Unit - 3

Q1:- Discuss distance vector routing using suitable example

Ans:- Distance Vector Routing Algorithm:-

- The Distance vector algorithm is iterative, asynchronous and distributed.
- **Distributed:** It is distributed in that each node receives information from one or more of its directly attached neighbours, performs calculation and then distributes the results back to its neighbours.
- **Iterative:** It is iterative in that its process continues until no more information is available to be exchanged between neighbors.
- **Asynchronous:** It does not require that all of its nodes operate in the lock step with each other.
- The distance vector algorithm is a dynamic algorithm.
- It is mainly used in ARPANET and RIP.
- Each router maintains a distance table known as vector.

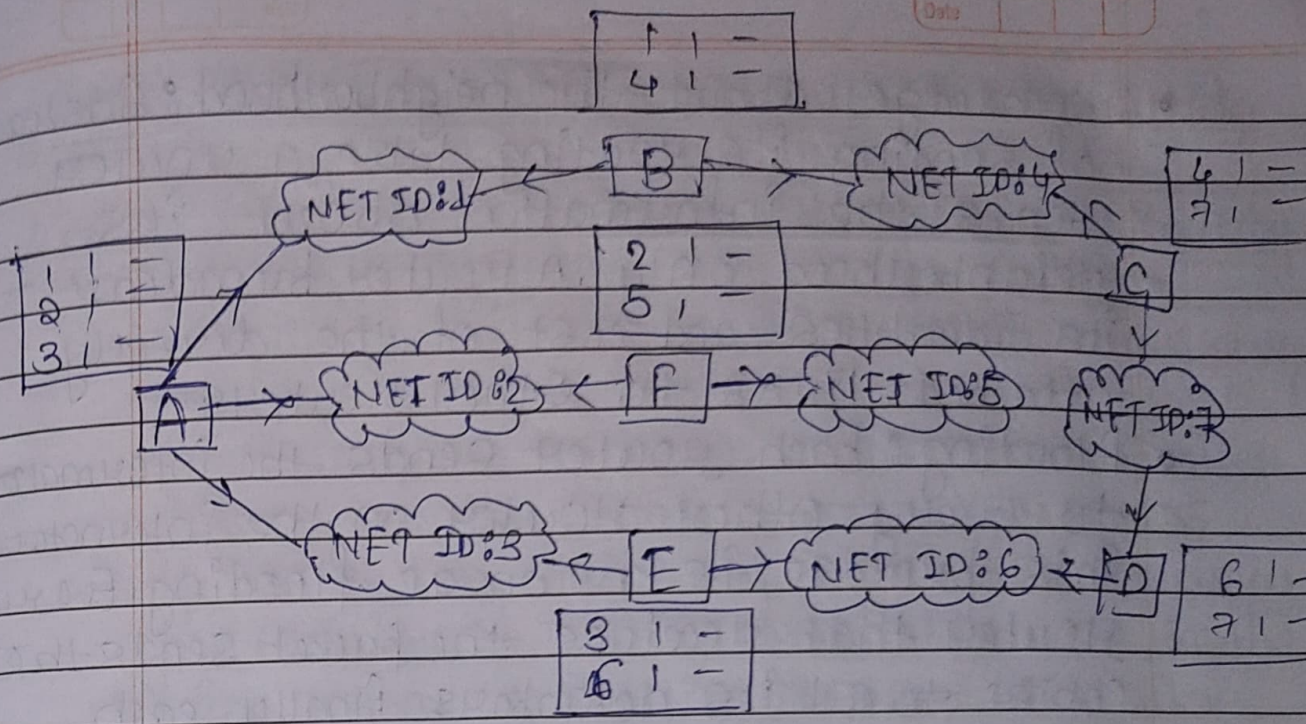
Working:-

- **Knowledge about the whole network:** Each router shares its knowledge through the entire network. The Router sends its collected knowledge about the network to its neighbours.

- **Routing only to neighbors:** The router sends its knowledge about the network to only those routers which have direct links. The router sends whatever it has about the network through the ports. The information is received by the router and uses the information to update its own routing table.
- **Information sharing at regular intervals:** ~~the~~ within 30 secs, the router sends the information to the neighboring routers.

Algorithm:

- let dx(y) be the cost of the least-cost path from node x to node y. The least costs are related by Bellman-Ford equation.
- $d_x(y) = \min_v \{c(x,v) + d_v(y)\}$
- where the minv is the equation taken for all x neighbors. After travelling from x to v, if we consider the least-cost path from v to y, the path cost will be c(x,v) + dv(y). The least cost from x to y is the minimum of c(x,v) + dv(y) taken over all neighbors.
- The node x has updated its own distance vector table by using the above equation and sends its updated table to all its neighbors so that they can update their own distance vectors.



Q2:- Discuss Link State Routing using suitable example.

Ans:- Link State Routing (adaptive - centralized)

- Centralised algorithm: It is also known as global routing algorithm as it computes the least-cost path between source and destination by using complete and global knowledge about the network.
- This algorithm takes the connectivity between the nodes and link cost as input, and this information is obtained before actually performing any calculation.
- Link State algorithm is referred to as a centralized algorithm since it is aware of the cost of each link in the network.

The three keys to understand the link State routing algorithm:

- Knowledge about the neighborhood: Instead of sending its routing table, a router sends the information about its neighborhood only. A router broadcast its identities and cost of the directly attached links to other routers.
- Flooding: Each router sends the information to every other router on the internetwork. This process is known as flooding. Every router that receives the packet sends the copies to all its neighbors. Finally, each and every router receives a copy of the same information.
- Information sharing: A router sends the information to every other router only when the change occur in the information.

Algorithm:

- Initialization
- N = {A} // A is a root node
- for all nodes v
- if v adjacent to A
- then D(v) = c(A,v)
- Else D(v) = infinity
- loop
- find w not in N such that D(w) is a minimum.
- Add w to N
- update D(v) for all v adjacent to w and not in N:
- D(v) = min{D(v), D(w) + c(w,v)}
- until all nodes in N

Q3:- Difference between DV and LS routing algorithm.

Ans:-

	Distance Vector Routing Algorithm	Link State Routing Algorithm
(1)	It is a dynamic routing algorithm in which each router computes a distance between itself and each possible destination.	(1) It is a dynamic routing algorithm in which each router shares knowledge of its neighbors with every other router in the network.
(2)	The router shares its knowledge about the whole network to its neighbors and accordingly updates the table based on its neighbors.	(2) A router sends its information about its neighbors only to all the routers through flooding.
(3)	The sharing of information with the neighbors takes place at regular intervals.	(3) Information sharing takes place only whenever there is a change.
(4)	It makes use of Bellman-Ford Algorithm for making routing tables.	(4) It makes use of Dijkstra's Algorithm for making routing tables.
(5)	Problems:- Count to infinity problem which can be solved by Splitting horizon. - Persistent looping problem	(5) Problems:- Heavy traffic due to flooding of packets. - Infinite looping problem can be solved by Time to live (TTL) field.

Q4:- Shortnotes on RIP(intra), OSPF (intra), BGP (inter domain).

Ans:- (1) RIP {Intra}:-

- RIP stands for routing information protocol. RIP is an intra-domain routing protocol used within an autonomous system.
- Here, intra-domain means routing the packets in a defined domain, for example, web browsing within an institutional area.
- To understand the RIP protocol, our main focus is to know the structure of the packets, how many

Few imp points:-

→ It is based on distance vector-based strategy, so we consider the entire structure as a graph where nodes are the routers, and the links are the network.

→ In routing table, the first column is the destination, or we can say that it is a network address.

→ The cost metric is the number of hops to reach the destination. The number of hops available in a network would be the cost. The hop count is the number of networks required to reach the destination.

→ The next column contains the address

of the routers to which the packet is to be sent to reach the destination.

(2) OPEN Shortest Path First (OSPF):-

→ It is a widely used and supported routing protocol. It is an intradomain protocol, which means that it is used within an area or a network. It is an interior gateway protocol that has been designed within a single autonomous system.

→ It is based on a link-state routing algorithm in which each router contains the information of every domain, and based on this information, it determines the shortest path. The goal of routing is to learn routes.

→ The OSPF achieves by learning about every router and subnet within the entire network. Every router contains the same information about the network. The way the router learns this information by sending LSA (link state Advertisement). These LSAs contains information about every router, subnet, and other networking information.

→ Once the LSAs have been flooded, the OSPF stores the information in a link-state database known as LSDB. The main goal is to have the same information about every router is an LSDBs.

(3) Border Gateway Protocol {BGP}:-
→ It is an interdomain routing protocol and it uses the path-vector routing. It is a gateway protocol that is used to exchange routing information among the autonomous system on the internet.

Features:-
(1) Open standards:- It is a standard protocol which can run on any window device.
(2) Exterior Gateway protocol:- That is used to exchange the routing information between two or more autonomous system numbers.
(3) Suppours internet:- It is the only protocol that operates on the internet backbones.
(4) Inter-AS-domain routing:- It is specially designed for inter-domain routing, where interAS-domain routing means exchanging the routing information between two or more autonomous number system.
(5) Classless:- It is a classless protocol.

Q5:- Discuss Hierarchical Routing.
Ans:- Hierarchical Routing:-
→ The routers are divided into regions.

Each router has complete details about how to route packates to destinations within its own region. But it does not have any idea about the internal structure of other regions.

→ As we know, in both link state and distance vector algorithm, every router needs to save some information about other routers. When network size is growing, the number of routers in the network will increase. Therefore, the size of routing table increases, then routers cannot handle network traffic as efficiently. To overcome this problem we are using hierarchical routing.

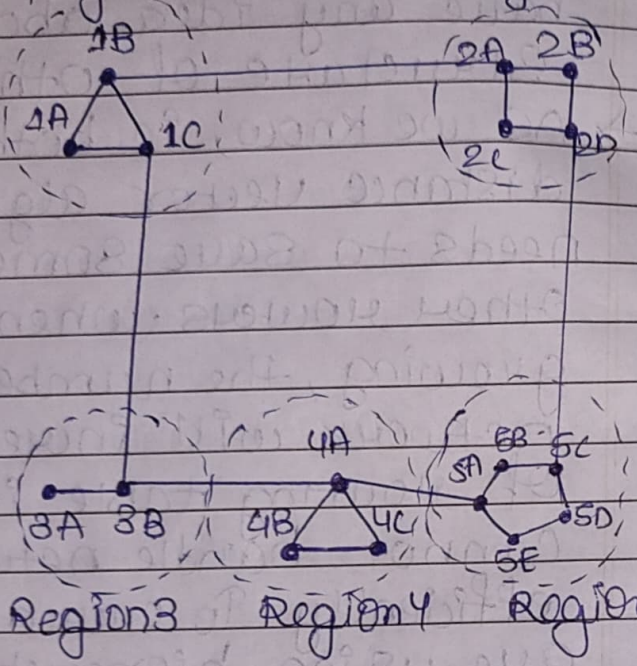
→ The router are classified in groups called regions. Each router has information about the routers in its own region and it has no information about routers in other regions. So, routers save one record in their table for every other region.

→ For huge networks, a two-level hierarchy may be insufficient hence, it may be necessary to group the regions into clusters, the clusters into zones, the zones into groups and so on.

Example:

→ consider an example of two-level hierarchy with five regions as shown in figure

→ Let see the full routing table for router 1A which has 17 entries, as shown below



- Full Table for 1A

Dest	Line	Hops
1A	-	-
1B	1B	1
1C	1C	1
2A	1B	2
2B	1B	3
2C	1B	3
2D	1B	4
3A	1C	3
3B	1C	2
4A	1C	3
4B	1C	4
4C	1C	4
5A	1C	4
5B	1C	5
5C	1C	5
5D	1B	6
5E	1C	5

→ When routing is done hierarchically then there will be only 7 entries as shown below-

- Hierarchical Table for 1A

Dest	Line	Hops
1A	-	-
1B	1B	1
1C	1C	1
2	1B	2
3	1C	2
4	1C	3
5	1C	4

→ unfortunately, this reduction in table space comes with the increased path length.

Q6:- Write short notes on MPLS (Multi Protocol Label Switching).

Ans:- Multiprotocol Label Switching (MPLS) is a routing technique that augments speed and control of the network traffic by directing data from one node to the next node based on short path labels. Instead of being routed using long network addresses, the data packets are routed through path labels that identify virtual path between the nodes rather than endpoints. MPLS speeds up traffic flows by avoiding complex lookups in the routing table at each node as in conventional routing algorithm.

MPLS is a scalable and protocol independent routing technique. It works with internet protocol (IP), Ethernet, Frame Relay and Asynchronous Transport Mode (ATM). Despite the advent of newer technologies, it remains relevant due to its features like security, flexibility and traffic engineering.

Working Principle:-

MPLS works by prefixing 32-bit labels

with the MPLS header. The 32-bit label contains four fields.
→ Label value field of 20-bits.
→ Traffic class field of 3-bits for QoS (Quality of Service)
→ Bottom of stack flag of 1-bit (1 values denotes that the current label is the last one in the stack).
→ TTL (time to live) field of 8-bits.

Q7:- Difference between IPv4 vs IPv6.

Ans:- IPv4 VS IPv6

Agenda	IPv4	IPv6
(1) Address length	IPv4 is a 32-bit address.	It is a 128-bit address.
(2) Fields	It is a numeric address that consists of 4 fields which are separated by dot (.).	It is an alphanumeric address that consists of 8 fields, which are separated by colon. It doesnot contains classes of IP addresses.
(3) Classes	IPv4 has 5 different of IP address that includes Class A, Class B, class C, class D and class E.	
(4) Number of IP address	It has a limited number of IP addresses.	It has a large number of IP addresses.
(5) VLSM	It Supports VLSM	It does not support

Agenda	IPv4	IPv6
	(virtual Subnet Mask). Here, VSLM means that IPv4 converts IP addresses into Subnet of different sizes.	VLSM.
6) Address configuration	It supports manual and DHCP configuration	It supports manual, DHCP, auto-configuration and Renumbering.
7) Address Space	It generates 4 billion unique addresses.	It generates 340 undecillion unique addresses.
8) Fragmentations	Fragmentation is done by the senders and the forwarding routers.	Fragmentation is done by the senders only.
9) End-to-end connection Integrity	In IPv4, end-to-end connection integrity is unachievable.	In the case of IPv6, end-to-end connection integrity
10) Security Features	~~In IPv4, Secu~~ In IPv4, security depends on the application. This IP address is not developed in keeping the security feature in mind.	In IPv6, IPSEC is developed for security purposes.
11) Address Representation	In IPv4, the IP address is represented in decimal.	In IPv6, the representation of IP address in hexadecimal.

Q8:- Broadcast & Multicast routing.

Ans:- Broadcast Routing:-

By default, the broadcast packets are not routed and forwarded by the routers on any network. Routers create broadcast domains. But it can be configured to forward broadcasts in some special cases. A broadcast message is destined to all network devices.

It can be done in two ways:-

(1) A router creates a data packets and then sends it to each host one by one. In this case, the router creates multiple copies of single data packet with different destination addresses. All packets are sent as unicast but because they are sent to all, it simulates as if router is broadcasting.
This method consumes lots of bandwidth and router must destination address of each node.

(2) Secondly, when router receives a packet that is to be broadcasted, it simply floods those packets out of all interfaces. All routers are configured in the same way.
This method is easy on router's CPU but may cause the problem of duplicate packets received from peer routers.

Reverse path forwarding is a technique, in which router knows in advance about its predecessor from where it should receive broadcast. This technique is used to detect and discard duplicates.

Multicast Routing:-
Multicast routing is special case of broadcast routing with significance difference and challenges. In broadcast routing, packets are sent to all nodes even if they do not want it. But in Multicast routing, the data is sent to only nodes which wants to receive the packets.

The router must know that there are nodes, which wish to receive multicast packets (or stream) them only it should forward. Multicast routing works spanning tree protocol to avoid looping.

Multicast routing also uses reverse path forward technique, to detect and discard duplicates and loops.

Q9: Subnetting vs Supernetting defination and numerical.

Ans:- Subnetting:- Subnetting is the practice of diuiding a network into two or more smaller networks. It

increases routing efficiency, enhances the security of the network and reduces the size of the broadcast domain.

Supernetting:-
It is the process of summarizing a bunch of contiguous subnetted networks back in a single large network. Supernetting is also known as route summarization and route aggregation.