Chapter-4

Network layer

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1) Network layer is one of the ~~most~~ key layers in OSI reference model. Why? (1)
Functions of network layer. (1)

→

Network layer is responsible for the source to destination delivery of a packet, possibly across multiple networks.

It controls the operations of subnet. It selects shortest path to transmit packets from number of routes available.

Functions of Network layer:-

1) Routing

When a packet reaches the router's input link, the router will move the packets to the router's output link.

2) logical Addressing

The network layer adds a header to the packet which includes the logical addresses of both the sender and the receiver.

3) Internetworking

Network layer provides the logical connection between different types of networks.

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4) Fragmentation

Fragmentation is the process of breaking the packets into the smallest individual data units that travel through different networks.

2) Explain working principle of different types of network devices: Repeater, Hub, Bridge, Switch & Router. (1)

Why do we prefer switch as networking device instead of Hub for LAN connection.

->

1) Repeater

Repeater is a network device through which we can ~~boots~~ boostup the weak signals. When the signal travels in a network, after travelling some distance the intensity of the signal becomes low.

In order to regenerate the weak signal we ~~usheu~~ should use repeater device.

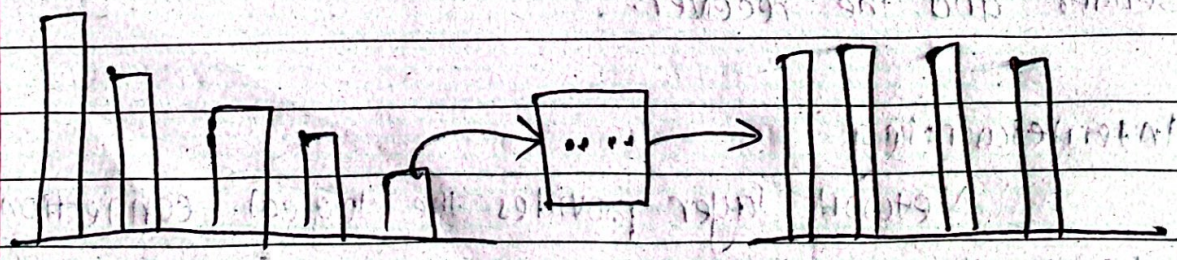

Fig:- Repeater

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2) Hub

Hub is a network device that is used to connect multiple computers in a network.

Hub is less expensive, less intelligence & less complicated. It is generally used to connect computers in a LAN.

3) Bridge

Bridge is a network device that is used to seperate LAN into no. of section.

It operates both physical as well as data link layer of OSI model.

4) Switch

Switch is a network device that connects multiple computers together in the network.

It is mainly used to send the private message as well as there is no wasting of data. Switch is more intelligent than Hub.

5) Router

Router is a network device which works as a traffic controller. Router uses both LAN & WAN network.

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3) What is classful and classless address? (1)

→

In classful addressing, IP addresses are divided into five classes i-e class A, class B, class C, class D & class E. Each class has a fixed subnet mask, which determines the network and host portions of the address.

Classless addressing also known as CIDR was introduced to overcome the limitations of classful addressing, particularly the inefficient allocation of IP address space.

It uses variable length subnet masks to provide more efficient & flexible IP address allocation.

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4) Write short note in internet protocol (IP)? (1)

→ The internet protocol (IP) is a set of rules that helps computers communicate over the internet. It assigns a unique address to each device, allowing data to be sent and received accurately. When we send an email or visit a website IP breaks the information into smaller ~~packe~~ pieces called packets, each containing the destinati address. Routers then direct these packets through various networks to reach the right place.

IP is crucial because it enables different devices around the world to connect and share information seamlessly, forming the backbone of the internet.

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(5) What is routing? (1+1+1)
Why is routing essential in computer networking? (1)
Criteria for Good Routing Algorithm (1+1)
Diff. between static Routing (Non adaptive Routing) & Dynamic (Adaptive Routing). (1)

→ Routing is the process of determining the path data packets take from their source to their destination across interconnected networks.

It involves using devices called routers which examine the destination IP address of each data packet and decide the best route to forward it.

Routers communicate with each other to share information about network conditions and paths ensuring that data takes the most efficient route.

Without routing, data wouldn't know how to find its way across the complex web of interconnected networks that make up the internet.

→ Criteria for Good Routing algorithm

(i) Correctness

Choose correct route and should accurately deliver packets.

(ii) Robustness

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Adaptive to changes of network topology and varying traffic load.

(iii) Efficiency

The algorithm should optimize the use of network resources, ensuring quick data when parts of the network go down or traffic conditions change.

(iv) Flexibility

It should ~~abc~~ adapt to different network conditions and requirements.

(v) Fairness

The algorithm should ensure that all data packets have an equal opportunity to reach their destination

(vi) Optimality

It should aim to find the best possible routes based on criteria like the shortest path, lowest cost or fastest delivery time.

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	Static Routing (Non adaptive Routing)	Dynamic Routing (Adaptive Routing)
–	In static routing, user defined routes are used in the routing table.	In dynamic routing, routes are updated as per the changes in network.
–	Simple routing algorithm is used to figure out the shortest path.	Complex routing - - - -
–	It provides higher security.	Dynamic routing is less secure.
–	It is manual process.	It is automatic process.
–	It is used in smaller networks.	large
–	It may not follow any specific protocol.	It follows protocols like RIP, BGP etc.

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6) What is Routing Algorithm? (1)

→

A routing algorithm is a set of rules or procedures used by routers in a network to determine the best path for forwarding packets from a source to a destination. It helps in deciding how data should travel through the network efficiently and effectively.

7) Compare distance vector routing protocol and link state routing protocol with examples (1+1+1+1+1+1+1+1)

Explain how routing loops are prevented in Distance vector routing with example. (1)

Show how routing tables is populated in LSR with eg. (1)

→

① Distance Vector Routing Protocol

Distance Vector routing is a method used by routers to determine the best path for sending data across the network. In this routing algorithm, each router periodically shares its knowledge about the entire network with its neighbouring nodes.

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Some of the keys to understand the algorithm are:-

i) knowledge about the whole network

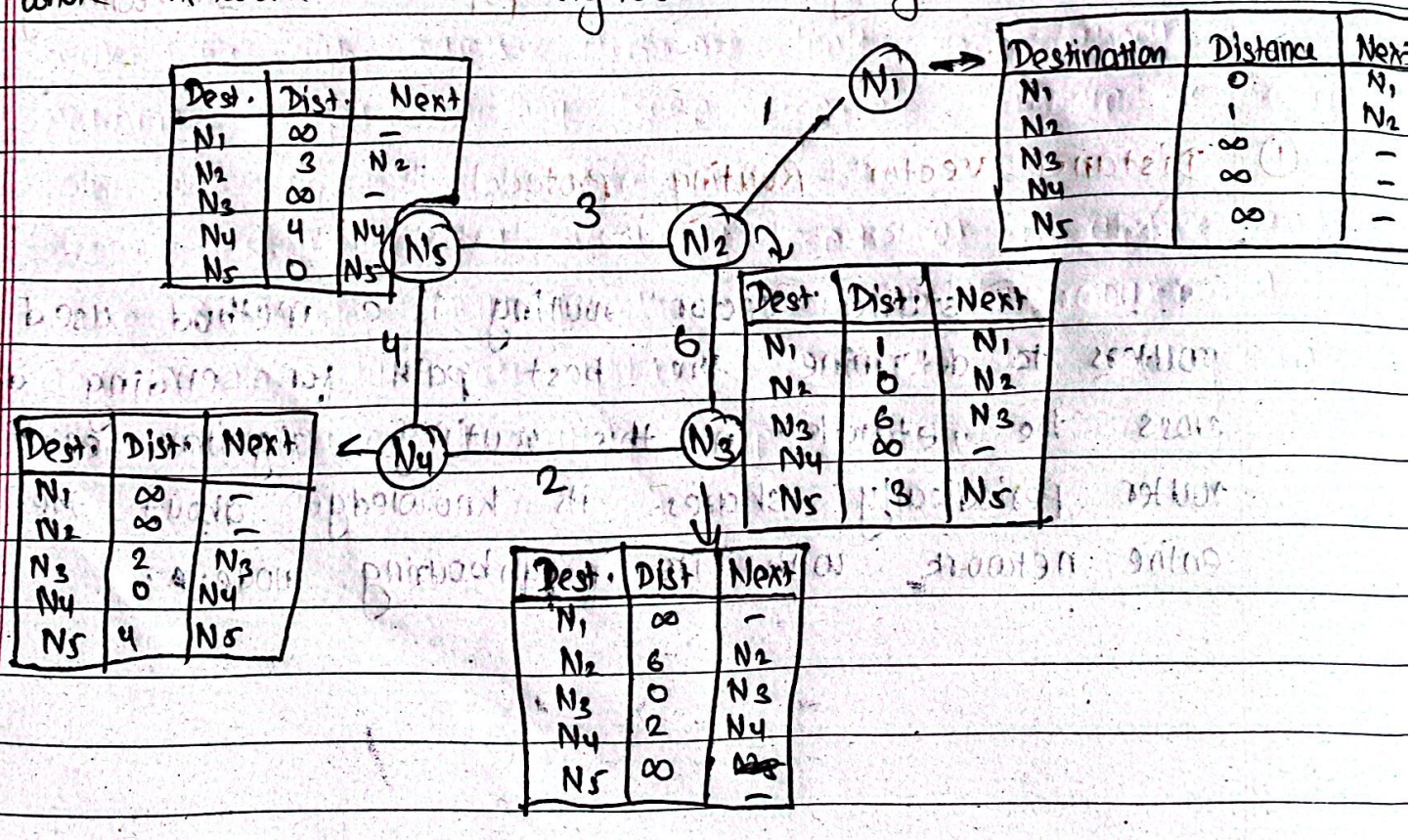
Each router shares its knowledge about the entire network. It sends all of its collected knowledge about the network to its neighbour.

ii) Routing only to neighbours

Each router periodically sends its knowledge about the entire network only to those routers to which it has direct links.

iii) Sharing information at regular intervals

Each router sends its information about the whole network to its neighbour at regular intervals.



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Updating routing table for N_1

At N_1

N_2

1
0
6
∞
3

New Routing table of N_1

Destination	Distance	Next
N_1	0	N_1
N_2	1	N_2
N_3	7	N_2, N_3
	∞	—
N_4	∞	—
N_5	4	N_5

At N_5

N_2	N_4
1	∞
0	∞
6	2
∞	0
3	4

New R.T of N_5

Destination	Distance	Next
N_1	4	N_2
N_2	3	N_2
N_3	6	N_4
N_4	4	N_4
N_5	0	N_5

Drawbacks

- Slow in convergence
- May suffer from a routing loop called count-to-infinity problem.
- Doesnot consider bandwidth

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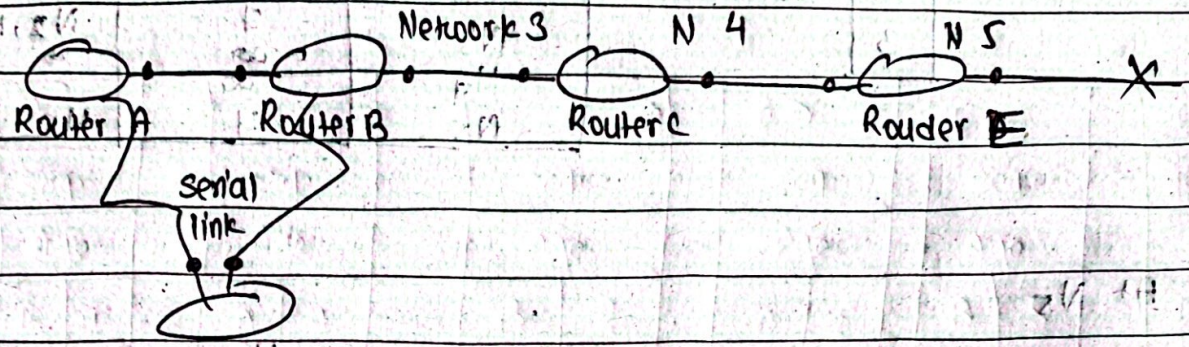
Count to Infinity Problem

Count to Infinity problem (routing problem) usually occur when two routers send updates to each other at the same time.



When network 5 fails, router E tells router C. This causes router C to stop routing to network 5 through router E. But routers A, B, D don't know about network 5 yet, so they keep sending out update information.

Router C will eventually send out its update and cause B to stop routing to network 5 but router A and D are still not updated. Due to this delay in information update, a routing loop occurs.

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2) Link state Routing

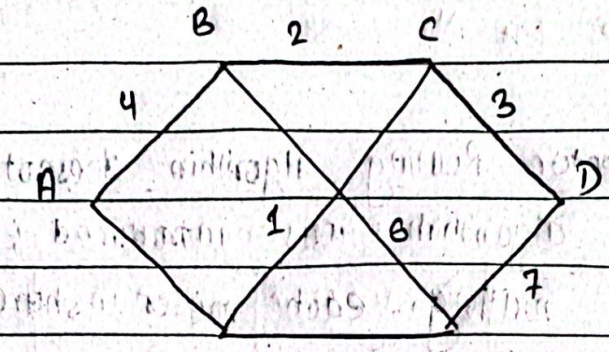
Distance vector Routing algorithm doesnot consider bandwith so a new algorithm was introduced ; link state routing. In link state routing, each router shares its knowledge of its neighbourhood with every other router in the internetwork.

Three keys to understand this algorithm are:-

i) Knowledge about the neighbourhood
Instead of sending its entire routing table, a router sends information about its neighbourhood only.

ii) Sharing information to all routers.
Each router sends the information to every router on the internetwork. It does so by a process called flooding.

iii) Information sharing when there is a change
Each router sends out information about the neighbours when there is a change.



A	
Seq.	
Age	
B	4
E	5

B	
Seq.	
Age	
A	4
C	2
F	6

C	
Seq.	
Age	
B	2
D	3
E	1

D	
Seq.	
Age	
C	3
F	7

E	
Seq.	
Age	
A	5
C	1
F	8

F	
Seq.	
Age	
B	6
D	7
E	8

This method is generally more efficient & scalable compared to distance vector routing, especially in large and more complex networks.

Each node maintains the full graph by collecting the updates from all other nodes. Each node then independently calculates the best logical path from it to every possible destination in the network.