HW5

P2.

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

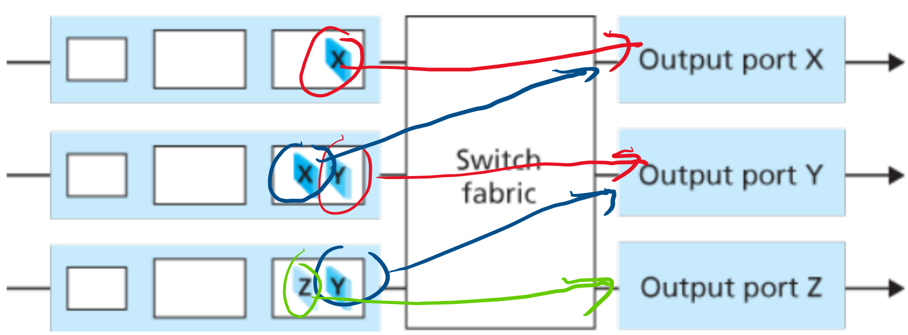
b) No, only one memory read/write can be done at a time over the shared system bus. However

, this is possible is if the two packet use different input and output buses. They will be forwarded

in parallel.

c) No, it is not possible, for it to be true, the two packets would have to be sent over the same output bus at the same time, which cannot be done

P4.



The largest number of slots is 3, The lines in red represent the first slot, in blue the second slot, and green the third slot.

1st slot(red):

- Send the top x and the y from the middle to their input queue

2nd slot(blue)

- Send middle x and bottom y to their input queue

3rd slot(green)

- Send bottom z to its input queue

P8.

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

Given:

- Parent network address: 223.1.17/24
- We know 24 bits are prefix, and 8 are for the subnet and host portions
- Subnet 1: 60 interfaces
- Subnet 2: 90 interfaces
- Subnet 3: 12 interfaces

223.1.17 binary representation -> 11011111 00000001 00010001 00000000

Subnet 1: we need 60 interfaces; thus, we need 6 bits -> (2^6)= 64We begin with the largest subnet-> subnet 2We begin with the largest subnet-> subnet 2

- Addresses: 223.1.17.0/26 to 223.1.17.59/26

Subnet 2: we need 90 interfaces; thus, we need 7 bits -> (2^7) = 127

- Addresses: 223.1.17.60/25 to 223.1.17.149/25

Subnet 3: we need 12 interfaces; thus, we need 4 bits -> (2^4) = 16

- Addresses: 223.1.17.150/28 to 223.1.17.173.165/28

P12.

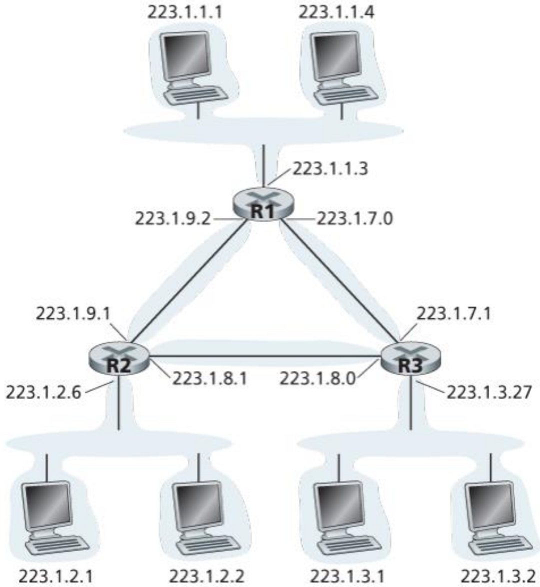


Figure 4.20 Three routers interconnecting six subnets

a) Given: addresses must be allocated from 214.97.254/23
   Subnet A should have enough addresses to support 250 interfaces
   Subnet B should have enough addresses to support 120 interfaces
   Subnet C should have enough addresses to support 120 interfaces
   Subnets D, E and F should each be able to support two interfaces

- 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 for the following answer we will assume no datagrams have router interfaces as ultimate destination. Labels D = upper right, E = bottom, F = upper left

Router 1

Longest Prefix Match	Outgoing Interface
00001110 01100001 11111111	Subnet A
00001110 01100001 11111110 0	Subnet D
00001110 01100001 11111110 1	Subnet F

Router 2

Longest Prefix Match	Outgoing Interface
00001110 01100001 11111111	Subnet D
00001110 01100001 11111110 0	Subnet B
00001110 01100001 11111110 1	Subnet E

Router 3

Longest Prefix Match	Outgoing Interface
00001110 01100001 11111111	Subnet F
00001110 01100001 11111110 0	Subnet E
00001110 01100001 11111110 1	Subnet C

P14.

We know :

- IP header = 20 bytes
- Max size of data field in each fragment = 680

Number of fragments = datagram bytes – IP header Bytes) / max size of data field in fragment

= (2400-20)/680 = 3.5

= roundup(3.5) = 4

All fragments will have the same identification number 422

The first 3 fragments will have size of 700 bytes (header included)

Fragment 4 will have size of 360 (including header) (680/2 + 20 = 360)

The offset of the 4 fragments: 0, 85, 170, 255

First 3 fragments have flag = 1, fragment 4 has flag = 0

P18.A TCP direct connection between Arnold and Bernard will require that Arnold or Bernard start a connection with the other. However, the NAT that covers Arnold and Bernard will drop the SYN packets, meaning that neither Arnold nor Bernard will be able to start a TCP connection wo the other. Thus, I don't think you can devise a technique.

Problem A.

(a) C4.5E.13.87

<u>C4.50.0.0/12</u>

Here 12 indicates network id is of 1st 12 bits and the mask is FF.F0.00.00

C4.5E.13.87 and FF.F0.00.00 is C4.50.00.00

Hence this packet can be routed into this network.

<u>C4.5E.10.0 / 20</u>

Now, 20 indicates network id is of 1^{st} 20 bits and the mask is FF.FF.F0.00

C4.5E.13.87 and FF.FF.F0.00 is C4.5E.10.00

This packet can be routed into this network.

For C4.60.00.00/12 and C4.68.0.0/14 the packet cannot be routed since the first 12 bits are different.

Also, the packet can't be routed in default routes because there are 2 networks above to route the packet

Finally, we just need to choose the mask with the largest length.

The packet is routed through C4.5E.10.0/20

(b) C4.5E.22.09

C4.50.0.0/12

Here 12 indicates network id is of 1st 12 bits and the mask is FF.F0.00.00

C4.5E.22.09 and FF.F0.00.00 is C4.50.00.00

Hence this packet can be routed into this network.

C4.5E.10.0 / 20

Now, 20 indicates network id is of 1^{st} 20 bits and the mask is FF.FF.F0.00

C4.5E.22.09 and FF.FF.F0.00 is C4.5E.20.00

This packet can't be routed into this network.

For C4.60.00.00/12 and C4.68.0.0/14 the packet cannot be routed since the first 12 bits are different.

Also, the packet can't be routed in default routes because there is 1 network above to route the packet

We conclude the packet is routed through C4.50.0.0/12

(c) C3.41.80.02

In this situation we can see that the masks lengths of 12,14,20 can't match for 8 bits. It is C3 but we only have C4. This means this packet will be routed through the default routes.

Since the first two bits of C3 are 11, it doesn't match with either 00.0.0.0/2 and 40.0.0.0/2

Finally, we can see that the first bit in C3 (1) will match with 80.0.0.0/1, meaning that the packet will be routed through 80.0.0.0/1

(d) 5E.43.91.12

In this situation we can see that the masks lengths of 12,14,20 can't match for 8 bits. It is C3 but we only have C4. This means this packet will be routed through the default routes.

The first two bits of 5E are 01 and these match with the first two bits of 40.0.0.0/2.

Thus, the packet will be routed through 40.0.0.0/2

(e) C4.6D.31.2E

<u>C4.50.0.0/12</u>

Here 12 indicates network id is of 1st 12 bits and the mask is FF.F0.00.00

C4.6D.31.2E and FF.F0.00.00 is C4.60.00.00

Hence this packet can't be routed into this network.

<u>C4.5E.10.0 / 20</u>

Now, 20 indicates network id is of 1^{st} 20 bits and the mask is FF.FF.F0.00

C4.6D.31.2E and FF.FF.F0.00 is C4.6D.30.00

This packet can't be routed into this network.

<u>C4.60.00.00 /12</u>

Here 12 indicates network id is of 1st 12 bits and the mask is FF.F0.00.00

C4.6D.31.2E and FF.F0.00.00 is C4.60.00.00

The packet can be routed into this network

<u>C4.68.0.0/14</u>

Here 14 indicates network id is of 1st 14 bits and the mask is FF.FC.00.00

C4.6D.31.2E and FF.FC.00.00 is C4.6C.00.00

This packet can't be routed into this network

Finally, we can say the packet is routed through C4.60.00.00 /12

(f) C4.6B.31.2E

<u>C4.50.0.0/12</u>

Here 12 indicates network id is of 1st 12 bits and the mask is FF.F0.00.00

C4.6B.31.2E and FF.F0.00.00 is C4.60.00.00

Hence this packet can’t be routed into this network.

<u>C4.5E.10.0 /20</u>

Now, 20 indicates network id is of 1st 20 bits and the mask is FF.FF.F0.00

C4.6B.31.2E and FF.FF.F0.00 is C4.6B.30.00

This packet can’t be routed into this network.

<u>C4.60.00.00 /12</u>

Here 12 indicates network id is of 1st 12 bits and the mask is FF.F0.00.00

C4.6B.31.2E and FF.F0.00.00 is C4.60.00.00

The packet can be routed into this network

<u>C4.68.0.0/14</u>

Here 14 indicates network id is of 1st 14 bits and the mask is FF.FC.00.00

C4.6B.31.2E and FF.FC.00.00 is C4.68.00.00

This packet can be routed into this network

Now we choose the packet with the longest mask length, therefore, the packet is routed through C4.68.0.0/14

Problem B.

<u>Shared Memory Router:</u>

bus support bit rate: 200 MHz * 32 bits = 6.4 Gbps

The packets will pass twice over the bus, one way to the memory, and one way to the output line, thus the limit on the packet throughput by the bus is 3.2 Gbps (6.4Gbps/2)

The packet will be written and read from memory, taking 10 ns (5ns*2)

Memory throughput = 32 bits / 10 ns = 3.2 Gbps

Thus, we can say the bus and memory both act as bottleneck for throughput.

Bus backplane router:

In this case since we have the forwarding table, the packets are put onto the bus only once.

Memory throughput = 64 bits / 10 ns = 6.4Gbps

Switch backplane router:

3.3Gbps * 25% = 800Mbps

Total throughput = 800Mbps * N