Routing Algorithms

- **Flooding** :

  - Whenever a packet is received by a router, it transmits it to all the OUTGOING LINKS connected to the router EXCEPT to the link it received the packet from.

Advantages	Disadvantages
• No routing table is required	• Traffic becomes very high
• The shortest path is always guaranteed i.e. the packet arrives at the destination first	• many duplicate packets are received by the receiver
• Is highly reliable. If one path is down, it can reach the destination by choosing another path	

- **Routing** :

  - The process of preparing the routing table for every router and finding the best path
  - Routing has NOTHING to do with forwarding packets. That process is called SWITCHING

Advantages	Disadvantages
• Traffic is very less	• Routing table is required
• No duplicate packet is received by the receiver	• Not reliable since the chosen path may go down
	• Shortest path depends on the algorithm

and some fail to find the shortest path

Routing Algorithm

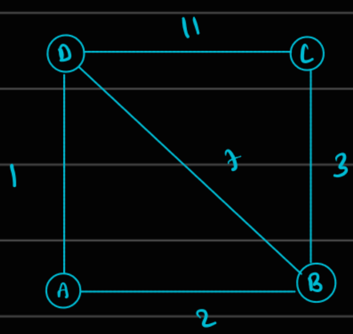
- Static
  - Route can not be changed while being in-transmit
- Dynamic
  - Route can be changed while being in-transmit
    - Distance Vector Routing
    - Link State Routing

- **Distance Vector Routing :**

  - Steps :
    1. Prepare the routing table at every router based on local knowledge meaning IMMEDIATE NEIGHBOURS.
    2. Repeat that till convergence. If graph is given with 'N' edges, no. of steps or no. of rounds required for convergence = N - 1

  - Disadvantages : • Count to ∞ problem

Eg. ① (Obviously, in real-world we won't have the graph with us. If we had it then we can just use shortest path finding algos. from the get go)



(NH = Next hop)

Step 1 :

At (A) :

Dest.	Dist.	NH
A	0	A
B	2	B
C	∞	-
D	1	D

At (B) :

Dest.	Dist.	NH
A	2	A
B	0	B
C	3	C
D	7	D

At (C) :

Dest.	Dist.	NH
A	∞	-
B	3	B
C	0	C
D	11	D

At (D) :

Dest.	Dist.	NH
A	1	A
B	7	B
C	11	C
D	0	D

Step 2 :

At (A) : Receives info. from B and D

$A \to A = 0$

$$A \to B = \min \begin{Bmatrix} A \to B + B \to B \\ A \to D + D \to B \end{Bmatrix} = \min(2, 8) = 2 \;;\; NH = B$$

$$A \to C = \min \begin{Bmatrix} A \to B + B \to C \\ A \to D + D \to C \end{Bmatrix} = \min(5, 12) = 5 \;;\; NH = B$$

$$A \to D = \min \begin{Bmatrix} A \to B + B \to D \\ A \to D + D \to D \end{Bmatrix} = \min(9, 1) = 1 \;;\; NH = D$$

Updated routing table :

Dest.	Dist.	NH
A	0	A
B	2	B
C	5	B
D	1	D

Do the same for all routers AND for convergence, complete the next step as well (N = 4 so, no. of steps req. for convergence = 3)

Shortcut

Step 2 :

At (A) : Receives info. from B and D :

	From B (AB = 2)	From D (AD = 1)	Updated distances	Updated NH
Updated AA	2 + AB = 4	1 + AD = 2	0	A
Updated AB	0 + AB = 2	7 + AD = 8	min (2, 8) = 2	B
Updated AC	3 + AB = 5	11 + AD = 12	min (5, 12) = 5	B
Updated AD	7 + AB = 9	0 + AD = 1	min (9, 1) = 1	D

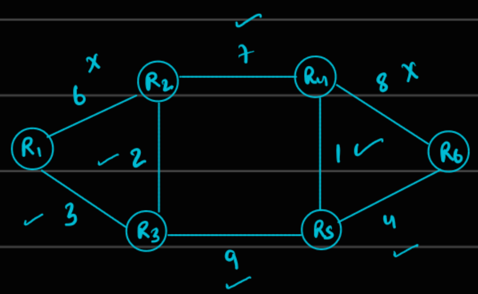
- A → A or any node X → X will ALWAYS have distance as 0 and NH = X regardless of what info. is received. OBVIOUSLY !

At (B) : Receives info. from A , C and D

From A (BA = 2)	From C (BC = 3)	From D (BD = 7)	Updated distances	Updated NH
0 + BA = 2	∞ + BC = ∞	1 + BC = 8	min (2, 8, ∞) = 2	A
2 + BA = 4	3 + BC = 6	7 + BC = 14	0	B
∞ + BA = ∞	0 + BC = 3	11 + BC = 18	min (∞, 3, 18) = 3	C
1 + BA = 3	11 + BC = 14	0 + BC = 7	min (3, 14, 7) = 3	A

And so on . . .

(2)



After all routing table has stabilized, how many links will never be used for carrying any data ?

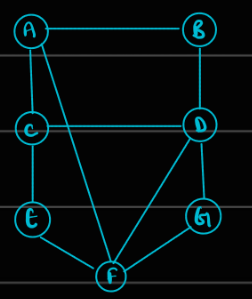
$R_1R_2 = 3+2 = 5$; $R_1R_3 = 3$; $R_1R_4 = 3+2+7 = 12$; $R_1R_5 = 3+9 = 12$; $R_1R_6 = 3+9+4$

↳ So, link with wt. 6 can be eliminated. So, be smart while picking links so that things get eliminated quickly. $R_4R_6 = 1+4$ ⇒ link with wt. 8 can be eliminated

∴ Answer = 2

③ Routing tables of nodes is given below. Updated routing table of F = ?

Node	A	Node	D	Node	E	Node	G
A	0	A	20	A	24	A	21
B	40	B	8	B	27	B	24
C	14	C	30	C	7	C	22
D	17	D	0	D	20	D	19
E	21	E	14	E	0	E	22
F	9	F	7	F	11	F	10
G	24	G	22	G	22	G	0



FA = 8 FE = 10

FD = 12 FG = 6

Updated routing table of F:

Node	Distance	Next Hop
A	min(0+8, 20+12, 24+10, 21+6) = 8	A
B	min(40+8, 8+12, 27+10, 24+6) = 20	D
C	min(14+8, 30+12, 7+10, 22+6) = 17	E
D	min(17+8, 0+12, 20+10, 19+6) = 12	D
E	min(21+8, 14+12, 0+10, 22+6) = 10	E
F	0	F
G	min(24+8, 22+12, 22+7, 0+6) = 6	G

Distance Vector Routing	Link State Routing
• Developed in 1990s	• Developed in 1980s
• Bandwidth is less since we only send the distance vector packet	• Bandwidth is more since we send the entire link state packet
• Local knowledge	• Global knowledge
• Uses Bellman-Ford algo	• Uses Djikstra's algo.
• Convergence is slow	• Convergence is fast
• Has count to ∞ problem	• No count to ∞ problem
• Persisent loops	• Transient loops
• Uses RIP (Routing Information Protocol)	• Uses OSPF (Open Shortest Path First)

NOTE:

•1 Persistent loops is the condition where incorrect routing tables are circulated causing the packets to loop.

•2 Transient loops is the condition of temporary sub-optimal routing / routing inconsistencies / looping that occurs during convergence, topology change (addition of new router, link failure, etc.), etc.

•3 RIP uses UDP as its transport protocol and uses port no. 520.
Max. hop count for RIP = 15. Hop count of 16 is considered Destination Unreachable.

•4 OSPF uses IP directly as its network protocol and uses protocol no. 89.
Since OSPF is NOT encapsulated in TCP or UDP, there is NO port no. associated with it.

•5 Protocol nos. are reserved for identifying NETWORK LAYER protocols. So, these are not assigned for protocols that use/ARE transport layer protocols like UDP or TCP.

- IP support Protocols :

1. **ARP** :
   - Address Resolution Protocol is used to find MAC (Media Access Control) address of a device from its IP address
   - ARP Request is broadcasting
   - ARP Response is unicasting

2. **ICMP** :
   - Internet Control Message Protocol
   - Feedback messages or error reporting :
     - Destination Unreachable
     - Time Exceeded
     - Redirection
     - Source Quench
     - Parameter Problem
   - Query or Request and Reply (RR)
     - Echo RR
     - Address Mask RR
     - Timestamp RR
     - Router Solicitation and Advertisement