Practical-

Date: - -

AIM: Understand and identify Layer-3 functionality.

Tools required:

1. Desktop Computer
2. Cisco Packet Tracer

Routing

- A Router is a process of selecting path along which the data can be transferred from source to the destination. Routing is performed by a special device known as a router.
- A Router works at the network layer in the OSI model and internet layer in TCP/IP model
- A router is a networking device that forwards the packet based on the information available in the packet header and forwarding table.
- The routing algorithms are used for routing the packets. The routing algorithm is nothing but a software responsible for deciding the optimal path through which packet can be transmitted.
- The routing protocols use the metric to determine the best path for the packet delivery. The metric is the standard of measurement such as hop count, bandwidth, delay, current load on the path, etc. used by the routing algorithm to determine the optimal path to the destination.
- The routing algorithm initializes and maintains the routing table for the process of path determination.

Types of routing

There are three types of routing as shown in figure 5.1.

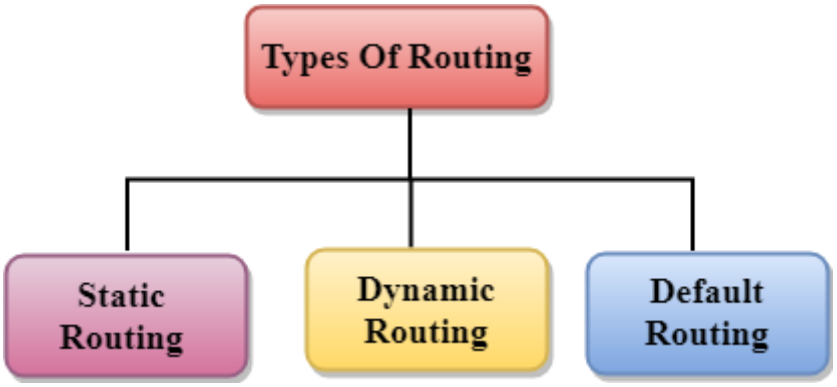


Figure 5.1

Static routing:

- Static Routing is also known as Nonadaptive Routing.
- It is a technique in which the administrator manually adds the routes in a routing table.

Dynamic routing:

- It is also known as Adaptive Routing.
- It is a technique in which a router adds a new route in the routing table for each packet in response to the changes in the condition or topology of the network.
- Dynamic protocols are used to discover the new routes to reach the destination.

Default routing:

- Default Routing is a technique in which a router is configured to send all the packets to the same hop device, and it doesn't matter whether it belongs to a particular network or not. A Packet is transmitted to the device for which it is configured in default routing.

Routing Protocols

Routing protocols can be either an interior protocol or an exterior protocol. An interior protocol handles intradomain routing; an exterior protocol handles interdomain routing.

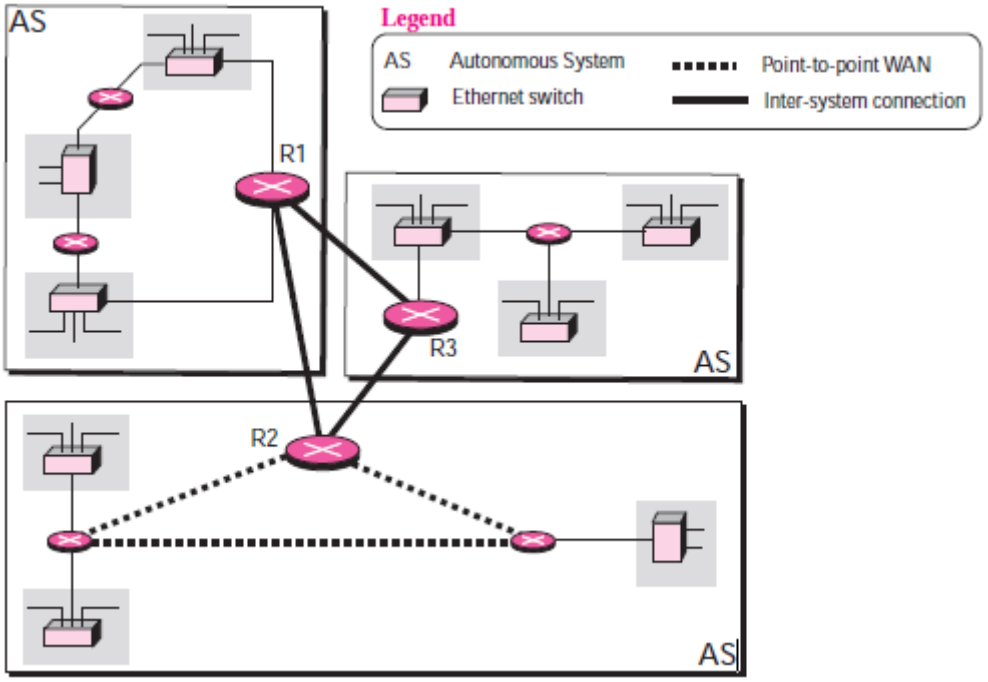


Figure 5.2 Intra domain and Inter domain routing protocol

Several intra-domain and inter-domain routing protocols are in use. We discuss two intra-domain routing protocols: distance vector and link state. We also introduce one inter-domain routing protocol: path vector.

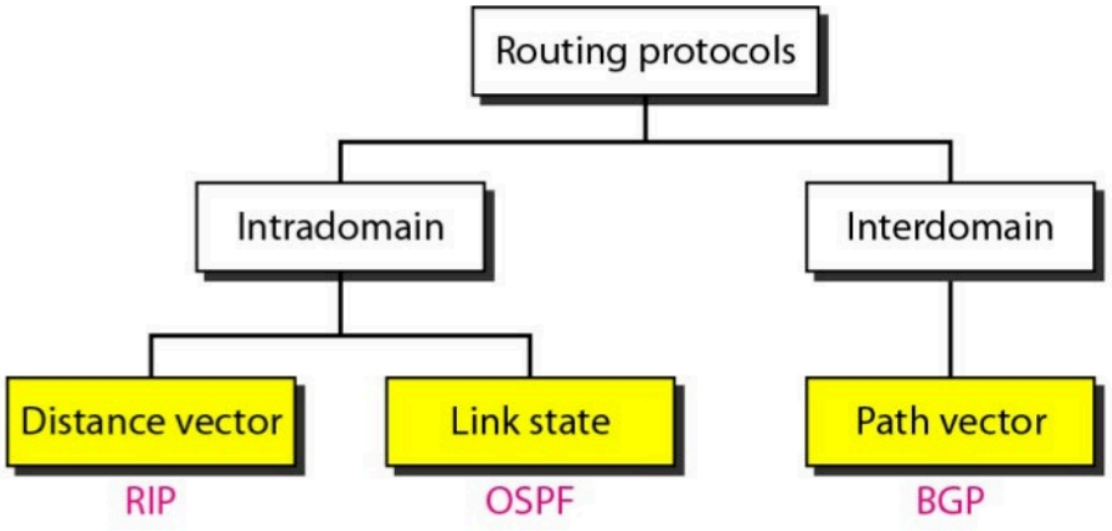


Figure 5.3 Routing Protocols

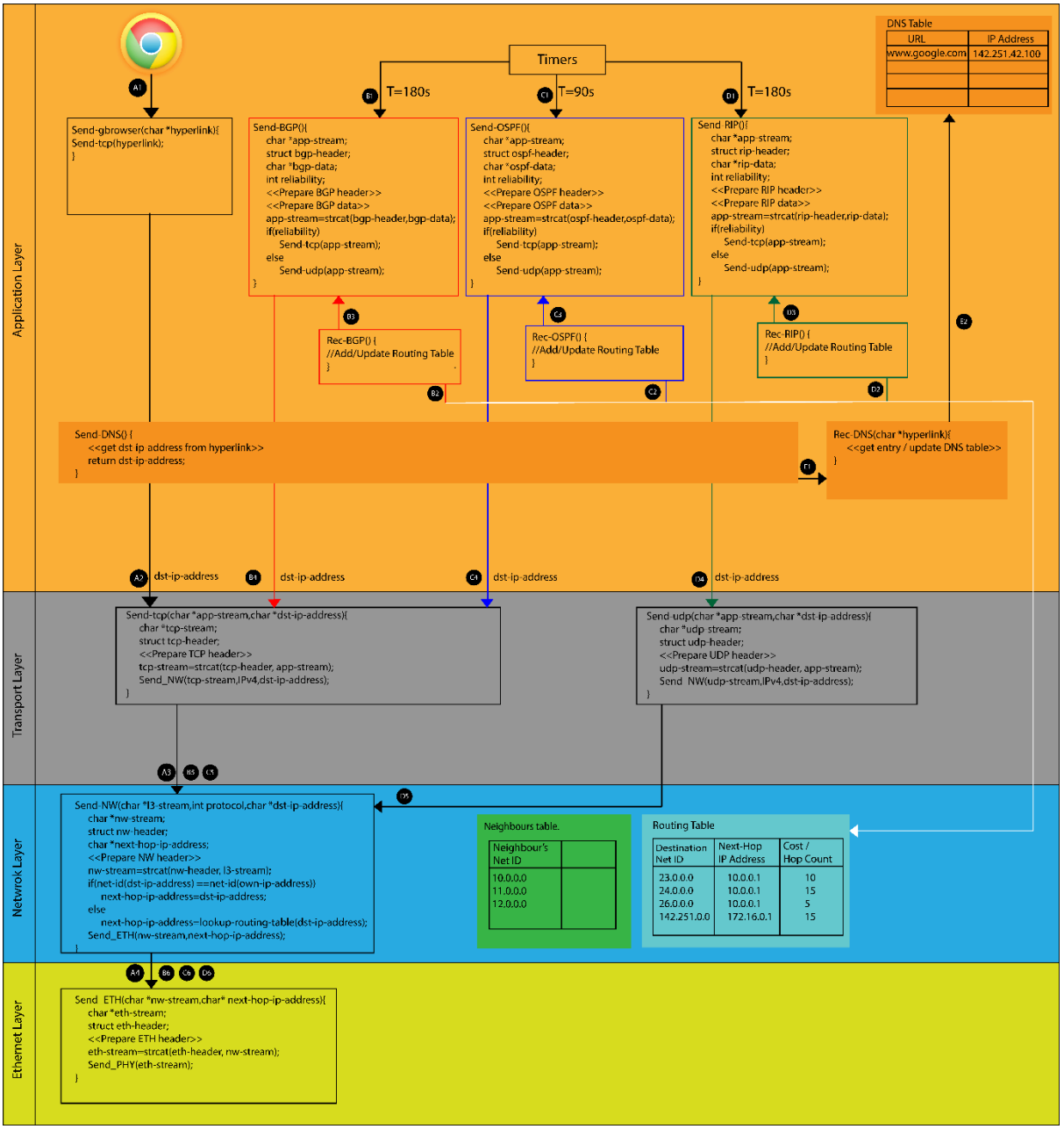
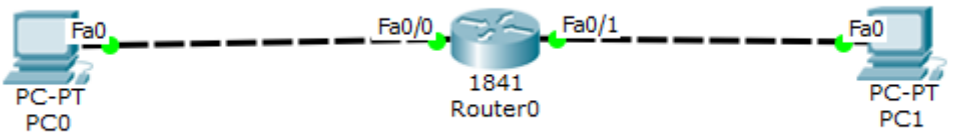


Figure 5.4 Demonstration of routing protocols in TCP/IP stack

1. How do DNS work?
   Ans.
2. What is the significance of the routing table?
   Ans.
3. What is the next hop IP address?
   Ans.
4. What is the significance of routing protocols?
   Ans.

Exercise-1



Redraw above diagram which includes IP address and MAC address. Take IP address and MAC address as per your knowledge.

<<Image from student>>

Ping from PC0 to PC1 and vice versa and get the output here.

<<Image from student>>

Write down the ARP table of PC0 and PC1. Write down Routing table Router0.

ARP table entry of PC0

IP address	MAC Address

ARP table entry of PC1

IP address	MAC Address

Routing table of Router0:

Destination Network ID	Next Hop IP address	Hop Count along a path
10.0.0.0	--	0
11.0.0.0	--	0

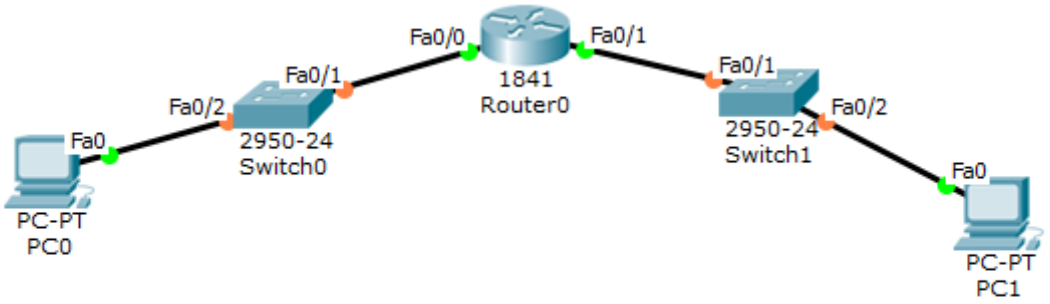
Which are the following statements correct? Also justify each statement.

1. Is PC0 having Ethernet Card?
   Ans.
   Justification:
2. PC1 is having Ethernet Card.
   Ans.
   Justification:
3. Router0 is having two NIC card.
   Ans.
   Justification:
4. Router 0 is having two Mac address
   Ans.
   Justification:
5. Router0 is having TWO IP address
   Ans.
   Justification:
6. MAC address pair on link 0(between PC0 and Router0) is different than MAC address pair in link 1(between Router0 and PC1) for message transfer.
   Ans.
   Justification:
7. Router0 is having switching table
   Ans.
   Justification:
8. Speed of Link 0 is 10 Mbps.
   Ans.
   Justification:
9. Speed of Link1 is 100 Mbps.
   Ans.
   Justification:
10. Router0 takes decision based on MAC address.
    Ans.
    Justification:
11. PC0 and PC1 can communicate because they are having same Ethernet cards i.e. Fa0.
    Ans.
    Justification:
12. PC1 and Router0 cannot communicate as they are having different Ethernet cards.
    Ans.
    Justification:

Conclusions (Inference):

1.
2.

Exercise-2



Redraw above diagram which includes IP address and MAC address. Take IP address and MAC address as per your knowledge.

<<Image from student>>

Ping from PC0 to PC1 and vice versa and get the output here.

<<Image from student>>

Write down ARP table of PC0 and PC1. Write down switch table of switches. Write down Routing table of routers.

ARP table entry of PC0

IP address	MAC Address

ARP table entry of PC1

IP address	MAC Address

Switch table entry of Switch0:

MAC Address	Ethernet port no

Switch table entry of Switch1:

MAC Address	**Ethernet port no**

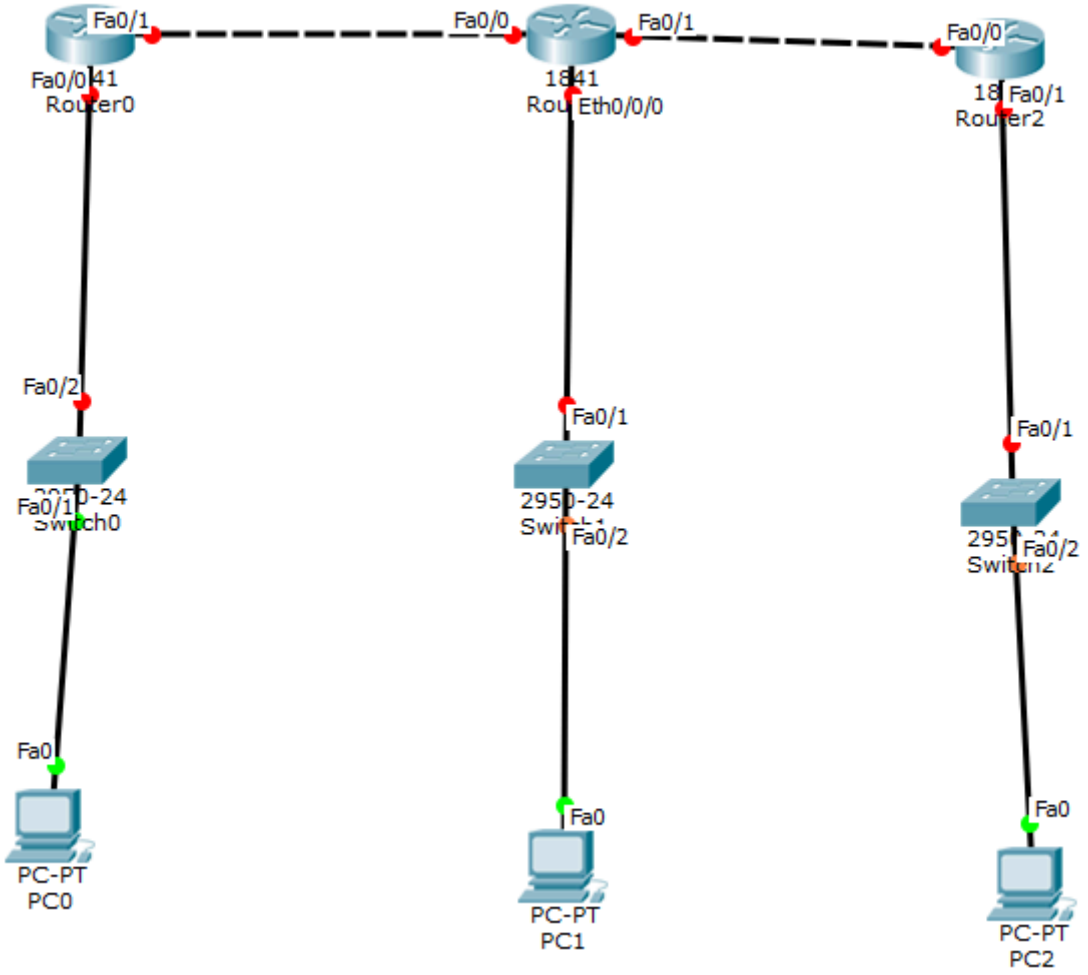
Routing table of Router0:

Destination Network ID	Next Hop IP address	Hop Count

Which are the following statements correct? Also justify each statement.

1. Switch0 contains MAC address of PC1 in their switching table.
   Ans.
   Justification:
2. Switch1 contains MAC address of PC1 in their switching table.
   Ans.
   Justification:
3. Any computer or device can be Router if it has two NIC cards.
   Ans.
   Justification:
4. Switch0 and Switch1 may take decision based on IP address.
   Ans.
   Justification:
5. Router0 works at layer 3, while switches work at layer 2.
   Ans.
   Justification:
6. By default, Network ID of NIC cards are routing table entries.
   Ans.
   Justification:
7. MAC address pair on link 0(between PC0 and Router0) is different than MAC address pair in link 1(between Router0 and PC1) for message transfer.
   Ans.
   Justification:

Exercise-3



Redraw above diagram which includes IP address and MAC address. Take IP address and MAC address as per your knowledge.

<<Image from student>>

Ping all PCs respectively and get the output here.

<<Image from student>>

Write down ARP table of PC0, PC1 and PC3 after successful ping. Write down switch table of switches. Write down Routing table of routers.

ARP table entry of PC0

IP address	MAC Address

ARP table entry of PC1

IP address	MAC Address

ARP table entry of PC2

IP address	MAC Address

Switch table entry of Switch0:

MAC Address	Ethernet port no

Switch table entry of Switch1:

MAC Address	Ethernet port no

Routing table of Router0:

Destination Network ID	Next Hop IP address	Hop Count

Routing table of Router1:

Destination Network ID	Next Hop IP address	Hop Count

Routing table of Router2:

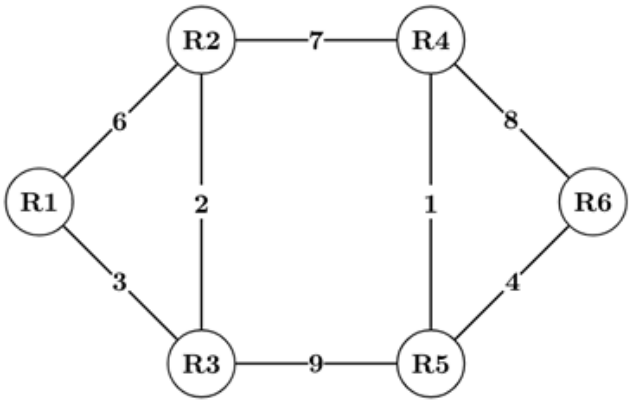
Destination Network ID	Next Hop IP address	Hop Count

Conclusions (Inference):

1.
2.
3.
4.

GATE Questions:

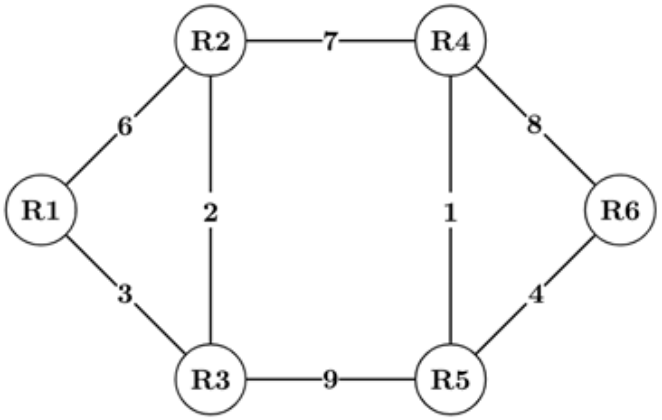
1. **Consider a network with 6 routers R1 to R6 connected with links having weights as shown in the following diagram.**



All the routers use the distance vector-based routing algorithm to update their routing tables. Each router starts with its routing table initialized to contain an entry for each neighbor with the weight of the respective connecting link. After all the routing tables stabilize, how many links in the network will never be used for carrying any data?

A) 4
B) 3
C) 2
D) 1

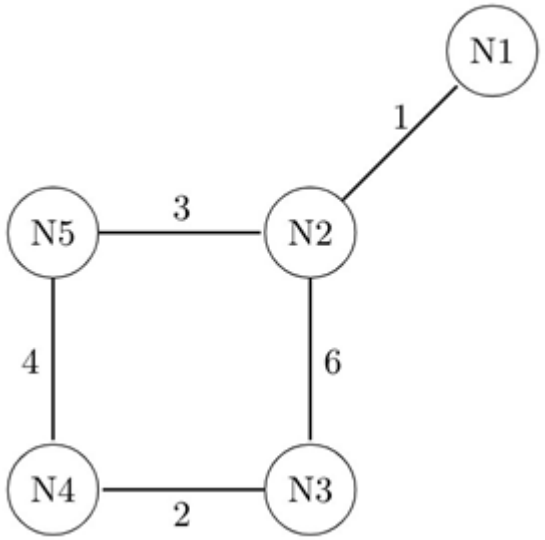
2. **Consider a network with 6 routers R1 to R6 connected with links having weights as shown in the following diagram.**



Suppose the weights of all unused links are changed to 2 and the distance vector algorithm is used again until all routing tables stabilize. How many links will now remain unused?

A) 0
B) 1
C) 2
D) 3

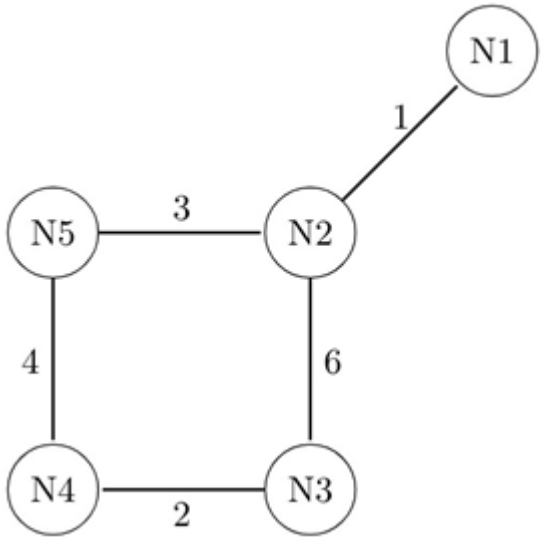
3. **Consider a network with five nodes, N1 to N5, as shown as below.**



The network uses a Distance Vector Routing protocol. Once the routes have been stabilized, the distance vectors at different nodes are as follows.
N1: (0, 1, 7, 8, 4)
N2: (1, 0, 6, 7, 3)
N3: (7, 6, 0, 2, 6)
N4: (8, 7, 2, 0, 4)
N5: (4, 3, 6, 4, 0)
Each distance vector is the distance of the best known path at that instance to nodes, N1 to N5, where the distance to itself is 0. Also, all links are symmetric and the cost is identical in both directions. In each round, all nodes exchange their distance vectors with their respective neighbors. Then all nodes update their distance vectors. In between two rounds, any change in cost of a link will cause the two incident nodes to change only that entry in their distance vectors. The cost of link N2 − N3 reduces to 2 (in both directions). After the next round of updates, what will be the new distance vector at node, N3?

A) (3, 2, 0, 2, 5)
B) (3, 2, 0, 2, 6)
C) (7, 2, 0, 2, 5)
D) (7, 2, 0, 2, 6)

4. Consider a network with five nodes, N1 to N5, as shown as below.



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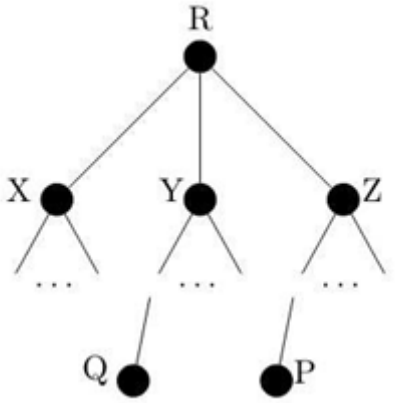
N4: (8, 7, 2, 0,
N5: (4, 3, 6, 4, 0)
Each distance vector is the distance of the best known path at that instance to nodes, N1 to N5, where the distance to itself is 0. Also, all links are symmetric and the cost is identical in both directions. In each round, all nodes exchange their distance vectors with their respective neighbors. Then all nodes update their distance vectors. In between two rounds, any change in cost of a link will cause the two incident nodes to change only that entry in their distance vectors. The cost of link N2 − N3 reduces to 2 (in both directions). After the next round of updates, the link N1 − N2 goes down. N2 will reflect this change immediately in its distance vector as cost, ∞. After the NEXT ROUND of update, what will be the cost to N1 in the distance vector of N3 ?

A) 3
B) 9
C) 10
D) ∞

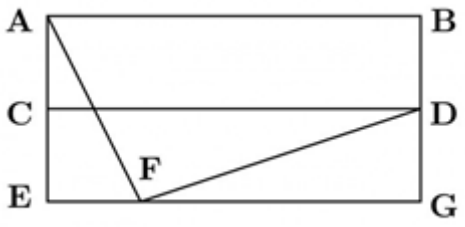
5. Consider a computer network using the distance vector routing algorithm in its network layer. The partial topology of the network is shown below.



The objective is to find the shortest-cost path from the router R to routers P and Q. Assume that R does not initially know the shortest routes to P and Q. Assume that R has three neighbouring routers denoted as X, Y and Z. During one iteration, R measures its distance to its neighbours X, Y , and Z as 3, 2 and 5, respectively. Router R gets routing vectors from its neighbours that indicate that the distance to router P from routers X, Y and Z are 7, 6 and 5, respectively. The routing vector also indicates that the distance to router Q from routers X, Y and Z are 4, 6 and 8 respectively. Which of the following statement(s) is/are correct with respect to the new routing table o R, after updation during this iteration?

A) The distance from R to P will be stored as 10
B) The distance from R to Q will be stored as 7
C) The next hop router for a packet from R to P is Y
D) The next hop router for a packet from R to Q is Z.

6. **For the network given in the figure below, the routing tables of the four nodes A, E, D and G are shown. Suppose that F has estimated its delay to its neighbors, A, E, D and G as 8, 10, 12 and 6 msecs respectively and updates its routing table using distance vector routing technique.**



Routing Table of A

A	0
B	40
C	14
D	17
E	21
F	9
G	24

Routing Table of D

A	20
B	8
C	30
D	0
E	14
F	7
G	22

Routing Table of E

A	24
B	27
C	7
D	20
E	0
F	11
G	22

Routing Table of G

A	21
B	24
C	22
D	19
E	22
F	10
G	0

A)

A	8
B	20
C	17
D	12
E	10
F	0
G	6

B)

A	21
B	8
C	7
D	19
E	14
F	0
G	22

C)

A	8
B	20
C	17
D	12
E	10
F	16
G	6

D)

A	8
B	8
C	7
D	12
E	10
F	0
G	6

7. Consider the following three statements about link state and distance vector routing protocols, for a large network with 500 network nodes and 4000 links.

[S1]: The computational overhead in link state protocols is higher than in distance vector protocols.
[S2]: A distance vector protocol (with split horizon) avoids persistent routing loops, but not a link state protocol.
[S3]: After a topology change, a link state protocol will converge faster than a distance vector protocol.
Which one of the following is correct about S1, S2, and S3?

A) S1, S2, and S3 are all true.
B) S1, S2, and S3 are all false.
C) S1 and S2 are true, but S3 is false.
D) S1 and S3 are true, but S2 is false.