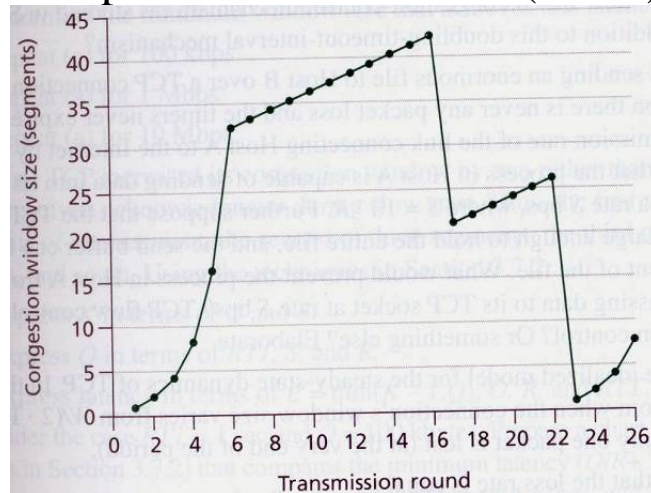


Computer Networks Final (107/1)

1. (a) How to run the tool to query specified DNS server to execute “Please send me the host names of the authoritative DNS for *aiit.or.kr*” operation? (2%)
(b) How to run the tool to query DNS server to execute “Please send me the host names of *www.aiit.or.kr*, but we want to the query sent to the DNS server *dns.ncue.edu.tw*” operation? (2%)
(c) What three services are provided by the domain name system? (6%)
(d) Explain iterated query and recursive query (4%)
(e) Authoritative DNS servers (2%) (16% total)
2. Draw the flow of the TCP three way handshake to explain its operations. Suppose the initial sequence numbers of the client and the server are 49 and 88, respectively. 必須在圖上分別清楚標示出 TCP 必要的 flag, sequence number, and ACK number. (10%)
3. Compare GBN, SR. Assume that the timeout values for all three protocols are sufficiently long such that 4 consecutive data segments and their corresponding ACKs can be received (if not lost in the channel) by the receiving host (Host B) and the sending host (Host A) respectively. Suppose Host A sends 4 data Segments to Host B, and the 3th segment (sent from A) is lost. In the end, all 4 data segments have been correctly received by Host B. How many segments has Host A sent in total and how many ACKs has Host B sent in total? What are their sequence numbers? Answer this question for all two protocols 畫出傳送過程說明，標示出每個訊息是 pkt or ack，並附加上 sequence number，只寫答案 1%. (5% each, 10% total)
4. (a) UDP and TCP uses 1’s complement for their checksums. Suppose you have the following 8-bit bytes: 11110001, 01010100. What is the 1’s complement for the sum of these 8-bit bytes? Show all work. (要寫出過程 4%) (b) Consider the CRC generator, $G=1001$, and suppose that D has the value 10101010000. What is the value of R ? (要寫出運算過程 6%, 10% total)
5. (a) Describe how TCP Reno does its congestion control. (4%)
(b) Answer and justify the following questions. (10%, 14% total)
 - a. After the 22th transmission round, is segment loss detected by a triple duplicate ACK or by a timeout? (2%)
 - b. During what transmission round is the 50th segment sent? (要說明，4%)
 - c. Identify the TCP slow start intervals. (2%)
 - d. Identify the TCP congestion avoidance intervals. (2%)

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6. 針對 120.107.172.1 這個 IP address，(以十進位表示，要寫完整過程) (20%)
- 這一個 IP 屬於那個 Class 的網路？以二進位說明(1%) 其所屬的 IP 網路表示法為何？(1%) 可用 IP 範圍？(2%) 共有幾個 IP 可用？(1%) mask 的值為何？(1%)
 - 將此 IP 網路分成 20 subnets，subnet mask 的值為何？(2%) 請列出第 1 個 subnet 的網路表示法 (1%) 可用 IP 範圍？(2%) 共有幾個 IP 可用？(1%)
 - 手動設定電腦的網路時，除了 default gateway 的 IP 外，至少要設定哪兩個項目的資訊，才可以上網？(2%)
 - default gateway 的 IP 有什麼用處？如何使用？(6%)
7. (a) Draw a figure to show four components of a router (4%) (b) Draw three types of switching fabrics with their names. (2% each) (10% total)
8. (a) What is the goal of DHCP? (2%) (b) List four steps of DHCP (8%) (10% total)

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只寫答案而沒有解釋說明，扣一半分數

1. (a) How to run the tool to query specified DNS server to execute “Please send me the host names of the authoritative DNS for *aiit.or.kr*” operation? (2%)
(b) How to run the tool to query DNS server to execute “Please send me the host names of *www.aiit.or.kr*, but we want to the query sent to the DNS server *dns.ncue.edu.tw*” operation? (2%)
(c) What three services are provided by the domain name system? (6%)
(d) Explain iterated query and recursive query (4%)
(e) Authoritative DNS servers (2%) (16% total)

Ans:

- (a) `nslookup -type=NS aiit.or.kr` (2%)
- (b) `nslookup www.aiit.or.kr dns.ncue.edu.tw` (2%)
- (c) DNS services (6%)
 - hostname to IP address translation (2%)
 - host aliasing (Canonical, alias names)
 - mail server aliasing
- (d) iterated query: (2%)
 - contacted server replies with name of server to contactrecursive query: (2%)
 - contacted server forwards the DNS query to next server and waits for the reply
- (e) authoritative DNS server (2%)
 - organization’s DNS servers, providing authoritative hostname to IP mappings for organization’s servers

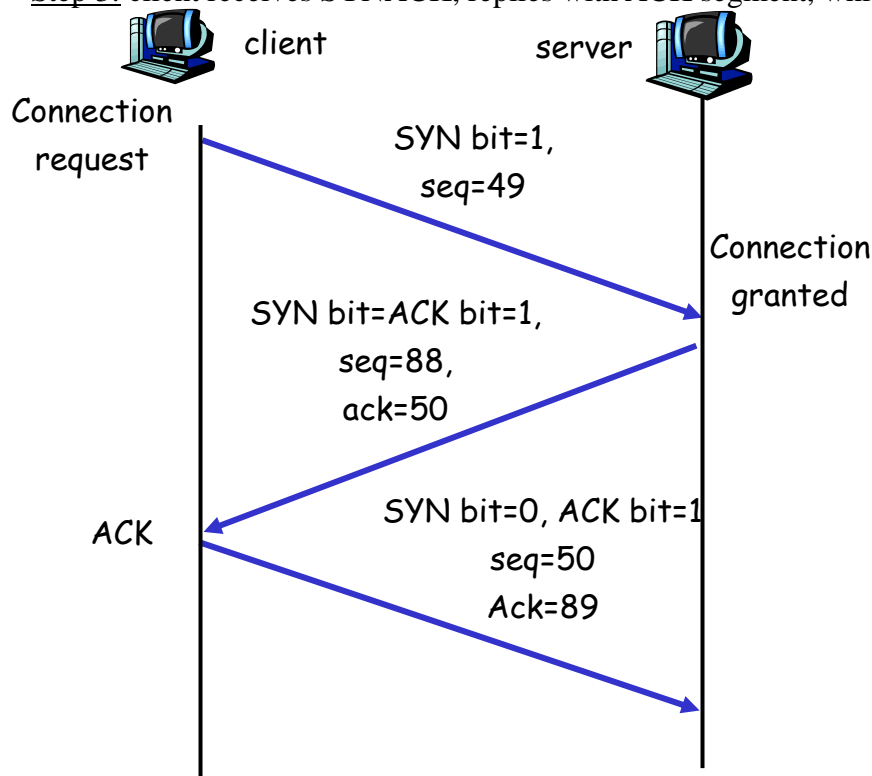
2. Draw the flow of the TCP three way handshake to explain its operations. Suppose the initial sequence numbers of the client and the server are 49 and 88, respectively. 必須在圖上分別清楚標示出 TCP 必要的 flag, sequence number, and ACK number. (10%)

Ans: Three way handshake:

Step 1: client host sends TCP SYN segment to server (搭配圖要正確 2%)

Step 2: server host receives SYN, replies with SYNACK segment (4%)

Step 3: client receives SYNACK, replies with ACK segment, which may contain data (4%)



上圖每個符號含內容 1 分，標示不全者，視狀況扣分，共 10 分

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3. Compare GBN, SR. Assume that the timeout values for all three protocols are sufficiently long such that 4 consecutive data segments and their corresponding ACKs can be received (if not lost in the channel) by the receiving host (Host B) and the sending host (Host A) respectively. Suppose Host A sends 4 data Segments to Host B, and the 3th segment (sent from A) is lost. In the end, all 4 data segments have been correctly received by Host B. How many segments has Host A sent in total and how many ACKs has Host B sent in total? What are their sequence numbers? Answer this question for all two protocols 畫出傳送過程說明，標示出每個訊息是 pkt or ack，並附上 sequence number，只寫答案 1%。(5% each, 10% total)

Ans:

a. **GoBackN:**

A sends 6 segments in total.

They are initially sent **segments 1, 2, 3, 4** and later **resent segments 3, 4**. (0.5%)

B sends 5 ACKs.

They are 3 ACKS with **sequence number 1, 2, 2**, and 2 ACKS with **sequence numbers 3, 4**. (0.5%)

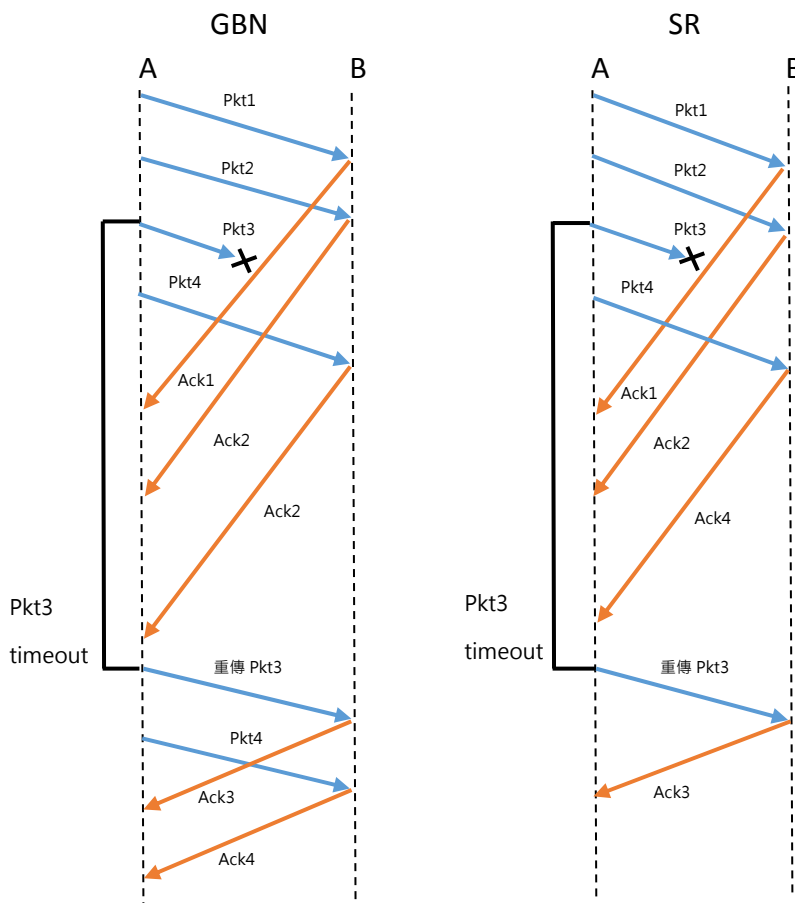
Selective Repeat:

A sends 5 segments in total.

They are initially sent **segments 1, 2, 3, 4** and later **resent segments 3**. (0.5%)

B sends 4 ACKs.

They are 3 ACKS with **sequence number 1, 2, 4**. And there is 1 ACK with **sequence number 3**. (0.5%)



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4. (a) UDP and TCP uses 1's complement for their checksums. Suppose you have the following 8-bit bytes: 11110001, 01010100. What is the 1's complement for the sum of these 8-bit bytes? Show all work. (要寫出過程 4%) (b) Consider the CRC generator, $G=1001$, and suppose that D has the value 10101010000. What is the value of R ? (要寫出運算過程 6%, 10% total)

Ans: (a)

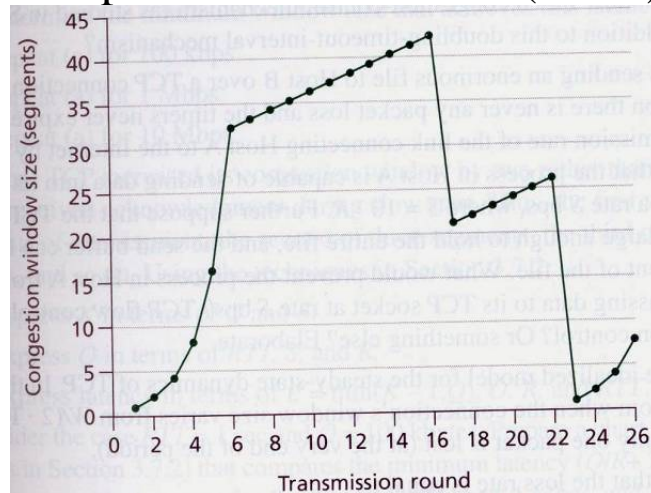
$$\begin{array}{r}
 11110001 \\
 + 01010100 \\
 \hline
 101000101 \\
 + \quad \quad 1 \\
 \hline
 01000110 \quad (2\%) \\
 \text{One's complement} = \underline{10111001} \quad (2\%)
 \end{array}$$

- (b) If we divide 1001 into 10101010000, we get 10111101(過程 4%), with a remainder of $R = 101$ (2%). (超出範圍，送分！)

$$\begin{array}{r}
 \overline{) 10101010000} \\
 \underline{1001} \\
 1110 \\
 \underline{1001} \\
 1111 \\
 \underline{1001} \\
 1100 \\
 \underline{1001} \\
 1010 \\
 \underline{1001} \\
 1100 \\
 \underline{1001} \\
 101
 \end{array}$$

5. (a) Describe how TCP Reno does its congestion control. (4%)
 (b) Answer and justify the following questions. (10%, 14% total)
- After the 22th transmission round, is segment loss detected by a triple duplicate ACK or by a timeout? (2%)
 - During what transmission round is the 50th segment sent? (要說明，4%)
 - Identify the TCP slow start intervals. (2%)
 - Identify the TCP congestion avoidance intervals. (2%)

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Ans: (a) (4%)

When **CongWin** is below **Threshold**, sender in slow-start phase, window grows exponentially (1%).

When **CongWin** is above **Threshold**, sender is in congestion-avoidance phase, window grows linearly (1%).

When a triple duplicate ACK occurs, **Threshold** set to **CongWin/2** and **CongWin** set to **Threshold** (1%).

When timeout occurs, **Threshold** set to **CongWin/2** and **CongWin** is set to 1 MSS (1%).

(b) (10%)

a. After the 22th transmission round, packet loss is recognized by a timeout. (2%)

b. During the 1st transmission round, packet 1 is sent; packet 2-3 are sent in the 2nd transmission round; packets 4-7 are sent in the 3rd transmission round; packets 8-15 are sent in the 4th transmission round; packets 16-31 are sent in the 5th transmission round; packets 32-63 are sent in the 6th transmission round; packets 64 – 96 are sent in the 7th transmission round. Thus packet 50 is sent in the 6th transmission round. (說明 2%, 答案 2%, 共 4%)

a. TCP slowstart is operating in the intervals [1,6] and [23,26] (1% each, 2% total)

b. TCP congestion avoidance is operating in the intervals [6,16] and [17,22] (1% each, 2% total)

6. 針對 120.107.172.1 這個 IP address, (以十進位表示, 要寫完整過程) (20%)

a. 這一個 IP 屬於那個 Class 的網路? 以二進位說明(1%) 其所屬的 IP 網路表示法為何?(1%) 可用 IP 範圍?(2%) 共有幾個 IP 可用?(1%) mask 的值為何?(1%)

b. 將此 IP 網路分成 20 subnets, subnet mask 的值為何?(2%) 請列出第 1 個 subnet 的網路表示法 (1%) 可用 IP 範圍?(2%) 共有幾個 IP 可用?(1%)

c. 手動設定電腦的網路時, 除了 default gateway 的 IP 外, 至少要設定哪兩個項目的資訊, 才可以上網?(2%)

d. default gateway 的 IP 有什麼用處? 如何使用?(6%)

Ans:

a.

120.107.172.1 的二進位表示法為 01111000.XXXXXXXXXX.XXXXXXXXXX.XXXXXXXXXX, 由前 1 個 bits 0 可判斷為 Class A 的 IP. (1%)

此 IP 所屬於的 Class A 的網路表示法為 120.0.0.0 (2%)

所有 Host IP 部分的 24 個 bit 的 X 不可以全為 0 或 1,

因此第一個可用 Host IP 為 120.00000000.00000000.00000001 = 120.0.0.1 (1%)

最後一個可用 Host IP 為 120.11111111.11111111.11111110 = 120.255.255.254 (1%)

->共有 $2^{24}-2$ 個可用 Host IP (1%)

Mask: 255.0.0.0 (1%)

b.

將此 Class A 網路分成 20 個 subnet, 加上全為 0 與全為 1 的兩個不能用的 subnet ID, 最少需要

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$20+2=22 \leq 2^5$, subnet mask 的值 \Rightarrow 需要 Host IP 的前 5 個 bits 當作 subnet ID。所以新的 subnet mask 是由原本 Class A 的 default subnet mask 255.0.0.0 來改，改成 255.11111000.0.0 \Rightarrow 255.248.0.0 (2%)

subnet 的 ID 要從此 Class A Network ID 120.0.0.0，需要 Host IP 的前 5 個 bits 當作 subnet ID，不可全為 0 或 1。因此第 1 個 subnet ID 為 120.00001000.0.0 \Rightarrow 120.8.0.0 (2%)

因此第一個可用 Host IP 為 120.00001000.0000000000.00000001 = 120.8.0.1 (1%)

最後一個可用 Host IP 為 120.00001111.11111111.11111110 = 120.15.255.254 (1%)

\rightarrow 共有 $2^{19}-2$ 個可用 Host IP (1%)

c. IP address, subnet mask, (2%)

d. source IP address AND subnet mask 得到 source IP address 所屬的 IP subnet, (1%)

destination IP address AND subnet mask 得到 destination IP address 所屬的 IP subnet, (1%)

if (兩者相同) then

 利用第二層，packet 送到 destination IP address (2%)

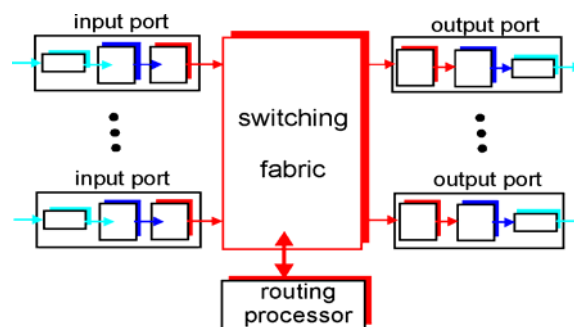
else

 利用第二層，packet 送到 default gateway (2%)

7. (a) Draw a figure to show four components of a router (4%) (b) Draw three types of switching fabrics with their names. (2% each) (10% total)

Ans:

(a) (1% each, 4% total)

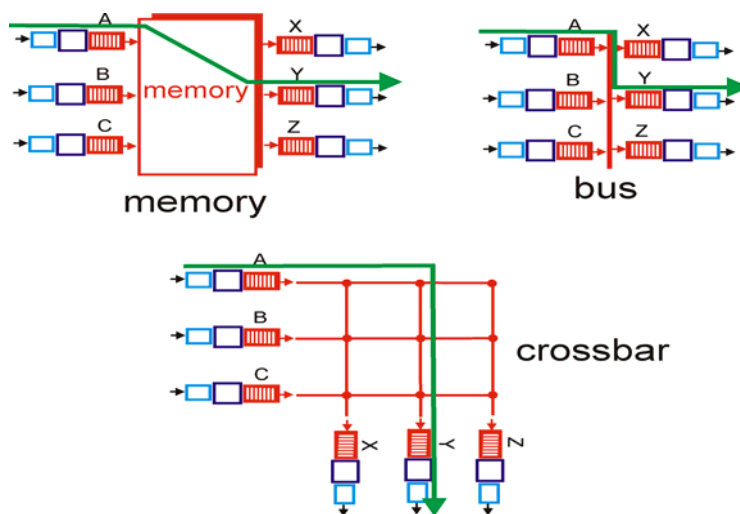


(b) (6%)

switching via memory; (6%)

switching via a bus; (6%)

switching via an interconnection network (6%)



8. (a) What is the goal of DHCP? (2%) (b) List four steps of DHCP (8%) (10% total)

Ans:

(a) Goal: allow host to *dynamically* obtain its IP address from network server when it joins network

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(2%)

(b) Flow: (8%)

- host broadcasts “DHCP discover” msg (2%)
- DHCP server responds with “DHCP offer” msg (2%)
- host requests IP address: “DHCP request” msg (2%)
- DHCP server sends address: “DHCP ack” msg (2%)