Cairo University
Faculty of Engineering
Electronics and Communications Department

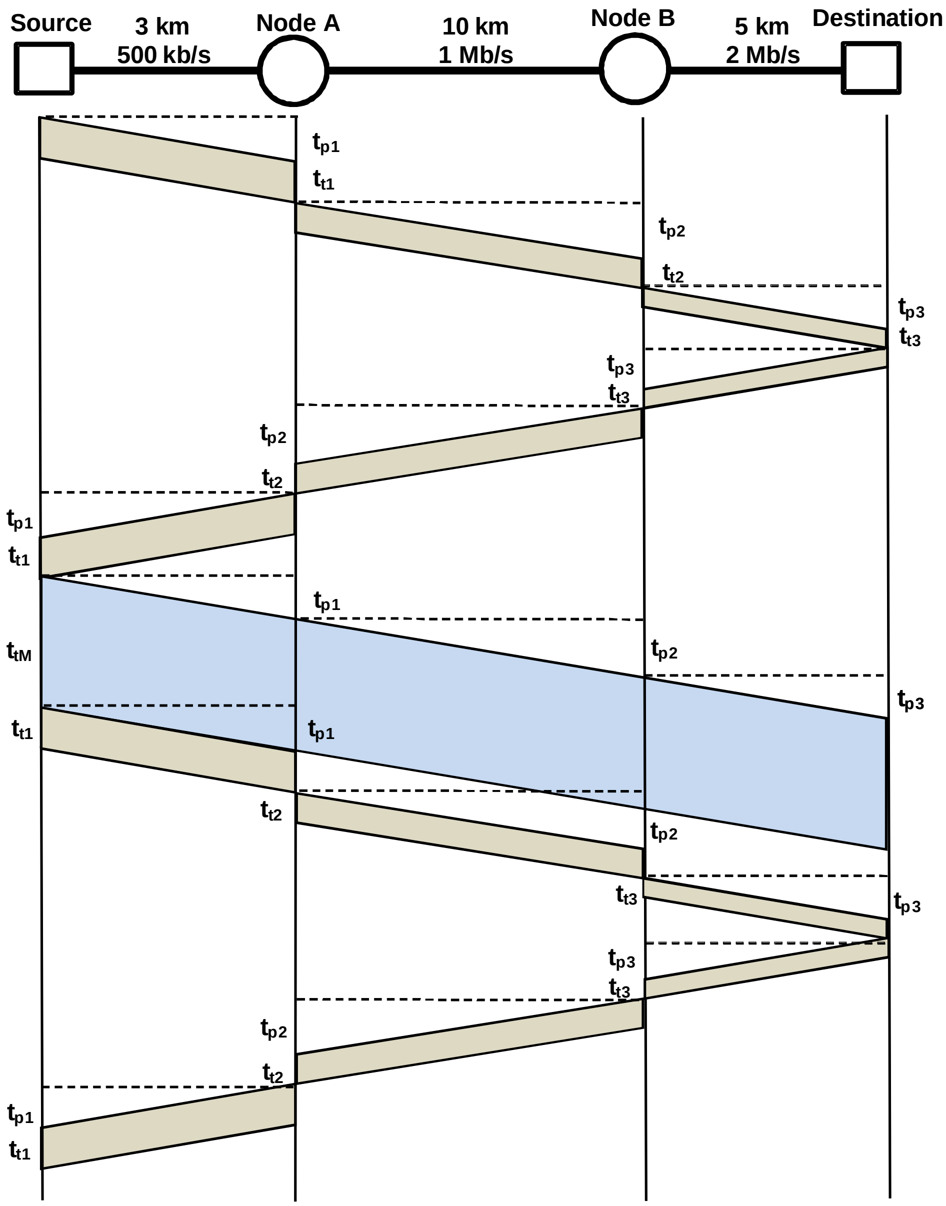
Fouth Year
Computer Networks
2011-2012

Midterm Test Solution (November)

Question (1):

a) Scenario (1) : Circuit Switching

i.

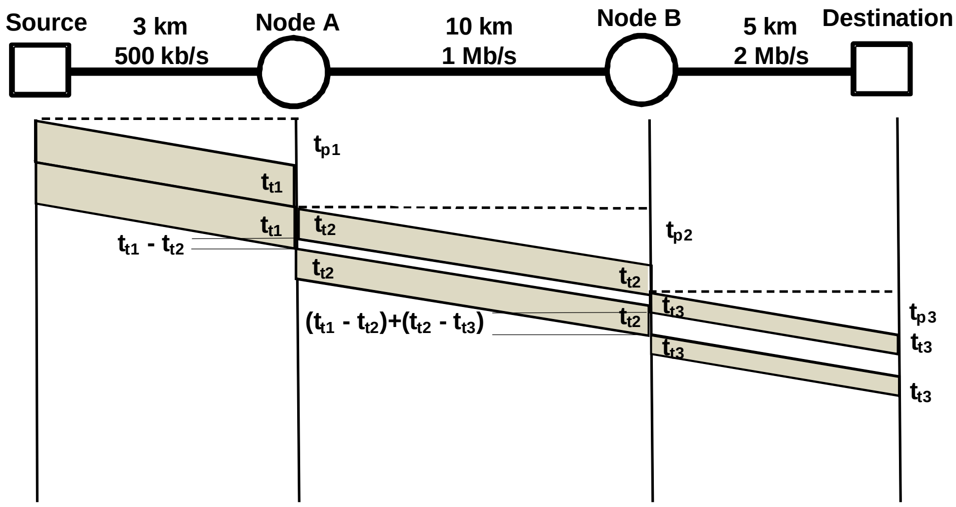


ii. $$Total\ delivery\ time\ for\ a\ message\ of\ size\ 1\ kB = (t_{p1} + t_{t1} + t_{p2} + t_{t2} + t_{p3} + t_{t3}) * 2 + (t_{p1} + t_{p2} + t_{p3}) + t_{tM} + (t_{t1} + t_{t2} + t_{t3}) + (t_{p1} + t_{t1} + t_{p2} + t_{t2} + t_{p3} + t_{t3}) =$$

$$\left(\frac{3*10^3}{1*10^8}+\frac{16*8}{5*10^5}+\frac{10*10^3}{2*10^8}+\frac{16*8}{1*10^6}+\frac{5*10^3}{1.25*10^8}+\frac{16*8}{2*10^6}\right)*4+\frac{1000*8}{5*10^5}$$
$$=1827.2*10^{-5}\ s$$

Scenario (2): Packet Switching with Pipelining

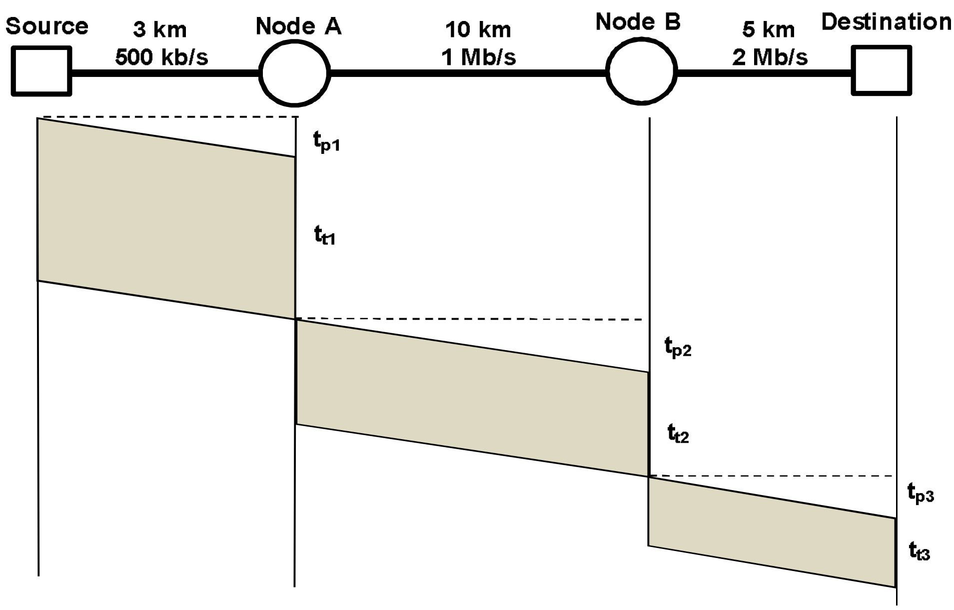
i.



ii. $$Total\ delivery\ time\ for\ a\ message of size\ 1\ kB=$$
$$(t_{p1}+t_{t1}+t_{p2}+t_{t2}+t_{p3}+t_{t3})+(t_{t1}-t_{t2})+(t_{t2}-t_{t3})+t_{t3}=$$
$$\left(\frac{3*10^3}{1*10^8}+\frac{520*8}{5*10^5}*2+\frac{10*10^3}{2*10^8}+\frac{520*8}{1*10^6}+\frac{5*10^3}{1.25*10^8}+\frac{520*8}{2*10^6}\right)$$
$$=2300*10^{-5}\ s$$

Scenario (3): Message Switching

i.



ii. $Total\ delivery\ time\ for\ a message\ of\ size\ 1\ kB =$

$$\left(t_{p1} + t_{t1} + t_{p2} + t_{t2} + t_{p3} + t_{t3}\right) =$$

$$\left(\frac{3*10^3}{1*10^8} + \frac{1020*8}{5*10^5} + \frac{10*10^3}{2*10^8} + \frac{1020*8}{1*10^6} + \frac{5*10^3}{1.25*10^8} + \frac{1020*8}{2*10^6}\right) = 2668*10^{-5}\ s$$

b)

Scenario (1)	18.272 ms	Smallest
Scenario (2)	23 ms	
Scenario (3)	26.68 ms	Largest

c) Delivery time of circuit switching = Delivery time of packet switching

$$\left(t_{p1} + t_{t1} + t_{p2} + t_{t2} + t_{p3} + t_{t3}\right)*4 + t_{tM} =$$

$$\left(t_{p1} + \widetilde{t_{t1}} + t_{p2} + \widetilde{t_{t2}} + t_{p3} + \widetilde{t_{t3}}\right) + [N-1]*[(\widetilde{t_{t1}} - \cancel{\widetilde{t_{t2}}}) + (\cancel{\widetilde{t_{t2}}} - \cancel{\widetilde{t_{t3}}}) + \cancel{\widetilde{t_{t3}}}]$$

$$t_{tM} = \frac{M*8}{5*10^5}, \qquad N = \frac{M}{500}$$

$$(3*10^{-5} + 5*10^{-5} + 4*10^{-5})*4 + \left(\frac{16*8}{5*10^5} + \frac{16*8}{1*10^6} + \frac{16*8}{2*10^6}\right)*4 + \frac{M*8}{5*10^5}$$
$$= (3*10^{-5} + 5*10^{-5} + 4*10^{-5}) + \frac{M}{500}*\frac{520*8}{5*10^5} + \frac{520*8}{1*10^6} + \frac{520*8}{2*10^6}$$

$$M = -6387.5 \rightarrow Not\ Feasible$$

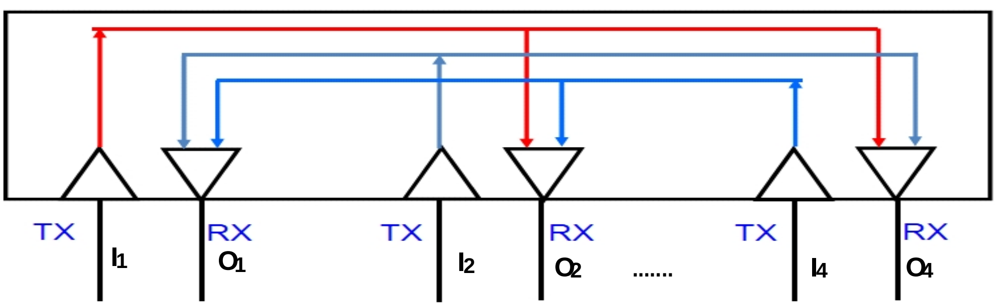
d) Delivery time of circuit switching = Delivery time of message switching

$$\left(t_{p1} + t_{t1} + t_{p2} + t_{t2} + t_{p3} + t_{t3}\right)*4 + t_{tM} = \left(t_{p1} + \widetilde{t_{t1}} + t_{p2} + \widetilde{t_{t2}} + t_{p3} + \widetilde{t_{t3}}\right)$$

$$(3*10^{-5} + 5*10^{-5} + 4*10^{-5})*4 + \left(\frac{16*8}{5*10^5} + \frac{16*8}{1*10^6} + \frac{16*8}{2*10^6}\right)*4 + \frac{M*8}{5*10^5}$$
$$= (3*10^{-5} + 5*10^{-5} + 4*10^{-5}) + \left(\frac{(M+20)*8}{5*10^5} + \frac{(M+20)*8}{1*10^6} + \frac{(M+20)*8}{2*10^6}\right)$$
$$M = 132.66\ B$$

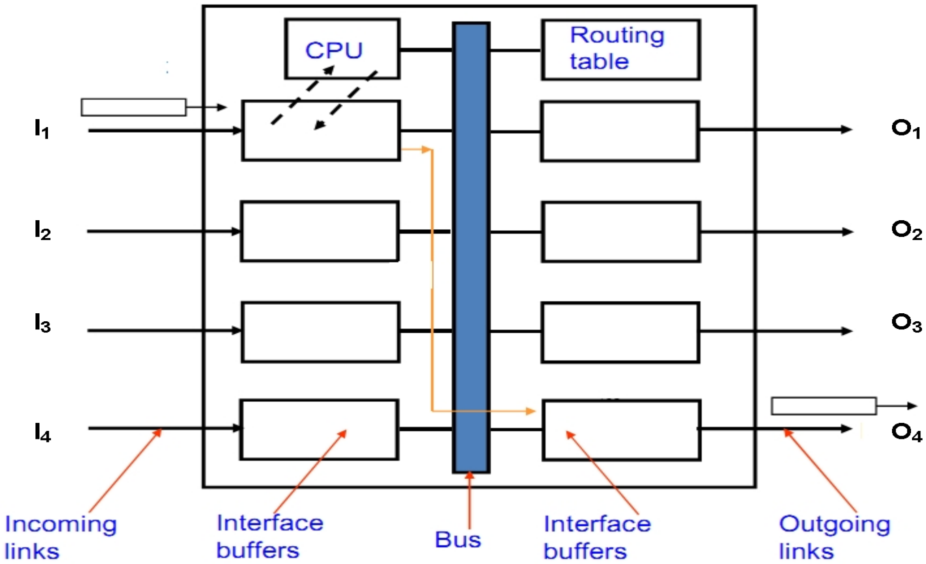
Question (2):

a) Hub



No software is used by a hub.

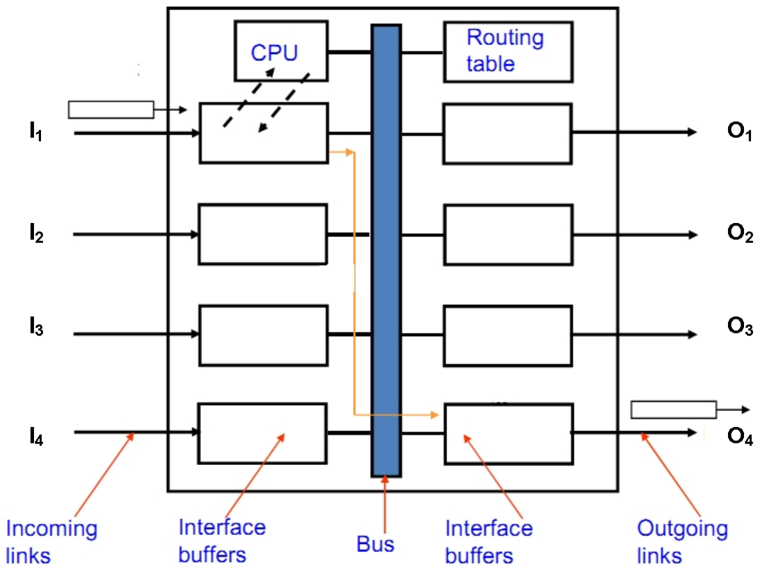
- Ethernet Switch



Software in the form of routing table is used. Learning is used to fill the routing table with MAC addresses.

Port 1	Port 2	Port 3	Port 4
	a : E1		d : E3
	k : E1		
	u : E2		
	s : E1		

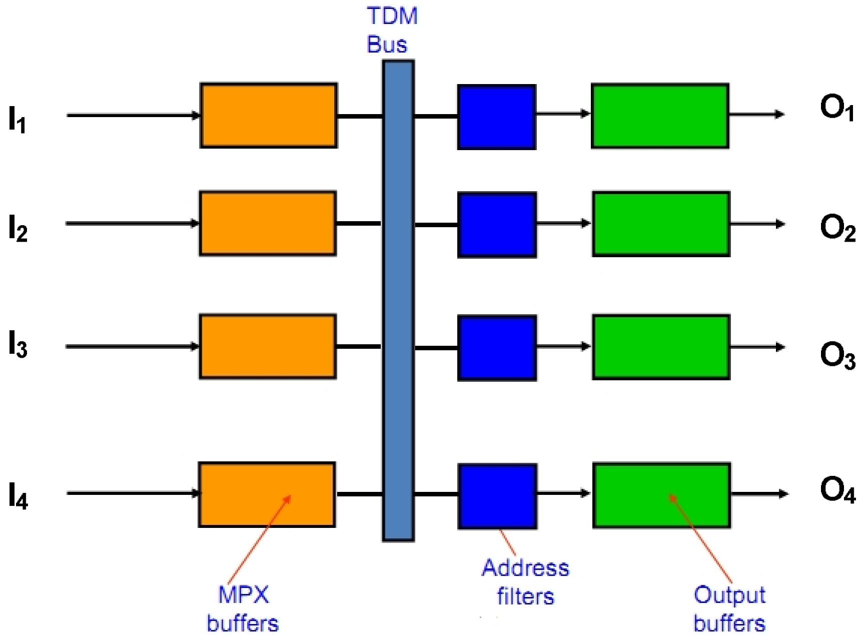
- Router



Software is needed to exchange routing information among routers (routing protocols, e.g. OSPF), which enables each router to build its routing table.

Subnet Address	Subnet Mask	Port	Next Hop
X	Mx	1	
Y	My	2	
K	Mk	3	

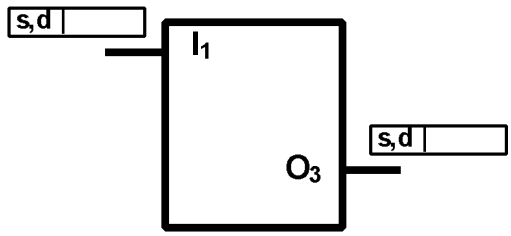
- ATM Switch



Software in the form of routing table is used. The entries of the routing table are obtained during the setup phase.

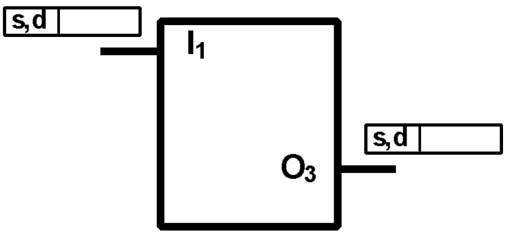
Input Port	VCI in	Output Port	VCI out
1	1	2	1
2	2	4	2
3	2	1	2

b) Packet/cell entering at Port 1, and leaving at Port 3:
  - For a hub, no processing takes place. Only simple repeating at all ports.

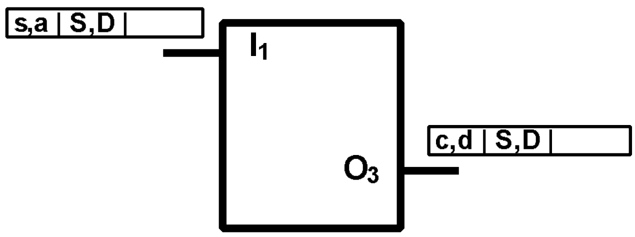


- For an Ethernet switch:
  - CPU extracts destination MAC address.
  - CPU compares destination MAC address with the entries of routing table:
    - If destination MAC address exists under specific port, packet is forwarded via such port.

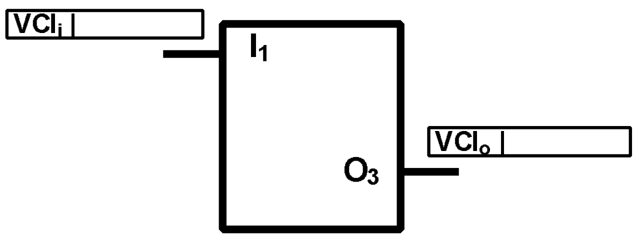
        - If destination MAC address doesn't exist, packet is forwarded via all other ports.
    - CPU extracts source MAC address:
        - If it doesn't exist in the routing table, it creates a new entry under port # through which packet entered, and places value of source MAC address.



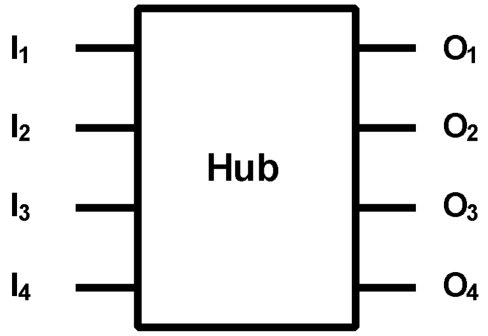
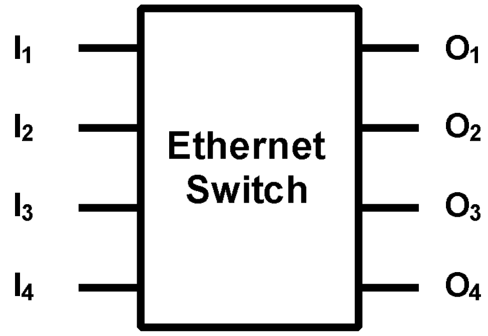
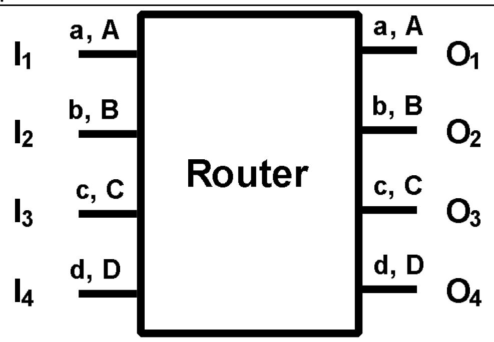
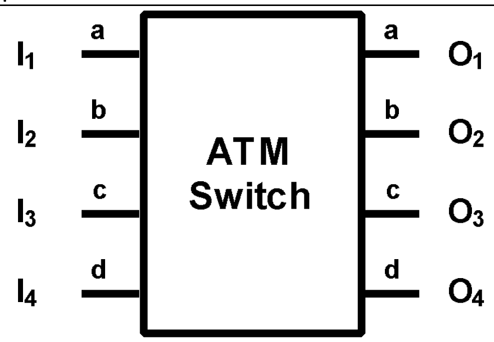
- For a router:
    - CPU extracts destination Network address.
    - CPU checks routing table to determine the record which contains the destination Network address.
    - CPU forwards incoming packet to port that matches destination Network address.
    - CPU replaces source MAC address and destination MAC address by new values corresponding to MAC address from which packet exits and MAC address to which packet is delivered.



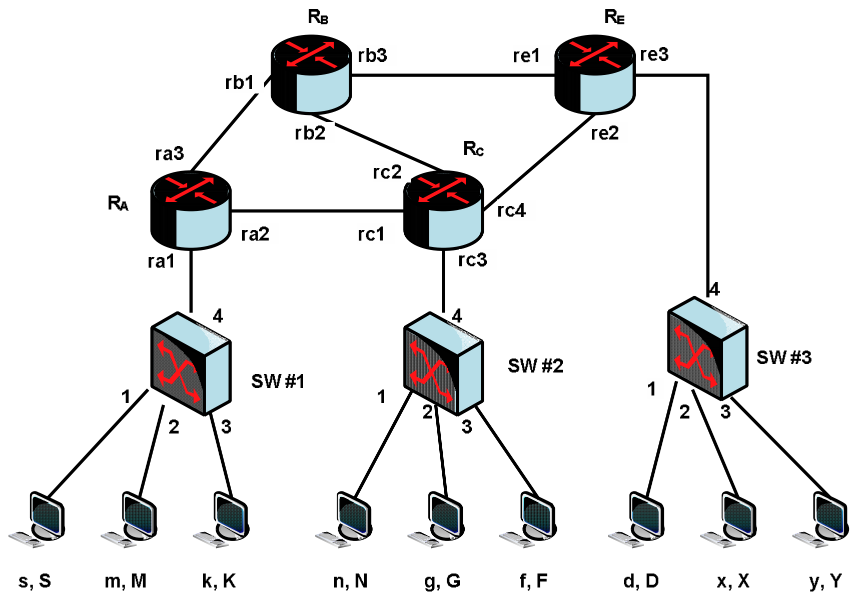
- For ATM switch:
    - CPU extracts VCI in header of cell.
    - CPU checks routing table to determine the record which contains Input Port/ Input VCI for incoming cell.
    - CPU forwards incoming cell to output port appearing in the record identified above.
    - CPU replaces VCI in header of incoming cell by output VCI in identified record of routing table.



c)

 No physical or logical addresses for the ports.	 No physical or logical addresses for the ports.
	 Only physical addresses for the ports.

Question (3):



NW address	Port	Next hop
S,M,K	1	-
N,G,F	2	Rc
D,X,Y	2	Rc

NW address	Port	Next hop
S,M,K	-	-
N,G,F	3	-
D,X,Y	4	RE

NW address	Port	Next hop
S,M,K	-	-
N,G,F	-	-
D,X,Y	3	-