CSE3214 Computer Network Protocols and Applications

Chapter 4

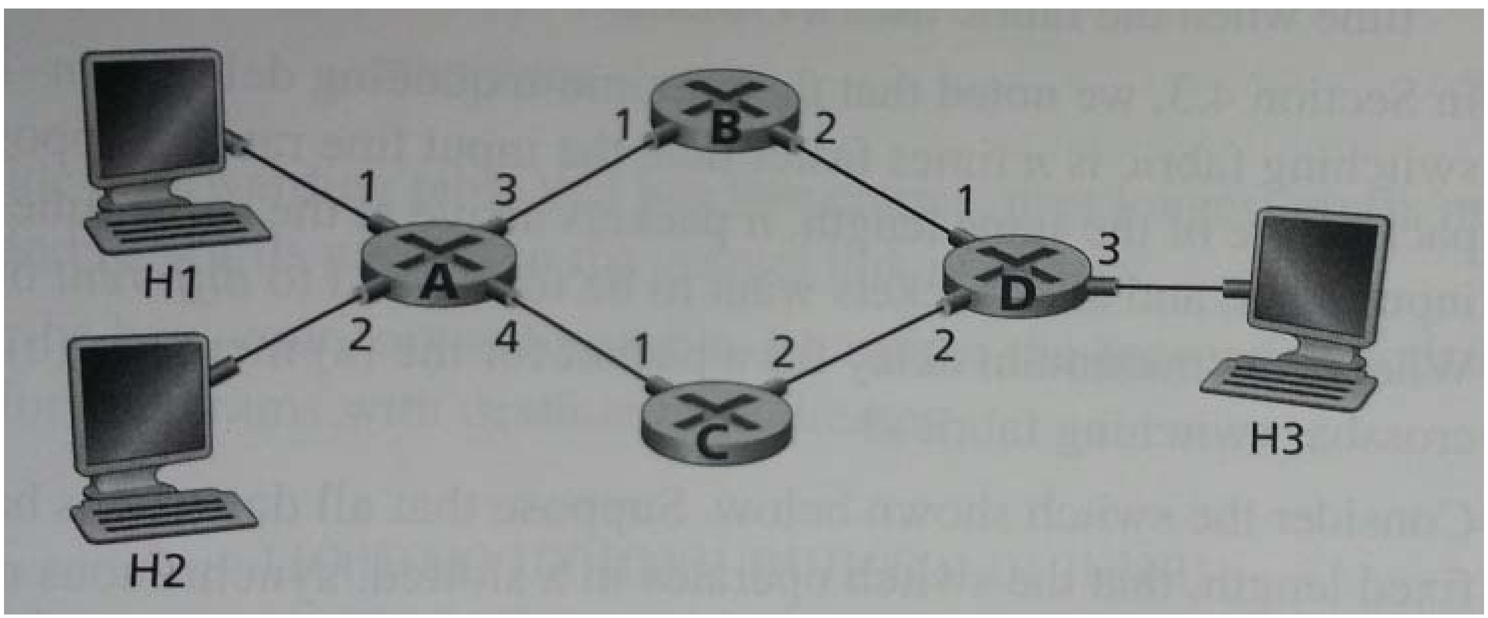
Examples and Homework Problems

Example 1 (R4)

For a datagram network below,

a. Show the forwarding table in router A, such that all traffic destined to host H3 is forwarded through interface 3.

b. Can you write down a forwarding table in router A, such that all traffic from H1 destined to host H3 is forwarded through interface 3, while all traffic from H2 destined to host H3 is forwarded through interface 4?



Solution to Example 1

(a) Data destined to host H3 is forwarded through interface 3

Destination Address	Link Interface
H3	3

(b) No, because forwarding rule is only based on destination address.

Example 2 (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
00	0
010	1
011	2
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.

Solution to Example 2

Destination Address Range	Link Interface
00000000 – 00111111	0
01000000 – 01011111	1
01100000 – 01111111	2
10000000 – 10111111	2
11000000 – 11111111	3

number of addresses for interface 0 = 2^6 =64

number of addresses for interface 1 = 2^5 =32

number of addresses for interface 2 = $2^5 + 2^6$ =32+64 =96

number of addresses for interface 3 = 2^6 =64

Example 3 (R27)

1. In the following classful IP addresses, find the class of each address:

(a) 00000001 00001011 00001011 00001011

(b) 227.12.14.87

(c) 14.23.120.8

2. In the classless IP address, what is the network address if one of its address is: 167.199.170.82/27

Solution to Example 3

1(a) 00000001 00001011 00001011 00001011

The leading bit is 0, Class A

1(b) 227.12.14.87

The first byte is 227, which falls between 224 to 239, Class D

1(c) 14.23.120.8

The first byte is 14, which falls between 0 to 127, Class A

Class	Leading bits	Size of *network number* bit field	Size of *rest* bit field	Number of networks	Addresses per network	Start address	End address
Class A	0	8	24	128 (2^7)	16,777,216 (2^{24})	0.0.0.0	127.255.255.255
Class B	10	16	16	16,384 (2^{14})	65,536 (2^{16})	128.0.0.0	191.255.255.255
Class C	110	24	8	2,097,152 (2^{21})	256 (2^8)	192.0.0.0	223.255.255.255
Class D (multicast)	1110	not defined	not defined	not defined	not defined	224.0.0.0	239.255.255.255
Class E (reserved)	1111	not defined	not defined	not defined	not defined	240.0.0.0	255.255.255.255

Solution to Example 3 (cont)

2. In the classless IP address, what is the network address if one of it's address is: 167.199.170.82/27

The prefix length is 27 → keep the first 27 bits as is and change the remaining 5 bits to 0s.

The last 5 bits affect only the last byte. The last byte is 01010010.

By setting the last 5 bits to 0s, we get 0100000=64

So network address is : 167.199.170.64/27

Example 4

An organization is granted a block of addresses with the beginning address 14.14.74.0/24. There are 256 addresses in this block. The organization needs to have 11 subnets as shown below:

a. 2 subnets, each with 64 addresses
b. 2 subnets, each with 32 addresses
c. 3 subnets, each with 16 addresses
d. 4 subnets, each with 4 addresses

Design the subnets. (To simplify your work, assume all 0-s and all 1-s subnet ID are allowed)

Solution to Example 4

a. 2 subnets, each with 64 addresses – 6-bit long hostIDs
b. 2 subnets, each with 32 addresses – 5-bit long hostIDs
c. 3 subnets, each with 16 addresses – 4-bit long hostIDs
d. 4 subnets, each with 4 addresses – 2-bit long hostIDs

The given IP address block is:

14.24.74.00/24 = 00001110 00011000 01001010 / 00000000

$\underbrace{00001110\ 00011000\ 01001010}_{/24\text{ bits}}\ /\ \underbrace{00000000}_{\text{remaining 8 bits}}$

Solution to Example 4 (cont 1)

1) With first 2 out of 8 available bits, we can create 4 networks (i.e. 4 blocks of addresses) each with 64 host. We use the first of the two blocks for the first two subnets.

6 bits for host IDs

Subnet 1:	14.24.74.00/26	=	00001110	00011000	01001010	00000000
Subnet 2:	14.24.74.64/26	=	00001110	00011000	01001010	01000000
unused 1:	14.24.74.128/26	=	00001110	00011000	01001010	10000000
unused 2:	14.24.74.192/26	=	00001110	00011000	01001010	11000000

2) We use the third block of 64 addresses (unused 1) for the next two subnets, each with 32 hosts.

5 bits for host IDs

Subnet 3:	14.24.74.128/27	=	00001110	00011000	01001010	10000000
Subnet 4:	14.24.74.160/27	=	00001110	00011000	01001010	10100000

3) We split the fourth block of 64 addresses (unused 2) into 4 sub-blocks, each with each with 16 hosts.

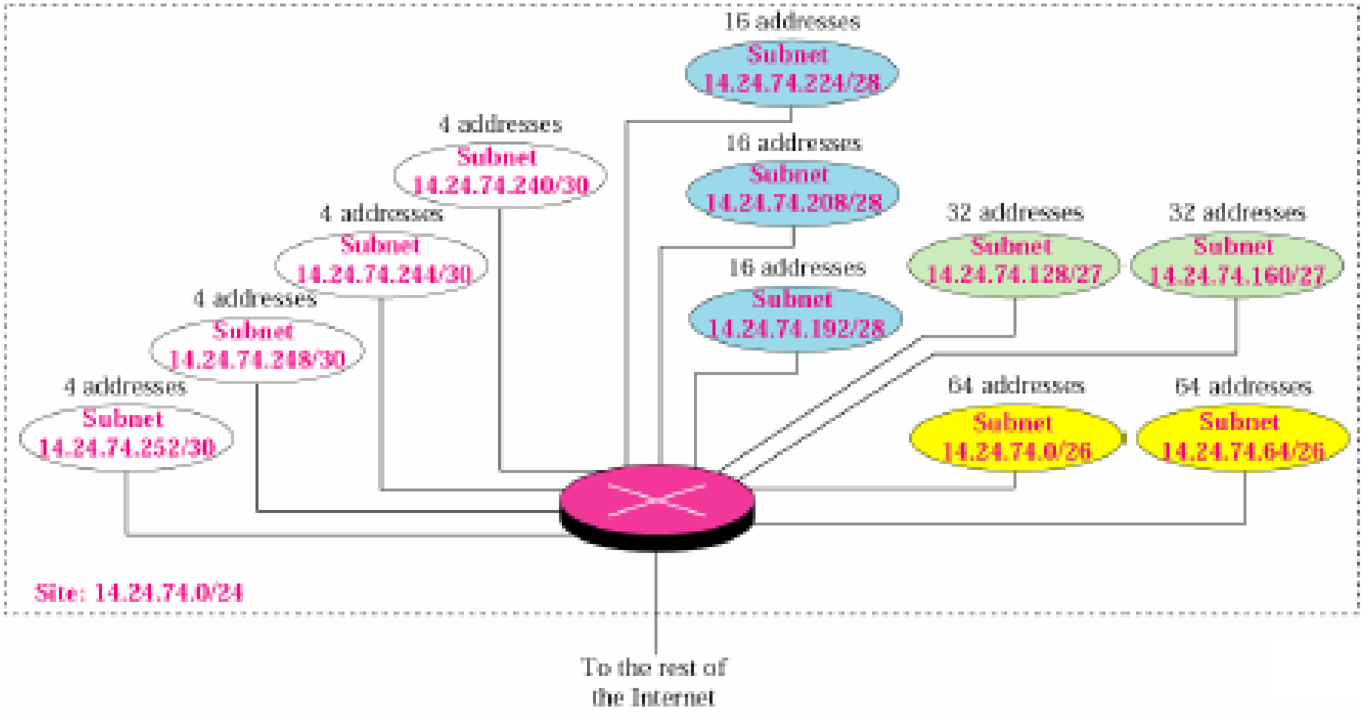
4 bits for host IDs

Subnet 5:	14.24.74.192/28	=	00001110	00011000	01001010	11000000
Subnet 6:	14.24.74.208/28	=	00001110	00011000	01001010	11010000
Subnet 7:	14.24.74.224/28	=	00001110	00011000	01001010	11100000
unused 3:	14.24.74.224/28	=	00001110	00011000	01001010	11110000

Solution to Example 4 (cont 2)

4) **We use the last available sub-block for the last four subnets, each with 4 addresses.**

						2 bits for host IDs
Subnet 8:	**14.24.74.240/30 =**	**00001110**	**00011000**	**01001010**	**11110000**
Subnet 9:	**14.24.74.244/30 =**	**00001110**	**00011000**	**01001010**	**11110100**
Subnet 10:	**14.24.74.248/30 =**	**00001110**	**00011000**	**01001010**	**11111000**
Subnet 11:	**14.24.74.252/30 =**	**00001110**	**00011000**	**01001010**	**11111100**



Homework Problems

Solutions will be available on course website:

http://wiki.cse.yorku.ca

Problem 1(R15)

1. 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?

Problem 2 (R17)

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?

Problem 3 (P13)

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 to at least 12 interfaces. Provide three network addresses (of the form a.b.c.d/x) that satisfy these constraints.

Problem 4 (P18)

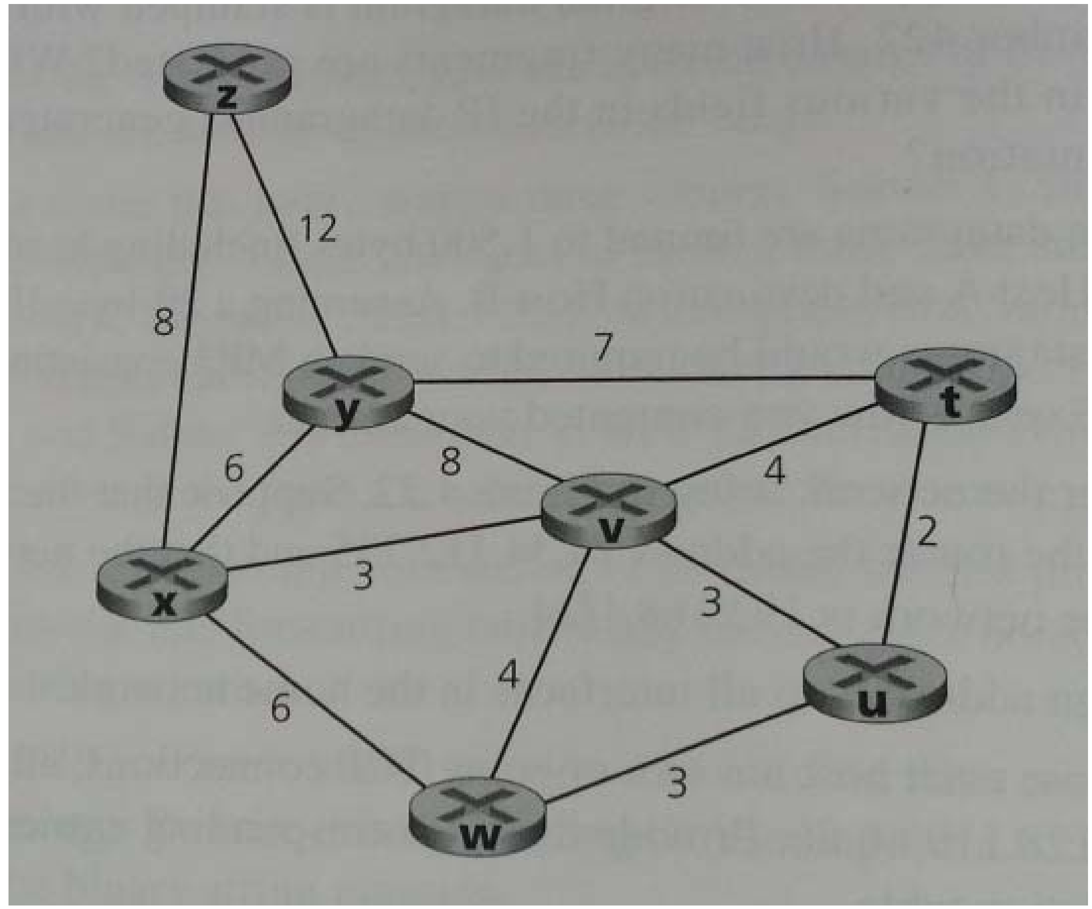
Use the whois service at the American Registry for Internet Numbers (http://www.arin.net/whois) to determine the IP address blocks for three universities. Can the whois services be used to determine with certainty the geographical location of a specific IP address? Use www.maxmind.com to determine the location of the Web servers at each of these universities.

3 universities:

1. Polytechnic Institute of New York University
2. Stanford University
3. University of Washington

Problem 5 (P26)

Consider the following network. With the indicated link costs, use Dijkstra's shortest-path algorithm to compute the shortest path from x to all network nodes. Show how the algorithm works by listing each steps in a table.



Problem 6 (P30)

Consider the network fragment shown on next page, x has only two attached neighbors, w and y. w has a minimum-cost path to destination u (not shown) of 5, and y has a minimum-cost path to u of 6. The complete paths from w and y to u are not shown. All link costs in the network have strictly positive values.

a. Give x's distance vector for destinations w, y, and u.
b. Give a link-cost change for either c(x,w) or c(x,y) such that x will inform its neighbors of a new minimum-cost path to u as a result of executing the distance vector algorithm.

Problem 6 figure (P30)