卷繳回