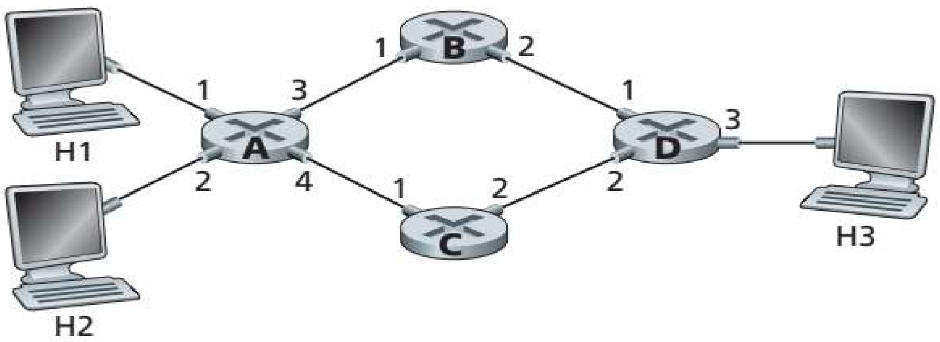
Tutorial_Network_Layer

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

b. Suppose that this network is a datagram network. 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? (Hint: this is a trick question.)

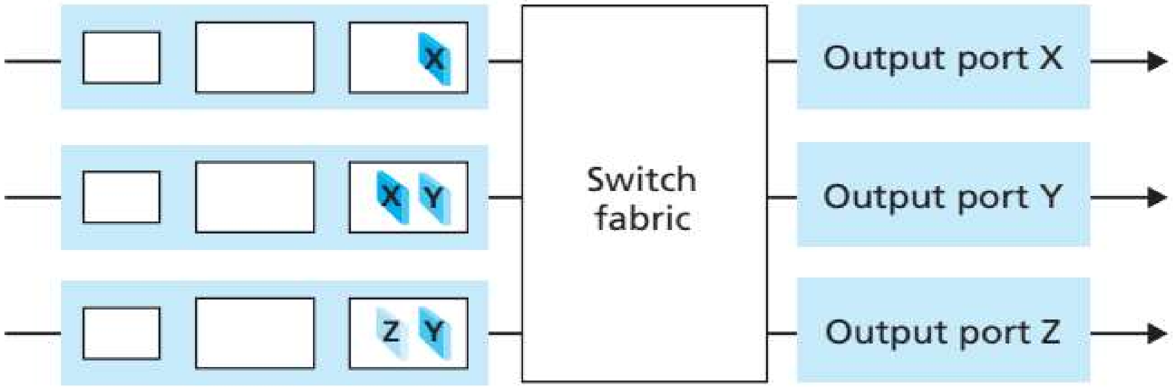
c. Now suppose that this network is a virtual circuit network and that there is one ongoing call between H1 and H3, and another ongoing call between H2 and H3. Write down a forwarding table in router A, such that all traffic from H1 destined to host H3 is forwarded through interface 3, while all traffic from H2 destined to host H3 is forwarded through interface 4.

d. Assuming the same scenario as (c), write down the forwarding tables in nodes B, C, and D.



P8. In Section 4.3, we noted that the maximum queuing delay is $(n-1)D$ if the switching fabric is n times faster than the input line rates. Suppose that all packets are of the same length, n packets arrive at the same time to the n input ports, and all n packets want to be forwarded to *different* output ports. What is the maximum delay for a packet for the (a) memory, (b) bus, and (c) crossbar switching fabrics?

P9. Consider the switch shown below. Suppose that all datagrams have the same fixed length, that the switch operates in a slotted, synchronous manner, and that in one time slot a datagram can be transferred from an input port to an output port. The switch fabric is a crossbar so that at most one datagram can be transferred to a given output port in a time slot, but different output ports can receive datagrams from different input ports in a single time slot. What is the minimal number of time slots needed to transfer the packets shown from input ports to their output ports, assuming any input queue scheduling order you want (i.e., it need not have HOL blocking)? What is the largest number of slots needed, assuming the worst-case scheduling order you can devise, assuming that a non-empty input queue is never idle?



Tutorial_Network_Layer

P10. Consider a datagram network using 32-bit host addresses. 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 matching, and forwards packets to the correct link interfaces.

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

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

P11. Consider a datagram network using 8-bit host addresses. 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.

Tutorial_Network_Layer

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

Tutorial_Network_Layer

P19. Consider sending a 2400-byte datagram into a link that has an MTU of 700 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?

P19. Consider sending a 2400-byte datagram into a link that has an MTU of 700 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?

Tutorial_Network_Layer

Chapter - 4

P4 :

a) Data to host H_3 → interface 3

Destination Address — Link Interface

(H_3) — 3.

b) Forwarding rule :- destination address

~~$H_1 \rightarrow H_3$ → interface~~

Dest Address — Link interface

$H_1 \rightarrow$ {(H_3) is fixed} — {Cannot be different}

$H_2 \rightarrow$ {(H_3)}

c) For VC diagram

Incoming interface	Incoming VC	Outgoing interface	Outgoing V
1	12	3	22
2	63	4	18

P8

* Single datagram in both Memory and Shared bus.

(a) & (b) → delay. $(n-1)D$.

(c) * Cross-bar.

Parallel flows for different

i/p → o/p pairs

NO Queing delay.

P9 :

Slot-1 : i/p-1 → X ; i/p-2 → Y Port

Slot-2 : i/p-3 → Y Port (o/p) ; i/p-2 → X

Slot-3 : i/p-3 → Z

Total - 3 slots

Even worst case scheduling is 3 slots.

P10

a)

Prefix	Interface
11100000 00	0
11100000 01000000	1
1110000	2
11100001 1	3
otherwise	3

b) (First address) → 5th → Interface-3

(Second address) → 2nd → Interface-2

(third address) → 4th → " -3

P11

8-bit	Interface	Address
00000000 – 00111111	0	$(6\text{ bit})2^6 = 64$
01000000 – 01011111	1	$(5\text{ bit})2^5 = 32$
01100000 – 01111111	2	$(5\text{ bit})2^5 + (6\text{ bit})2^6 = 32+64 = 96$
10000000 – 10111111	2	
11000000 – 11111111	3	$2^6 = 64/256$

P18

given Prefix : 223.1.17/24

Subnet-1 to support = 60
Subnet-2 " " = 90
Subnet-3 " " = 12

Sub Net-1 ⟹ 60 ⟶ $2^6 = 64$ 32 ~~[illegible]~~ −6 = 26

223.1.17.0 /26

Sub Net-2 ⟹ 90 ⟶ $2^7 = 128$ 32 − 7 = 25

223.1.17.128/25

Subnet-3 ⟹ 12 ⟶ $2^4 = 16$ 32 − 4 = 28

223.1.17.192/28

P19

Assume header = 20

700 − 20 = 680

$= \frac{2400-20}{680} = 4$

8 data gram - 1, 2 & 3 ⟶ 700
" - 4 ⟶ 360

	offset	flag	bytes	seq NO
D-1 :	0	1	700	422
D2 :	85	1	700	422
D-3 :	170	1	700	422
D-4 -	255	0	360	422

Computer Networks

Solutions to Homework #4

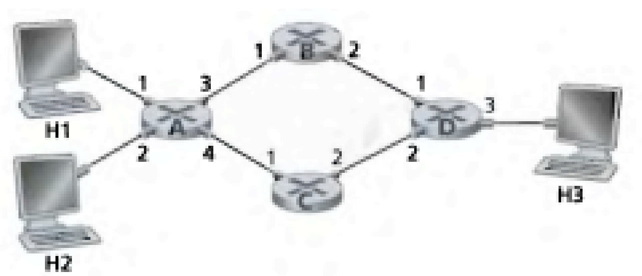
Chapter 4 - The Network Layer

P 4. Consider the network below.

a.Suppose that this network is a datagram network. Show the forwarding table in router A, such that all traffic destined to host H3 is forwarded through interface 3. b. Suppose that this network is a datagram network. Can you write down a forwarding table in router A, such that all traffic from HI destined to host H3 is forwarded through interface 3, while all traffic from H2 destined to host H3 is forwarded through interface 4? (Hint: this is a trick question.)

c.Now suppose that this network is a virtual circuit network and that there is one ongoing call between HI and H3, and another ongoing call between H2 and H3. Write down a forwarding table in router A, such that all traffic from HI destined to host H3 is forwarded through interface 3, while all traffic from H2 destined to host H3 is forwarded through interface 4.

d. Assuming the same scenario as (c), write down the forwarding tables in nodes B, C, and D.



Solution:

a) For Router A, data destined to host H3 is forwarded through interface 3.

Distention address	Link interface
H3	#3

b) No, because, for datagram networks, forwarding rule is only based only on destination address (not the source address).

c) One possible configuration for Router A is:

Incoming interface	Incoming VC#	Outgoing Interface	Outgoing VC#

1	12	3	22
2	63	4	18

Note, that the two flows could actually have the same VC numbers.

d) One possible configuration is: for Router B

Incoming interface	Incoming VC#	Outgoing Interface	Outgoing VC#
1	22	2	24

For Router C

Incoming interface	Incoming VC#	Outgoing Interface	Outgoing VC#
1	18	2	50

For Router D

Incoming interface	Incoming VC#	Outgoing Interface	Outgoing VC#
1	24	3	70
2	50	3	76

P 7. Suppose two packets arrive at different input ports of a router at exactly the same time. Also suppose there are no other packets in the router.

a. Suppose the two packets are to be forwarded to two different output ports. Is it possible to forward the two packets through the switch fabric at the same time when the fabric uses a *shared bus*?

b. Suppose the two packets are to be forwarded to two different output ports. Is it possible to forward the two packets through the switch fabric at the same time when the fabric uses a *crossbar*?

c. Suppose the two packets are to be forwarded to the same output port. Is it possible to forward the two packets through the switch fabric at the same time when the fabric uses a *crossbar*?

Solution:

a) No, you can only transmit one packet at a time over a shared bus.

1 <u>3</u>

2 4

b) Yes, as long as the two packets use different input busses and different output busses, they can be forwarded in parallel.

1

2

3 4

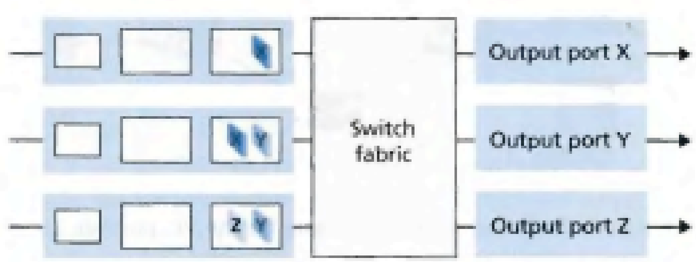
c) No, in this case the two packets would have to be sent over the same output bus at the same time, which is not possible.

1

2

3 4

P 9. Consider the switch shown below. Suppose that all datagrams have the same fixed length, that the switch operates in a slotted, synchronous manner, and that in one time slot a datagram can be transferred from an input port to an output port. The switch fabric is a crossbar so that at most one datagram can be transferred to a given output port in a time slot, but different output ports can receive datagrams from different input ports in a single time slot. What is the minimal number of time slots needed to transfer the packets shown from input ports to their output ports, assuming any input queue scheduling order you want? What is the largest number of slots needed, assuming the worst-case scheduling order you can devise, assuming that a non-empty input queue is never idle?



<u>Solution:</u>

The minimal number of time slots needed is 3. The scheduling is as follows. Slot 1: send X in top input queue, send Y in middle input queue.
Slot 2: send X in middle input queue, send Y in bottom input queue
Slot 3: send Z in bottom input queue.

Largest number of slots is still 3. Actually, based on the assumption that a non-empty input queue is never idle, we see that the first time slot always consists of sending X in the top input queue and Y in either middle or bottom input queue, and in the second time slot, we can always send two more datagram, and the last datagram can be sent in third time slot.

NOTE: Actually, if the first datagram in the bottom input queue is X, then the worst case would require 4 time slots.

P 10. Consider a datagram network using 32-bit host addresses. 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 four entries, uses longest prefix matching, and forwards packets to the correct link interfaces.

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

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

Solition:

a)

Prefix Match Link Interface

11100000 00 0
11100000 01000000 1
1110000 2
11100001 1 3
otherwise 3

b) Prefix match for first address is 5th entry: link interface 3
Prefix match for second address is 3rd entry: link interface 2
Prefix match for third address is 4th entry: link interface 3

P 13. 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 up to 60 interfaces, Subnet 2 is to support up to 90 interfaces, and Subnet 3 is to support up to 12 interfaces. Provide three network addresses (of the form a.b.c.d/x) that satisfy these constraints.

<u>Solution:</u>

The parent network address is 223.1.17/24.
24 bits are prefix for the network. 8 bits can be used for subnet portions & host portions. Start with the largest required subnet (Subnet 2)

- Subnet #2 (90 interfaces)

Subnet
portion Host portion
128 64 32 16 8 4 2 1

With 7 bits, we can get 128 addresses (126 usable host addresses + 1 subnet address + 1 subnet broadcast address), which is > 90.
1 bit is left for the subnet portion (we can have 2 subnets, each with 128 addresses) 223.1.17.0/25 (range 223.1.17.0 to 223.1.17. 127)
223.1.17.128/25 (range 223.1.17.128 to 223.1.17. 255)
We assign one of those subnets to our Subnet #2 and further subnet the other range for out Subnet #1 & Subnet #3.

Subnet #2 223.1.17.128/25 , Mask 255.255.255.128

Subnet ID 223.1.17.128 , Subnet broadcast address

223.1.17.255 Hosts 223.1.17.129 to 223.1.17.254

• Subnet #1 (60 interfaces)

The parent network 223.1.17.0/25 (32-25= 7 bits can be used for subnet portions & and host portions)

portion Host portion

Prefix to 0

Subnet

128 64 32 16 8 4 2 1 We can have 2 subnets, each with 64 addresses: 223.1.17.0/26 (range 223.1.17.0 to 223.1.17. 63) 223.1.17.64/26 (range 223.1.17.64 to 223.1.17. 127)

Subnet #1 223.1.17.0/26 , Mask 255.255.255.0

Subnet ID 223.1.17.0 , Subnet broadcast address

223.1.17.63 Hosts 223.1.17.1 to 223.1.17.62

• Subnet #3 (12 interfaces)

The parent network is 223.1.17.64/26

Prefix to 0 Subnet portion

Prefix to 1 portion Host

128 64 32 16 8 4 2 1

We can have 4 subnets, each with 16 addresses:

223.1.17.64/28 (range 223.1.17.64 to 223.1.17. 79)

223.1.17.80/28 (range 223.1.17.80 to 223.1.17. 95)

223.1.17.96/28 (range 223.1.17.96 to 223.1.17. 111)

223.1.17.112/28 (range 223.1.17.112 to 223.1.17. 127)

We assign one of these to our Subnet #3

Subnet #3 223.1.17.96/28 , Mask 255.255.255.96

Subnet ID 223.1.17.96 , Subnet broadcast address

223.1.17.111 Hosts 223.1.17.97 to 223.1.17.110

P 16. Consider a subnet with prefix 128.119.40.128/26. Give an example of one IP address (of form xxx.xxx.xxx.xxx) that can be assigned to this network. Suppose an ISP owns the block of addresses of the form 128.119.40.64/26. 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 form a.b.c.d/x) for the four subnets?

Solution:

Any IP address in range 128.119.40.128 to 128.119.40.191 can be an example.

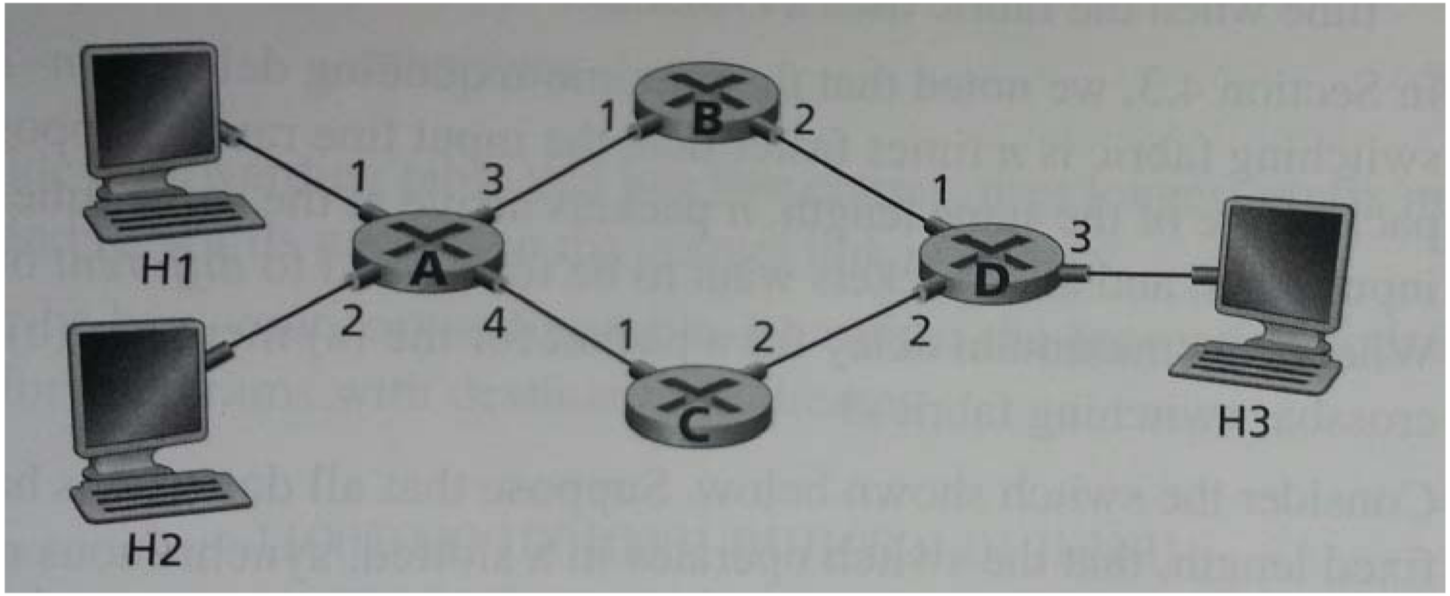
Four equal size subnets:
128.119.40.64/28,
128.119.40.80/28,
128.119.40.96/28,
128.119.40.112/28

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:

$$14.24.74.00/24 \;=\; \underbrace{00001110\quad 00011000\quad 01001010}_{/24\text{ bits}} \,/\, \underbrace{00000000}_{\text{remaining 8 bits}}$$

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) <u>each with 64 host</u>. 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, <u>each with 32 hosts</u>.

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, <u>each with</u> <u>each with 16 hosts</u>.

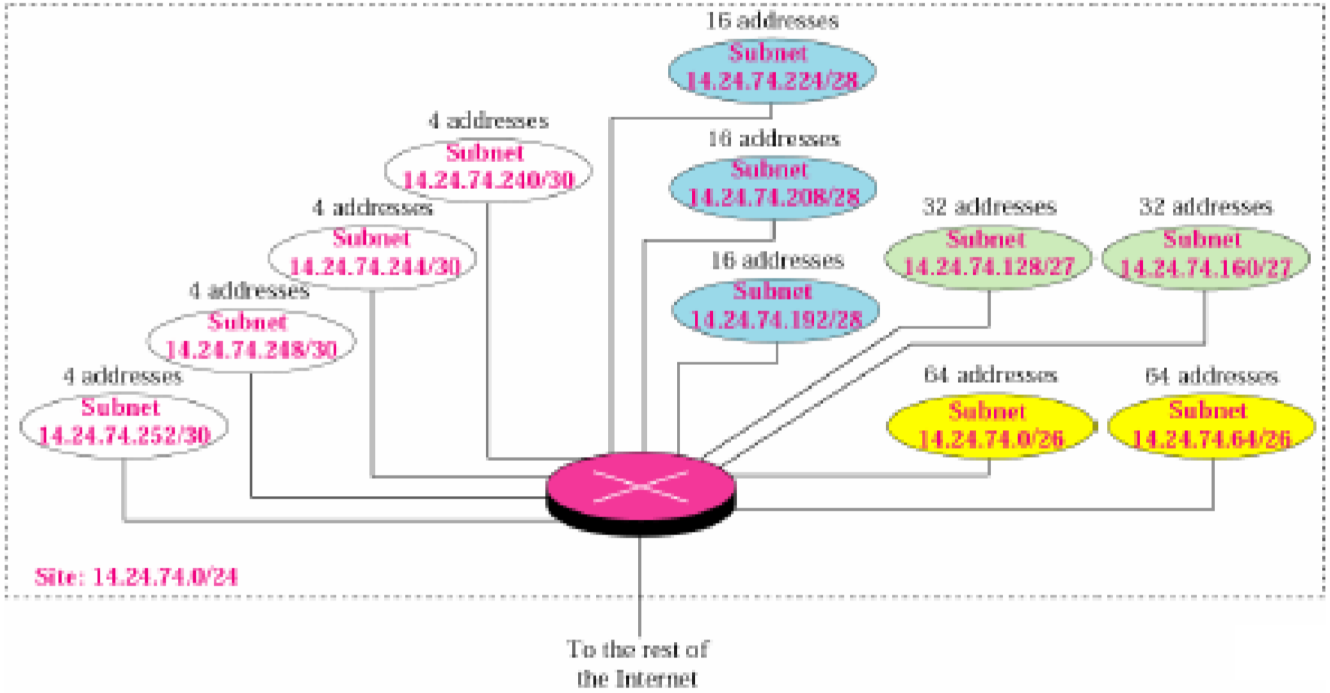
4 bits for host IDs

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)

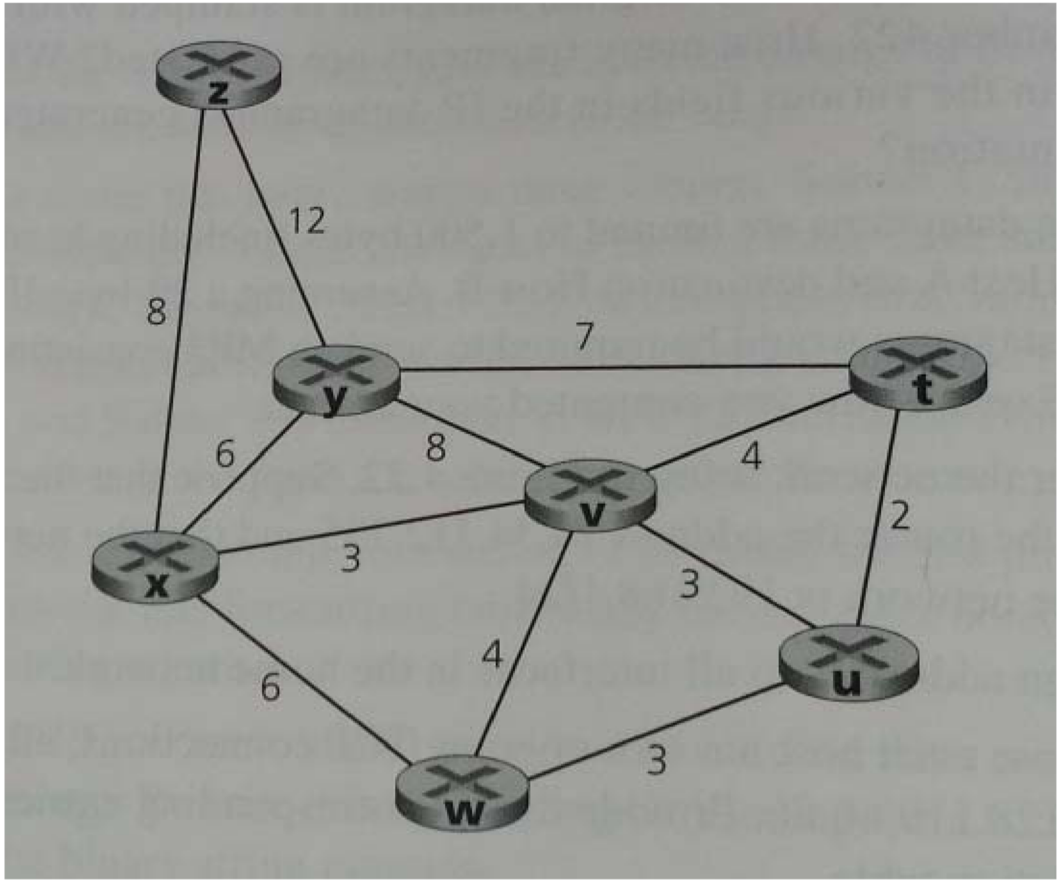
Use the whois service at the American Registry for Internet Numbers (http://www.arin.net/whois) to determine the IP address blocks for three universities. Can the whois services be used to determine with certainty the geographical location of a specific IP address? Use www.maxmind.com to determine the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

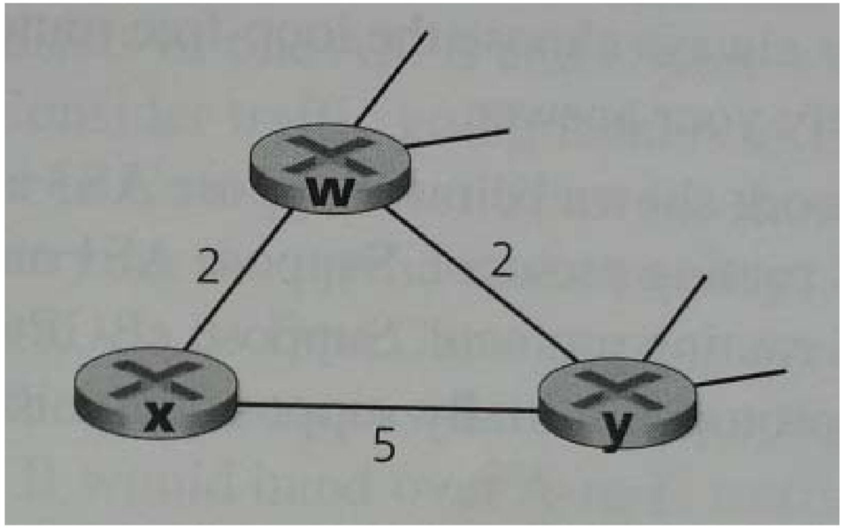


Problem 6 (P30)

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)



P 13. 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 up to 60 interfaces, Subnet 2 is to support up to 90 interfaces, and Subnet 3 is to support up to 12 interfaces. Provide three network addresses (of the form a.b.c.d/x) that satisfy these constraints.

Solution:

The parent network address is 223.1.17/24.
24 bits are prefix for the network. 8 bits can be used for subnet portions & host portions.
Start with the largest required subnet (Subnet 2)

- Subnet #2 (90 interfaces)

Subnet portion	Host portion					
128	64	32	16	8	4	2	1

With 7 bits, we can get 128 addresses (126 usable host addresses + 1 subnet address + 1 subnet broadcast address), which is > 90.
1 bit is left for the subnet portion (we can have 2 subnets, each with 128 addresses)
223.1.17.0/25 (range 223.1.17.0 to 223.1.17. 127)
223.1.17.128/25 (range 223.1.17.128 to 223.1.17. 255)
We assign one of those subnets to our Subnet #2 and further subnet the other range for out Subnet #1 & Subnet #3.

Subnet #2→ 223.1.17.128/25 , Mask →255.255.255.128

Subnet ID → 223.1.17.128 , Subnet broadcast address → 223.1.17.255

Hosts → 223.1.17.129 to 223.1.17.254

- Subnet #1 (60 interfaces)
The parent network 223.1.17.0/25 (32-25= 7 bits can be used for subnet portions & and host portions)

Prefix to 0	Subnet portion	Host portion					
128	64	32	16	8	4	2	1

We can have 2 subnets, each with 64 addresses:
223.1.17.0/26 (range 223.1.17.0 to 223.1.17. 63)
223.1.17.64/26 (range 223.1.17.64 to 223.1.17. 127)

Subnet #1→ 223.1.17.0/26 , Mask →255.255.255.0 Subnet ID → 223.1.17.0 , Subnet broadcast address → 223.1.17.63 Hosts → 223.1.17.1 to 223.1.17.62

- Subnet #3 (12 interfaces)

  The parent network is 223.1.17.64/26

Prefix to 0	Prefix to 1	Subnet portion		Host portion			
128	64	32	16	8	4	2	1

We can have 4 subnets, each with 16 addresses:

223.1.17.64/28 (range 223.1.17.64 to 223.1.17. 79)

223.1.17.80/28 (range 223.1.17.80 to 223.1.17. 95)

223.1.17.96/28 (range 223.1.17.96 to 223.1.17. 111)

223.1.17.112/28 (range 223.1.17.112 to 223.1.17. 127)

We assign one of these to our Subnet #3

Subnet #3→ 223.1.17.96/28 , Mask →255.255.255.96 Subnet ID → 223.1.17.96 , Subnet broadcast address → 223.1.17.111 Hosts → 223.1.17.97 to 223.1.17.110