期中考

1. What is “sorcerer’ s apprentice sydrome”? Please design a scheme to avoid it. (2009)

只會發生於stop-and-wait protocol，當封包傳送延遲但未掉包時，會導致sender在time out後重送一次data，導致receiver重複收到兩次資料並回應兩次ACK，而sender收到重複的ACK又再重複送出一次data。 解決方式為令sender只承認第一次收到的ACK，只要再收到同一個資料的重複ACK都直接無視並丟棄。

2. In which protocol BOOTP is encapsulated? BOOTP uses port 67 for the server and 68 for the client. That means the client does not choose an unused ephemeral port. It seems different from the general client-server model. Could you explain the reason?(2009)

BOOTP is encapsulated in UDP。若server的reply在廣播時使用的是隨機的port，沒有發出request卻剛好用到該隨機port的機器就會誤收來自server的reply。

3. For some disk-less hosts(clients), they are bootstrapping at the same time by using BOOTP, and if the server broadcasts the replies, each client can see the replies. How can a client match replies with requests? (i.e., how does a client know a reply intended for myself?(2009)

有一個transaction ID的欄位是用來判斷reply是要給哪個client的。

4. What is stop-and-wait protocol?(2009)

Sender必須在傳送資料後等待一固定時間到對方回應ACK後才會進行下筆資料的傳輸。如果time out時會重送同一筆資料。

5. What is *pointer queries* for DNS? Consider the command “host 140.117.11.1”. What domain name is passed from the resolver to the name server?(2009)

pointer query: 將IP轉為host name。 dns.nsysu.edu.tw。

6. In IGMP ,the query message from multicast router is sent to destination IP 224.0.0.1, and report message is sent to the IP of the group address. Why is not the report message sent to the multicast router by unicast?

因為當有人已經report的時候，其他人也會聽到這個report因此就不會再送同樣的訊息給multicast router。

7. IGMP messages are encapsulated in IP datagrams. Because it is usually restricted within a local network, for performance issue a smart engineer redesigns his own IGMP in his private network by encapsulating IGMP messages in Ethernet frame. The query message is sent to destination MAC address ff:ff:ff:ff:ff:ff, and report message is sent back to the requesting host by unicasting (of cource, the *type* field in ethernet header is also defined for this new IGMP). Do you think whether this “link layer IGMP” is working? If the query message’s destination MAC address is changed to 01:00:5e:00:00:01 (i.e., MAC address of 224.0.0.1), is it also working? Please answer “YES” or “NO” and then justify your answer.(8%) Forthermore, please try to explain the effect in performance of the report message sent by unicast, multicast, or broadcast in Ethernet. Which one is the best choice?(5%)(2009)

1.在data link layer使用IGMP是可行的，MAC address ff:ff:ff:ff:ff:ff等於是將此IGMP message廣播到所有相鄰的MAC address。而目的端改為224.0.0.1代表送給所有subnet的成員，其效果與前述的廣播是相同的。

2.broadcast的效率最不好，因為會讓所有不相干的機器都收到訊息，浪費資源。unicast次之，雖然只有特定的目的端會收到，但一個目的端就要個別送一次unicast的訊息，會重送很多重複的封包。multicast效果最好，只需要送一次multicast的訊息就可以讓特定group的成員都收到。

8. What is *IP source routing*? Then further describe strict and loose source routing.(2009)

即為封包送出前就決定好整個routing的路徑，且不能改變。

strict: 限制必須只能經過指定的router。

loose: 除了指定的router外，在指定的router之間可以穿插其他的router，但經過指定router的順序不可改變。

9. Consider a broadcast operation “ping 140.117.176.255” (assume the network mask 255.255.255.0). What is outgoing packet’ s destination MAC address in the ethernet frame?(2%) ARP cache will be different before and after this *ping* of the broadcast address (if cache is empty before *ping* and is full afterward). How does this happen?(i.e., when are ARP request sent?)(3%)(2009)

1.ff:ff:ff:ff:ff:ff

2.當一個host收到訊息後即會檢查自己是否就是目的端IP，如果是則更新ARP cache並回送一個ARP reply，sender收到reply後即會更新此IP與MAC的對應關係。

10. Describe the operation of IP fragmentation and reassembly. Additionally, where does the reassembly opreation do?(2009)

當IP packet大於MTU時，就透過fragmentation將packet切為符合MTU的大小後才傳送。reassembly則是反過來將收到且被切割過的packet組合回來。目的端會在網路層(IP層)依照所收到的packet的identification field來進行reassembly。

11. What is “path MTU”?(2%) Please show a way to determine the path MTU.(3%)(2009)

1.在兩個host之間所有data link的MTU中，最小的那一個。

2.在送出的packet header中設定DF(Don’ t Fragment)的option，因此當路徑上有一條link的MTU小於這個packet時，此packet就會被drop掉並回送一個ICMP message通知sender這個狀況。如此sender就知道要降低packet的大小並重複以上步驟直到packet順利抵達目的端。如此便可以確認path MTU的大小。

12. What difference between “link-state” routing protocol and “distance-vector” routing protocol?(2009)

link-state protocol會在透過與網路中所有的router交換訊息得到全域的資訊後，才利用最短路徑演算法計算出routing path。

distance-vector protocol是只依靠交換相鄰的router的資訊來建立routing table。

13. In which protocol RIP is encapsulated? How about OSPF?(2009)

RIP為distance-vector protocol。OSPF為link-state protocol。

14. What situation happens, a router will send ICMP redirect error?(2009)

當此router知道存在一條不需要透過自己轉發，且比它還要更好的路徑可以讓封包更快的傳遞到目的端時，就會回傳此ICMP message。

15. We have already have *ping* command to record router(i.e., -R option). Why do we still need *traceroute* command? Please also describe *traceroute* design idea(i.e., *expanding ring search*).(2009)

並非所有的router都支援"record route option"，且IP header最多只能記錄9個router。

traceroute透過送出不同TTL值的UDP封包來實現，當TTL等於1時此封包抵達第一個router就會丟棄此封包並回應一個ICMP message，透過不斷重送並增加TTL值就可以透過這個回傳的ICMP訊息達到獲得路徑上所有router的資訊。

16. If you are asked to pick up an IP address from a given IP list, describe a test to make sure that this chosen IP address is not currently used by other?(2009)

送出一個gratuitous ARP，IP的欄位則填入要使用的IP。若之後有ARP reply且這個reply中的MAC address不是自己，代表這個IP已經有別人在使用了。

17. How can we know if an IP packet is carrying an ICMP packet?(2009)

看IP header的protocol field，ICMP為0x01。

18. Why can not CSMA/CD be used in wireless channels? However, CSMA/CA is suitable. Please describe why it works.(2009)

無線環境中不容易偵測是否發生碰撞，因此才使用CSMA/CA來避免碰撞。CSMA/CA中sender會先送出一個RTS訊號通知receiver以及自己的鄰居即將傳送資料。receiver收到RTS之後則會回應一個CTS訊號通知sender以及自己的鄰居即將接收資料，因此只有在傳送RTS時會發生碰撞。藉此可避免sender與receiver在收送資料時會受到來自其他節點的訊號導致資料碰撞。

19. Please describe the responsibility of transport layer.(2009)

確保end to end的資料可以順利送達。

20. Please describe the responsibility of MAC (Medium Access Control) and LLC (Logic Link Control) layer.(2009)

MAC：提供定址以及媒體存取。

LLC：提供流量控制。

21. What is encapsulation?(2%) What is the maximal Ethernet frame size?(2%)(2009)

1.將資料加上一層header，讓下層的功能可以被包裝在上層協定的data中

2.Ethernet frame的最大payload，1500bytes。

22. What is meaning of *demultiplexing* between two layers?(2%) Which field is IP layer demultiplexing based on?(2%)(2009)

1.當資料要從下層往上層送時，透過header來確定要將資料送往上層的哪一個protocol或應用程式處理。

2.IP根據protocol field的值作解多工。

23. Why do we need loopback interface?(2009)

讓client跟server可以在同一個host上面利用TCP/IP作溝通。

24. According to network architecture, a message which is sent to network must be processed through many network layers. Consider a host’ s IP address is X. This host sends a message to itself by setting receiver IP X or loopback address 127.0.0.1. Please show the difference of both cases.(2009)

如果sender是設定自己的IP X，則會將資料先送到network的interface(如eth0)後，再送往loopback。

若是填127.0.0.1，則資料會直接送往loopback。

25. Is it necessary to have a globally unique IP address and a globally unique MAC address for a host?(3%) Someone likes to “steal” the other’s IP address. Can you propose an approach by thinking about ARP to prevent the stealing IP event?(4%)(2009)(2007.2)

1.Globally unique IP是必須的，MAC不需要globally unique但在同一個網段上面不能重複。

2.利用arp -s的flag去永久綁定MAC與IP的對應關係。

26. Is it necessary to have the multicast MAC address in data-link layer? You may justify answer by an example.(2009)(2007.3)

YES，有multicast MAC address可以減少在ethernet上面的流量。因為ARP的設計無法直接查到multicast的MAC address。

27. Given an IP address, say 140.117.176.47 for example, how can you decide if it is a direct broadcast address?(2009)(2007.4)

direct broadcast會在host name的欄位全部填入1。

28. NSYSU is assigned a Class B IP address (140.117.X.X). So the default network mask is 255.255.0.0. No matter what subnetting we are using, users still keep the default mask in network interface. Can packets be correct delivered? Please explain your answer.(2009)(2007.5)

收送140.117.X.X以外的封包不會有問題，但在140.117.X.X內的各個subnet間傳送封包時，會因為default的mask沒有辦法順利區分出不同的subnet而產生問題。

29. Please give an example to show why a host may send an ARP request with the target IP to be the same as sender IP.(2009)(2007.6)

透過ARP封包去確認同一個網段上是不是有跟自己重複的IP。也就是說對照ARP reply的內容，若reply中的MAC與自己的MAC不一樣，就代表這個IP已經被使用了。

30. For a IP datagram, its header is changed because TTL field decrements 1 for each hop delivery. Please explain why checksum(CRC) verification is always no problem.(2009)(2007.7)

當router改變TTL欄位時，因為header內容已經被修改了，所以router就會再重新計算一次新的checksum。

31. If the mask of a network interface inside a router, *eth0*, is 255.255.255.255, please describe how the IP routing module processes incoming IP datagrams from *eth0*.(2009)(2007.9)

比對收到的IP與mask做「and運算」後得到的netid是否有在routing table中，如果有的話就往下層送。

32. Referring the IP datagrams, what part is the *checksum* calculated over? Additionally, where is the checksum computed and verified, respectively?(2009)(2007.11)

Checksum只會以IP datagram的header為對象來計算。只要router一收到IP封包即會檢查checksum，若checksum檢查沒有問題後router會將header中的TTL欄位值減去1，再重新對header計算一個新的checksum。

33. IP provides unreliable service. That is, there is no guarantees that IP datagram successfully gets to its destination. How does the sender know it datagram transmission to be successful or not in the *network layer*?(2009)(2007.12)

透過ICMP的message來得知。(TCP是Transport Layer的協定)

34. Please describe the flow control in Data Link layer and Network layer.(2009)(2007.13)

Data Link layer：利用stop and wait與sliding window的機制來控制傳送速度。

Network layer：利用ICMP送出source quench通知sender降低傳送速度。

35. Please explain (1) connectionless protocol; (2) connection-oriented protocol. Illustrate an example for each protocol.(2009)(2007.14)

1. 在兩端點間傳送訊息時不事先建立連線，直接將資料送給對方且不檢查有無送達，如UDP。
2. 兩端點在交換資料前先建立一連線，並且將資料循序的透過這個連線送達，如TCP。

36. Consider the example:

richard % ssh sun4.cse.nsysu.edu.tw

Some one tries to remote login sun4.cse.nsysu.edu.tw from a host *richard*. The IP address of *richard* is 140.117.171.1 and the one of sun4 is 140.117.174.18. The sender (*richard*) needs to encapsulate TCP, IP, and Ethernet headers to the payload (i.e., data) before the data is sent. Please describe what should be filled into the following fields:

- **port numbers of the source and destination in the TCP header; (you need not show the exact port number, but just describe it.)**
- **IP address of the source and destination in IP header;**
- **Ethernet address of the source and destination in the Ethernet header;**

In addition, you need to show what protocol will be triggered during each above field to be filled if there is.(2009)(2007.15)

1.source port：隨機的。destination port：一固定的port(本題為例則為ssh port:22)。

2.source IP：140.117.171.1。destination IP：140.114.174.18。

3.source MAC：richard主機的MAC。destination MAC：若destination在不同網段，則欄位為下一個要轉送封包的router的MAC。

37. What is *proxy ARP* and *gratuitous ARP*? What are MAC addresses of the hosts behind proxy ARP reported? Why do we need *gratuitous ARP*?(2009)(2007.17)

1.proxy ARP是指由router來代為回應一個位在他後面網段的某個主機的ARP request。

gratuitous ARP是指sender送出一個填入自己IP的ARP request，用來確認這個IP是否已經被使用，若ARP reply內的MAC與自己的MAC不同則代表此IP已經有人使用。

2.What are MAC addresses of the hosts behind proxy ARP reported?

Router的MAC address

38. (1) An organization with a block of 64 IP address (140.117.176.128/26, this "26" means netmask 1 bit number) needs to be divided into one block with 32 addresses, two blocks with 16 address in each. Find the beginning address and mask of each block. (2) For the 32-address block, if we need to further subnet it into three blocks with 16, 8, 8 addresses, please find the beginng address and mask of each new block. Then show the network ID and the broadcast address of each new block.(2009)(2007.19)

(1)

32-26 = 6; 2^6 = 64(個位置)

32(個位置) = 2^5; 32-5 = 27; 140.117.176.128/27

16(個位置) = 2^4; 32-4 = 28; 140.117.176.160/28 ;140.117.176.176/28

(2)

16(個位置) = 2^4; 32-4 = 28;

Beginning address: 140.117.176.128/28

network ID: (140.117.176.128) & (255.255.255.240) = 140.117.176.128

broadcast address: (140.117.176.128) | NOT(255.255.255.240) = (140.117.176.128) |(0.0.0.15) = 140.117.176.143

8(個位置) = 2^3; 32-3 = 29;

Beginning address: 140.117.176.144/29

network ID: (140.117.176.144) & (255.255.255.248) = 140.117.176.144

broadcast address: (140.117.176.144) | NOT(255.255.255.248) = (140.117.176.144) |(0.0.0.7) = 140.117.176.151

8(個位置) = 2^3; 32-3 = 29;

Beginning address: 140.117.176.152/29

network ID: (140.117.176.152) & (255.255.255.248) = 140.117.176.152

broadcast address: (140.117.176.152) | NOT(255.255.255.248) = (140.117.176.152) |(0.0.0.7) = 140.117.176.159

network ID：起始位置與mask做「bitwise and」運算。

broadcast address：起始位置與「NOT mask(mask的0與1對調)」做「bitwise or」運算。

39. If we want to broadcast a data to all hosts attached on a common physical network,we can use Link-layer (ff:ff:ff:ff:ff:ff) or IP-layer (224.0.0.1) broadcast address.What are the differences between both?(2009)(2007.21)

ff:ff:ff:ff:ff:ff為廣播給同一個網段內的所有主機。224.0.0.1為multicast address，資料會廣播給支援multicast group內的所有主機。

40. An application using UDP sends a datagram that gets fragments into four pieces. Assume that fragment 1 and 2 make it to the destination, with fragments 3 and 4 being lost. The application then times out and retransmits the UDP datagram 10 seconds later and this datagram is fragmented identically to the first transmission (i.e., the same offset and lengths). Assume that this time fragments 1 and 2 lost but 3 and 4 make it to the destination. Also assume that the reassembly timer on the receiver host is 60 seconds, so when fragments 3 and 4 of the retransmission make it to the destination, fragments 1 and 2 frome the first transmission have not been discarded. Can the receiver reassemble the IP datagram from the four fragments it now has?(2009)

無法重組，因為兩次所送出的datagram的identification field會不一樣。

41. Suppose a bridge has two of its ports on the same physical network. How might the bridge detect and correct this?(2009)

由於相同介面的冗餘線路會導致迴圈，故使用spanning tree協定即可決定哪個port該處於active。

42. If we let ARP reply to be multicast, does it still work? If so, is there any advantages or disadvantages?(2009)
實際上的ARP reply沒有multicast的機制。但若要設計一個ARP reply的multicast的話，好處是其他收到這個multicast reply的機器也可以同時把這個MAC存起來。缺點是不需要用到這個MAC的機器也需要額外花資源去處理這個資訊。

1. In IGMP, is it necessary for multicast router to know how many hosts join in a multicast group? Please justify your answer.(2007)
不需要，因為router只要知道某個port是否還有group要接收資料，直接把資料送到該port就好。

8. How can a host determine if another host is already configured with the same IP address? Please describe the detail.(2007)
透過gratuitous ARP，也就是request的IP欄位填入自己的IP，若之後ARP reply得到的MAC與自己的MAC不一樣，代表這個IP已經有其他人在使用。

10.Please show an example that we need the RARP.(2007)
disk-less system.

16. For an IGMP report message, what are the differences if the field of the destination IP address is the multicast router, group address, or 224.0.0.1? Are they all correct?(2007)
Yes

18. A multicast router would forward datagrams to a given multicast address, say 224.0.64.32 within its attached physical network. What IP address and link-layer address should be specified in a packet?
multicast address的group ID的最後23個bit會被複製到link-layer的ethernet address最後23個bit，ethernet address對應的multicast address為01:00:5e:XX:XX:XX，所以本題答案應為01:00:5e:00:40:20。

20.(1)Which command can be used to query the routing table for use by IP on a host?
(2)Which command can be used to show the route(i.e,each intermediate routers) to a destination host?(2007)
1. route -n
2. traceroute