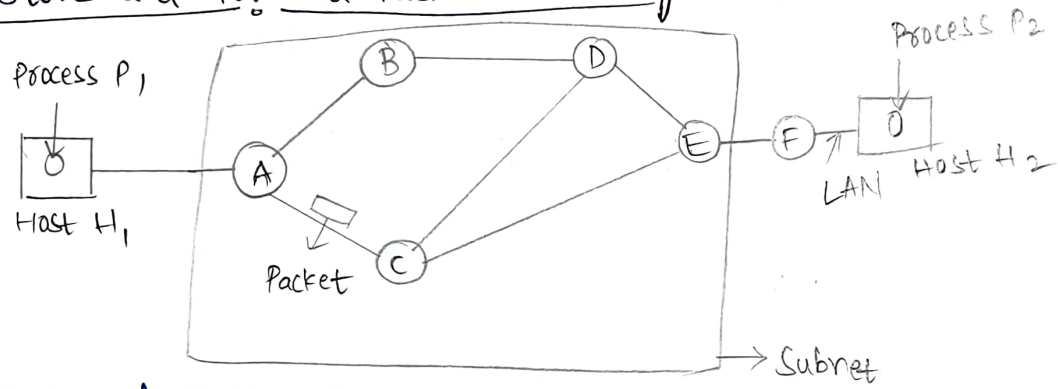
1. Explain design issues of network layer.

Design issues

→ While designing the network layer, the designer has to focus on 4 issues :

1. Store and forward Packet switching
2. Services provided to transport layer
3. Implementation of connectionless service
4. Implementation of connection oriented service.

1. Store and forward Packet switching



→ H_1, H_2 and Hosts. H_1 is source, H_2 is destination host.
→ P_1, P_2 are Processes
→ A, B, C, D, E, F are routers.
→ Process P_1 is running on Host H_1 & P_2 is running on host H_2.
→ Assume that process is Email & aim is to send email from H_1 to H_2
→ In network layer the data (or) message is represented in the form of Packets.
→ Here Subnet contains of some routers.
→ Host H_2 is connected over LAN
→ Inorder to send the message in the form of Packets, first H_1 sends Packet to its nearest ~~neighbour~~ router i.e A.
→ A will wait until it receives the complete Packet.
→ After receiving the Packet, it stores the Packet & then checks for errors.
→ If there are no errors, the Packet is send to nearest router i.e. C.

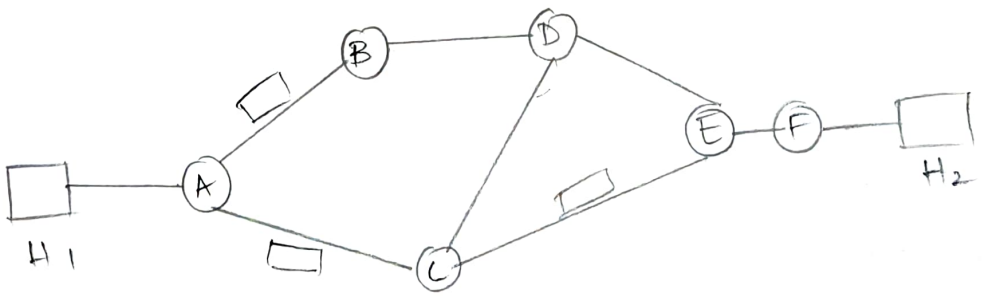
→ Same process is followed until the packet reaches to Host H_2 (i.e. destination).
→ Router F is not a part of Subnet.

2. Services Provided to Transport Layer

→ All the services should be independent of router technology.
→ the transport layer should be shielded/hidden from the number type & topology of routers present.
→ Irrespective of LAN, MAN, it uses all the addresses

3. Implementation of Connection less Service

→ Host H_1 wants to send message to H_2.
→ Assume the message is bigger one (or) large message.
→ That message is splitted into 4 packets.
→ Initially, H_1 sends packet to its nearest router A
→ Connection less means there is no connection b/w source & destination.
→ Message is broken into packets & each packet is individually routed.
→ Routers decides done (or) to which route next we move, based on routing table.
→ Packets may follow different paths.
→ Not guaranteed to arrive in order.

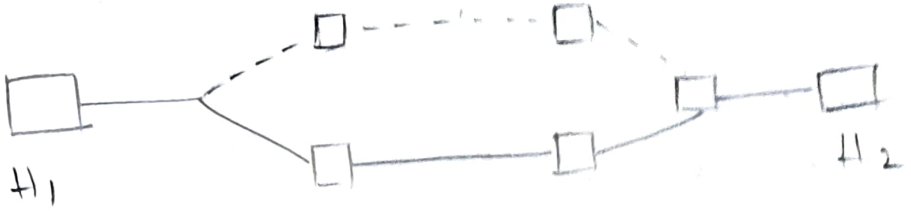


4. Connection Oriented Service

→ Connection is established beforehand.

→ Message is broken into packets and routed over the established route.

→ Reliable data transmission.

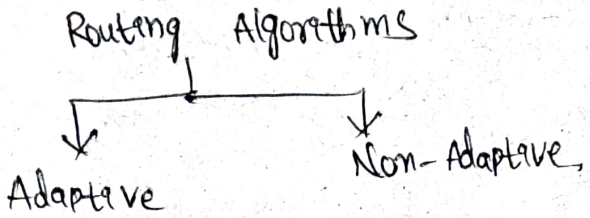


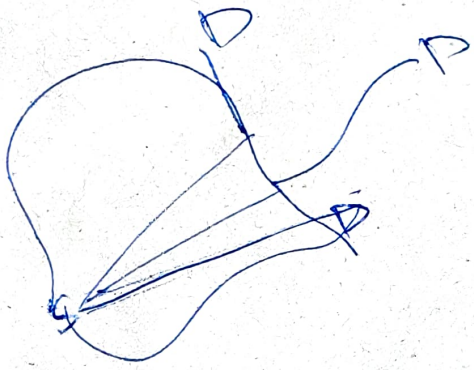
Unit-5

Routing algorithms

→ Routing is the process of selecting the best path to send data from source to destination.

→ To transfer data, a routing table is created





1. Distance Vector Routing Algorithm

→ It is a dynamic algorithm

→ It is distributed, iterative & asynchronous.

→ Based on distance, it will be performed.

→ Minimum distance path is selected.

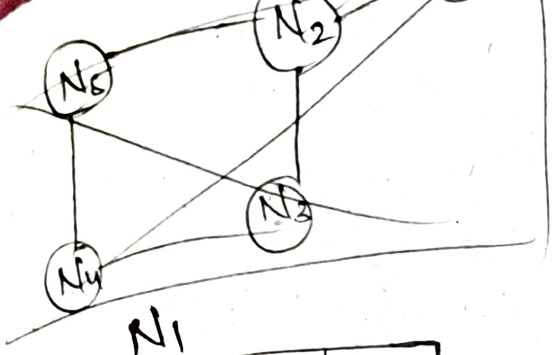
$$d_x(y) = \min_v \{cost(x,v) + d_v(y)\}$$

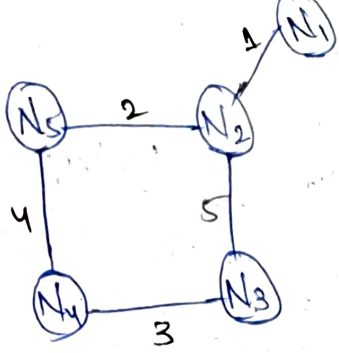
Routing table:

→ Creating the routing table for each n/w.

→ updating the table.

N/w ID/Destn	Cost/distance	Next Hop





N1

Destination	Distance	Next
N1	0	N1
N2	1	N2
N3	∞	–
N4	∞	–
N5	∞	–

N2

Destination	Distance	Next
N1	1	N1
N2	0	N2
N3	5	N3
N4	∞	–
N5	2	N5

N3

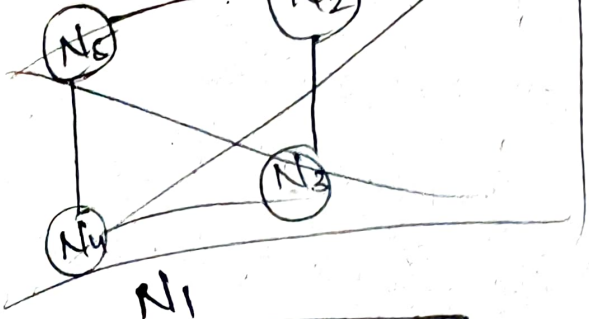
Destination	Distance	Next
N1	∞	–
N2	5	N2
N3	0	N3
N4	3	N4
N5	∞	–

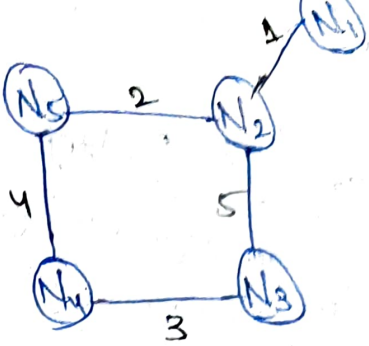
N4

Dest	Distance	Next
N1	∞	–
N2	∞	–
N3	3	N3
N4	0	N4
N5	4	N5

N5

Destination	Distance	Next
N1	∞	–
N2	2	N2
N3	∞	–
N4	4	N4
N5	0	N5





N_1

Destination	Distance	Next
N_1	0	N_1
N_2	1	N_2
N_3	∞	–
N_4	∞	–
N_5	∞	–

N_2

Destination	Distance	Next
N_1	1	N_1
N_2	0	N_2
N_3	5	N_3
N_4	∞	–
N_5	2	N_5

N_3

Destination	Distance	Next
N_1	∞	–
N_2	5	N_2
N_3	0	N_3
N_4	3	N_4
N_5	∞	–

N_4

Dest	Distance	Next
N_1	∞	–
N_2	∞	–
N_3	3	N_3
N_4	0	N_4
N_5	4	N_5

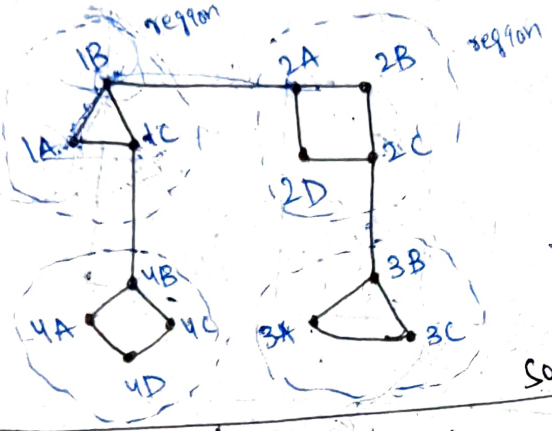
N_5

Destination	Distance	Next
N_1	∞	–
N_2	2	N_2
N_3	∞	–
N_4	4	N_4
N_5	0	N_5

12 - 25
21 - 45

Hierarchical Routing

→ Collection of routers called as Regions
→ Collection of regions called as clusters
→ Collection of clusters called as Zone's
→ Collection of Zones called as Groups



→ 1A, 1B, 1C, 2A, 2B, 2C..... are routers.

→ 1A, 1B, 1C is a region

Source (1A)

Destination	Next hop	No. of hops
1A	—	—
1B	1B	1
1C	1C	1
2A	1B	2
2B	1B	3
2C	1B	4
2D	1B	3
3A	1B	6
3B	1B	5
3C	1B	6
4A	1C	3
4B	1C	2
4C	1C	3
4D	1C	4

Source 1A

Destination	Next Hop	No. of ho
1A	—	—
1B	1B	1
1C	1C	1
2	1B	2
3	1B	4
4	1C	2

Flooding Routing

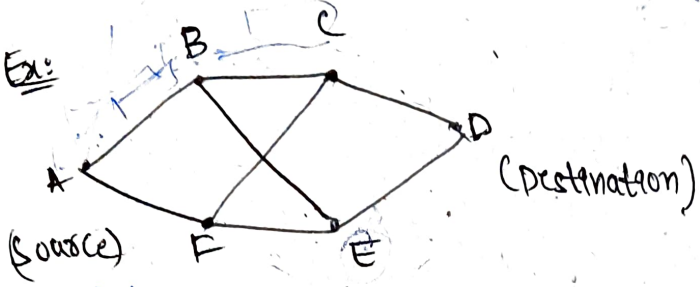
→ Flooding means Broadcasting.

→ Broadcasting means sending data to all the devices.

Flooding

→ Transmitting data to all its neighbouring routers - except to the link from which it was received

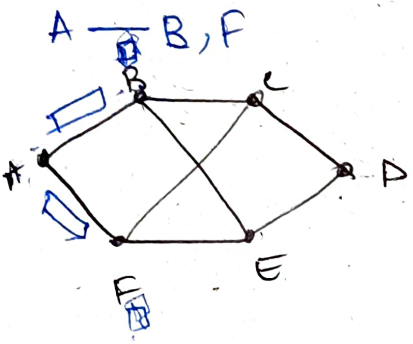
Ex:



→ Select a vertex as source i.e A

→ Neighbouring vertices of A

A — B, F

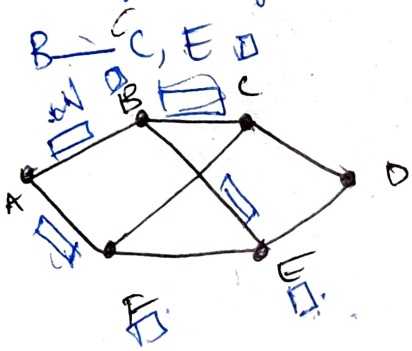


▭ — Packet / data

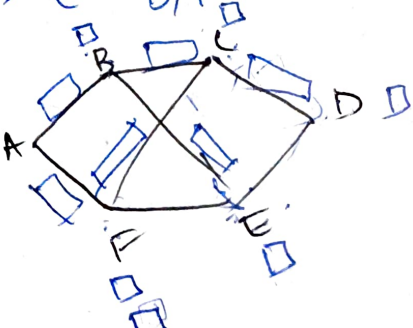
▯ — data received

→ Neighbouring vertices of B

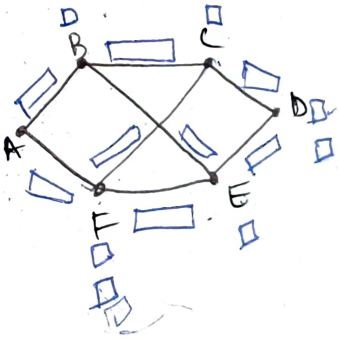
B — C, E



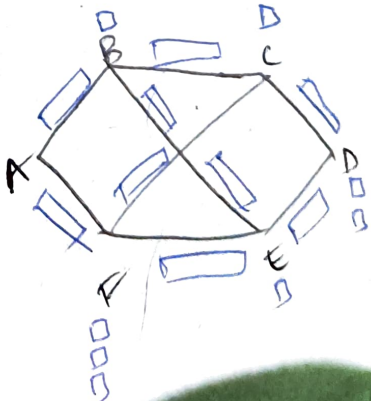
→ C — D, F



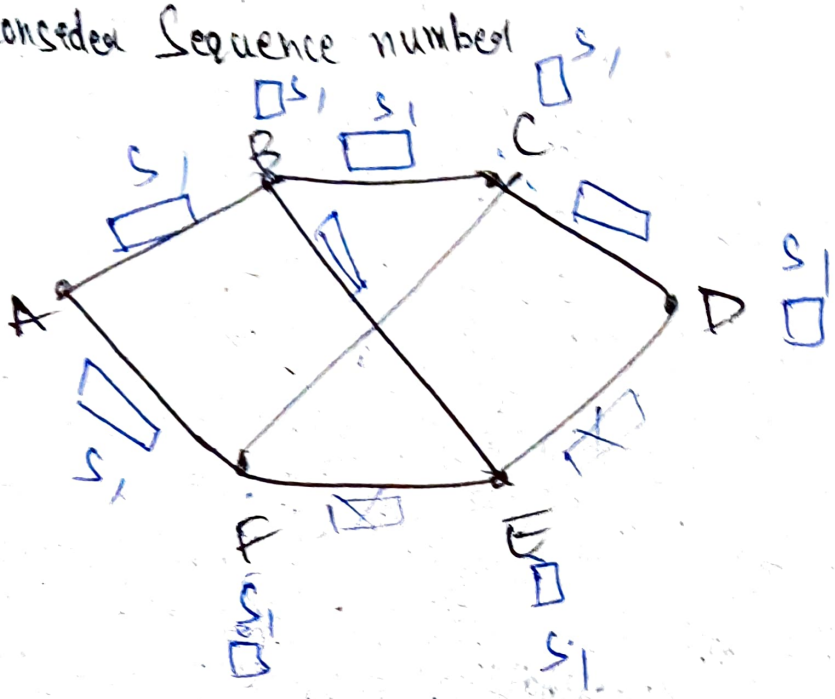
→ E — B, D, F



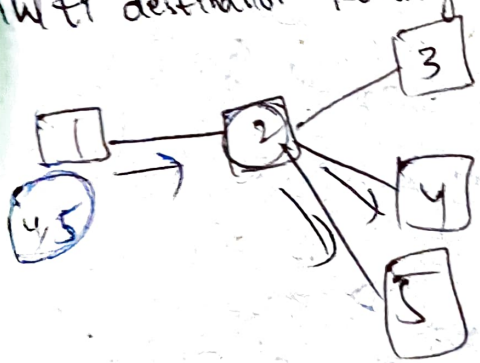
→ F — E



Consider Sequence number

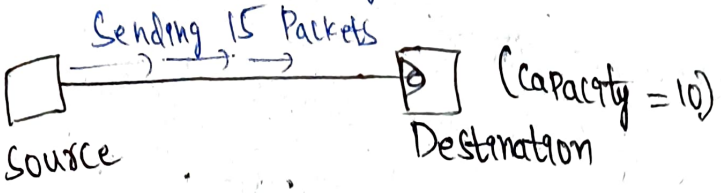


Multi destination Routing



* Congestion Control algorithms

→ Sending data Packets more than network capacity as known as Congestion.



→ Here the capacity as 10

→ But, Source as trying send to 15 Packets.

→ It exceeds the capacity. This situation as called as Congestion.

* No. of data Packets > Capacity

→ Congestion as a network.

→ It may occur if the load on the n/w as greater than capacity of n/w.

Ex: If your mbl data capacity as 1GB.

→ But you are downloading videos greater than 1 GB.

→ Here congestion occurs.

→ It slow down the process.

Congestion Control:

→ It as a process or mechanism or technique
- that can prevent congestion before it happens
- or remove congestion after it happened.

→ Congestion control Algorithms are:

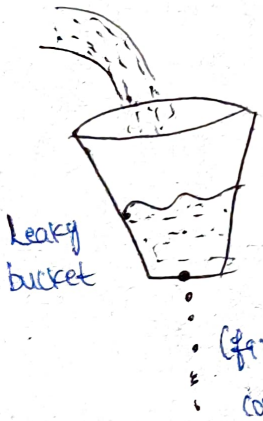
1. Leaky Bucket algorithm
2. Token Bucket algorithm.

1. Leaky Bucket algorithm

→ It is one of the congestion control algorithms.

→ Used to remove or prevent congestion.

→ It controls the congestion.



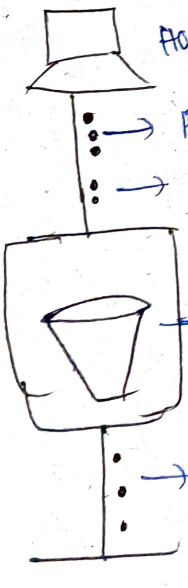
→ Imagine a bucket with hole.

→ No matter how speed the water coming into bucket.

→ the water will go out with constant rate.

→ If the bucket full, then it spills out.

→ Water will waste.



→ In this case, water means data Packets.

→ leaky bucket holds data.

→ No matter with how much speed the data is coming into bucket,

→ the Leaky bucket hold Packets

→ only one data Packets will flow (or) come out at a time.

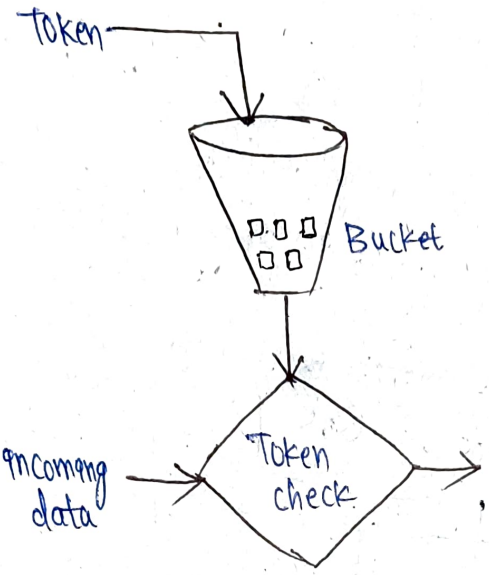
→ the input rate can be different,

→ But the output rate remains constant,

→ It follows FIFO

2. Token Bucket Algorithm

→ It is one of the congestion control algorithm.
→ It is flexible algorithm.
→ Used to control congestion.
→ It handles traffic in congestion control.
→ It is a method of Congestion Control.



→ First we take tokens in bucket.
→ Suppose we have 5 tokens in bucket. Present.
→ Data Packet coming, if the token is
  - then the bucket accepts Packet
→ After the Packet goes out.
→ If token is not present, Packet will be stopped.

Steps.
→ First tokens are thrown into the bucket.
→ The bucket has a maximum capacity.
→ If the Packet is ready, then a token is removed from bucket.
  - and the Packet is sent.
→ If there is no token in the bucket, then Packet cannot be sent.

* Quality of Service (QoS)

→ QoS is an overall performance measure of computer N/w.

→ Flow Characteristics of QoS are:

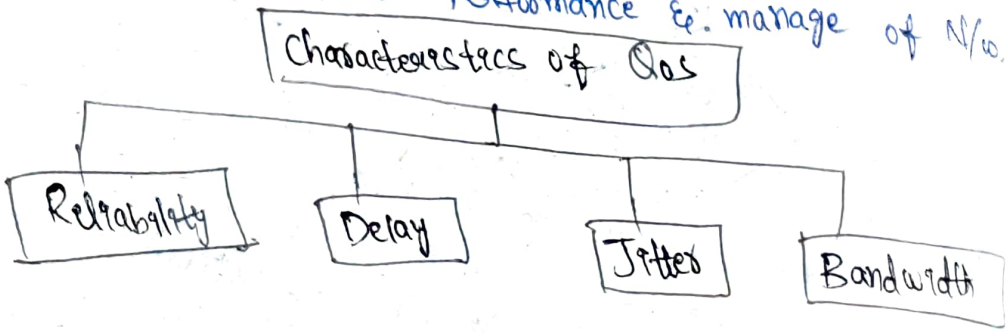
1. Reliability
2. Delay
3. Jitter
4. Bandwidth

DJBR

→ QoS is an internetworking issue.

→ QoS is capability of a n/w to provide quality of services.

→ Used to improve performance & manage of N/w.



1. Reliability

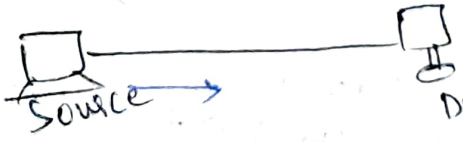
→ Reliability means guaranteeing the delivery of each Paket.

→ It is a characteristic, that a Packet needs

→ If we loose a Packet or acknowledgement while Sending from Source to destination.

then

→ we need to retransmit.



Ex: Email, File transfer,

→ Different applications has different reliability

→ High reliability is essential.

2. Delay: (or) Time taken

→ How much time the packet takes to travel from source to destination, is called as Delay.

→ Lower delay is essential

Ex: Gaming, Video-calls.

→ Different applications tolerate delay in different degrees.

3. Jitter

→ Jitter is variation in packet delay.

→ Lower Jitter is essential / important.

Ex: Live video streaming.

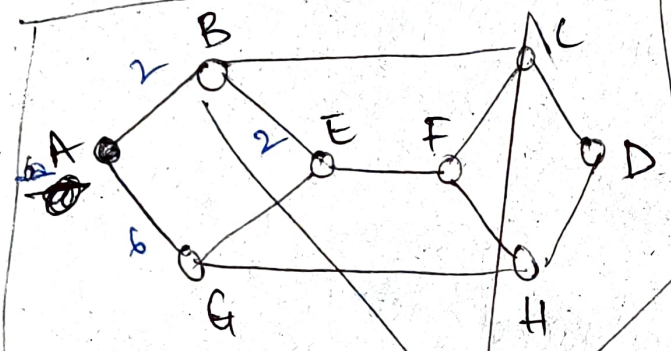
4. Bandwidth

→ Bandwidth is no. of bits send.

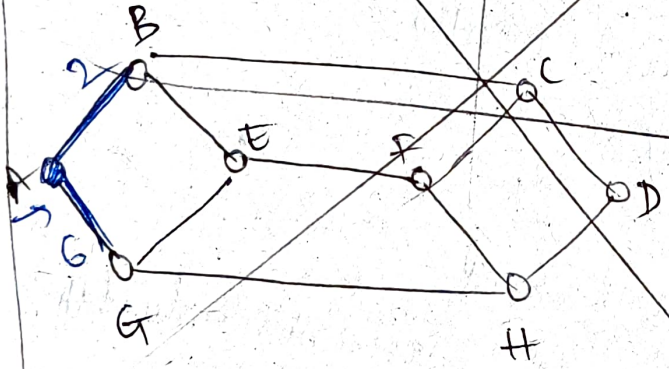
→ Different application needs different bandwidth.

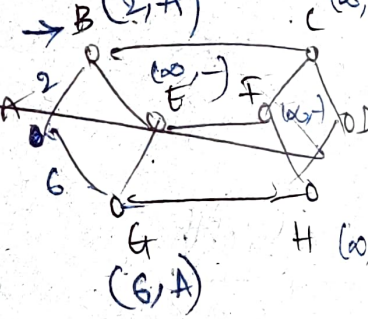
Shortest Path routing Algorithm

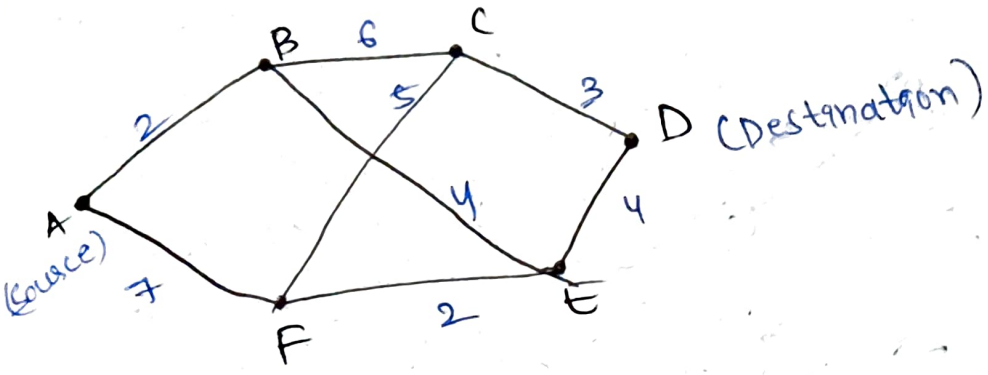
→ It is one of the routing algorithms.
→ Also known as Dijsktra Algorithm.
→ We will find shortest path from source router - destination router.



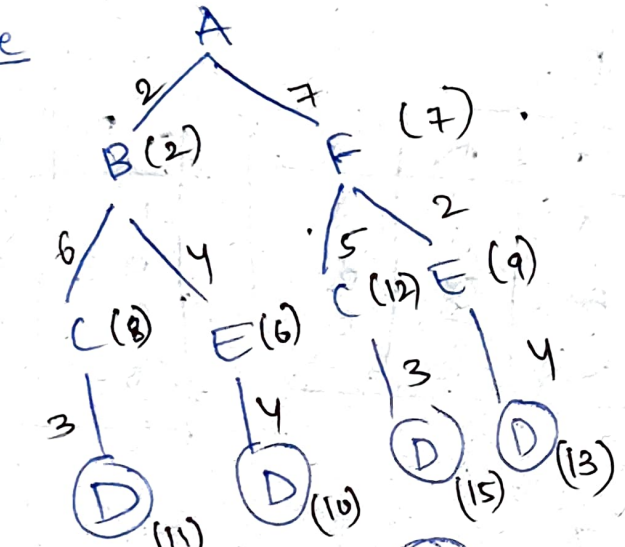
→ ●: working node
○: tentative node / not
●: Permanent / Visited node







Tree

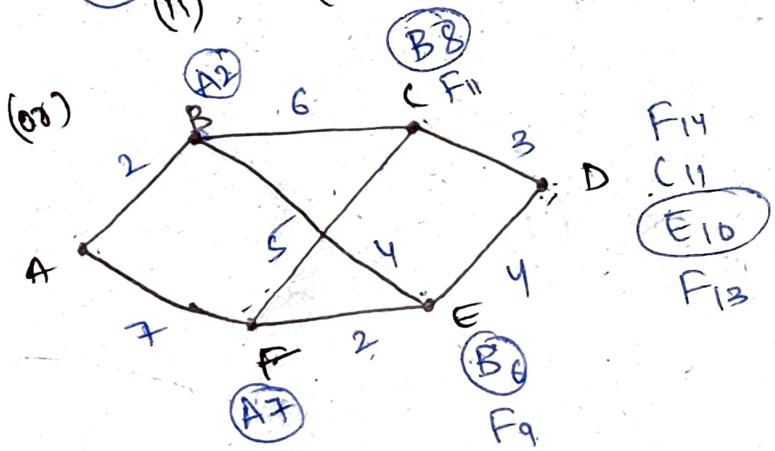


A-B-C-D — 11

A-B-E-D — 10

A-F-C-D — 15

A-f-E-D — 13



A → B → E → D

Total distance = 10