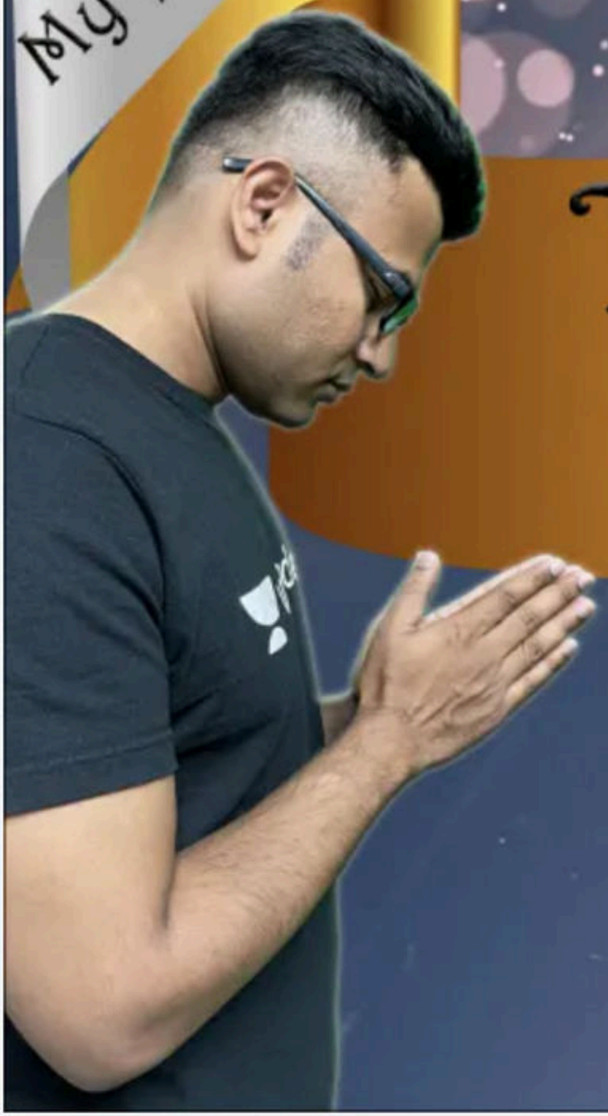
Introduction to Congestion, Congestion Control, TCP Timers, TIME OUT TIMER COMPUTATION ALGO

Complete Course on Computer Networks - Part III

Ravindrababu Ravula • Lesson 12 • Apr 5, 2021

My philosophy



TEACHING IS WORSHIP

STUDENTS ARE GODS

05-04-2021 Full Day Schedule of RBR

Lecture Name	Time
BCNF Introduction and BCNF Examples | DBMS	6:00 - 7:00AM
Introduction to Congestion, Congestion Control, TCP Timers, TIME OUT TIMER COMPUTATION ALGO | CN	07:00 - 08:00 AM
Analysing time and space complexity | L:1 | | Data Structures and Algorithms | For GATE and Interview Preparation | Ravindrababu Ravula	05:00 - 6:00 PM
How to take user input in Java | L:12 | Java Course	06:00PM-07:00PM
File management system calls:creat(), unlink(), open(), read (), write(), close() | L:6 | Linux course for Engg and UGC-NET	07:00PM-08:00PM
What is version control system? | Why do we need VCS? | L:1 | Git Basics | Ravindrababu Ravula	08:00PM-09:00PM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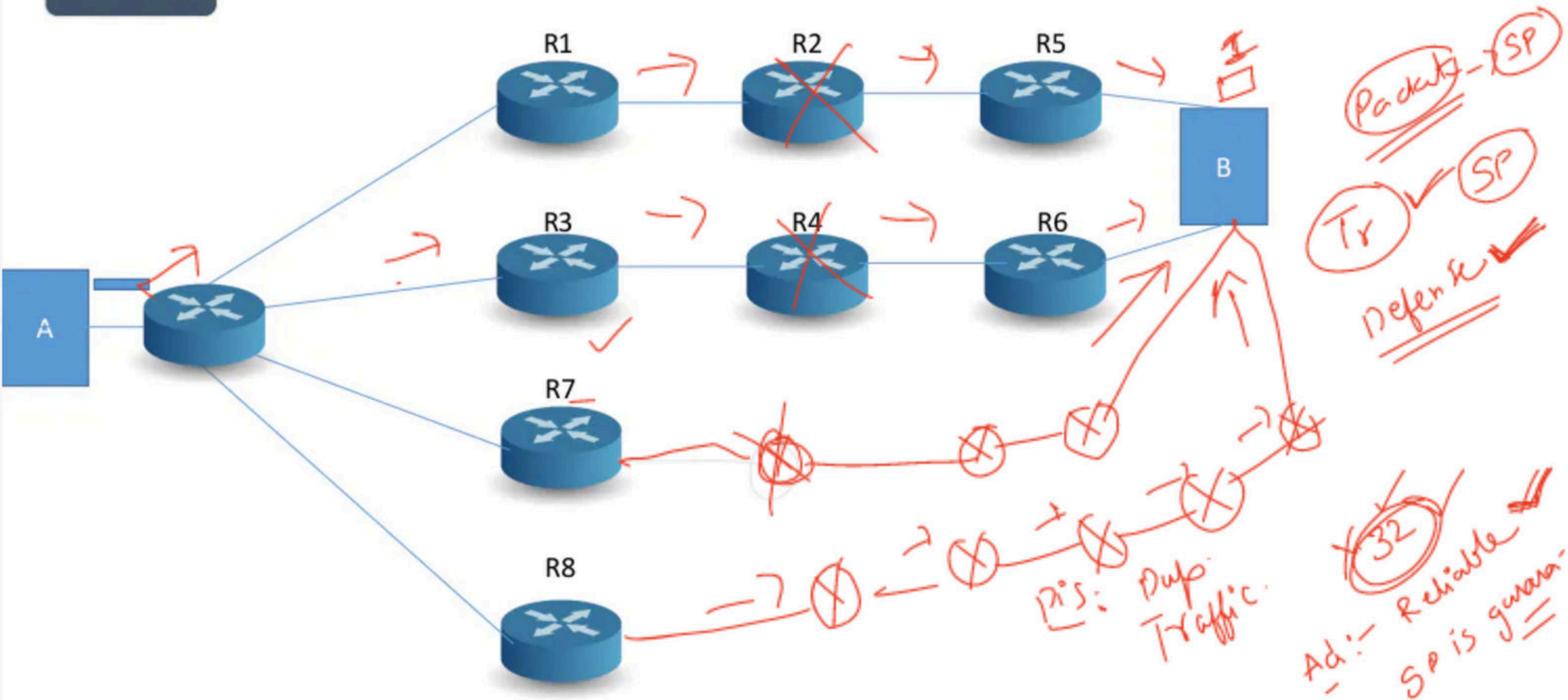
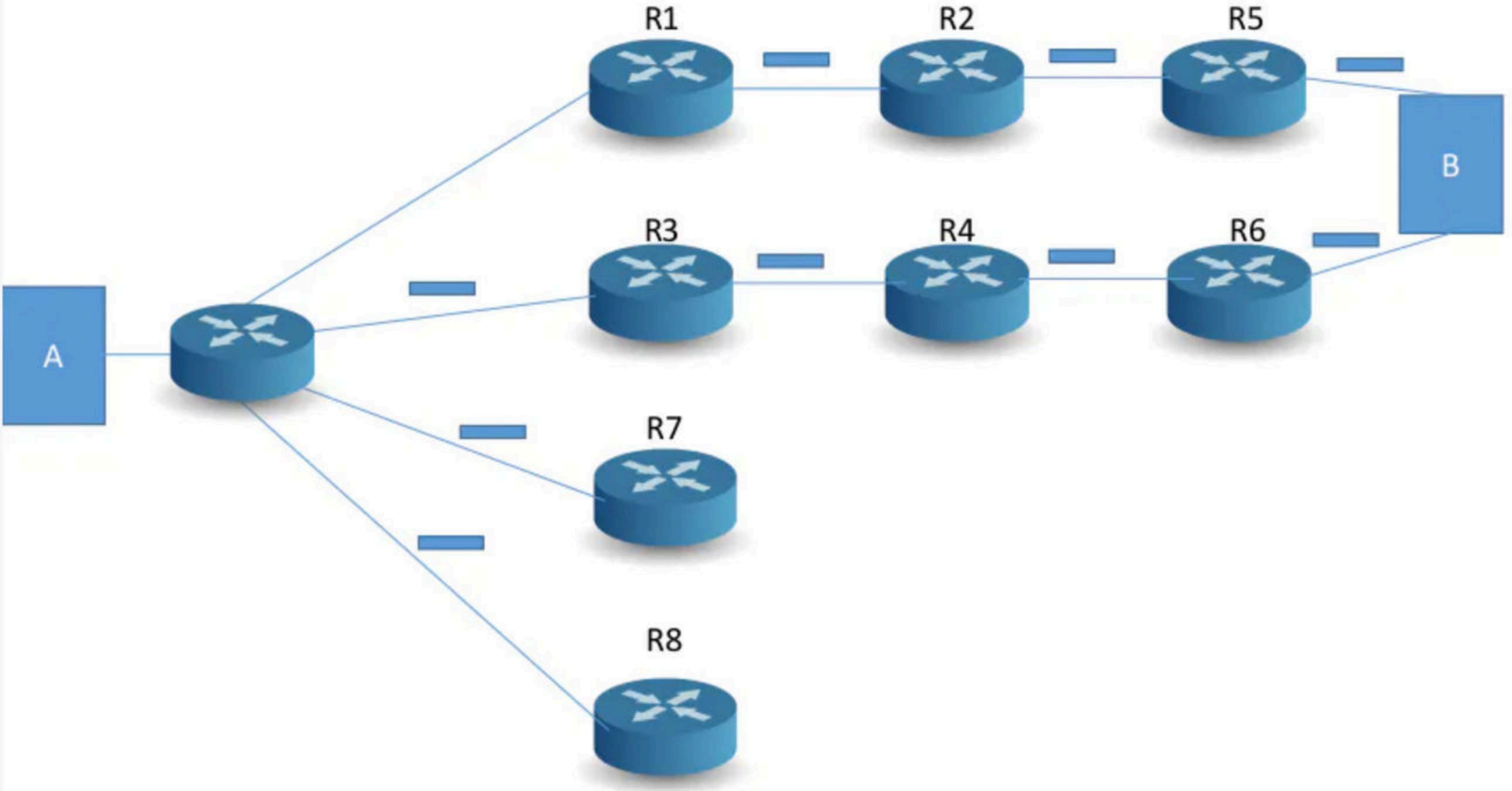
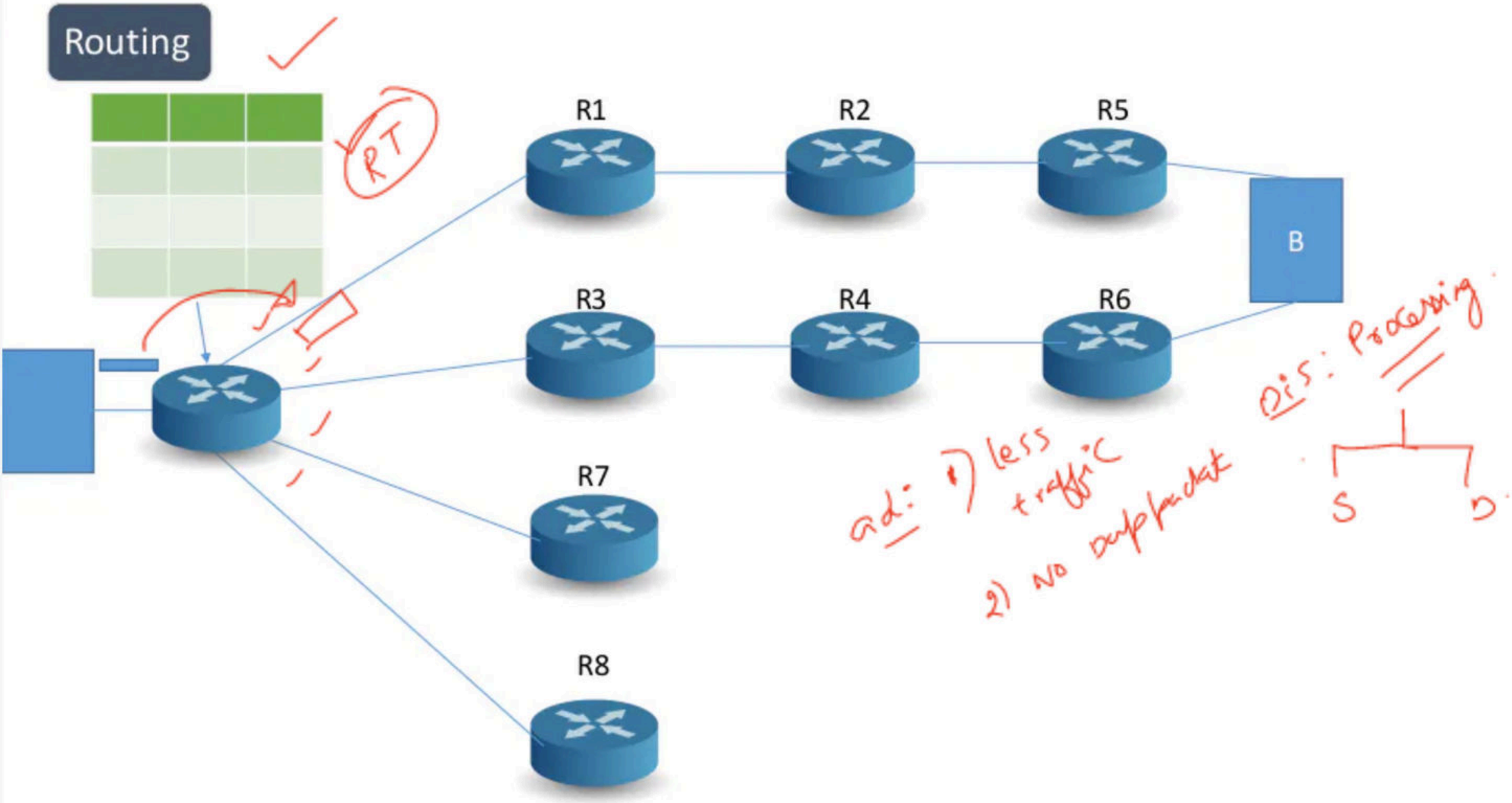
Computer Networks

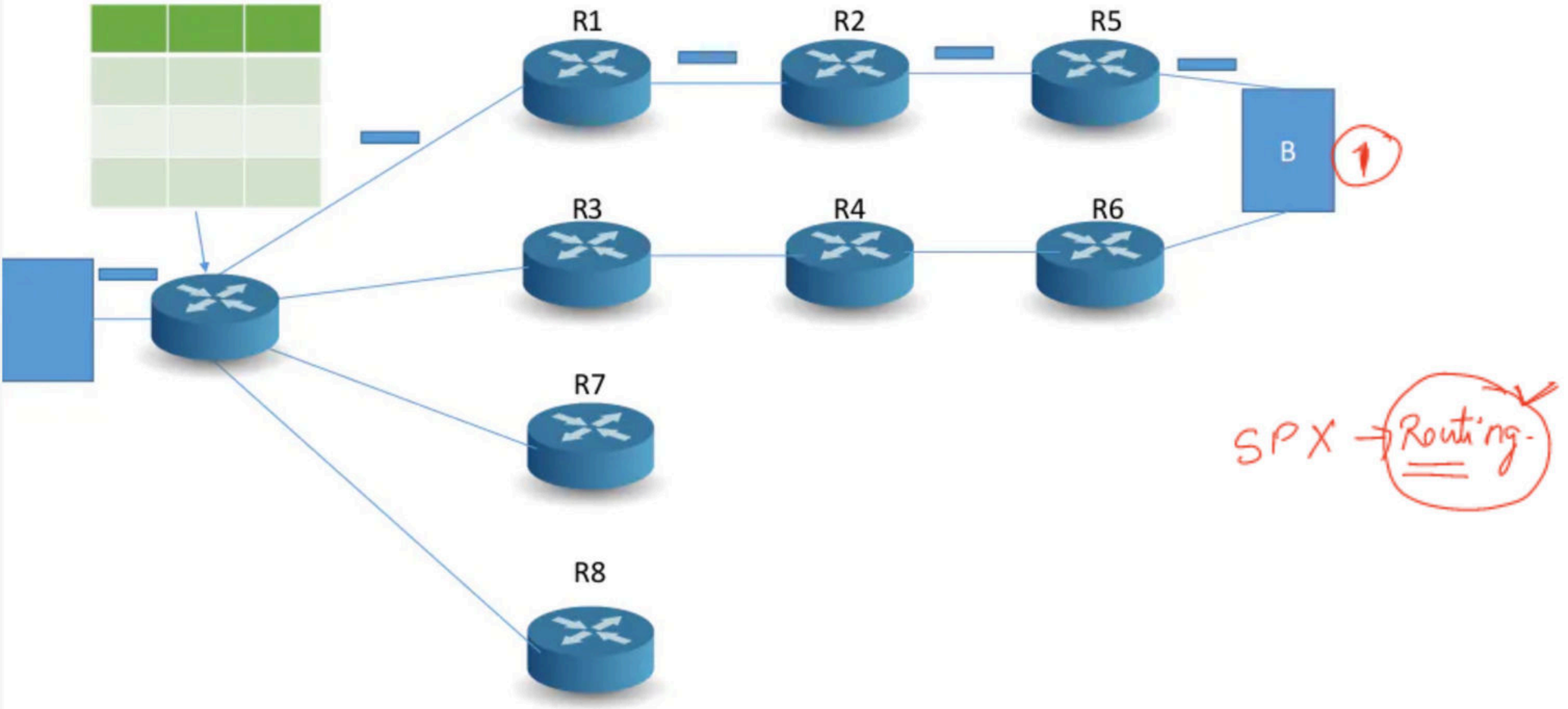
Difference Between Routing and Flooding

Flooding




R1
R2
R5
B
R3
R4
R6
A
R7
R8


Routing
RT
R1
R2
R5
B
R3
R4
R6
R7
R8
adv: 1) less traffic
2) No duplicate
Dis: Processing
S
D


R1
R2
R5
B
1
R3
R4
R6
R7
R8
SPX → Routing

Routing

Advantages:

- No Duplicates
- Low Traffic

Disadvantages:

- Routing Table are required
- Reliability is less

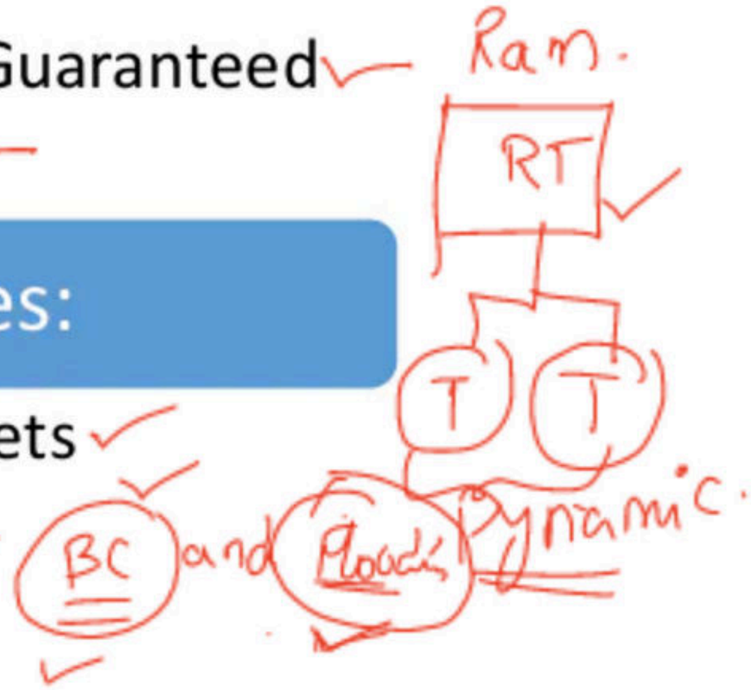
Flooding

Advantages:

- No routing
- Shortest Path Guaranteed
- Reliability

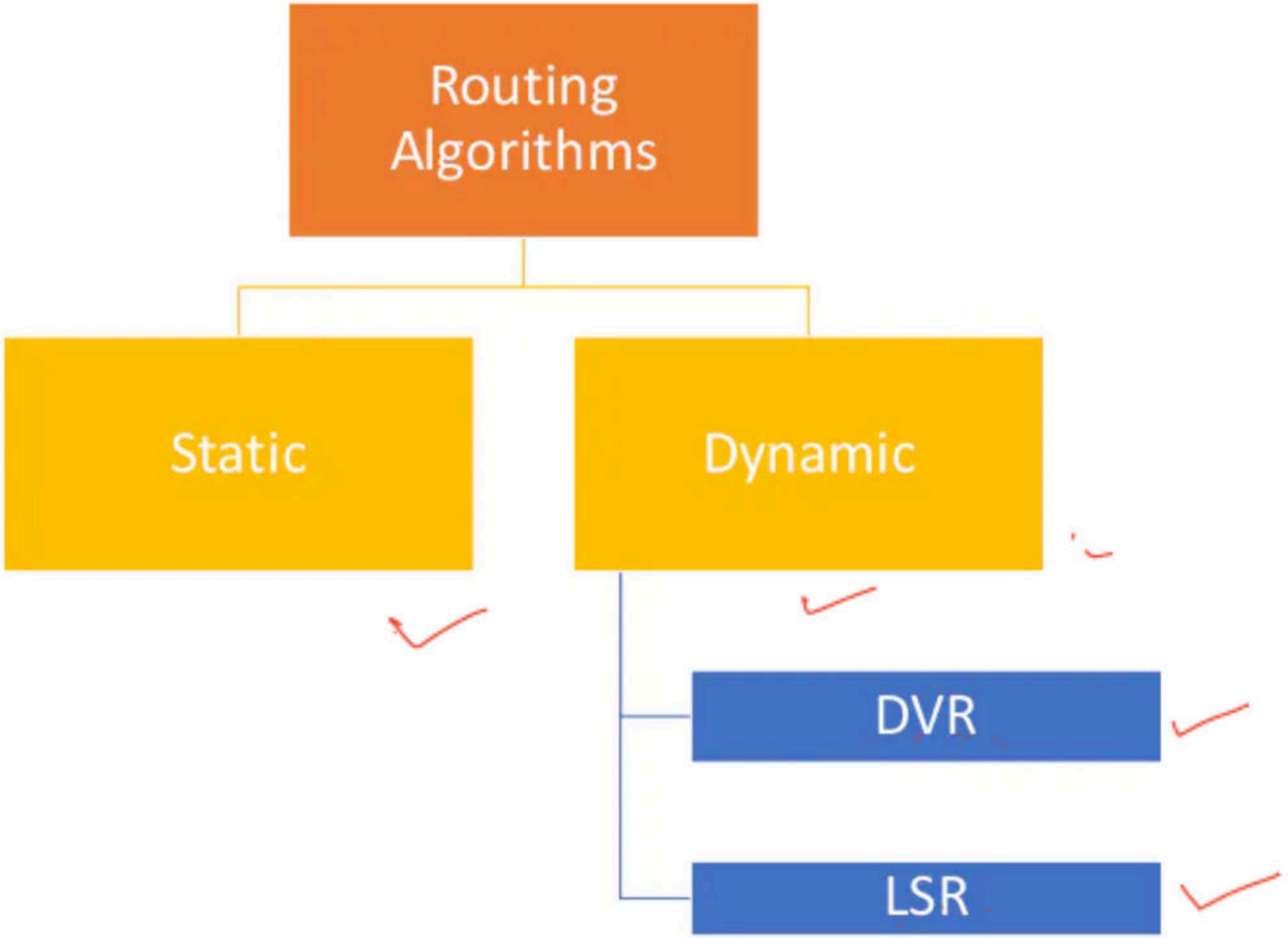
Disadvantages:

- Duplicate packets
- Traffic High



Computer Networks

Types of Routing Algorithms


Routing Algorithms
Static
Dynamic
DVR
LSR

STATIC

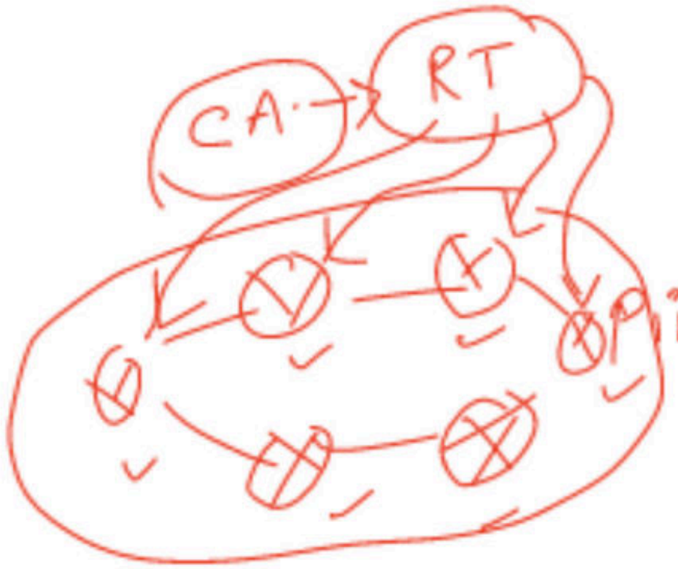
They don't change based on topology and traffic

In static routing, user defined routes are used in routing table.

No complex algorithm used to figure out shortest path.

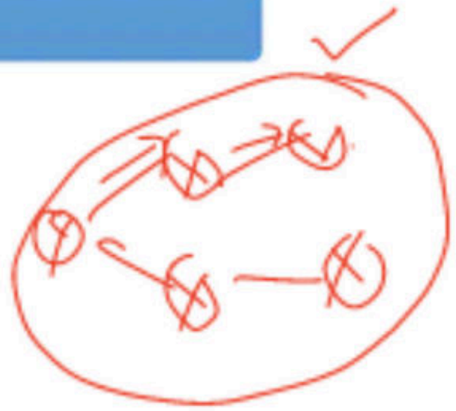
Static routing is used in smaller networks.

Static routing may not follow any specific protocol.



ping google

→ RTT = 10ms



Traffic

Topology Ping

= 20ms

Dynamic.

static.

Dynamic

They change based on topology and traffic

In dynamic routing, routes are updated as per the changes in network.

Dynamic routing employees complex algorithms to find the shortest routes.

Dynamic routing is implemented in large networks.

Dynamic routing uses complex routing algorithms.

Computer Networks

Distance Vector Routing

Distance Vector Routing is a dynamic routing algorithm.

Step-01:

Each router prepares its routing table

Each router knows about-

- All the routers present in the network
- Distance to its neighboring routers

Step-02:

Each router exchanges its distance vector with its neighboring routers.

DV → DVR

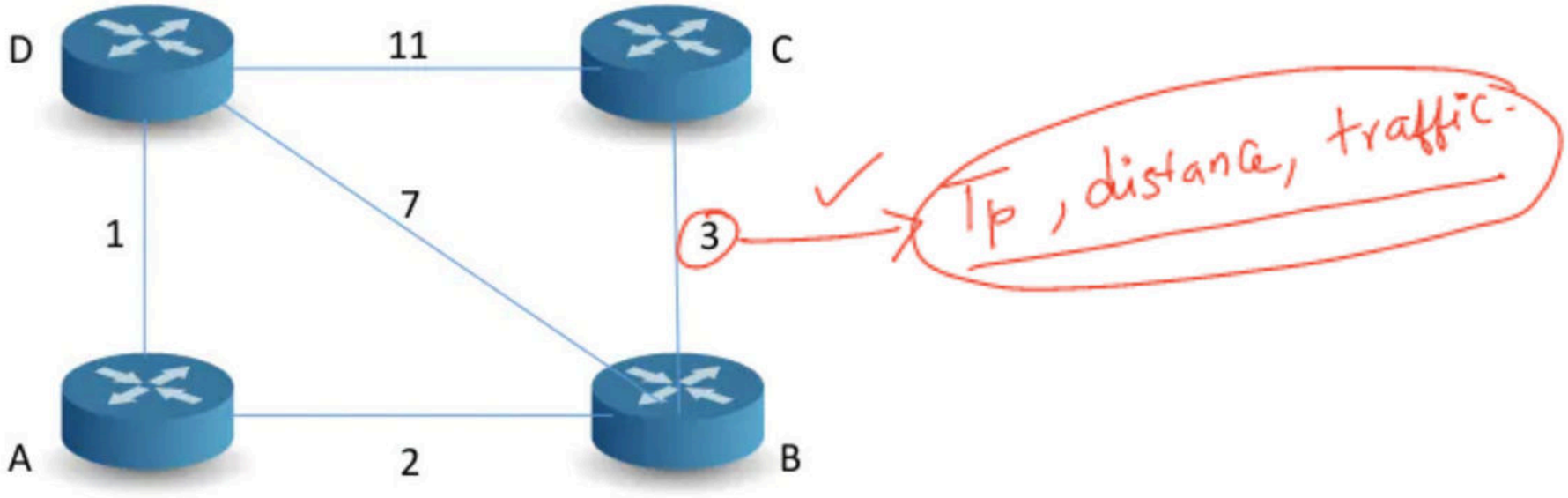
Each router prepares a new routing table using the distance vectors it has obtained from its neighbors.

This step is repeated for (n-2) times if there are n routers in the network.

After this, routing tables converge / become stable.

Distance Vector Routing Example-

Consider-
There is a network consisting of 4 routers.
The weights are mentioned on the edges.
Weights could be distances or costs or delays.



Step-01:

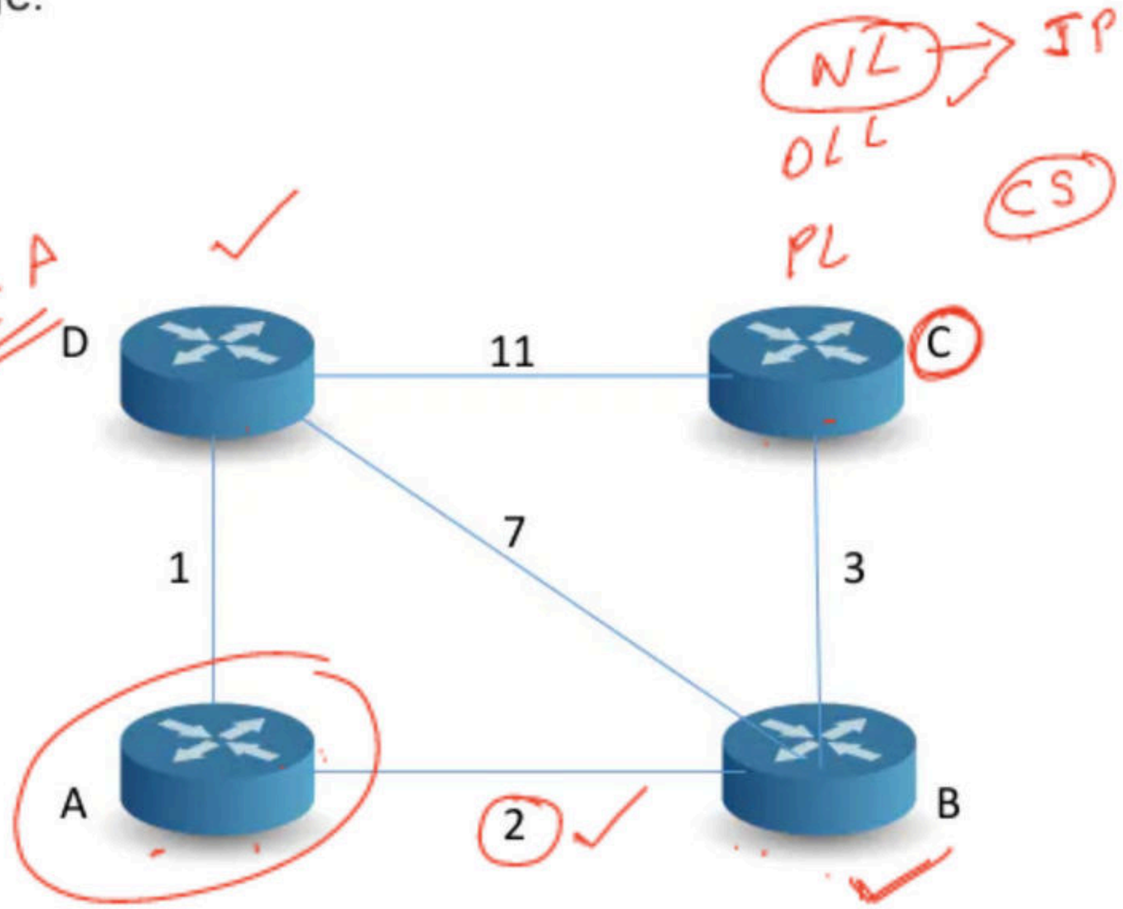
Each router prepares its routing table using its local knowledge.
Routing table prepared by each router is shown below-

At Router A-

Destination	Distance	Next Hop
A	0	A
B	2	B
C	∞	–
D	1	D

At Router B-

Destination	Distance	Next Hop
A	2	A
B	0	B
C	3	C
D	7	D

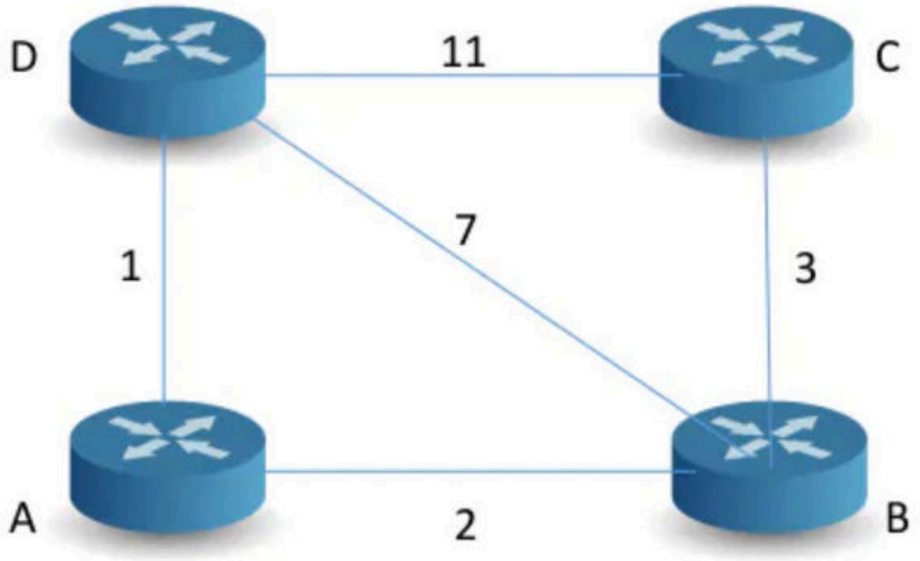


At Router C-

Destination	Distance	Next Hop
A	∞	–
B	3	B
C	0	C
D	11	D

At Router D-

Destination	Distance	Next Hop
A	1	A
B	7	B
C	11	C
D	0	D



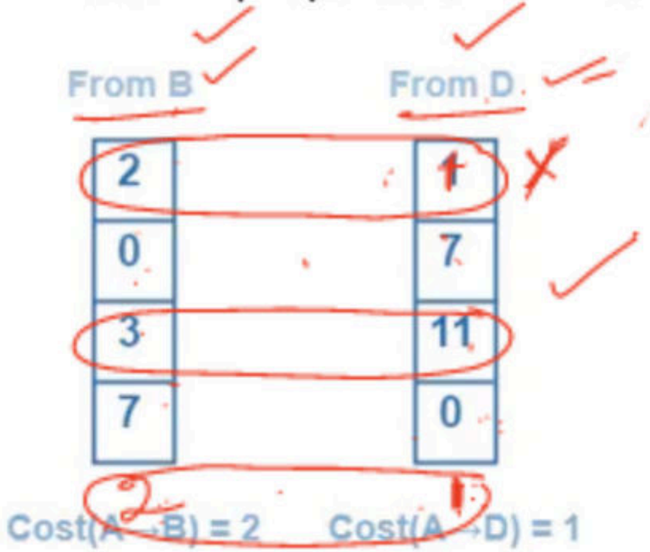
Step-02:

- Each router exchanges its distance vector obtained in Step-01 with its neighbors.
- After exchanging the distance vectors, each router prepares a new routing table.

This is shown below-

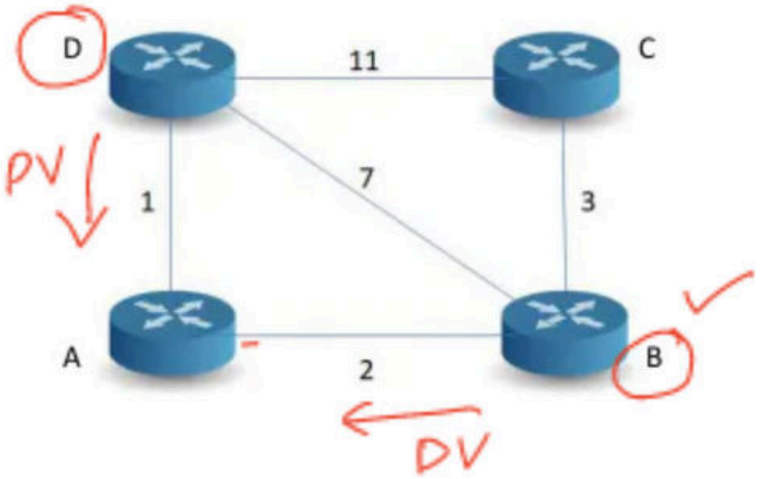
At Router A-

- Router A receives distance vectors from its neighbors B and D.
- Router A prepares a new routing table as-



Destination	Distance	Next hop
A	0	A
B	2	B
C	5	B
D	1	D

New Routing Table at Router A



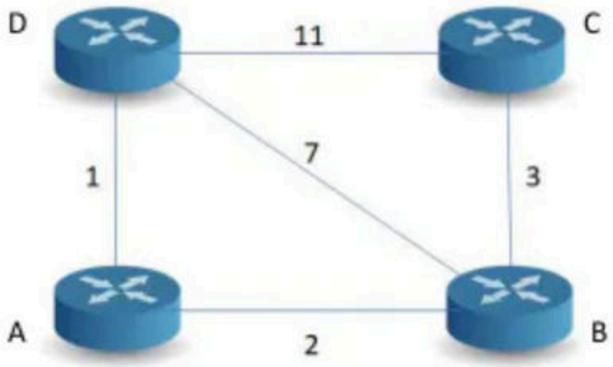
Cost of reaching destination B from router A = min { 2+0 , 1+7 } = 2 via B.
Cost of reaching destination C from router A = min { 2+3 , 1+11 } = 5 via B.
Cost of reaching destination D from router A = min { 2+7 , 1+0 } = 1 via D.

Explanation For Destination B

- Router A can reach the destination router B via its neighbor B or neighbor D.
- It chooses the path which gives the minimum cost.
- Cost of reaching router B from router A via neighbor B = Cost (A→B) + Cost (B→B)= **2 + 0** = 2
- Cost of reaching router B from router A via neighbor D = Cost (A→D) + Cost (D→B) = **1 + 7** = 8
- Since the cost is minimum via neighbor B, so router A chooses the path via B.
- It creates an entry (2, B) for destination B in its new routing table.
- Similarly, we calculate the shortest path distance to each destination router at every router.

Thus, the new routing table at router A is-

Destination	Distance	Next Hop
A	0	A
B	2	B
C	5	B
D	1	D



At Router B-

- Router B receives distance vectors from its neighbors A, C and D.
- Router B prepares a new routing table as-

From A

0
2
∞
1

Cost (B→A) = 2

From C

∞
3
0
11

Cost (B→C) = 3

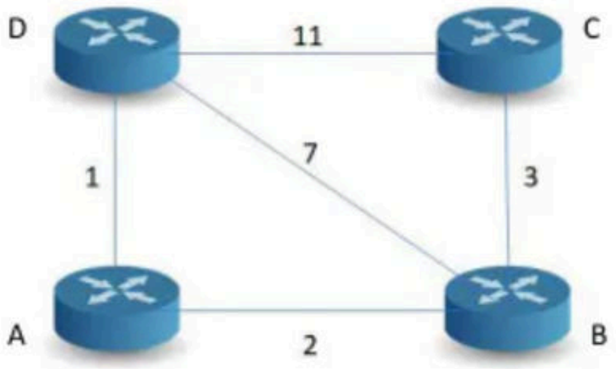
From D

1
7
11
0

Cost (B→D) = 7

Destination	Distance	Next hop
A	2	A
B	0	B
C	3	C
D	3	A

New Routing Table at Router B



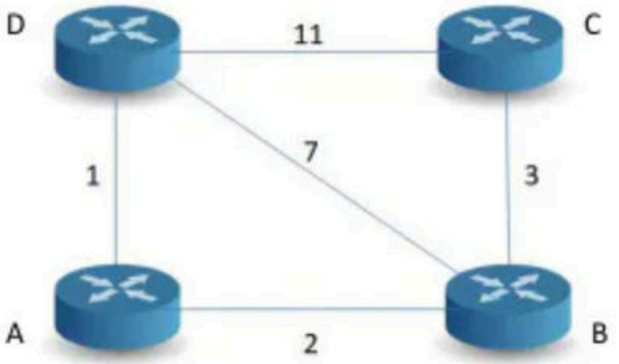
Cost of reaching destination A from router B = min { 2+0 , 3+∞ , 7+1 } = 2 via A.

Cost of reaching destination C from router B = min { 2+∞ , 3+0 , 7+11 } = 3 via C.

Cost of reaching destination D from router B = min { 2+1 , 3+11 , 7+0 } = 3 via A.

Thus, the new routing table at router B is-

Destination	Distance	Next Hop
A	2	A
B	0	B
C	3	C
D	3	A



At Router C-

•Router C receives distance vectors from its neighbors B and D.

•Router C prepares a new routing table as-

From B

2
0
3
7

Cost (C→B) = 3

3

From D

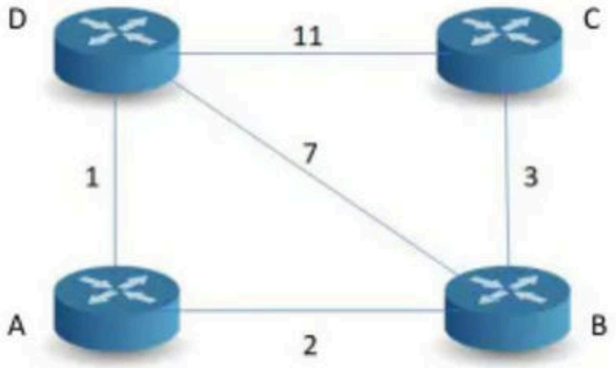
1
7
11
0

Cost (C→D) = 11

11

New Routing Table at Router C

Destination	Distance	Next hop
A	5	B
B	3	B
C	0	C
D	10	B



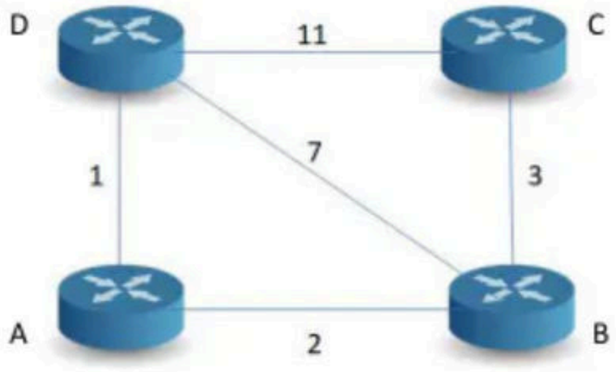
•Cost of reaching destination A from router C = min { 3+2 , 11+1 } = 5 via B.

•Cost of reaching destination B from router C = min { 3+0 , 11+7 } = 3 via B.

•Cost of reaching destination D from router C = min { 3+7 , 11+0 } = 10 via B.

Thus, the new routing table at router C is-

Destination	Distance	Next Hop
A	5	B
B	3	B
C	0	C
D	10	B



At Router D-

•Router D receives distance vectors from its neighbors A, B and C.

•Router D prepares a new routing table as-

From A

0
2
∞
1

Cost (D→A) = 1

From B

2
0
3
7

Cost (D→B) = 7

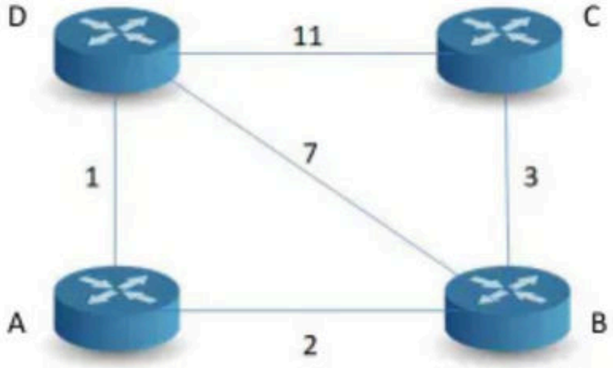
From C

∞
3
0
11

Cost (D→C) = 11

Destination	Distance	Next hop
A	1	A
B	3	A
C	10	B
D	0	D

New Routing Table at Router D



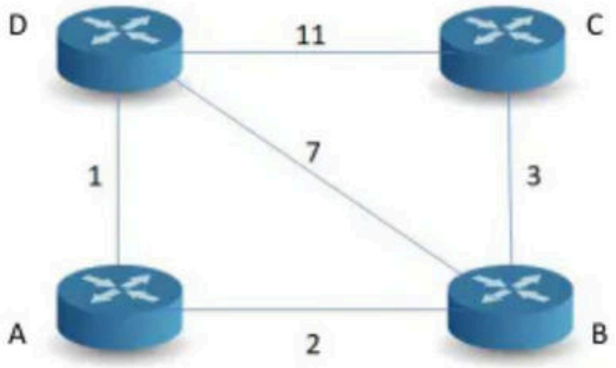
Cost of reaching destination A from router D = min { 1+0 , 7+2 , 11+∞ } = 1 via A.

Cost of reaching destination B from router D = min { 1+2 , 7+0 , 11+3 } = 3 via A.

Cost of reaching destination C from router D = min { 1+∞ , 7+3 , 11+0 } = 10 via B.

Thus, the new routing table at router D is-

Destination	Distance	Next Hop
A	1	A
B	3	A
C	10	B
D	0	D



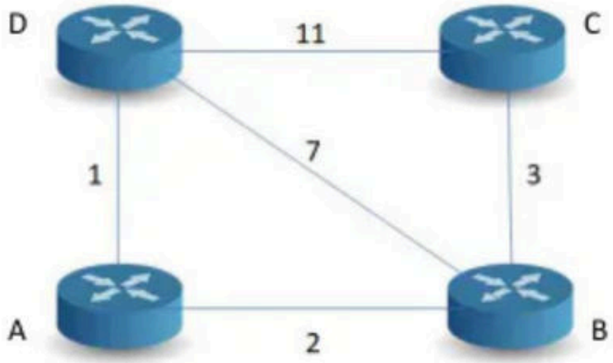
Step-03:

•Each router exchanges its distance vector obtained in Step-02 with its neighboring routers.
•After exchanging the distance vectors, each router prepares a new routing table.

This is shown below-

At Router A-

•Router A receives distance vectors from its neighbors B and D.
•Router A prepares a new routing table as-



From B

2
0
3
3

Cost(A→B) = 2

From D

1
3
10
0

Cost(A→D) = 1

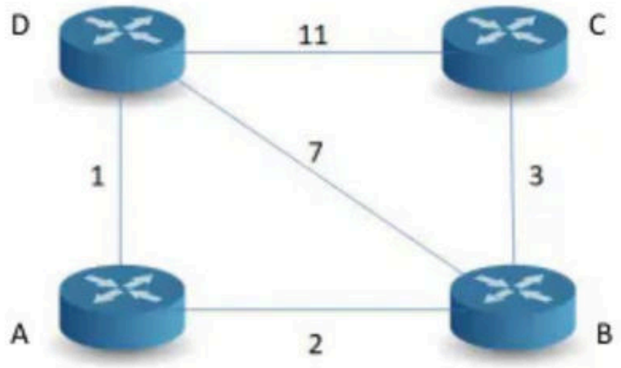
Destination	Distance	Next hop
A	0	A
B	2	B
C	5	B
D	1	D

New Routing Table at Router A

Cost of reaching destination B from router A = min { 2+0 , 1+3 } = 2 via B.
Cost of reaching destination C from router A = min { 2+3 , 1+10 } = 5 via B.
Cost of reaching destination D from router A = min { 2+3 , 1+0 } = 1 via D.

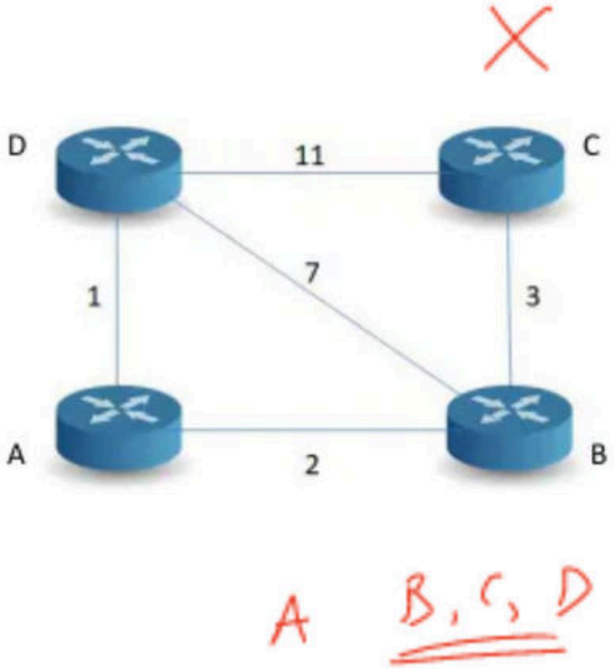
Thus, the new routing table at router A is-

Destination	Distance	Next Hop
A	0	A
B	2	B
C	5	B
D	1	D



At Router B-

- Router B receives distance vectors from its neighbors A, C and D.
- Router B prepares a new routing table as-



From A

0
2
5
1

Cost (B→A) = 2

From C

5
3
0
10

Cost (B→C) = 3

From D

1
3
10
0

Cost (B→D) = 3

Destination	Distance	Next hop
A	2	A
B	0	B
C	3	C
D	2	A

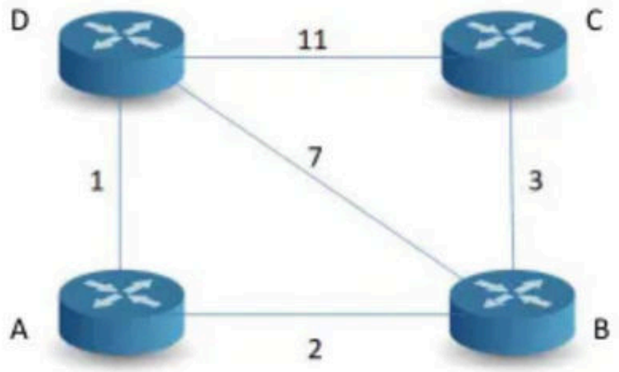
New Routing Table at Router B

A B, C, D

Cost of reaching destination A from router B = min { 2+0 , 3+5 , 3+1 } = 2 via A.
Cost of reaching destination C from router B = min { 2+5 , 3+0 , 3+10 } = 3 via C.
Cost of reaching destination D from router B = min { 2+1 , 3+10 , 3+0 } = 3 via A.

Thus, the new routing table at router B is-

Destination	Distance	Next Hop
A	2	A
B	0	B
C	3	C
D	3	A



At Router C-

•Router C receives distance vectors from its neighbors B and D.
•Router C prepares a new routing table as-

From B

2
0
3
3

Cost (C→B) = 3

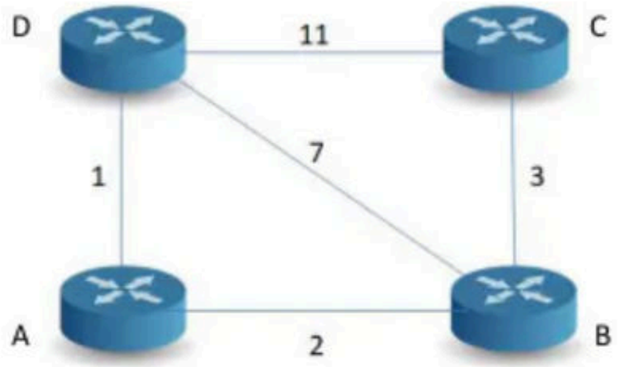
From D

1
3
10
0

Cost (C→D) = 10

Destination	Distance	Next hop
A	5	B
B	3	B
C	0	C
D	6	B

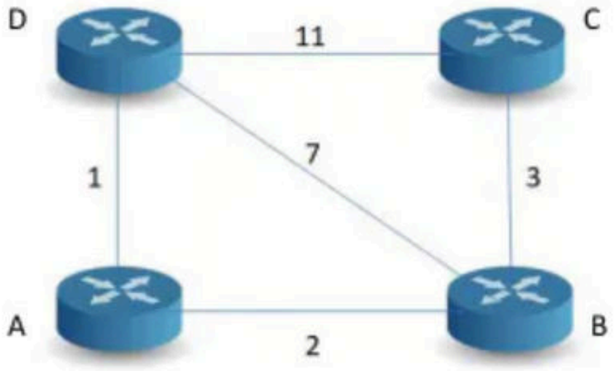
New Routing Table at Router C



Cost of reaching destination A from router C = min { 3+2 , 10+1 } = 5 via B.
Cost of reaching destination B from router C = min { 3+0 , 10+3 } = 3 via B.
Cost of reaching destination D from router C = min { 3+3 , 10+0 } = 6 via B.

Thus, the new routing table at router C is-

Destination	Distance	Next Hop
A	5	B
B	3	B
C	0	C
D	6	B



At Router D-

•Router D receives distance vectors from its neighbors A, B and C.
•Router D prepares a new routing table as-

From A

0
2
5
1

Cost (D→A) = 1

From B

2
0
3
3

Cost (D→B) = 3

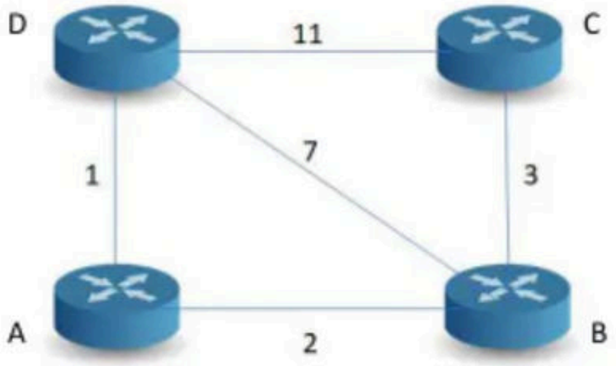
From C

5
3
0
10

Cost (D→C) = 10

Destination	Distance	Next hop
A	1	A
B	3	A
C	6	A
D	0	D

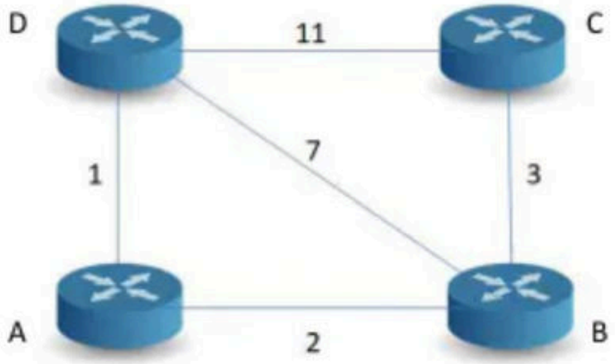
New Routing Table at Router D



Cost of reaching destination A from router D = min { 1+0 , 3+2 , 10+5 } = 1 via A.
Cost of reaching destination B from router D = min { 1+2 , 3+0 , 10+3 } = 3 via A.
Cost of reaching destination C from router D = min { 1+5 , 3+3 , 10+0 } = 6 via A.

Thus, the new routing table at router D is-

Destination	Distance	Next Hop
A	1	A
B	3	A
C	6	A
D	0	D



These will be the final routing tables at each router.

Destination	Distance	Next Hop
A	0	A
B	2	B
C	5	B
D	1	D

A

Destination	Distance	Next Hop
A	2	A
B	0	B
C	3	C
D	3	A

B

Destination	Distance	Next Hop
A	5	B
B	3	B
C	0	C
D	6	B

C

Destination	Distance	Next Hop
A	1	A
B	3	A
C	6	A
D	0	D

D

Identifying Unused Links-

After routing tables converge (becomes stable),
- Some of the links connecting the routers may never be used.
- In the above example, we can identify the unused links as-

Aishwarya -> From this page

We have-
- The value of next hop in the final routing table of router A suggests that only edges AB and AD are used.
- The value of next hop in the final routing table of router B suggests that only edges BA and BC are used.
- The value of next hop in the final routing table of router C suggests that only edge CB is used.
- The value of next hop in the final routing table of router D suggests that only edge DA is used.

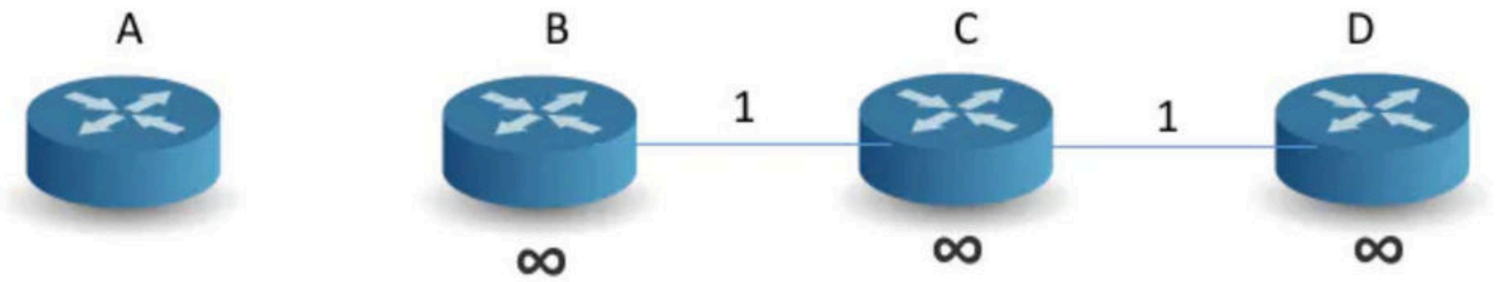
Thus, edges BD and CD are never used

Computer Networks

DVR – Count To Infinity

Count to Infinity – Bad news spreads slow, Good news spreads fast

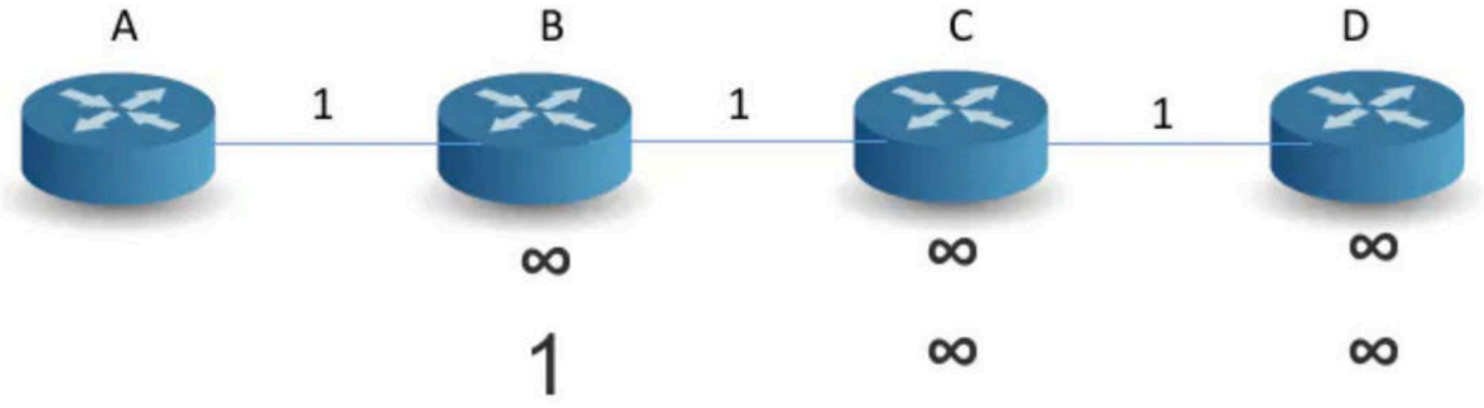
Good news



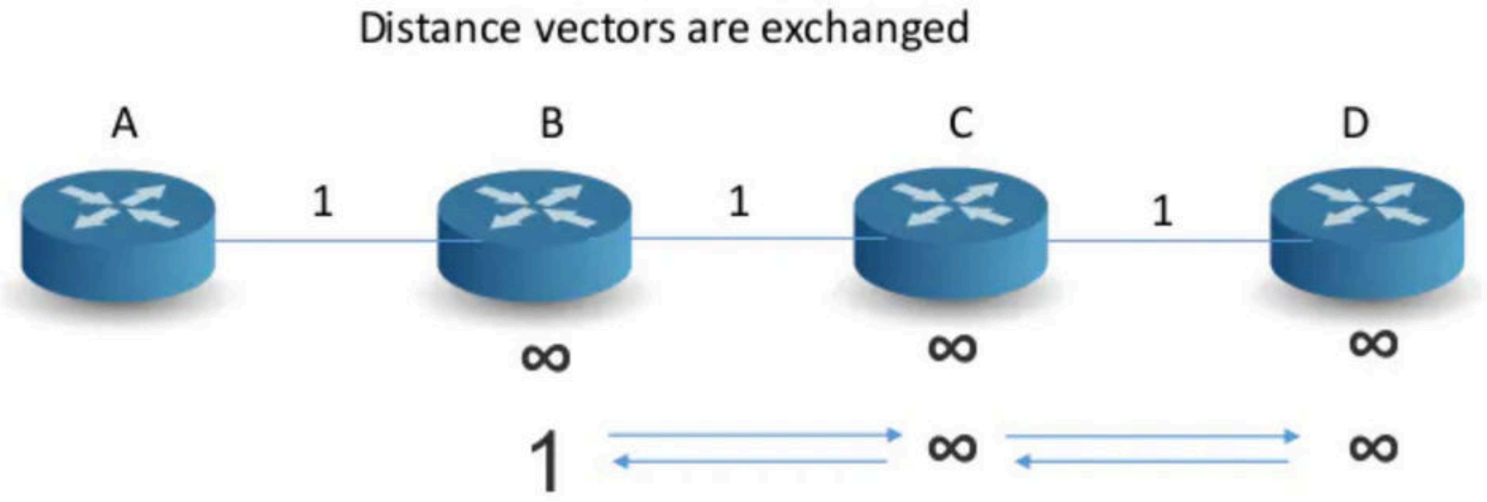
Initially A is not connected to the network

Count to Infinity – Bad news spreads slow, Good news spreads fast

A is now connected to the network



Count to Infinity – Bad news spreads slow, Good news spreads fast



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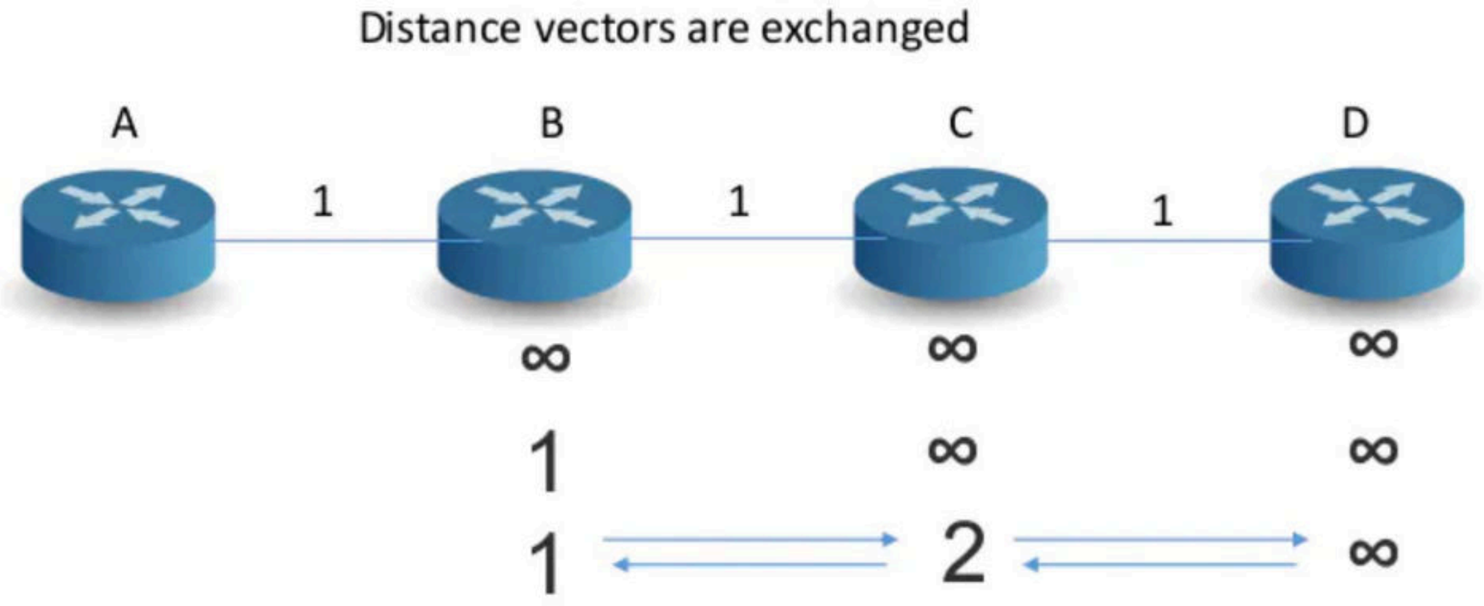

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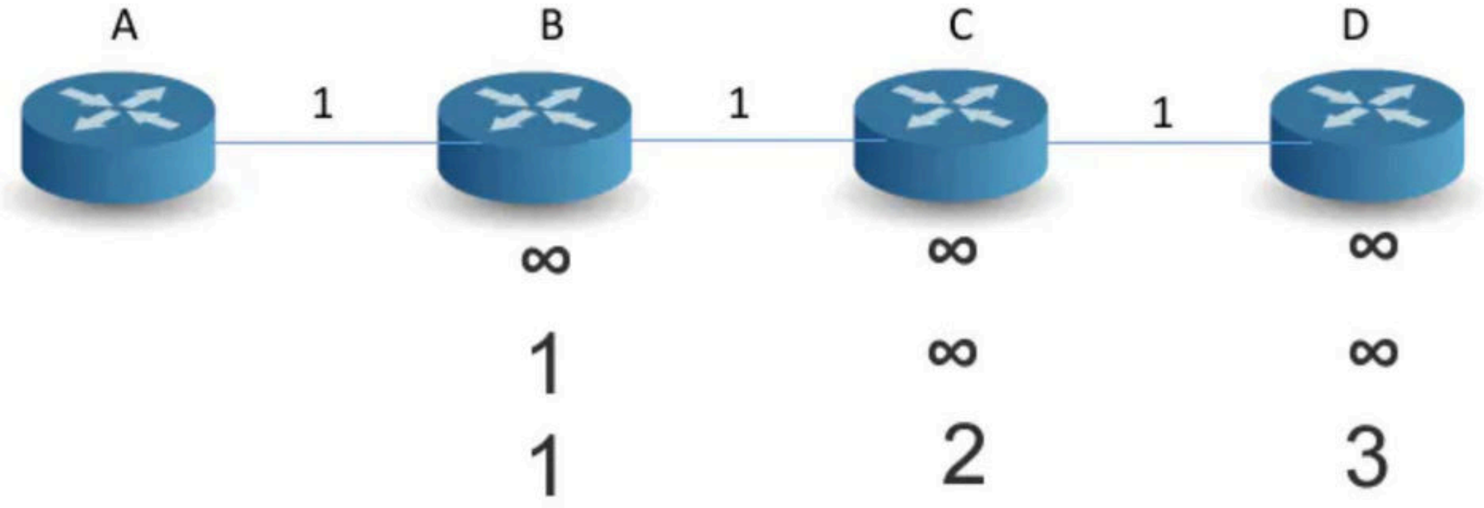
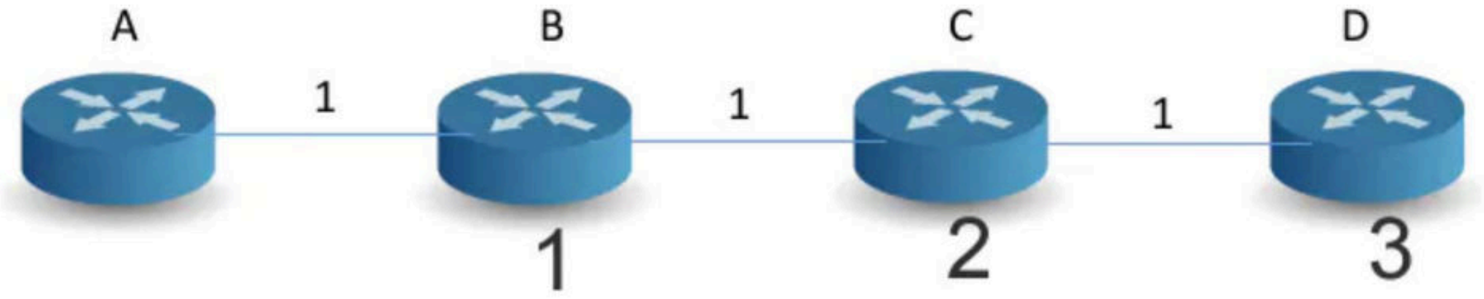
Distance vectors are exchanged



THIS IS GOOD NEWS

Count to Infinity – Bad news spreads slow, Good news spreads fast

Bad news



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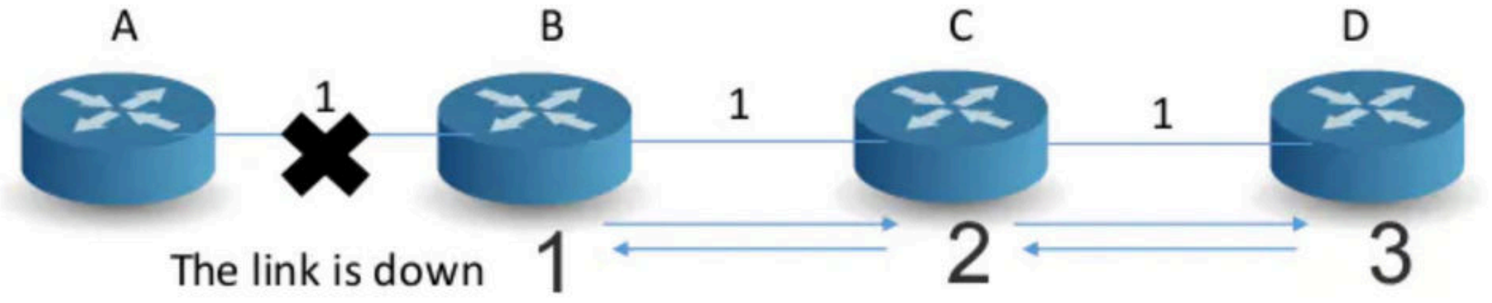

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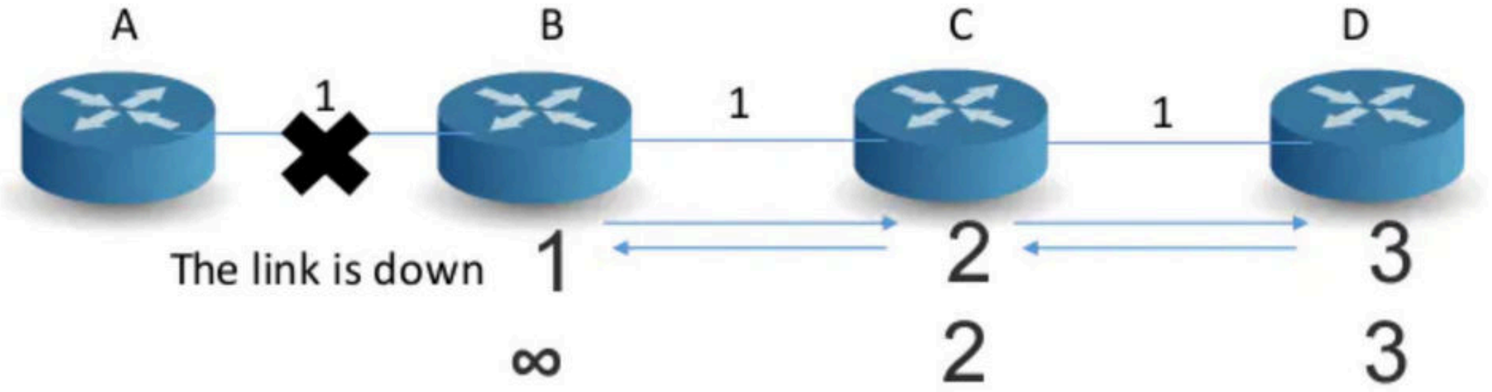

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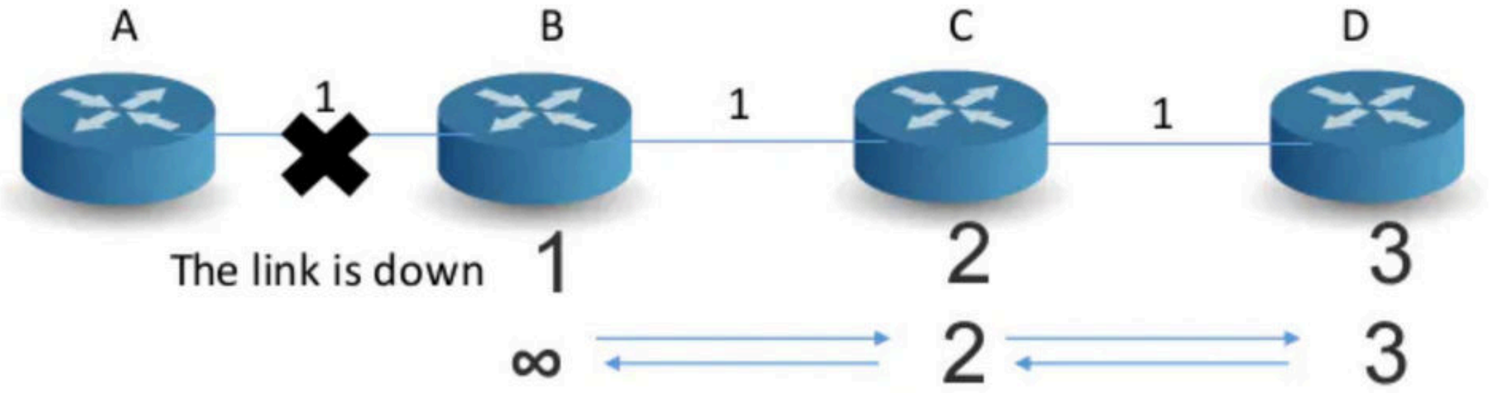

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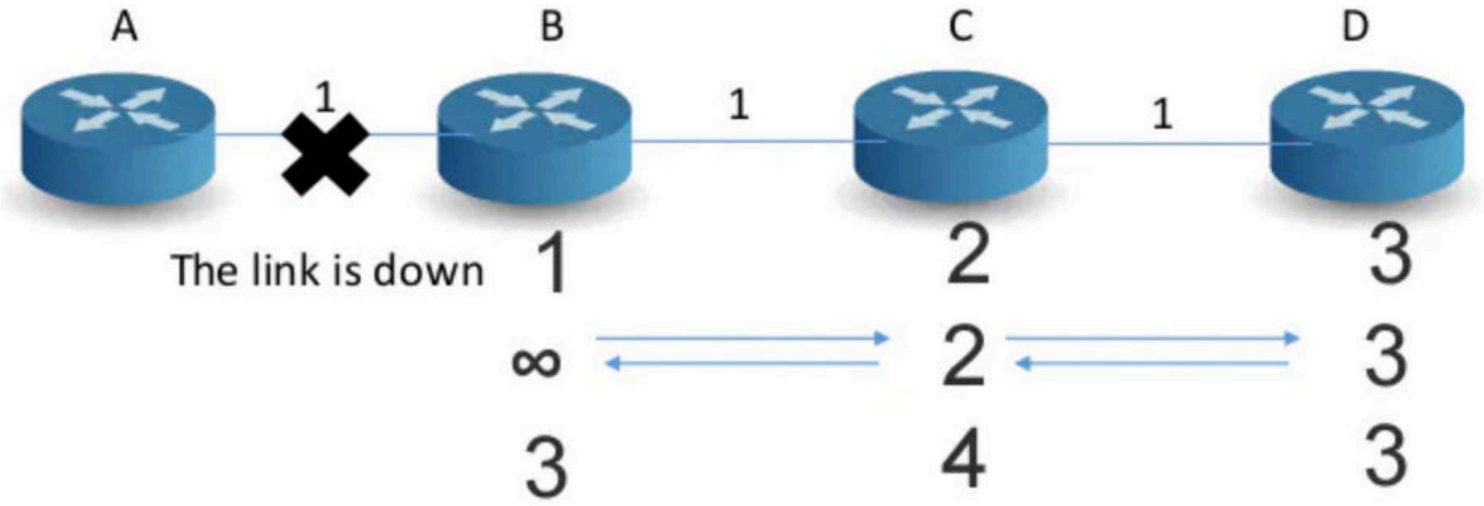

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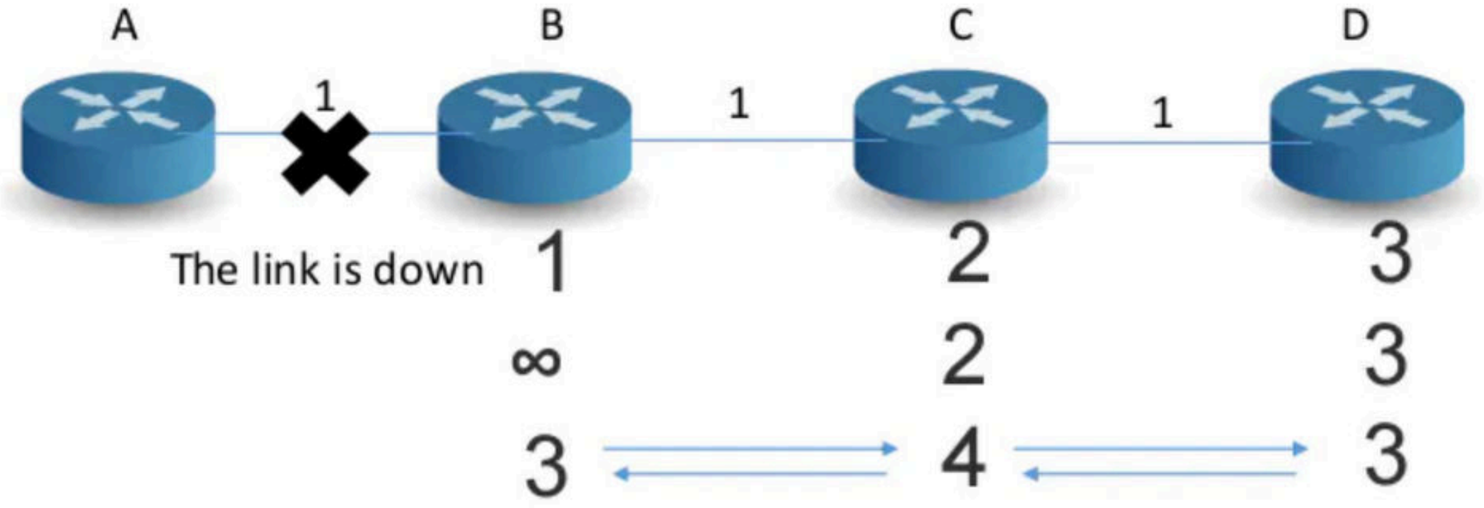

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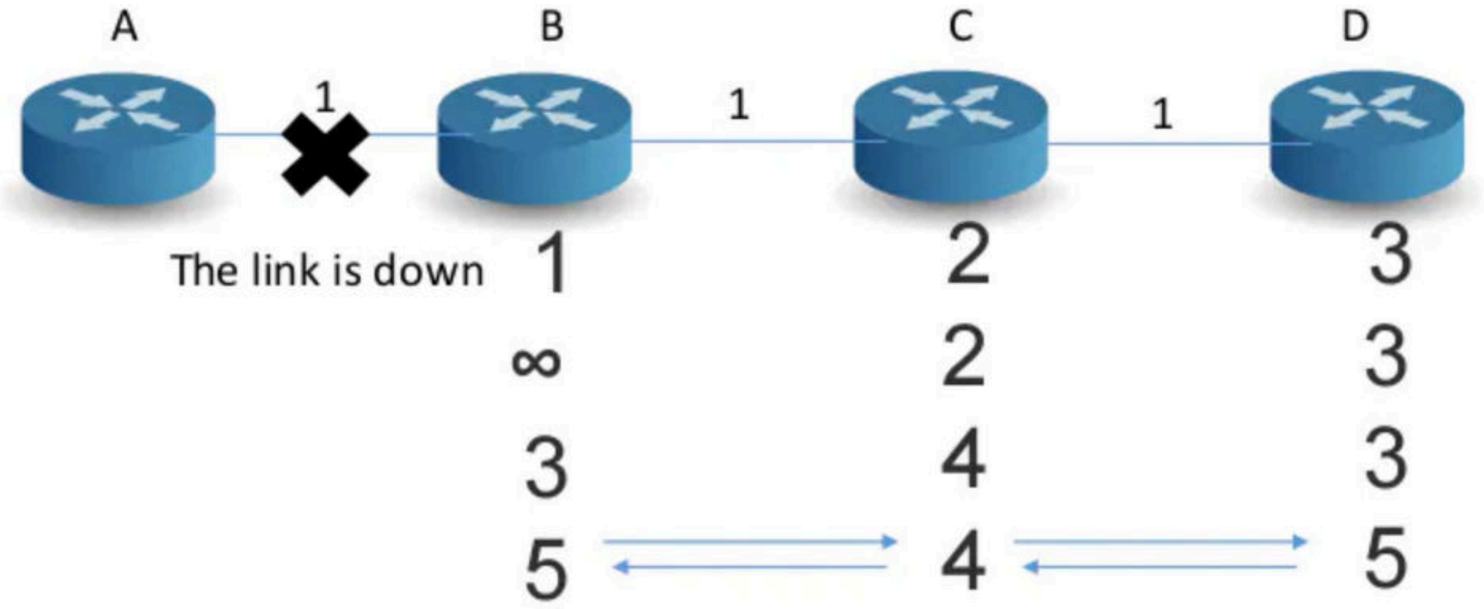

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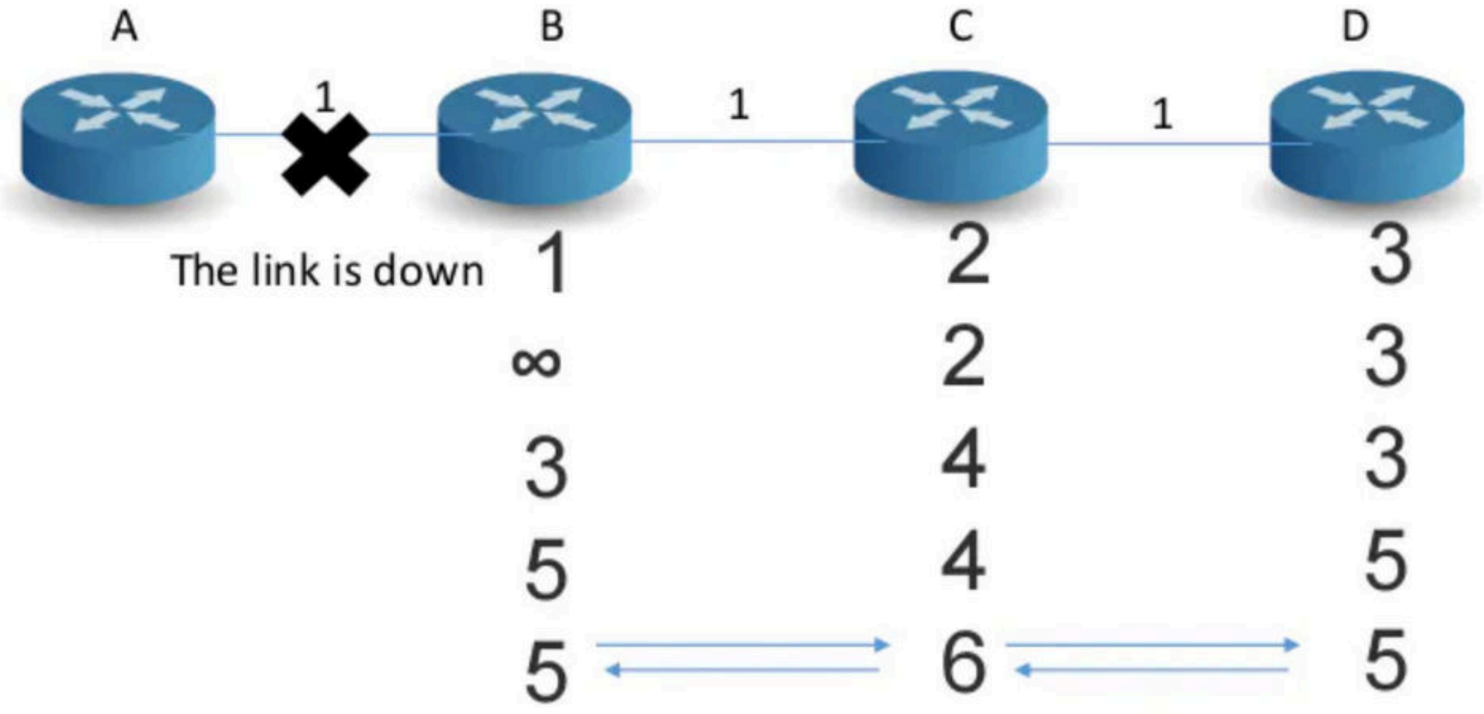

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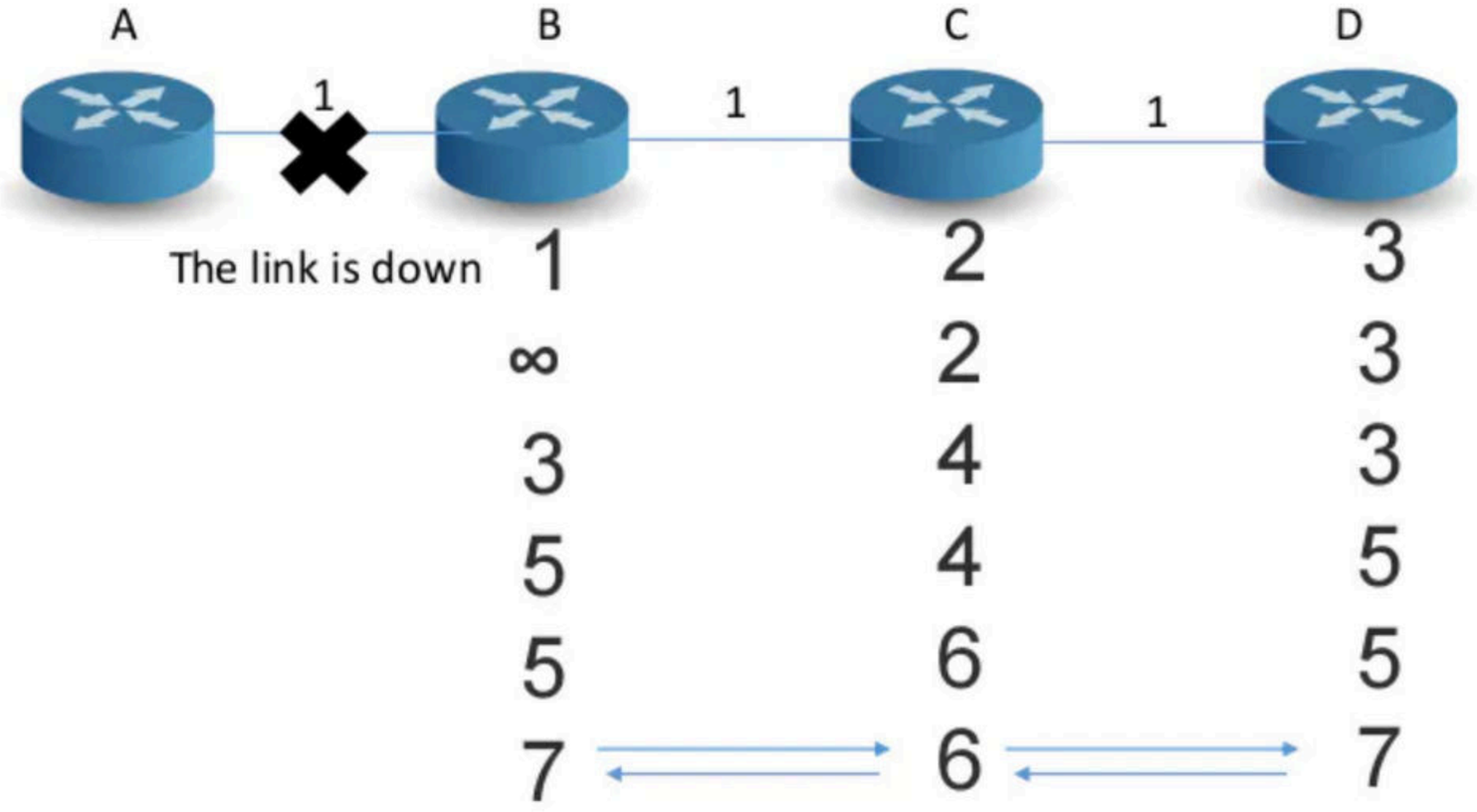

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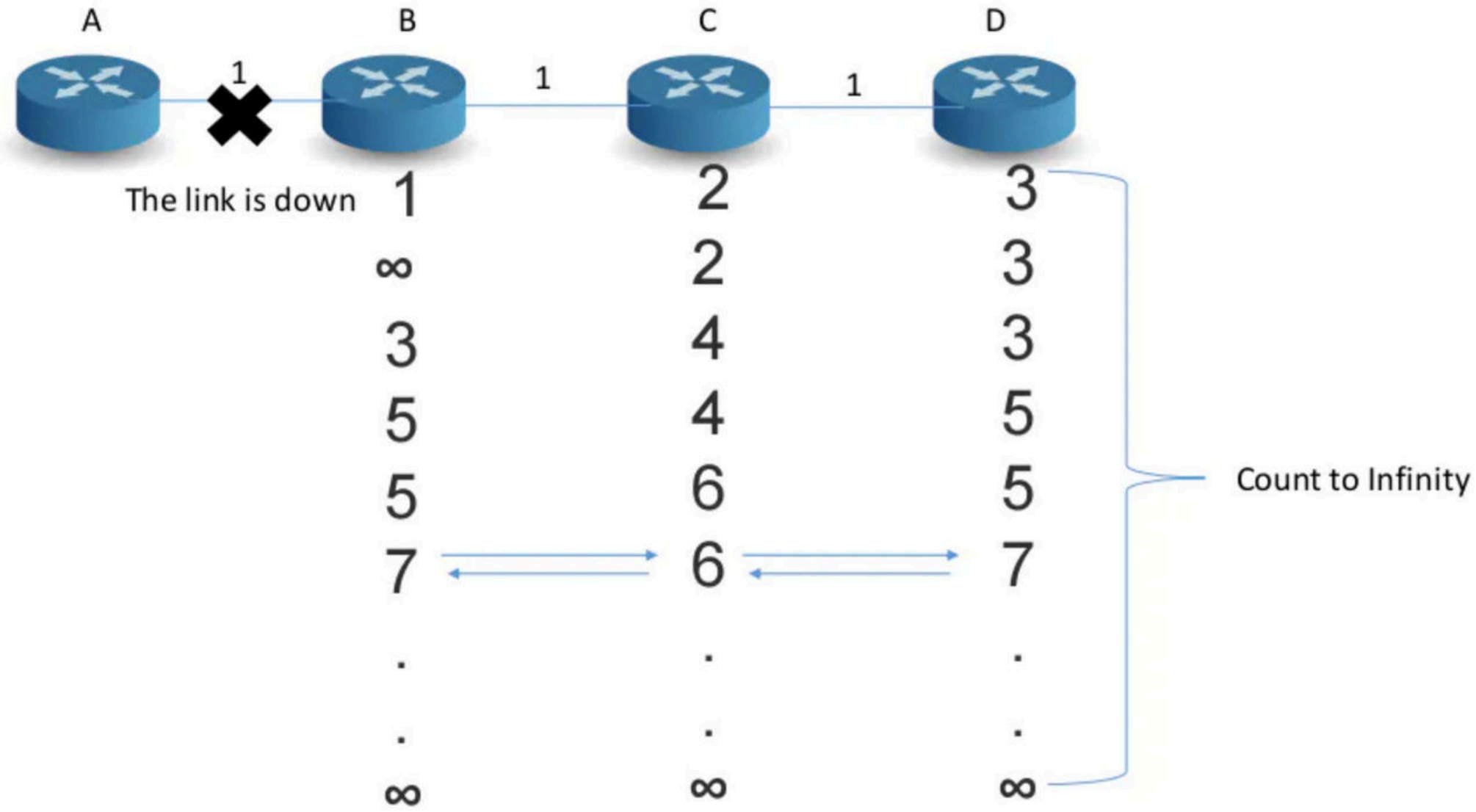
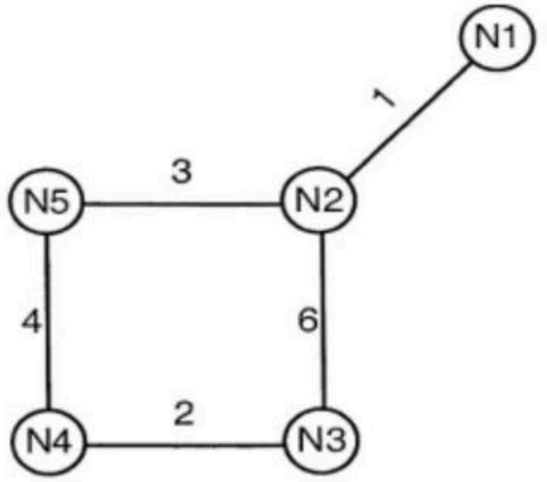


GATE CS 2011

1.) Consider a network with five nodes, N1 to N5, as shown below.



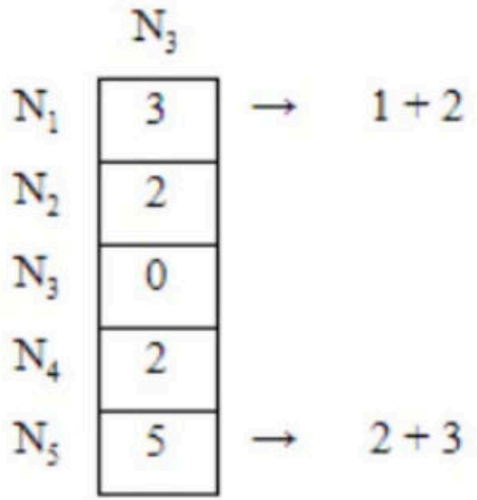
The network uses a Distance Vector Routing protocol.
Once the routes have stabilized, the distance vectors at different nodes are as following.

N1: (0, 1, 7, 8, 4)
N2: (1, 0, 6, 7, 3)
N3: (7, 6, 0, 2, 6)
N4: (8, 7, 2, 0, 4)
N5: (4, 3, 6, 4, 0)

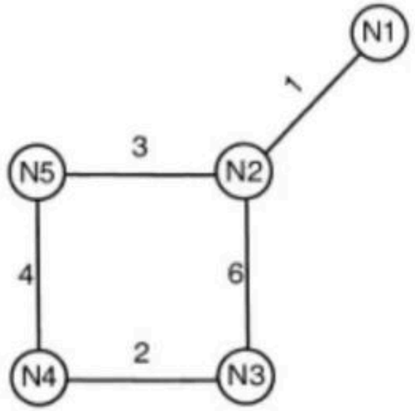
Each distance vector is the distance of the best known path at the instance to nodes, N1 to N5, where the distance to itself is 0. Also, all links are symmetric and the cost is identical in both directions. In each round, all nodes exchange their distance vectors with their respective neighbors. Then all nodes update their distance vectors. In between two rounds, any change in cost of a link will cause the two incident nodes to change only that entry in their distance vectors. 52. The cost of link N2-N3 reduces to 2(in both directions). After the next round of updates, what will be the new distance vector at node, N3.

(A) (3, 2, 0, 2, 5)
(B) (3, 2, 0, 2, 6)
(C) (7, 2, 0, 2, 5)
(D) (7, 2, 0, 2, 6)

Solution:
In the next round, every node will send and receive distance vectors to and from neighbors, and update its dostance vector.
N3 will receive (1, 0, 2, 7, 3) from N2 and it will update distances to N1 and N5 as 3 and 5 respectively.



2.)Consider a network with five nodes, N1 to N5m as show below. The network a distance vector protocol. What is the routes Have stabilized, the distance vector a different notes are as follows N1:(0,1,7,8,4) N2:(1,0,6,7,3) N3:(7,6,0,2,6) N4:(8,7,2,0,4) N5:(4,3,6,4,0)



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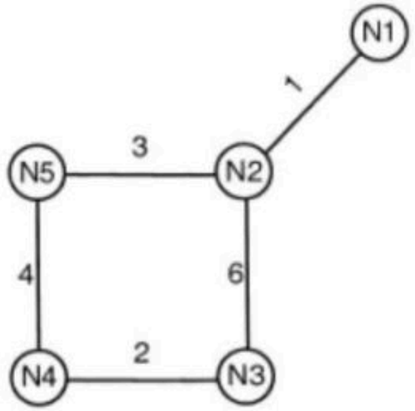
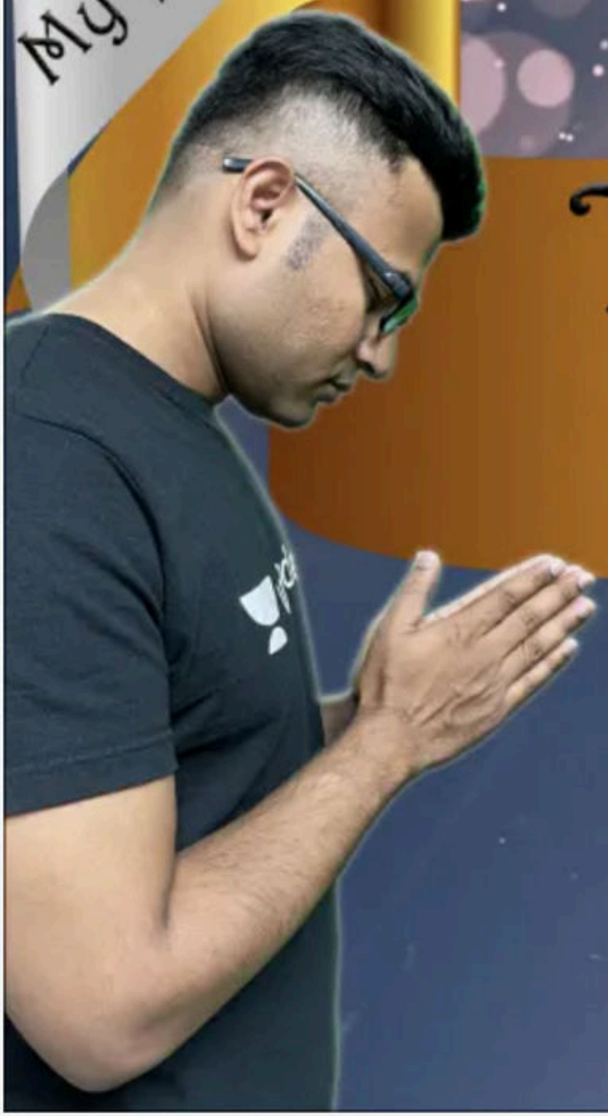


Solution:
N3 has neighbors N2 and N4
N2 has made entry ∞
N4 has the distance of 8 to N1
N3 has the distance of 2 to N4
So 2 + 8 = 10

My philosophy



TEACHING IS WORSHIP

STUDENTS ARE GODS