計算機網路概論 EE 3650 Midterm 2014 April 28, 2014

1. (Encoding 10%) Please be brief in answering the following questions.
   (a) (2%) Describe the baseline wander problem.
   (b) (2%) Describe how the NRZI solves the problem of consecutive 1s. 101
   (c) (2%) Describe the idea of the 4B/5B encoding scheme and how it can be used for solving the problem of consecutive 0s.
   (d) (2%) HDLC uses the bit sequence 01111110 as the beginning and the end of a frame. Describe how bit stuffing is done.
   (e) (2%) Describe how the Internet checksum $\boxed{\text{is}}$ computed.

2 (IP packet format 10%) The IP packet format is shown in Figure 3. Please be brief in answering the following questions.

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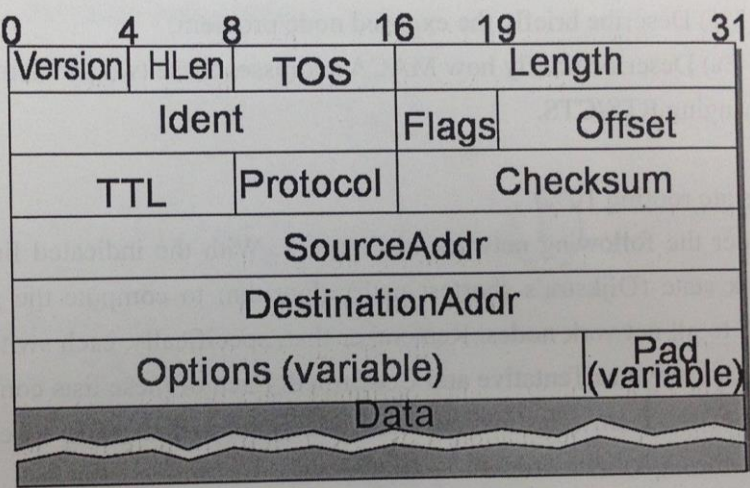


Fig 3

to show the time to live number,

how many

(a) (2%) What is the current version?
(b) (2%) What is the maximum size of an IP packet?
(c) (2%) What is the purpose of the TTL field?
(d) (2%) What is the purpose of the Protocol field?
(e) (2%) What is the purpose of the Offset field?

3. (a) what is Band-width/Latency ?

(b) what is ARP ?

(c) (2%) What does DHCP do?

(d) (2%) Can FIFO queues achieve the fundamental limits (100% throughput) in input-buffered switches? Why?

(e) (2%) Can the Batcher-banyan network realize all the permutations? Why?

4.

802.3 10%) Ethernet' s medium access control uses CSMA/CD.

(a) (3%) Describe the scenario that collisions can still occur even every node is capable of carrier sensing.

(b) (3%) Ethernet is limited to 2500m and the round-trip delay is determined to be 51.2 μs. Early Ethernets run on 10Mbits/sec. For CSMA/CD to work properly, what is the minimum size of an Ethernet packet?

(c) (4%) Describe briefly how exponential backoff works when a collision occurs.

5. (802.11 10%) Wi-Fi' s medium access control uses MACA.

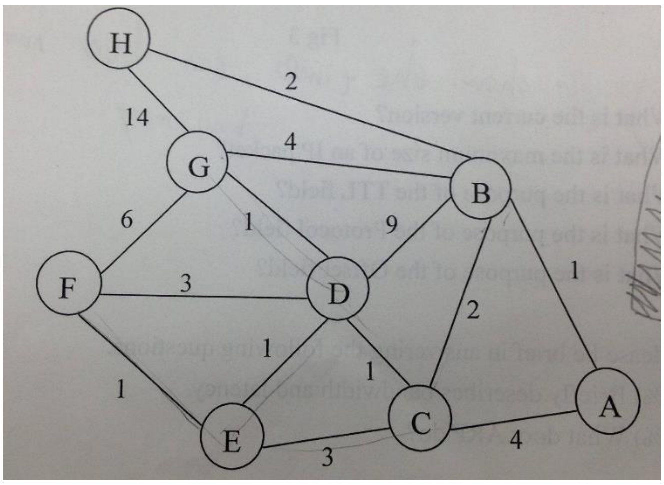
(a) (3%) Describe briefly the hidden node problem.

(b) (3%) Describe briefly the exposed node problem,

(c) (4%) Describe briefly how MACA addresses these two problems by exchanging RTS/CTS.

6. (Link state routing 10%)

Consider the following network in Figure 1. With the indicated link costs, use the link state (Dijkstra's shortest path) algorithm to compute the shortest path from **F** to all network nodes. Remember that, specifically, each switch maintains two lists, known as Tentative and Confirmed. Each of these lists contains a set of entries of the form (Destination, Cost, Next-Hop). If there is a tie, choose the node in the alphabetic order.



(Distance-vector routing 15%)

Assume all nodes exchange information synchronously. For the network given in Figure 2, give global distance-vector tables like the following table when

	A	B	C	D	E	F
A						
B						
C						
D						
E						
F						

(a) Each node knows only the distances to its immediate neighbors.

(b) Each node has reported the information it had in the preceding step to it immediate neighbors.

(c) Give the final routing table.

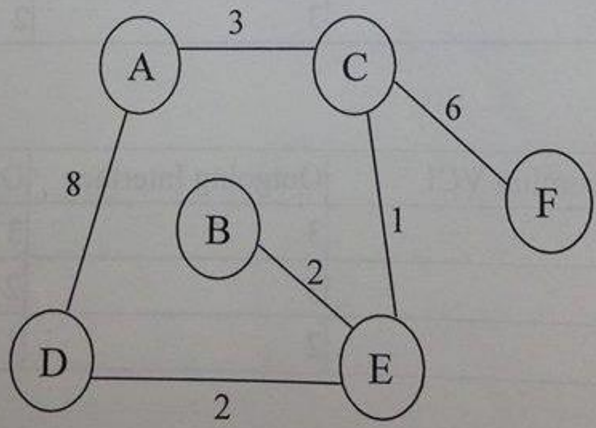


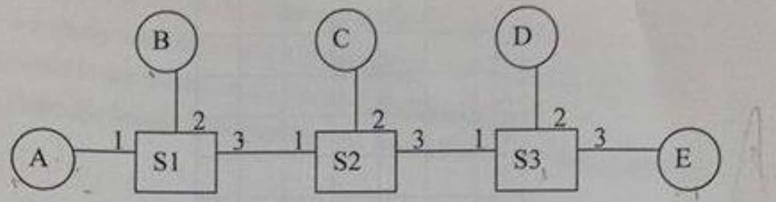
Figure 2

8. (CIDR 5%) The following table is a routing table using CIDR. Address bytes are in hexadecimal. The notation "/12" in C4.50.0.0/12 (with each byte being represented by two hexadecimal numbers) denotes a netmask with 12 leading 1 bits, that is, FF.F0.0.0. Find next hop of the IP address C4.5E.05.09.

Net/MaskLength	NextHop
C4.50.0.0/12	A
C4.5E.10.0/20	B
C4.68.0.0/14	C
80.0.0.0/1	D

9. (Virtual circuits 10%)

Consider the virtual circuit switches in the following figure. The three tables below list (for the three switches) what <port, VCI> (or <VCI, interface>) pairs are connected to what other. Connections are bi-directional. List all end-to-end connections.



Switch S1

Incoming Interface	Incoming VCI	Outgoing Interface	Outgoing VCI
1	5	3	4
1	2	3	1
2	1	3	2

Switch S2

Incoming Interface	Incoming VCI	Outgoing Interface	Outgoing VCI
1	1	3	3
1	2	3	2
1	4	2	1

Switch S3

Incoming Interface	Incoming VCI	Outgoing Interface	Outgoing VCI
1	3	2	1
1	2	3	1

10. (Saturation throughputs 10%)

(a) (5%) Consider a slotted ALOHA system with N users. Suppose that every user always has a packet to send. Further, we assume that every user is aware of the total number of users in the system, i.e., N, and can use that information to optimize the probability p of transmitting a packet. The saturation throughput of such a system is defined as the probability that there is exactly one packet transmitted at a time slot. Show that the saturation throughput of such a system is $1/e$ when N goes to infinity.

(b) (5%) Consider an input-buffered switch with N input ports and N output ports. Suppose that there are an infinite number of packets buffered at each virtual output queue (VOQ) at each input. At each time slot, each input randomly picks a Head-Of-Line (HOL) packet from one of its N VOQs and sends its *request* to the destined output of that packet. If an output receives more than one *request*, it randomly selected one of them and sends a *grant* to the input of that packet. When an input receives a *grant*, it then transmits the packet through the switch fabric. The saturation throughput of such a system is defined as the probability that a packet is received at an output at a time slot. Show that the saturation throughput of such a system is $1-1/e$ when N goes to infinity.

1. 5

5(a) 沒作答

-5

(b)

Non-return to Zero · Invert

Compare to NRZ, high to low → "1"

?

連續的1

(c)

將4bit重新編碼成5bit，此5bit無論怎麼連接，首尾連起來出現連續的0不會超過4，可解決 the problem of consecutive 0's.

(d)

$\boxed{01111110}$ → special pattern.

So when sending data，每當有連續5個1出現，加上一個零。在 receiver 端解碼時，則將連續5個1之後的零去除。

(e) checksum → 每組data的和若為奇數補1，偶數補0，

4(a) IPv4.

-6

(b)

16-bit.

(c)

避免 packet 在一個 loop 裡繞不出來，每過一個 Hub，減1，當歸零還沒傳到，packet 自動銷毀.

(d)

Define the rules when transmit packet.

(e) 沒作答

3.

(a)

Bandwidth: The number of bits can be passed per second.

Latency: Time between sending a message and getting by receiver.

Including propagation delay, Queue delay, ... etc.

(b)

ARP.

A Host want to send a message.

先檢查自己的表(cache)知不知道目標在哪，若有直接傳送。

若無，傳packet給大家，包含target IP address，每個收到的人會打開檢查是否為自己IP，若是則收下，回傳收到的訊息。update the local table.

(c)

DHCP.

like a pool of IP address server.

因為資源有限，有需要時才向他要求IP address，使用後歸還。

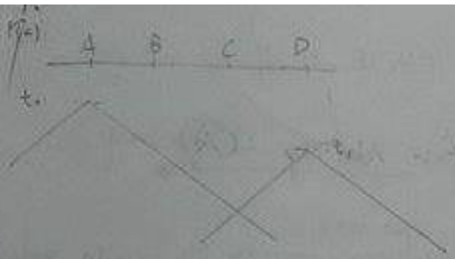
(d)

No.

Will be limited by queue delay or some other reasons.

(e)

(a)



因為實際的傳輸有距離上的因素，造成的時間差，還是會有collision發生

現在傳的時候認為已經clear了。

(b)

$51.2\mu = \frac{2500}{3\times10^8} + \frac{x}{10\times10^6}$

$51.2\mu = 8.33\mu + \frac{x}{\ }\mu$

$x = 428.7$ bits. $= 53.6$ Bytes

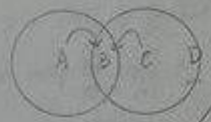
?

(c)

when collision occurs. the transmit frequency ÷ 2. (讓大家都有空間可以傳)

5.

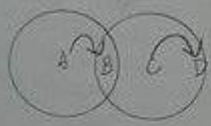
(a) hidden node problem



A傳給B
C傳給B

在確認到傳送的時候，都一定會發生collision，導致無法傳到B.

(b)



A傳給B
C傳給D.

其實A.C都可以確實的將資訊傳到，但他們會以為有collision發生。

(c) MACA

sender發出Request to send, (RTS) 等到receiver端收到後發出Clear to Send (CTS), 有聽到CTS的人便知道先暫時不能傳資料。Sender收到CTS → Send the message.

6. 6

0°	(F, 0, -)	(G, 6, G) (D, 8, D) (E, 1, E)
1°	(F, 0, -) (E, 1, E)	(G, 1, G) (D, 7, E) (C, 4, E)
2°	(F, 0, -) (E, 1, E) (D, 2, E)	(G, 3, [illegible]) (C, 3, [illegible]) (B, [illegible], [illegible])
3°	(F, 0, -) (E, 1, E) (D, 2, E) (C, 3, [illegible])	(G, 3, [illegible]) (A, 7, [illegible]) (B, 5, [illegible])
4°	(F, 0, -) (E, 1, E) (D, 2, E) (C, 3, [illegible]) (G, 3, [illegible])	(A, 7, [illegible]) (B, 5, [illegible]) (H, 17, [illegible])
5°	(F, 0, -) (E, 1, E) (D, 2, E) (C, 3, [illegible]) (G, 3, [illegible]) (B, 5, [illegible])	(A, 6, [illegible]) (H, 7, [illegible])
6°	(F, 0, -) (E, 1, E) (D, 2, E) (C, 3, [illegible]) (G, 3, [illegible]) (B, 5, [illegible]) (A, 6, [illegible]) (H, 7, [illegible])	

-4

7. 15

(a)

	A	B	C	D	E	F
A	0	∞	3	8	∞	∞
B	∞	0	∞	∞	2	∞
C	3	∞	0	∞	1	6
D	8	∞	∞	0	2	∞
E	∞	2	1	2	0	∞
F	∞	∞	6	∞	∞	0

(b)

	A	B	C	D	E	F
A	0	∞	3	8	4	9
B	∞	0	3	4	2	∞
C	3	3	0	3	1	6
D	8	4	3	0	2	∞
E	4	2	1	2	0	7
F	9	∞	6	∞	7	0

(c)

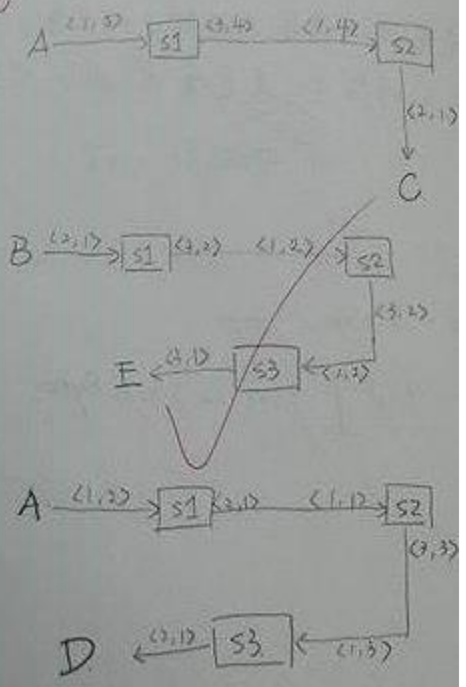
	A	B	C	D	E	F
A	0	6	3	6	4	9
B	6	0	3	4	2	9
C	3	3	0	3	1	6
D	6	4	3	0	2	9
E	4	2	1	2	0	7
F	9	9	6	9	7	0

8. 5 C4. SE. 03. 09

Ans: Next Hop : A

9. 10

<port, VCI>



10. 3

(a) exactly one packet

$= C_1^N p \times (1-p)^{N-1}$

$\Rightarrow \lim_{N\to\infty} N \times p \cdot \left[1^{N-1} + C_1^{N-1} 1^{N-2}(-p) + C_2^{N-1}(-p)^2 + \dots + C_{N-2}^{N-1}(-p)^{N-2} + C_{N-1}^{N-1}(-p)^{N-1} \right]$

$= \lim_{N\to\infty} N \times p \left[1 + (N-1)(-p) + \frac{(N-1)(N-2)}{2}(-p)^2 \right.$

(b) -2

N inputs, N outputs

prob that a packet is received at an output at a time slot.

1 - (exactly zero packet transmit at a time slot)

by (a) $\Rightarrow 1 - \frac{1}{e}$ why?