Chap 4 Homework 2 R12-20 P6,8-19

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R12. Does routers have IP address? If so, how many?

Yes, They have one address for each interface.

R13. Suppose Host A sends Host B a TCP segment encapsulated in an IP datagram. When Host B receives the datagram, how does the network layer in Host B know it should pass the segment (that is, the payload of the datagram) to TCP rather than to UDP or to something else?

Consider data:

- *Suppose Host A sends Host B a TCP segment encapsulated in an IP datagram. That means, 8-bit field.*
- *If Host B receives the datagram, then encapsulated Host A sends a TCP segment. Then network layer transfer the data to TCP in the Host B.*

R14. Suppose there are three routers between a source host and a destination host. Ignoring fragmentation, an IP datagram sent from the source host to the destination host will travel over how many interfaces? How many forwarding tables will be indexed to move the datagram from the source to the destination?

An IP datagram sent from the source host to the destination host will travel over 8 interfaces.

3 forwarding tables will be indexed to move the datagram from the source to the destination

R15. Visit a host that uses DHCP to obtain its IP address, network mask, default router and IP address of its local DNS server. List these values and give screenshots of how you obtained them and describe.

Windows IP 配置

以太网适配器 以太网:

连接特定的 DNS 后缀 . . . . :
IPv6 地址 . . . . : 2001:da8:205:4092:e94a:e579:7a54:9060
临时 IPv6 地址. . . . . : 2001:da8:205:4092:7d8a:8370:d369:62d5
本地链接 IPv6 地址. . . . . : fe80::e94a:e579:7a54:9060%19
IPv4 地址 . . . . : 172.29.74.84
子网掩码 . . . . : 255.255.254.0
默认网关. . . . . : fe80::deda:80ff:fe44:c8b6%19
172.29.74.1

R16. Suppose an application generates chunks of 40 bytes of data every 20 msec, and each chunk gets encapsulated in a TCP segment and then an IP datagram. What percentage of each datagram will be overhead, and what percentage will be application data?

Given data:

Suppose an application generates chunks of 40 bytes of data every 20 msec, and each chunk gets encapsulated in a TCP segment and then an IP datagram

That means, TCP segment and IP datagram are 20 bytes each.

*Assume to added to the 40 byte to each chunk makes 2*40=80 total bytes.*

The over head is 40 of the 80 total, that means 50%.

So, the percentage will be application data 50%

R17. It has been said that when IPv6 tunnels through IPv4 routers, IPv6 treats theIPv4 tunnels as link-layer protocols. Do you agree with this statement? Why or why not?

The entire IPv6 datagram (including header fields) is encapsulated in an IPv4 datagram

R18. What is the 32-bit binary equivalent of the IP address 223.1.327?
Convert each decimal number to binary in given IP address:

223=11011111
1=00000001
3=00000011
27=00011100

So, the 32-bit binary equivalent of the IP addresses 223.1.3.27:
11011111 00000001 00000011 00011100

R19. Compare and contrast the IPv4 and the IPv6 header fields. Do they have any fields in common?

IPv6 has a fixed length header, which does not include most of the options an IPv4 header can include. Even though the IPv6 header contains two 128-bit addresses (source and destination IP address) the whole header has a fixed length of 40 bytes only. Several of the fields are similar in spirit. Traffic class, payload length, next header and hop limit in IPv6 are respectively similar to type of service, datagram length, upper-layer protocol and time to live in IPv4.

R20. Suppose you purchase a wireless router and connect it to your cable modem. Also suppose that your ISP dynamically assigns your connected device (that is, your wireless router) one IP address. Also suppose that you have five Pcs at home that use 802.11 to wirelessly connect to your wireless router. How are IP addresses assigned to the five PCs? Does the wireless router use NAT? Why or why not?

Typically the wireless router includes a DHCP server. DHCP is used to assign IP addresses to the 5 PCs and to the router interface. Yes, the wireless router also uses NAT as it obtains only one IP address from the ISP.

P6. Consider a router with a switch fabric, 2 input ports (A and B) and 2 output ports (C and D). Suppose the switch fabric operates at 1.5 times the line speed.

a. If, for some reason, all packets form A are destined to D, and all packets from B are destined to C, can a switch fabrics be designed so that there is no input port queuing? Explain why or why not in one sentence.

b. Suppose now packets from A and B are randomly destined to both C and D. Can a switch fabric be designed so that there is no input port queuing? Explain why or why not in one sentence.

a) No. To have no input port queuing, the switching fabric should operated at a speed at least 2 times the line speed.

b) No. To have no input port queuing, the switching fabric should operated at a speed at least 2 times the line speed.

P8. Consider a datagram network using 32-bit host address. Suppose a router has four links, numbered 0 through 3, and packets are to be forwarded to the link interfaces as follows:

Destination Address Range	Link Interface
11100000 00000000 00000000 00000000 through 11100000 00111111 11111111 11111111	0
11100000 01000000 00000000 00000000 through 11100000 01000000 11111111 11111111	1
11100000 01000001 00000000 00000000 through 11100001 01111111 11111111 11111111	2
otherwise	3

a. Provide a forwarding table that has five entries, uses longest prefix match- ing, and forwards packets to the correct link interfaces.

b. Describe how your forwarding table determines the appropriate link inter- face for datagrams with destination addresses:

11001000 10010001 01010001 01010101
11100001 01000000 11000011 00111100
11100001 10000000 00010001 01110111

a)

Prefix Match Link Interface

11100000 0

11100001 00000000 1

11100001 2

otherwise 3

b) Prefix match for first address is 4th entry: link interface 3

Prefix match for second address is 2nd entry: link interface 1

Prefix match for first address is 3rd entry: link interface 2

P9. In Problem P6 you are asked to provide a forwarding table (using longest prefix matching). Rewrite this forwarding table using the a.b.c.d/x notation instead of the binary string notation.

Destination Address Link Interface

200.23.16/21 0

200.23.24/24 1

200.23.24/21 2

otherwise 3

P10. Consider a router that interconnects three subnets: Subnet 1, Subnet 2, and Subnet 3. Suppose all of the interfaces in each of these three subnets are required to have the prefix 223.1.17/24. Also suppose that Subnet 1 is required to support at least 60 interfaces, Subnet 2 is to support at least 90 interfaces, and Subnet 3 is to support at least 12 interfaces. Provide three net- work addresses (of the form a.b.c.d/x) that satisfy these constraints.

Three net- work addresses (of the form a.b.c.d/x) that satisfy given constraints as follows:

223.1.17.0/25
223.1.17.128/26
223.1.17.192/26

P11. Consider a datagram network using 8-bit host address. Suppose a router uses longest prefix matching and has the following forwarding table:

Prefix Match	Interface
1	0
11	1
111	2
Otherwise	3

For each of the four interfaces, give the associated range of destination host addresses and the number of addresses in the range.

Destination Address Range Link Interface

00000000
through 0
00111111

01000000
through 1
01111111

10000000
through 2
10111111

11000000
through 3
11111111
Number of addresses in each range = $2^6 = 64$

P12. In Section 4.2.2 an example forwarding table (using longest prefix matching). Rewrite this forwarding table using the a.b.c.d/x notation instead of the binary string notation.

Destination Address Link Interface

200.23.16/21 0

200.23.24/24 1
200.23.24/21 2
otherwise 3

P13. Consider a subnet with prefix 101.101.101.64/26. Give an example of one IP address (of from xxx.xxx.xxx.xxx) that can be assigned to this network. Suppose an ISP owns the block of addresses of the form 101.101.128/17. suppose it wants to create four subnets from this block, with each block having the same number of IP addresses. What are the prefixes (of from a.b.c.d/x) for the four subnets?

Any IP address in range 101.101.101.65 to 101.101.101.127
Four equal size subnets: 101.101.128/19, 101.101.160/19, 101.101.192/19, 101.101.224/19

P14. Consider a datagram network using 8-bit host address. Suppose a router uses longest prefix matching and has the following forwarding table:

Prefix Match	Interface
00	0
01	1
10	2
11	3

For each of the four interfaces, give the associated range of destination host addresses and the number of addresses in the range.

P15. Consider the network setup in Figure 4.22. Suppose that the ISP instead assigns the router the address 24.34.112.235 and that the network address of the home network is 192.168.1/24.

a. Assign addresses to all interfaces in the home network.
b. Suppose each host has two ongoing TCP connections, all to port 80 at host 128.119.40.86. Provide the six corresponding entries in the NAT translation table.

a) Home address : 192.168.1.1, 192.168.1.2, 192.168.1.3, 192.168.1.4
b) NAT Transalation table

WAN side	*LAN side*
24.34.112.235.4000	*192.168.1.1.3345*
24.34.112.235.4001	*192.168.1.1.3346*
24.34.112.235.4002	*192.168.1.1.3345*
24.34.112.235.4003	*192.168.1.1.3346*
24.34.112.235.4004	*192.168.1.1.3345*
24.34.112.235.4005	*192.168.1.1.3346*

P16. Consider the topology shown in Figure 4.17. Denote the three subnets with hosts (starting clockwise at 12:00) as Networks A, B, and C. Denote the sub- nets without hosts as Networks D, E, and F.

a. Assign network addresses to each of these six subnets, with the follow- ing constraints: All addresses must be allocated from 214.97.254/23; Subnet A should have enough addresses to support 250 interfaces; Sub- net B should have enough addresses to support 120

interfaces; and Subnet C should have enough addresses to support 120 interfaces. Of course, subnets D, E and F should each be able to support two interfaces. For each subnet, the assignment should take the form a.b.c.d/x or a.b.c.d/x – e.f.g.h/y.

b. Using your answer to part (a), provide the forwarding tables (using longest prefix matching) for each of the three routers.

a)

Subnet A: 214.97.255/24 (256 addresses)

Subnet B: 214.97.254.0/25 - 214.97.254.0/29 (128-8 = 120 addresses)

Subnet C: 214.97.254.128/25 (128 addresses)

Subnet D: 214.97.254.0/31 (2 addresses)

Subnet E: 214.97.254.2/31 (2 addresses)

Subnet F: 214.97.254.4/30 (4 addresses)

b) To simplify the solution, assume that no data grams have router interfaces as ultimate destinations. Also, label D, E, F for the upper-right, bottom, and upper-left interior subnets, respectively.

Router 1:

Longest Prefix Match Outgoing Interface

11010110 01100001 11111111 Subnet A

11010110 01100001 11111110 0000000 Subnet D

11010110 01100001 11111110 000001 Subnet F

Router 2:

Longest Prefix Match Outgoing Interface

11010110 01100001 11111111 0000000 Subnet D

11010110 01100001 11111110 0 Subnet B

11010110 01100001 11111110 0000001 Subnet E

Router 3:

Longest Prefix Match Outgoing Interface

11010110 01100001 11111111 000001 Subnet F

11010110 01100001 11111110 0000001 Subnet E

11010110 01100001 11111110 1 Subnet C

P17. Consider sending a 3,000-byte datagram into a link that has an MTU of 500 bytes. Suppose the original datagram is stamped with the identification number 422. How many fragments are generated? What are the values in the various fields in the IP datagram(s) generated related to fragmentation?

Assume that the DF flag was not set :)

Assume that no optional fields of the IP header are in use (i.e. IP header is 20 bytes)

The original datagram was 3000 bytes, subtracting 20 bytes for header, that leaves 2980 bytes of data.

Assume the ID of the original packet is 'x'

With an MTU of 500 bytes, 500 - 20 = 480 bytes of data may be transmitted in each packet

Therefore, ceiling(2980 / 480) = 7 packets are needed to carry the data.
The packets will have the following characteristics (NOTE: offset is measured in 8 byte blocks, you don't need to specify Total_len)

Packet 1: ID=x, Total_len=500, MF=1, Frag_offset=0
Packet 2: ID=x, Total_len=500, MF=1, Frag_offset=60
Packet 3: ID=x, Total_len=500, MF=1, Frag_offset=120
Packet 4: ID=x, Total_len=500, MF=1, Frag_offset=180
Packet 5: ID=x, Total_len=500, MF=1, Frag_offset=240
Packet 6: ID=x, Total_len=500, MF=1, Frag_offset=300
Packet 7: ID=x, Total_len=120, MF=0, Frag_offset=360

P18. In this problem we'll explore the impact of NATs on P2P applications. Suppose a peer with username Arnold discover s through querying that a peer with username Bernard has a file it wants to download. Also suppose that Bernard and Arnold are both behind a NAT. Try to devise a technique that will allow Arnold to establish a TCP connection with Bernard without application-specific NAT configuration. If you have difficulty devising such a technique, discuss why.

It is not possible to devise such a technique. In order to establish a direct TCP connection between Arnold and Bernard, either Arnold or Bob must initiate a connection to the other. But the NATs covering Arnold and Bob drop SYN packets arriving from the WAN side. Thus neither Arnold nor Bob can initiate a TCP connection to the other if they are both behind NATs.

P19. Suppose datagrams are limited to 1,500 bytes (including header) between source Host A and destination Host B. Assuming a 20-byte IP header, how many datagrams would be required to send an MP3 consisting of 5 million bytes? Explain how you computed your answer.

Assuming the data will be transmitted over TCP connection, each TCP segment having 20 bytes of header. Therefore, each datagram can carry 1460 bytes of MP3 data. Total number of datagrams required,= (5 x 10^6) / 1460= 3424.6Therefore, a total of 3435 datagrams with all but the last datagram will have a size of 1500bytes. The last datagram will have a size of 1000 bytes (960 + 40).
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