Problem 1

Suppose two packets arrive to two different input ports of a router at exactly the same time. Also suppose there are no other packets anywhere 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 switching via memory?

(c) 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?

Write your solution to Problem 1 in this box

(a) It is not possible, because of collision.
When a shared bus topology is being used,
only one packet is allowed to be transmitted
through the bus at ~~a~~ a time.

(b) No, it's not possible.
Essentially, there is one ~~sig~~ single bus that
connects the input ports & the output ports ~~&~~ to memory.
Therefore, when packets are transmitted, input ports
write the packets to memory one at a time,
out put ports read from memory one at a time.
Therefore, the transmission is not accomplished concurrently
but in order.

(c) Yes, it's possible.
Both packets can be forwarded through the
switch concurrently, as long as the destinations differ.

Problem 2

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 subnet addresses (of the form a.b.c.d/x) that satisfy the constraints. You may use the following link to help verify your result: `http://jodies.de/ipcalc`.

Write your solution to Problem 2 in this box

~~223.1.17.0/26~~
~~223.1.17.128/25~~
~~223.1.17.192/28~~

Sub1 223.1.17.128/26
Sub2 223.1.17.0/25
Sub3 223.1.17.192/28

Problem 3

Consider sending a 2400 B datagram into a link that has an MTU (maximum transmission unit) of 700 B. Suppose the original datagram is stamped with the identification number 422.

(a) How many fragments are generated?

(b) What are the values in the various fields in the IP datagram(s) generated related to fragmentation?

Write your solution to Problem 3 in this box

(a) IP header : 20 bytes

max fragmentation size: 700 bytes

$$\left\lceil \frac{2400-20}{700-20} \right\rceil = 4$$

Therefore, 4 fragments are generated.

(b)
- identification number is 422 for each fragment
- size of first three fragments : 700 bytes
  size of the last fragment : 360 bytes
- offsets : 0, 85, 170, 255 respectively.
- flag = 1 for the first three ~~packets~~ fragments
  flag = 0 for the last fragment

Problem 4

In this problem we will explore the impact of NATs on P2P applications. Suppose a peer with username Arnold discovers 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.

Write your solution to Problem 4 in this box

It's impossible to device such a technique.

To establish a TCP connection between Arnold and Bernard, one of them (P2P users) need to initiate the connection towards the other. Since both of them are behind a NAT, ~~the~~ NAT will drop the handshake of TCP.

Therefore a TCP connection can not be initiated, thus, cannot be established.

Problem 5

Consider the SDN OpenFlow network shown as follows. Suppose that the desired forwarding behavior for datagrams arriving at s2 is as follows:

- Any datagrams arriving on input port 1 from hosts h5 or h6 that are destined to hosts h1 or h2 should be forwarded over output port 2;
- Any datagrams arriving on input port 2 from hosts h1 or h2 that are destined to hosts h5 or h6 should be forwarded over output port 1;
- Any arriving datagrams on input ports 1 or 2 and destined to hosts h3 or h4 should be delivered to the host specified;
- Host h3 and h4 should be able to send datagram to each other.

Specify the flow table entries in s2 that implement this forwarding behavior.

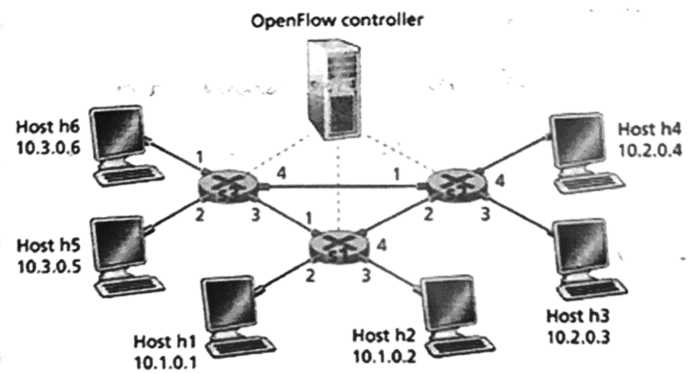

Figure 4.30 ♦ OpenFlow match-plus-action network with three packet switches, 6 hosts, and an OpenFlow controller

Write your solution to Problem 5 in this box

S_2 flow Table :

Match	Action
Ingress Port = 1 ; IP Src = 10.3.*.*; IP Dst = 10.1.*.*;	Forward(2)
Ingress Port = 2; IP Src = 10.1.*.*; IP Dst = 10.3.*.*;	Forward(1)
Ingress Port = 1; IP Dst = 10.2.0.3;	Forward(3)
Ingress Port = 2; IP Dst = 10.2.0.3;	Forward(3)
Ingress Port = 1; IP Dst = 10.2.0.4;	Forward(4)
Ingress Port = 2; IP Dst = 10.2.0.4;	Forward(4)
Ingress Port = 4	Forward(3)
Ingress Port = 3	Forward(4)