Chapter 01 (LP)

1). Compare and contrast link-state & distance-vector routing algorithms.

★ Distance Vector Routing :-

- It is a dynamic routing algorithm in which each router computes distance between itself and each possible destination i.e. its immediate neighbours.
- The router shares its knowledge about the whole network to its neighbors & accordingly updates table based on its neighbours.
- The sharing of information with the neighbours takes place at regular intervals.
- It makes use of Bellman Ford algorithm for making routing tables.

★ Link State Routing :-

- It is a dynamic routing algorithm in which each router shares knowledge of its neighbors with every other router in the network.
- A router sends its information about its neighbours only to all routers through flooding.
- Information sharing takes place only when there is a change.

• It makes use of Dijkstra's Algorithm for making routing tables.

Distance Vector Routing	Link State Routing
i) Bandwidth required is less due to local sharing, small packets & no flooding.	i) Bandwidth required is more due to flooding & sending of large link state packets.
ii) Based on local knowledge since it updates table based on info. from neighbors.	ii) Based on global knowledge i.e. it have knowledge about entire network.
iii) Make use of Bellman Ford.	iii) Make use of Dijkstra's Algorithm.
iv) Traffic is less.	iv) Traffic is more.
v) Converges slowly i.e. good news spread fast & bad news spread slowly.	v) Converges faster.
vi) Count to infinity problem.	vi) No count to ∞ problem.
vii) Persistent looping problem i.e. loop will be there forever.	vii) No persistent loops, only transient loops.
viii) Practical Implementation is RIP & IGRP.	viii) Practical implementation is OSPF & ISIS.

2). Compare and contrast the advertisements used by RIP & OSPF.

With OSPF, a router periodically broadcasts routing information to all other routers in the Autonomous System, not just to its neighboring routers.

This routing information sent by a router has one entry for each of the router's neighbors. The entry gives the distance from the router to the neighbor.

A RIP advertisement sent by a router contains information about all the networks in the AS, although this information is only sent to its neighboring routers.

The address value for RIP is 120 & it is 110 for OSPF.

3). Consider the count-to-infinity problem in the distance vector routing. When the count-to-infinity problem occurs if we decrease the cost of a link? Why? How about if we connect two nodes which do not have a link?

The distance vector routing algorithm suffers from count-to-infinity problem.

The count-to infinity problem does not occur when the cost of a link is decreased.

When a node detects the decrease in the cost of a link, it updates its distance vector & informs its neighbors about the change in its distance vector.

In the further iterations, according to the updates received, the node computes their new least costs & in turn send their updates. Hence, it reaches an inactive state.

When the two nodes are connected with a new link, then the previously connected node & its cost is not existed.

Hence, it decreases the cost from infinity to the new cost of the link.

Thus, there is no chance of the count-to infinity problem for the new node.

4). Describe how loops in paths can be detected in BGP.

The loops in the BGP protocol can be detected as :-

- The BGP protocol propagates & obtains reachability of all the neighbouring AS.
- The attributes AS-PATH & NEXT-HOP are used for routing.
- The router verifies all the AS numbers. If it finds its own no., it will discard the advertisement to prevent the looping. In this way BGP detects the loops & prevents them.

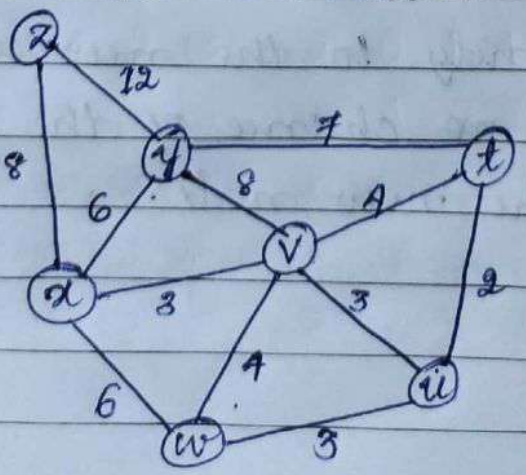
Chapter 1 : Network Layer.

4) Describe how loops in path can be detected in BGP.

The loops in the BGP (Border Gateway Protocol) can be detected as

- The BGP protocol propagates and obtains reachability of all the neighboring AS (Autonomous System)
- The attributes AS-PATH and NEXT-HOP are used for routing.
- The router verifies all the AS numbers. If it finds its own number, it will discard the advertisement to prevent the looping. In this way BGP detects the loops and prevents them

5) 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.

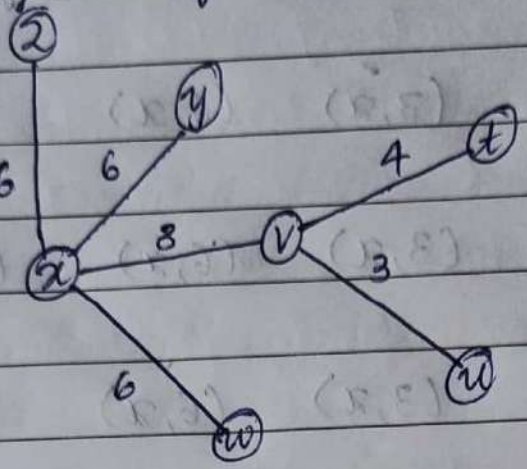


N'	t p(t)	u, p(u)	v, p(v)	w, p(w)	y, p(y)	z, p(z)
{x}	(∞, -)	(∞, -)	(3, x)	(6, x)	(6, x)	(8, x)
{x, v}	(7, v)	(6, v)	(3, x)	(6, x)	(6, x)	(8, x)
{x, v, u}	(7, v)	(6, v)	(3, x)	(6, x)	(6, x)	(8, x)
{x, v, u, w}	(7, v)	(6, v)	(3, x)	(6, x)	(6, x)	(8, x)
{x, v, u, w, y}	(7, v)	(6, v)	(3, x)	(6, x)	(6, x)	(8, x)
{x, v, u, w, y, t}	(7, v)	(6, v)	(3, x)	(6, x)	(6, x)	(8, x)
{x v u w y t z}	(7, v)	(6, v)	(3, x)	(6, x)	(6, x)	(8, x)

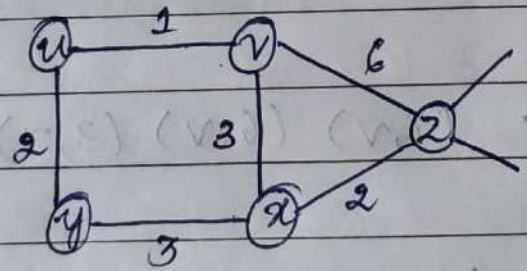
Path for z from x :- cost = 8, ⓧ → ⓩ

Path for u from x :- cost = 6, ⓧ → ⓥ → ⓤ
Path for y from x :- cost = 6, ⓧ → ⓨ
Path for v from x : cost = 3 ⓧ → ⓥ
Path for w from x : cost = 6 ⓧ → ⓦ
Path for t from x : cost = 7 ⓧ → ⓥ → ⓣ

Spanning tree for the given graph is



6) Consider the network shown, assume that each node initially knows the cost to each of its neighbors. Consider the distance-vector algorithm and show the distance table intries at node z



Initialization

	u	v	x	y	z
x	0	1	∞	2	∞
v	∞	∞	∞	∞	∞
u x	∞	∞	∞	∞	∞
y	∞	∞	∞	∞	∞
z	∞	∞	∞	∞	∞

	u	v	x	y	z
u	0	1	4	2	7
v	1	0	3	∞	6
x	∞	3	0	3	2
y	2	∞	3	0	∞
z	∞	6	2	∞	0

	u	v	x	y	z
u	0	1	4	2	6
v	1	0	3	3	5
x	4	3	0	3	2
y	2	3	3	0	5
z	7	5	2	5	0

V

	u	v	x	y	z
u	∞	∞	∞	∞	∞
v	1	0	3	∞	6
x	∞	∞	∞	∞	∞
y	∞	∞	∞	∞	∞
z	∞	∞	∞	∞	∞

	u	v	x	y	z
u	0	1	∞	2	∞
v	1	0	3	3	5
x	∞	3	0	3	2
y	2	∞	3	0	∞
z	∞	6	2	∞	0

	u	v	x	y	z
u	0	1	4	2	7
v	4	1	0	3	5
x	4	3	0	3	2
y	2	3	3	0	5
z	7	5	2	5	0

x

	u	v	x	y	z
u	∞	∞	∞	∞	∞
v	∞	∞	∞	∞	∞
x	∞	3	0	3	2
y	∞	∞	∞	∞	∞
z	∞	∞	∞	∞	∞

	u	v	x	y	z
u	0	1	∞	2	∞
v	1	0	3	∞	6
x	4	3	0	3	2
y	2	∞	3	0	∞
z	∞	6	2	∞	0

	u	v	x	y	z
u	0	1	4	2	7
v	1	0	3	3	5
x	4	3	0	3	2
y	2	3	3	0	5
z	7	5	2	5	0

y

	u	v	x	y	z
u	∞	∞	∞	∞	∞
v	∞	∞	∞	∞	∞
x	∞	∞	∞	∞	∞
y	2	∞	3	0	∞
z	∞	∞	∞	∞	∞

	u	v	x	y	z
u	0	1	∞	2	∞
v	1	0	3	∞	6
x	∞	3	0	3	2
y	2	3	3	0	5
z	∞	6	2	∞	0

	u	v	x	y	z
u	0	1	4	2	7
v	1	0	3	3	5
x	4	3	0	3	2
y	2	3	3	0	5
z	7	5	2	5	0

z

	u	v	x	y	z
u	∞	∞	∞	∞	∞
v	∞	∞	∞	∞	∞
x	∞	∞	∞	∞	∞
y	∞	∞	∞	∞	∞
z	∞	6	2	∞	0

	u	v	x	y	z
u	0	1	∞	2	∞
v	1	0	3	∞	6
x	∞	3	0	3	2
y	2	∞	3	0	∞
z	7	5	2	5	0

	u	v	x	y	z
u	0	1	4	2	7
v	1	0	3	3	5
x	4	3	0	3	2
y	2	3	3	0	5
z	6	5	2	5	0

u

	u	v	x	y	z
u	0	1	4	2	6
v	1	0	3	3	5
x	4	3	0	3	2
y	2	3	3	0	5
z	6	5	2	5	0

v

	u	v	x	y	z
u	0	1	4	2	6
v	1	0	3	3	5
x	4	3	0	3	2
y	2	3	3	0	5
z	6	5	2	5	0

z

	u	v	x	y	z
u	0	1	4	2	6
v	1	0	3	3	5
x	4	3	0	3	2
y	2	3	3	0	5
z	6	5	2	5	0

x

	u	v	x	y	z
u	0	1	4	2	6
v	1	0	3	3	5
x	4	3	0	3	2
y	2	3	3	0	5
z	6	5	2	5	0

y

	u	v	x	y	z
u	0	1	4	2	6
v	1	0	3	3	5
x	4	3	0	3	2
y	2	3	3	0	5
z	6	5	2	5	0

7) OSPF: intra-domain routing, link state
RIP: intra-domain routing, distance vector
EBGP: external BGP runs between routers in different ASs
IBGP: internal BGP runs between routers in same ASs

i) a eBGP: Router 3c learns about x from eBGP.
ii) iBGP: Router 3a learns about x from iBGP.
iii) eBGP: Router 1c learns about x from eBGP.
iv) iBGP: Router 1d learns about x from iBGP.

2) Compare and contrast the advertisement value used by RIP and OSPF

With OSPF, a router periodically broadcasts routing information to all other routers in the AS, not just to its neighbouring routers. This routing information sent by a router has one entry for each of the router's neighbors; the entry gives the distance from the router to the neighbor.

An RIP advertisement sent by a router contains information about all the networks in the AS, although this information is only sent to its neighboring routers.

The add value for RIP is 120 and it is 110 for OSPF

Chapter 02 : (LP)

[NETWORK LAYER]

Nidhi Singh

Ques 1). What is the difference between a group-shared tree and a source-based tree in the context of multicast routing?

- In a group-shared tree, all senders send their multicast traffic using the same routing tree.
- With source-based tree, the multicast datagrams from a given source are routed over specific routing tree constructed for that source.
- Thus, each source may have a different source-based tree and a router may have to keep track of several source-based trees for a given multicast group.
- Group shared tree is a multicast group includes all the edge routers & hosts.
- Group shared tree shares a single tree for all the hosts & initiate the multicast join.
- However, source based tree maintain all the trees to a multicast group. It contains multiple individual trees.
- Source based tree multicast the packets without hosts.

Q). Explain the uncontrolled flooding mechanism for broadcasting.

In this mechanism, every intermediate node transmits the broadcast packet to all the nodes except to the node from which it received.

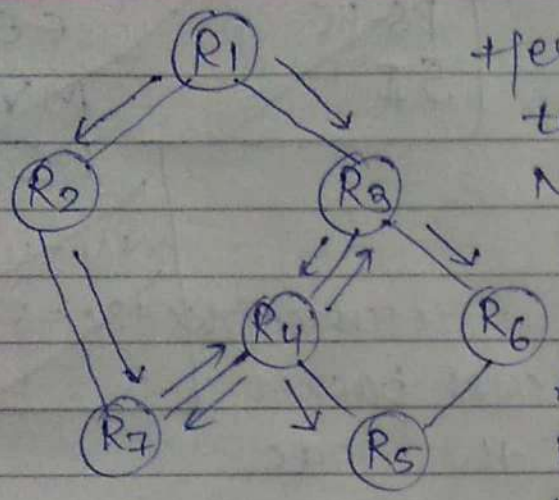
Mainly, every node will continue to send the data to all other nodes except from which it received.

Thus, there occurs a situation in which too many copies of broadcast packets are generated in the network. This is known as Broadcast Storm.

Here, although all the nodes are able to receive the broadcast packets in the network, the network becomes too much congested.

Also, multiple / duplicate copies of broadcast packet is received at each node.

This mechanism can be understood using the following figure:



Here, R1 will send the pkt to R2 and R3.
Now, R2 will sent to R7 and R3 will send to R4 & R6.

At R4, it received a pkt from R3, so that pkt will be sent to R7 and R5.

Similarly, R4 also received a pkt from R7 thus that pkt will be transmitted to R3 & R5.

Here, it can be observed that multiple copies of a pkt are being generated at each node & the network is getting congested.

3). Describe the reverse path forwarding algorithm for broadcasting.

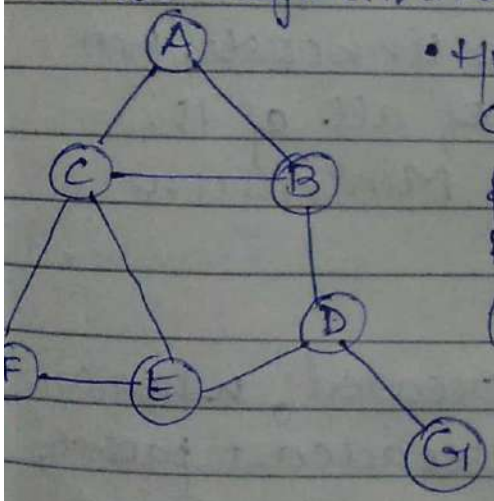
- This algorithm is based on controlled flooding mechanism.

- According to this algorithm, a node broadcasts a packet if it receives from the node which exists in the shortest path (minimum cost) to the source node.

- When a router receives a broadcast packet with a given source address, it transmits the packet on all of its outgoing links (except

the one on which it was received) only if the packet arrived on the link that is on its own shortest unicast path back to the source.

- Otherwise, the router simply discards the incoming packet without forwarding it on any of its outgoing links.
- Such a packet can be dropped because the router knows it either will receive or has already received a copy of this packet on the link that is on its own shortest path back to the sender.
- This algorithm avoids Broadcast Storm.



- Here, A will forward the pkt to B & C. B will ignore (drop, without forwarding) any source-A pkts it receives from any other nodes (for example, from routers C or D).
- Now node C, will receive a pkt from src A and B.

Since B is not on C's own shortest path back to A, C will ignore any src-A pkt it receives from B.

- On the other hand, when C receives pkt from A, it will forward the packet to nodes B, E & F.

4). Explain with diagram the Spanning-Tree Broadcast mechanism.

- This algorithm helps to avoid the transmission of redundant broadcast packets. i.e every node should receive only one copy of the broadcast packet.

- This broadcast mechanism involves the construction of spanning tree at the beginning. A spanning tree is a tree that consists of each & every node in a graph/network with no cycles.

- If each link has some cost associated to it & the cost of a tree is sum of all the link costs, then a tree whose cost is minimum of all of the graph's spanning tree is called Minimum Spanning tree.

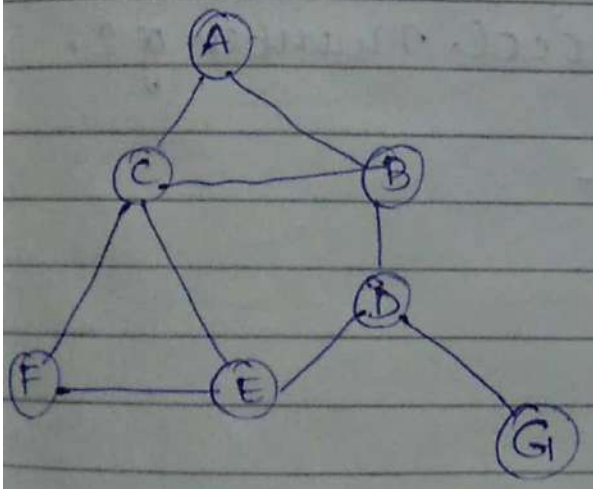
- Now, once the spanning tree is created, when a source node wants to send a broadcast packet, it sends the packet out on all of the incident links that belong to the spanning tree.

- A node which receives a broadcast packet then forwards the packet to all its neighbors in the spanning tree.

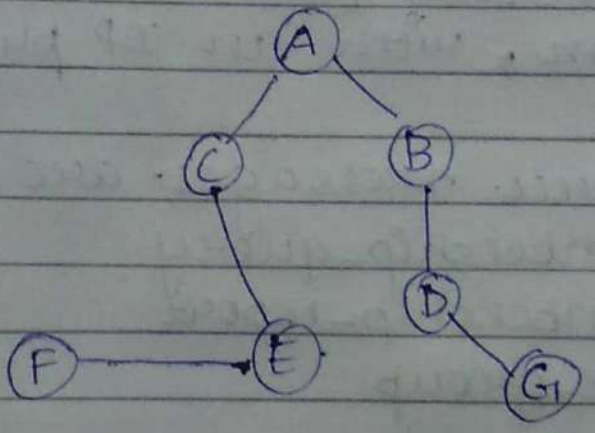
- Spanning tree eliminates redundant broadcast packets. It can also be used by any node to begin a broadcast.

- Here, a node need not be aware of the entire tree. It simply needs to know which of its neighbors are spanning tree neighbors.

- The complexity in this approach is the overhead for creation & maintenance of the spanning tree.



Initial Network



Spanning tree

- Here, node B & C first sends tree join request to node A & link is created.

- Node D has 2 options but since B is in the shortest path, thus it sends the tree join req to B.

- Similarly, a link is created b/w E & F and D and G. And spanning tree is generated.

Internet Group Management Protocol

5). Discuss the different IGMP operations.

- The IGMP protocol operates between a host & its directly attached router / first-hop router.
- IGMP provides the means for a host to inform its attached router that an application running on the host wants to join a specific multicast group.
- IGMP has three message types. IGMP messages are carried (encapsulated) within an IP datagram, with an IP protocol number of 2.
- The three messages are :-
  (i) membership_query
  (ii) membership_report
  (iii) leave_group

The membership_query message is sent by a router to all hosts on an attached interface to determine the set of all multicast groups that have been joined by the hosts on that interface.

Hosts respond to a membership-query message with an IGMP membership_report message. This can also be generated by a host when an application first joins a multicast group

without waiting for a membership-query message from the router.

Leave-group message is the final type of IGMP message. It is an optional message. Since it is optional, the router detects when a host leaves the multicast group using another approach.
~~It includes~~ The router infers that a host is no longer in the multicast group if it no longer responds to a membership-query message with the given group address.