

Routing Protocols | Neso Academy

 nesoacademy.org/cs/06-computer-networks/ppts/05-routingprotocols

CHAPTER - 5

Routing Protocols

Neso Academy

RoutingProtocolsNeso AcademyCHAPTER - 5

OUTCOMES

Upon the completion of this lecture, the learner will be able to

- ★ Understand static routing and dynamic routing.
- ★ Know the pros and cons of static and dynamic routing.

Neso Academy

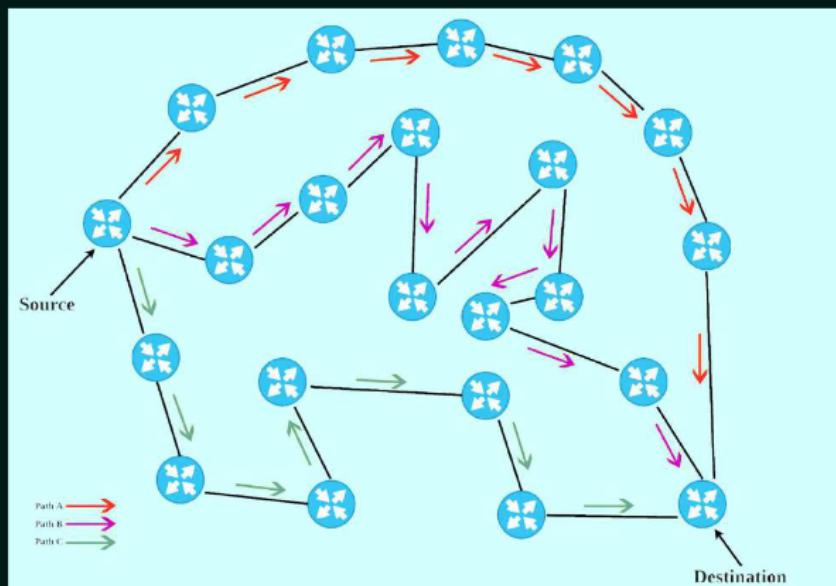
Outcomes★★Neso Academy

VARIOUS METHODS TO BUILD A ROUTING TABLE

- ★ Static Routing
- ★ Dynamic Routing

Various methods to build a routing table ★★ Neso Academy

ROUTING



Routing Neso Academy

STATIC ROUTING

- ★ A static routing table is created, maintained, and updated by a network administrator, manually.
- ★ A static route to every network must be configured on every router for full connectivity.
- ★ This provides a granular level of control over routing, but quickly becomes impractical on large networks.
- ★ Routers will not share static routes with each other, thus reducing CPU/RAM overhead and saving bandwidth.
- ★ However, static routing is not fault-tolerant, as any change to the routing infrastructure (such as a link going down, or a new network added) requires manual intervention.
- ★ Routers operating in a purely static environment cannot seamlessly choose a better route if a link becomes unavailable.

Static Routing★★★★★Neso Academy

DYNAMIC ROUTING

- ★ A dynamic routing table is created, maintained, and updated by a routing protocol running on the router.
- ★ The choice of the “best route” is in the hands of the routing protocol, and not the network administrator.
- ★ Examples of routing protocols: RIP (Routing Information Protocol), OSPF (Open Shortest Path First), and EIGRP (Enhanced Interior Gateway Routing Protocol).
- ★ Routers do share dynamic routing information with each other, which increases CPU, RAM, and bandwidth usage.
- ★ However, routing protocols are capable of dynamically choosing a different (or better) path when there is a change to the routing infrastructure.

Dynamic Routing★★★★★Neso Academy

OUTCOMES

Upon the completion of this lecture, the learner will be able to

- ★ Understand the need for dynamic routing protocols.

Outcomes ★ Neso Academy

DYNAMIC ROUTING PROTOCOLS

A static approach has several shortcomings:

- ★ It does not deal with node or link failures
- ★ It does not consider the addition of new nodes or links
- ★ It implies that edge costs cannot change

What is the solution?

- ★ Need a distributed and dynamic protocol
- ★ Two main classes of protocols
 1. Distance Vector
 2. Link State

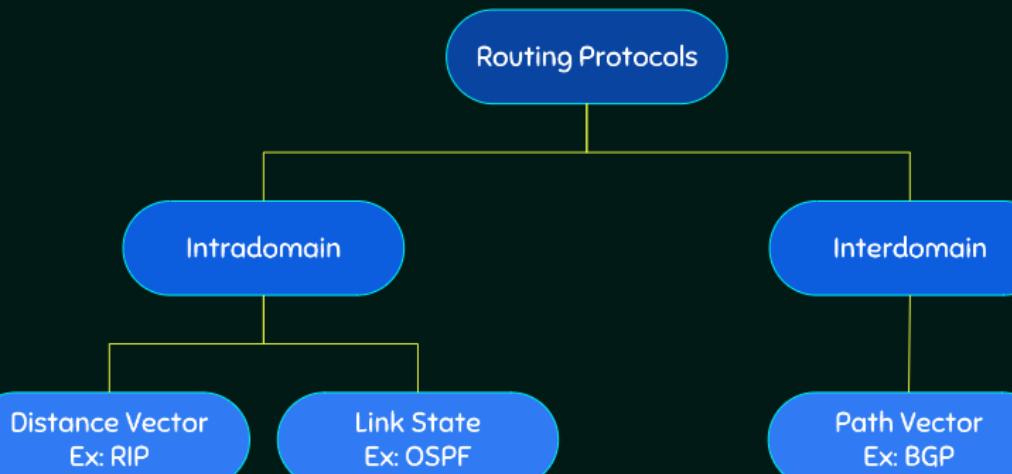
Dynamic Routing Protocols ★★★★★ Neso Academy

DYNAMIC ROUTING PROTOCOLS

- ★ A routing table can be either static or dynamic.
- ★ A static table is one with manual entries.
- ★ A dynamic table is one that is updated automatically when there is a change somewhere in the Internet.
- ★ A routing protocol is a combination of rules and procedures that lets routers in the Internet inform each other of changes.

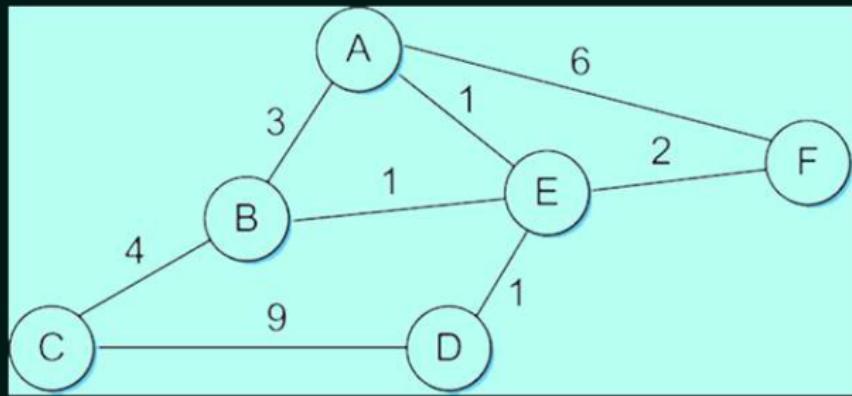
Dynamic Routing Protocols★★★★Neso Academy

POPULAR ROUTING PROTOCOLS



Popular Routing ProtocolsNeso Academy

NETWORK AS A GRAPH



Network as a graph Neso Academy

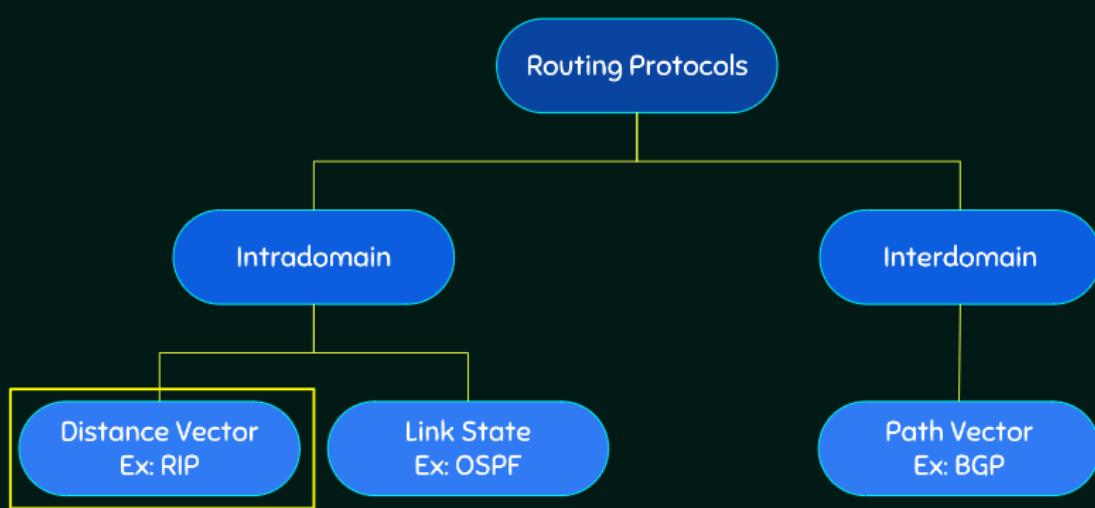
OUTCOMES

Upon the completion of this lecture, the learner will be able to

- ★ Understand Distance Vector Routing (DVR).

Outcomes ★ Neso Academy

POPULAR ROUTING PROTOCOLS



Popular Routing Protocols Neso Academy

DISTANCE VECTOR ROUTING

- ★ Each node constructs a one dimensional array (a vector) containing the “distances” (costs) to all other nodes and distributes that vector to its immediate neighbors.
- ★ Starting assumption is that each node knows the cost of the link to each of its directly connected neighbors.
- ★ The distance vector routing algorithm is sometimes called as **Bellman-Ford algorithm**.
- ★ Every T seconds each router sends its table to its neighbor and each router then updates its table based on the new information.

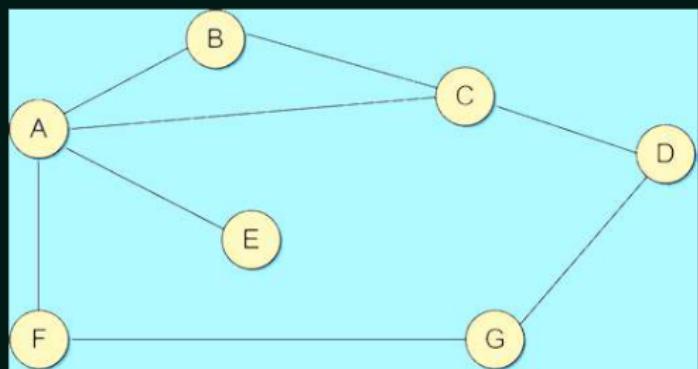
Distance Vector Routing ★★★★ Neso Academy

DISTANCE VECTOR ROUTING

- ★ Problems include fast response to good news and slow response to bad news.
- ★ Also too many messages to update.

Distance Vector Routing ★★ Neso Academy

EXAMPLE



Routing Table Entries: (Destination, Distance/Cost, Next Hop)
Node A: (B,1,B), (C,1,C), (F,1,F), (E,1,E), (D,2,C) etc.,

Example Neso Academy

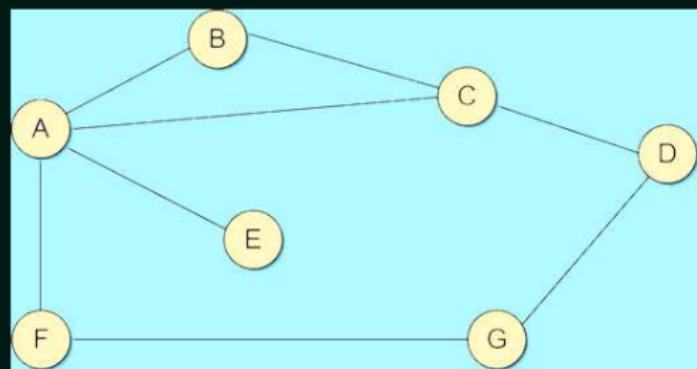
OUTCOMES

Upon the completion of this lecture, the learner will be able to

- ★ Understand the working of Distance Vector Routing (DVR).

Outcomes ★ Neso Academy

EXAMPLE

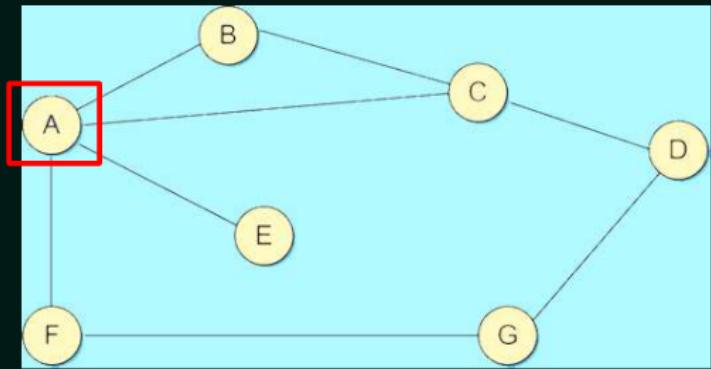


Routing Table Entries: (Destination, Distance/Cost, Next Hop)
Node A: (B,1,B), (C,1,C), (F,1,F), (E,1,E), (D,2,C) etc.,

Example Neso Academy

INITIAL ROUTING TABLE OF A

Destination	Cost	Next Hop
A	0	-
B	1	B
C	1	C
D	∞	-
E	1	E
F	1	F
G	∞	-

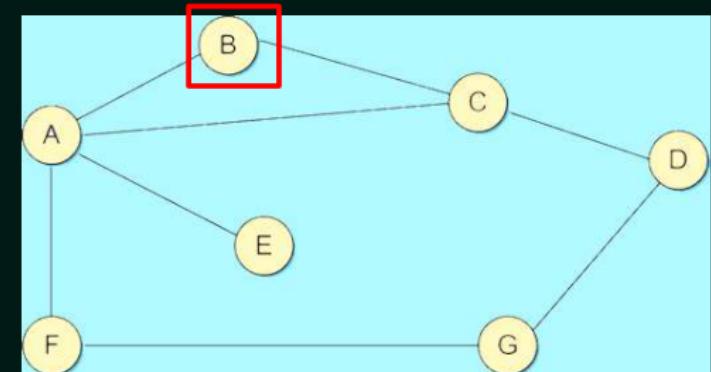


Neso Academy

Initial Routing table of A $\infty \infty$ Neso Academy

INITIAL ROUTING TABLE OF B

Destination	Cost	Next Hop
A	1	A
B	0	-
C	1	C
D	∞	-
E	∞	-
F	∞	-
G	∞	-

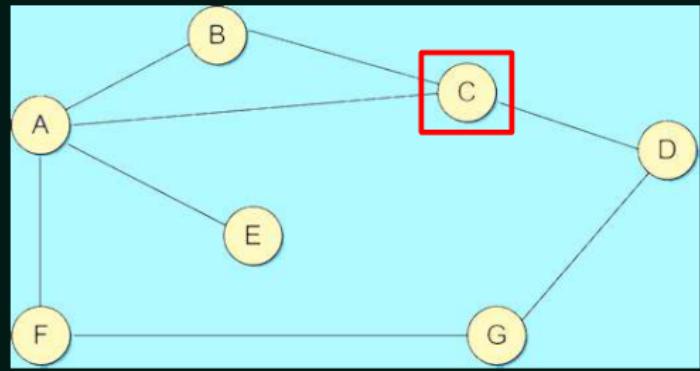


Neso Academy

Initial Routing table of B $\infty \infty \infty \infty$ Neso Academy

INITIAL ROUTING TABLE OF C

Destination	Cost	Next Hop
A	1	A
B	1	B
C	0	-
D	1	D
E	∞	-
F	∞	-
G	∞	-

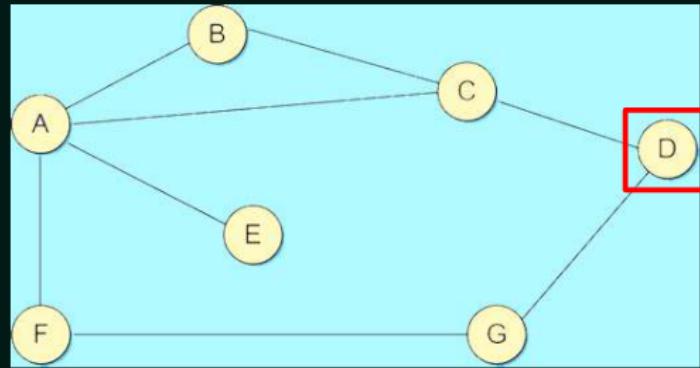


Neso Academy

Initial Routing table of C $\infty \infty \infty$ Neso Academy

INITIAL ROUTING TABLE OF D

Destination	Cost	Next Hop
A	∞	-
B	∞	-
C	1	C
D	0	-
E	∞	-
F	∞	-
G	1	G

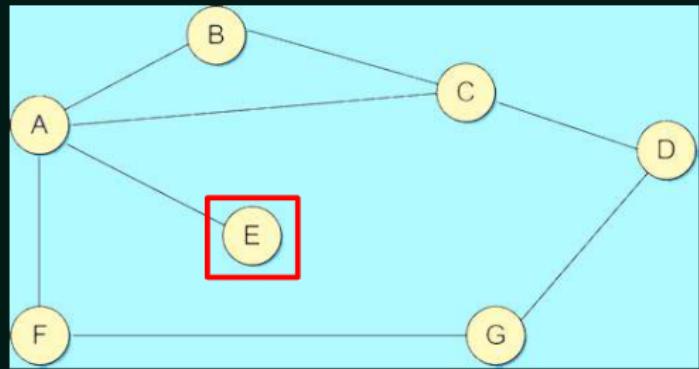


Neso Academy

Initial Routing table of D $\infty \infty \infty \infty$ Neso Academy

INITIAL ROUTING TABLE OF E

Destination	Cost	Next Hop
A	1	A
B	∞	-
C	∞	-
D	∞	-
E	0	-
F	∞	-
G	∞	-

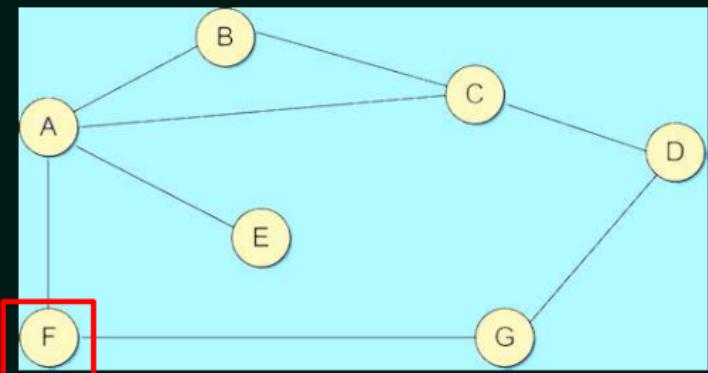


Neso Academy

Initial Routing table of E $\infty \infty \infty \infty \infty$ Neso Academy

INITIAL ROUTING TABLE OF F

Destination	Cost	Next Hop
A	1	A
B	∞	-
C	∞	-
D	∞	-
E	∞	-
F	0	-
G	1	G

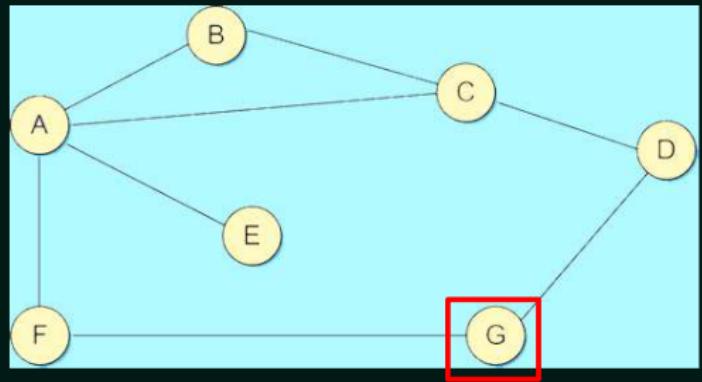


Neso Academy

Initial Routing table of F $\infty \infty \infty \infty \infty$ Neso Academy

INITIAL ROUTING TABLE OF G

Destination	Cost	Next Hop
A	∞	-
B	∞	-
C	∞	-
D	1	1
E	∞	-
F	1	1
G	0	-



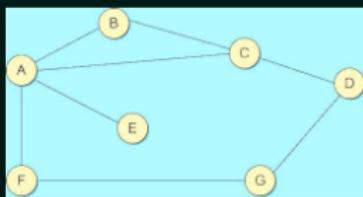
Initial Routing table of G∞∞∞∞Neso Academy

INITIAL DISTANCE STORED AT EACH NODE

Information stored at Node	Distance to reach node						
	A	B	C	D	E	F	G
A	0	1	1	∞	1	1	∞
B	1	0	1	∞	∞	∞	∞
C	1	1	0	1	∞	∞	∞
D	∞	∞	1	0	∞	∞	1
E	1	∞	∞	∞	0	∞	∞
F	1	∞	∞	∞	∞	0	1
G	∞	∞	∞	1	∞	1	0

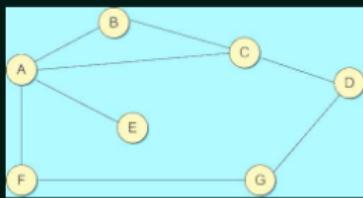
.....to be continued

INITIAL DISTANCE STORED AT EACH NODE



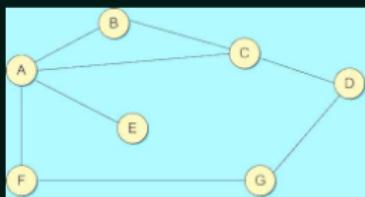
Information stored at Node	Distance to reach node						
	A	B	C	D	E	F	G
A				∞			∞
B				∞	∞	∞	∞
C					∞	∞	∞
D	∞	∞			∞	∞	
E		∞	∞	∞		∞	∞
F		∞	∞	∞	∞		
G	∞	∞	∞		∞		

INITIAL ROUTING TABLE OF NODE A



Initial routing table of node ANeso Academy

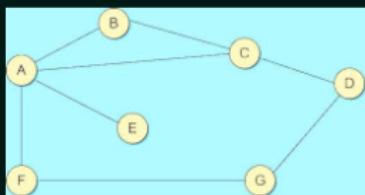
FINAL ROUTING TABLE OF NODE A



Destination	Cost	Next Hop
B		
C		
D		
E		
F		
G		

Final routing table of node A
Neso Academy

FINAL DISTANCE STORED AT EACH NODE



Information stored at Node	Distance to reach node						
	A	B	C	D	E	F	G
A				∞			∞
B				∞	∞	∞	∞
C					∞	∞	∞
D	∞	∞			∞	∞	
E		∞	∞	∞		∞	∞
F		∞	∞	∞	∞		
G	∞	∞	∞		∞		

Final distance stored at each node
Neso Academy

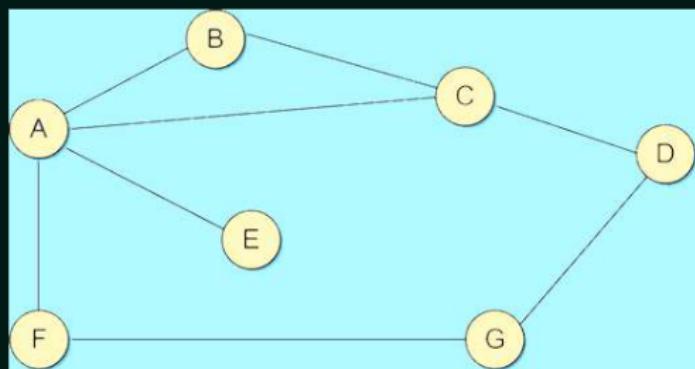
OUTCOMES

Upon the completion of this lecture, the learner will be able to

- ★ Understand the working of Distance Vector Routing (DVR).

Outcomes ★ Neso Academy

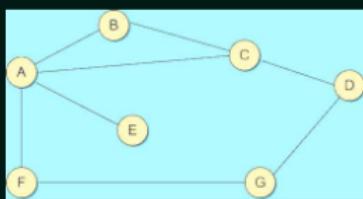
EXAMPLE



Routing Table Entries: (Destination, Distance/Cost, Next Hop)
Node A: (B,1,B), (C,1,C), (F,1,F), (E,1,E), (D,2,C) etc.,

Example Neso Academy

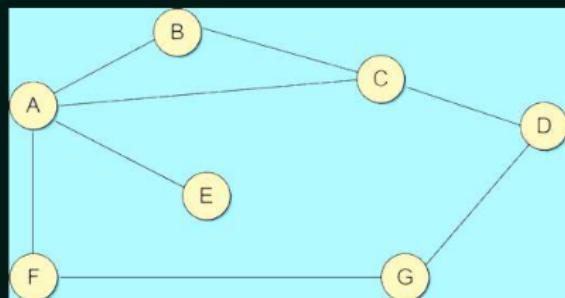
INITIAL DISTANCE STORED AT EACH NODE



Information stored at Node	Distance to reach node						
	A	B	C	D	E	F	G
A	0	1	1	∞	1	1	∞
B	1	0	1	∞	∞	∞	∞
C	1	1	0	1	∞	∞	∞
D	∞	∞	1	0	∞	∞	1
E	1	∞	∞	∞	0	∞	∞
F	1	∞	∞	∞	∞	0	1
G	∞	∞	∞	1	∞	1	0

EXAMPLE

A	0
B	1
C	1
D	∞
E	1
F	1
G	∞



A	1
B	0
C	1
D	∞
E	∞
F	∞
G	∞

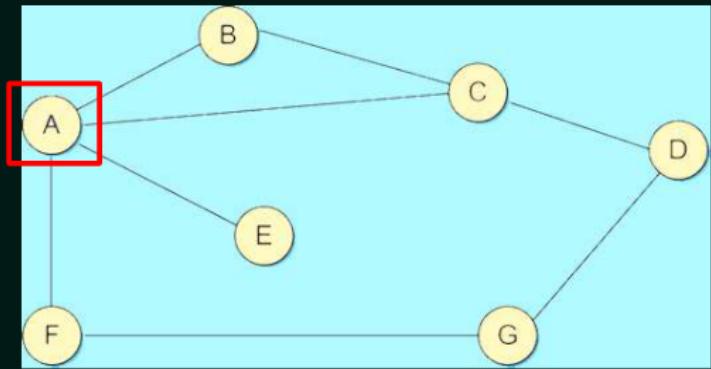
A	1
B	1
C	0
D	1
E	∞
F	∞
G	∞

A	1
B	∞
C	∞
D	∞
E	0
F	∞
G	∞

Example E B CA Neso Academy

FINAL ROUTING TABLE OF A

Destination	Cost	Next Hop
A	0	-
B	1	B
C	1	C
D	2	C
E	1	E
F	1	F
G	2	F

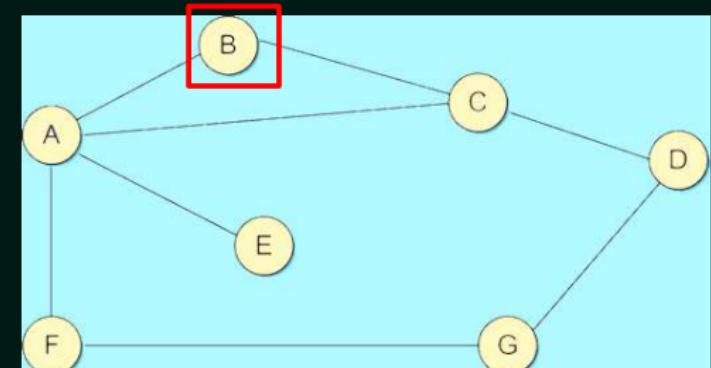


Neso Academy

Final Routing table of ANeso Academy

FINAL ROUTING TABLE OF B

Destination	Cost	Next Hop
A	1	A
B	0	-
C	1	C
D	2	C
E	2	A
F	2	F
G	3	F

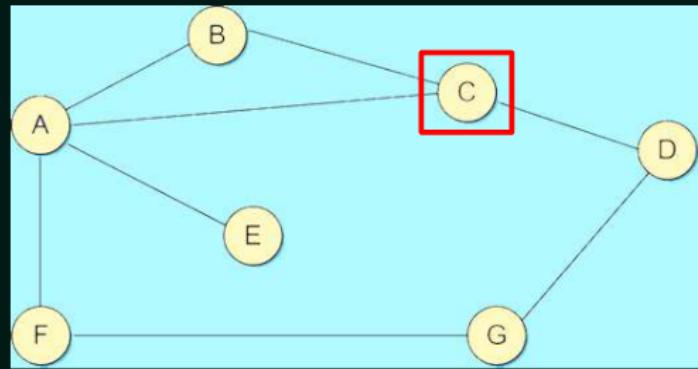


Neso Academy

Final Routing table of BNeso Academy

INITIAL ROUTING TABLE OF C

Destination	Cost	Next Hop
A	1	A
B	1	B
C	0	-
D	1	D
E	2	A
F	2	A
G	2	D

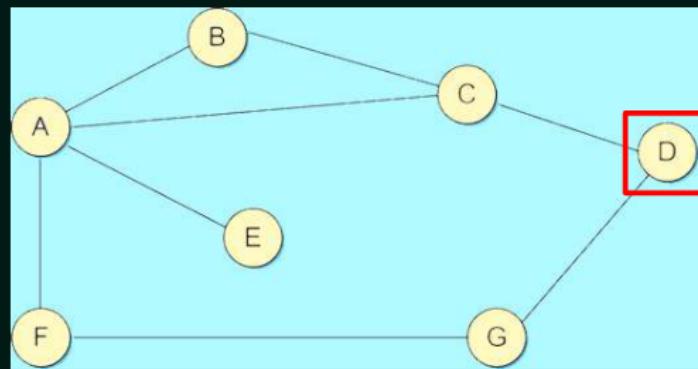


Neso Academy

Initial Routing table of CNeso Academy

INITIAL ROUTING TABLE OF D

Destination	Cost	Next Hop
A	2	C
B	2	C
C	1	C
D	0	-
E	3	C
F	2	G
G	1	G

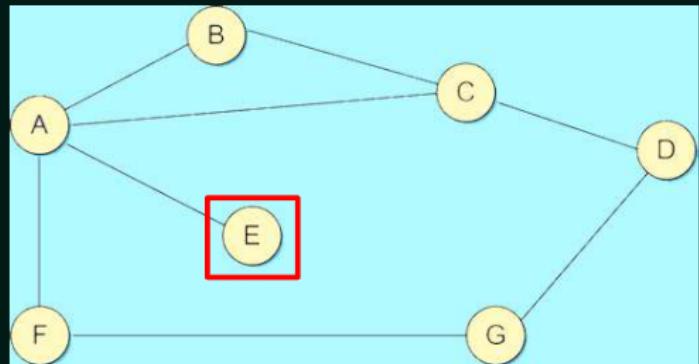


Neso Academy

Initial Routing table of DNeso Academy

INITIAL ROUTING TABLE OF E

Destination	Cost	Next Hop
A	1	A
B	2	A
C	2	A
D	3	A
E	0	-
F	2	A
G	3	A

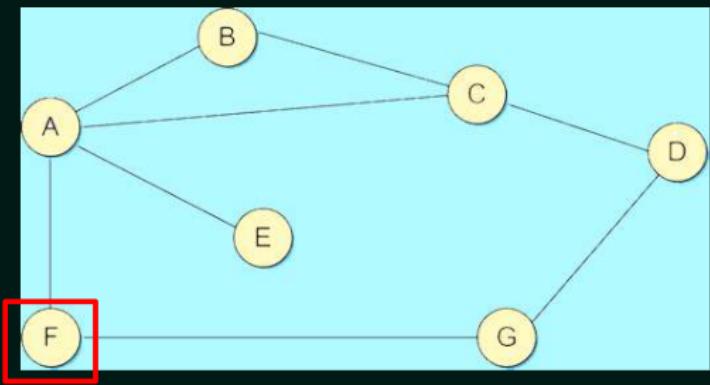


Neso Academy

Initial Routing table of ENeso Academy

INITIAL ROUTING TABLE OF F

Destination	Cost	Next Hop
A	1	A
B	2	A
C	2	A
D	2	G
E	2	A
F	0	-
G	1	G

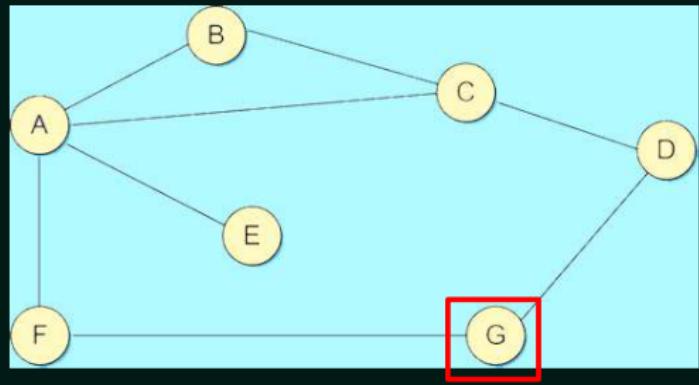


Neso Academy

Initial Routing table of FNeso Academy

INITIAL ROUTING TABLE OF G

Destination	Cost	Next Hop
A	2	F
B	3	F
C	2	D
D	1	1
E	3	F
F	1	1
G	0	-



Initial Routing table of G
Neso Academy

FINAL DISTANCE STORED AT EACH NODE

Information stored at Node	Distance to reach node						
	A	B	C	D	E	F	G
A	0	1	1	2	1	1	2
B	1	0	1	2	2	2	3
C	1	1	0	1	2	2	2
D	2	2	1	0	3	2	1
E	1	2	2	3	0	2	3
F	1	2	2	2	2	0	1
G	2	3	2	1	3	1	0

Final distance stored at each node
Neso Academy

OUTCOMES

Upon the completion of this lecture, the learner will be able to

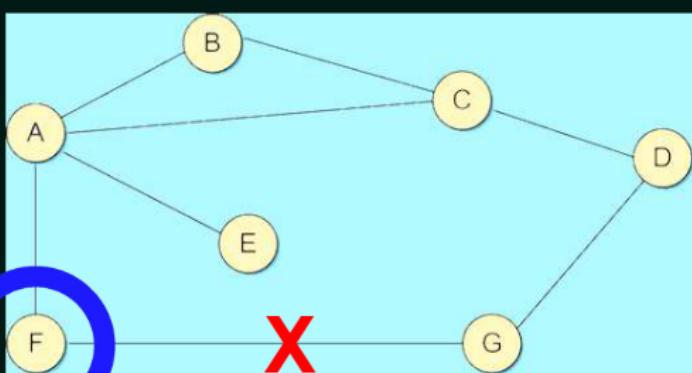
- ★ Understand how link failure is handled in Distance Vector Routing (DVR).

Outcomes ★ Neso Academy

WHEN A NODE DETECTS A LINK FAILURE?

F

A	1
B	2
C	2
D	2
E	2
F	0
G	1



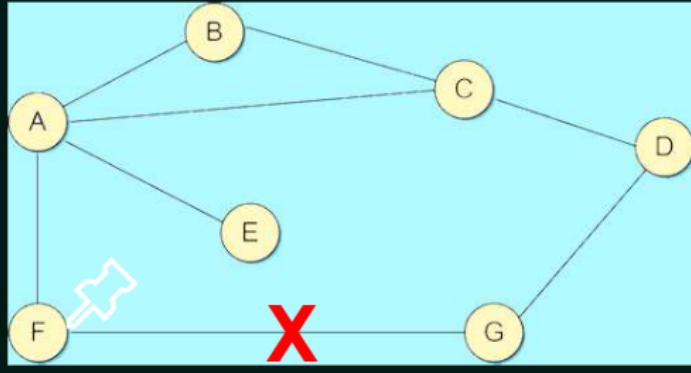
F detects that link to G has failed.

When a node detects a link failure? XFNeso Academy

WHEN A NODE DETECTS A LINK FAILURE?

F

A	1
B	2
C	2
D	2
E	2
F	0
G	1



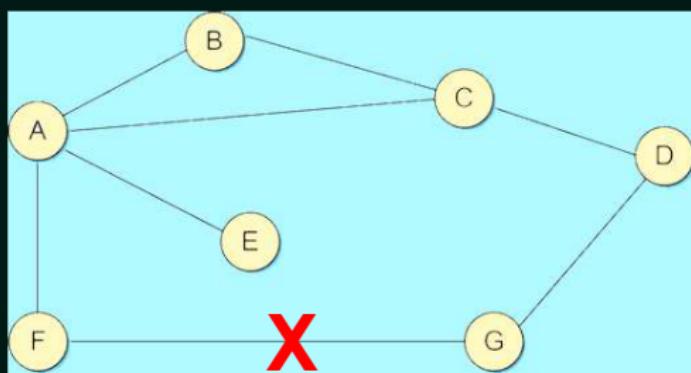
F sets distance to G to infinity and sends update to A.

When a node detects a link failure? X FNeso Academy

WHEN A NODE DETECTS A LINK FAILURE?

F

A	1
B	2
C	2
D	2
E	2
F	0
G	1



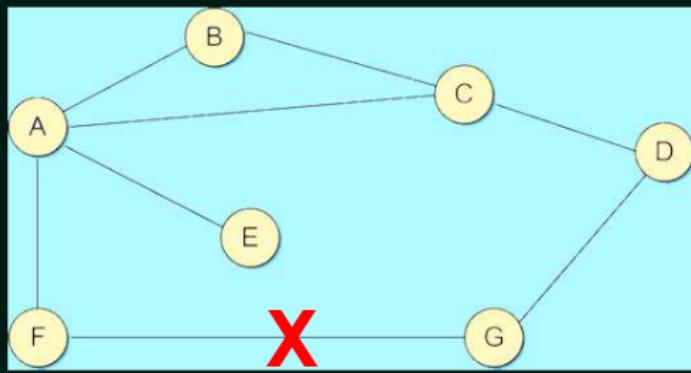
F sets distance to G to infinity and sends update to A.

When a node detects a link failure? X FNeso Academy

WHEN A NODE DETECTS A LINK FAILURE?

F

A	1
B	2
C	2
D	2
E	2
F	0
G	



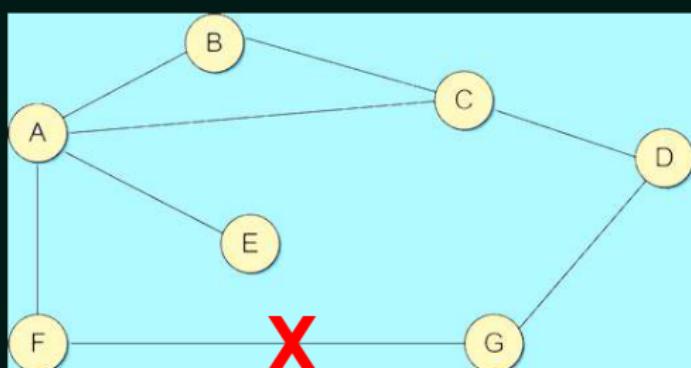
F sets distance to G to infinity and sends update to A.

Neso Academy

WHEN A NODE DETECTS A LINK FAILURE?

F

A	1
B	2
C	2
D	2
E	2
F	0
G	∞



F sets distance to G to infinity and sends update to A.

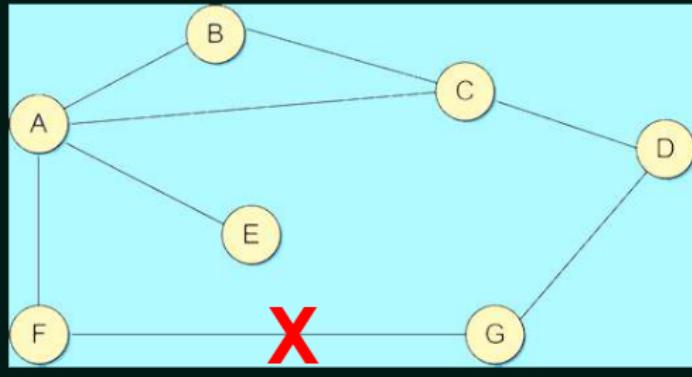
Neso Academy

When a node detects a link failure? X F ∞ Neso Academy

WHEN A NODE DETECTS A LINK FAILURE?

F

A	1
B	2
C	2
D	2
E	2
F	0
G	∞



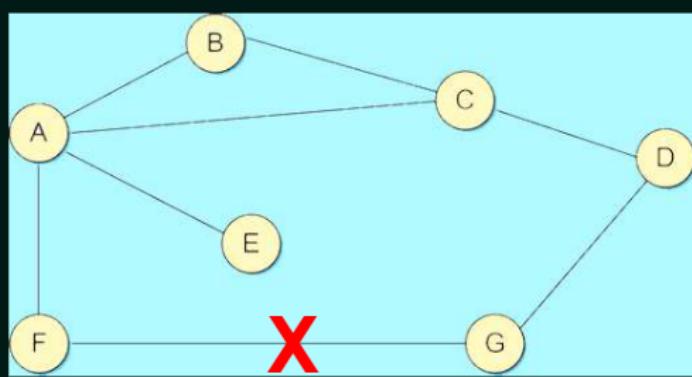
F sets distance to G to infinity and sends update to A.

Neso Academy

WHEN A NODE DETECTS A LINK FAILURE?

F

A	1
B	2
C	2
D	2
E	2
F	0
G	∞



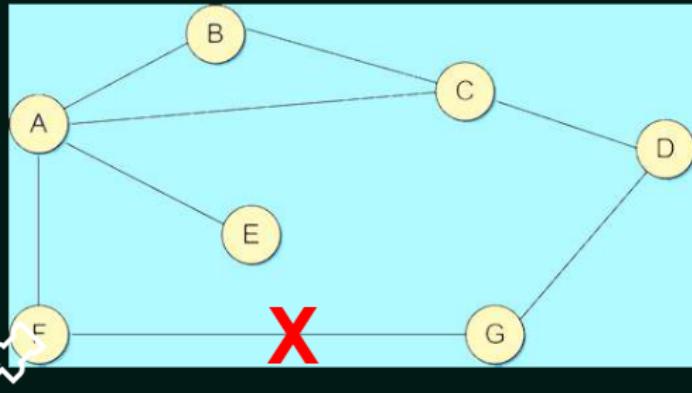
F sets distance to G to infinity and sends update to A.

Neso Academy

When a node detects a link failure?XF ∞ Neso Academy

WHEN A NODE DETECTS A LINK FAILURE?

F	A
A	1
B	2
C	2
D	2
E	2
F	0
G	∞

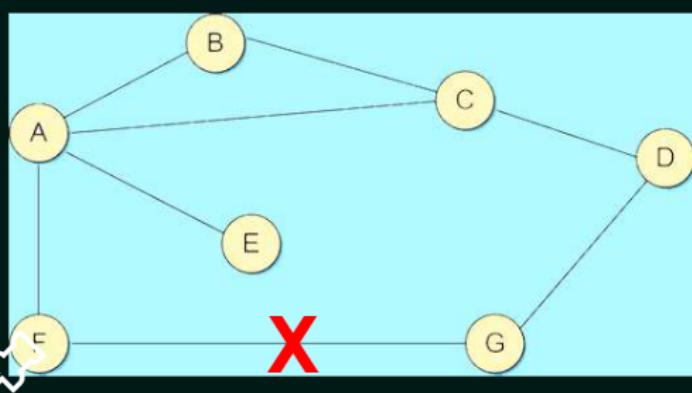


A sets distance to G to infinity since it uses F to reach G.

When a node detects a link failure? XF ∞ A Neso Academy

WHEN A NODE DETECTS A LINK FAILURE?

F	A
A	1
B	2
C	2
D	2
E	2
F	0
G	∞

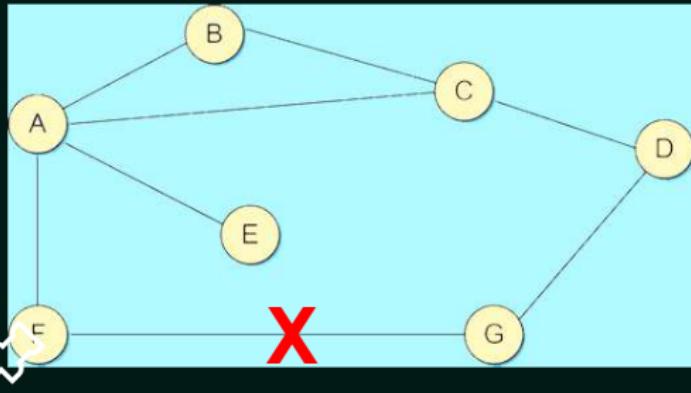


A sets distance to G to infinity since it uses F to reach G.

When a node detects a link failure? XF ∞ A Neso Academy

WHEN A NODE DETECTS A LINK FAILURE?

F	A
A	1
B	2
C	2
D	2
E	2
F	0
G	∞



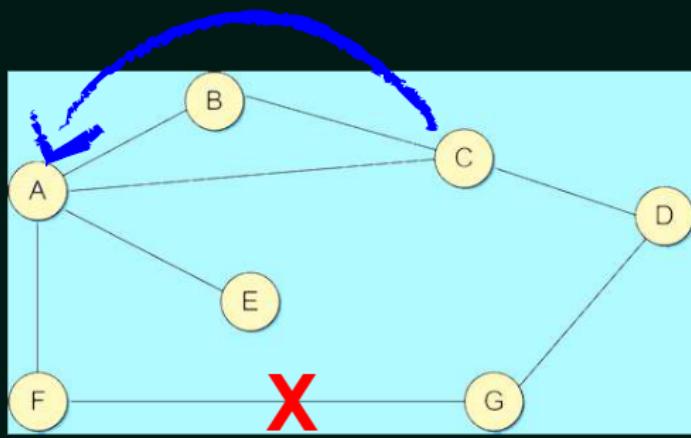
A sets distance to G to infinity since it uses F to reach G.

Neso Academy

When a node detects a link failure? XF ∞ A ∞ Neso Academy

WHEN A NODE DETECTS A LINK FAILURE?

F	A
A	1
B	2
C	2
D	2
E	2
F	0
G	∞



C	
A	
B	
C	0
D	
E	
F	
G	2

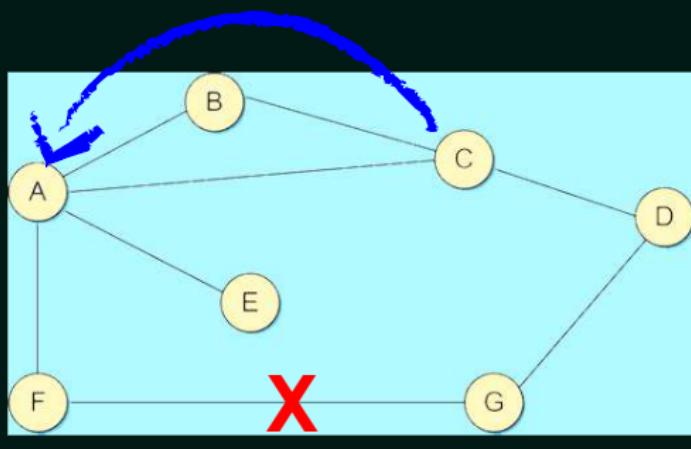
A receives periodic update from C with 2-hop path to G.

Neso Academy

When a node detects a link failure? XF ∞ A ∞ C Neso Academy

WHEN A NODE DETECTS A LINK FAILURE?

F	A
A 1	G 0
B 2	B 1
C 2	C 1
D 2	D 2
E 2	E 1
F 0	F 1
G ∞	G ∞



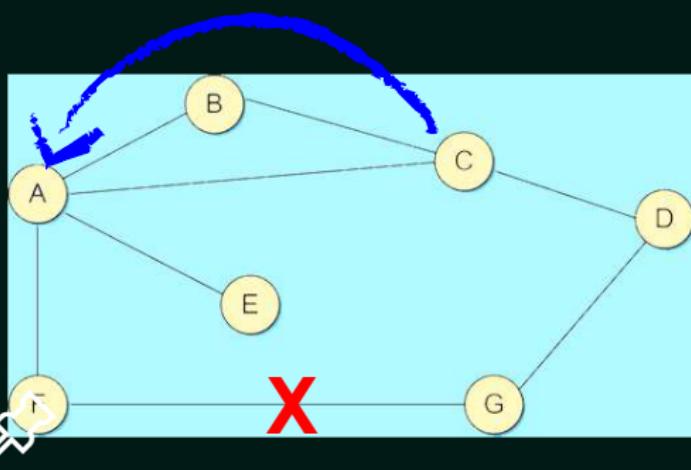
C
A 1
B 1
C 0
D 1
E 2
F 2
G 2

A sets distance to G to 3 and sends update to F.

When a node detects a link failure? XF ∞ A ∞ C Neso Academy

WHEN A NODE DETECTS A LINK FAILURE?

F	A
A 1	G 0
B 2	B 1
C 2	C 1
D 2	D 2
E 2	E 1
F 0	F 1
G ∞	G ∞

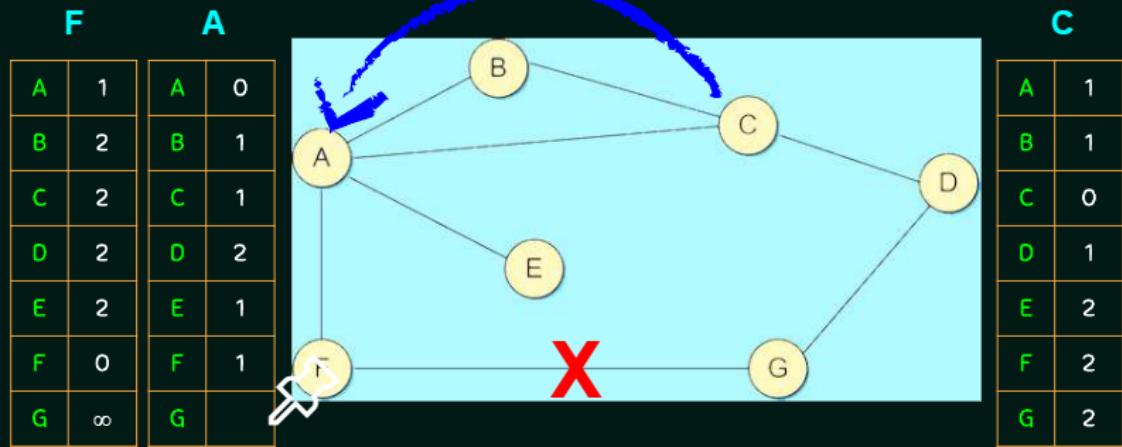


C
A 1
B 1
C 0
D 1
E 2
F 2
G 2

A sets distance to G to 3 and sends update to F.

When a node detects a link failure? XF ∞ A ∞ C Neso Academy

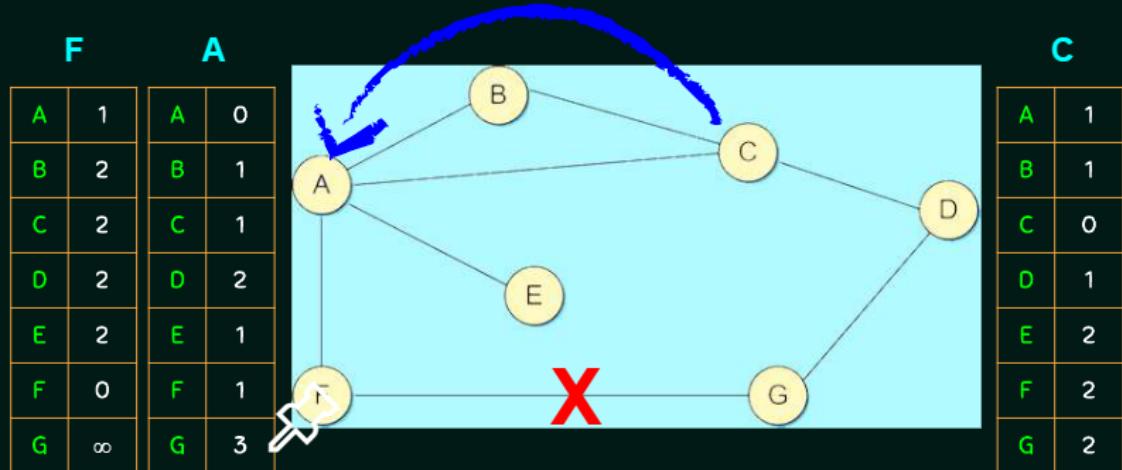
WHEN A NODE DETECTS A LINK FAILURE?



A sets distance to G to 3 and sends update to F.

When a node detects a link failure? XF ∞ AC Neso Academy

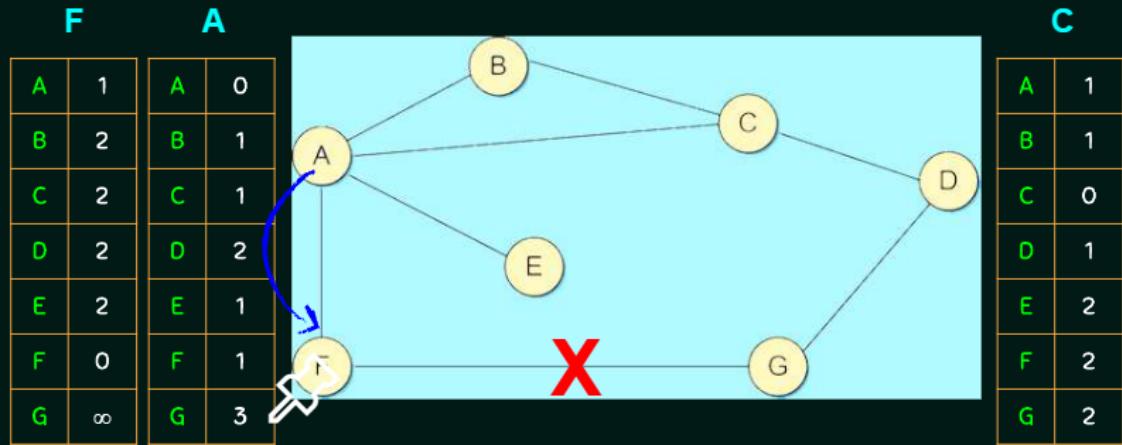
WHEN A NODE DETECTS A LINK FAILURE?



A sets distance to G to 3 and sends update to F.

When a node detects a link failure? XF ∞ AC Neso Academy

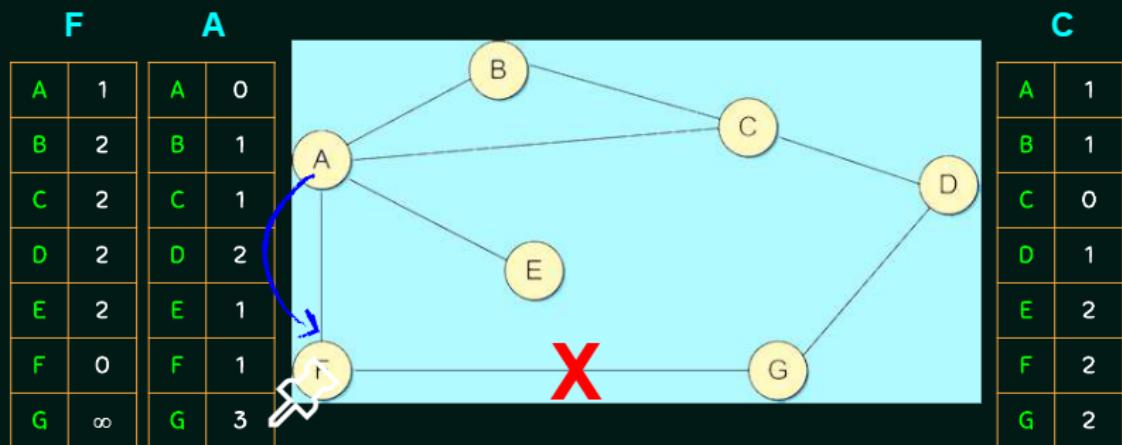
WHEN A NODE DETECTS A LINK FAILURE?



A sets distance to G to 3 and sends update to F.

When a node detects a link failure? XF∞AC Neso Academy

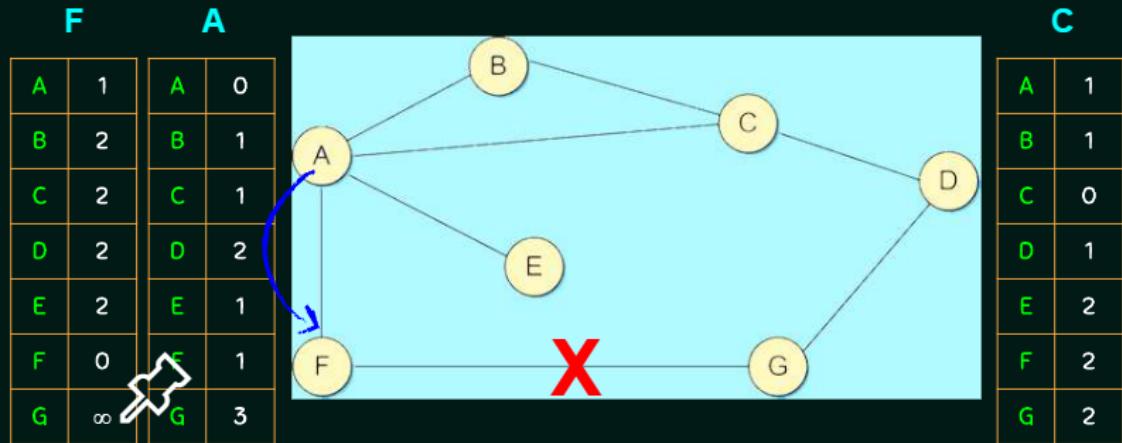
WHEN A NODE DETECTS A LINK FAILURE?



F decides it can reach G in 4 hops via A.

When a node detects a link failure? XF∞AC Neso Academy

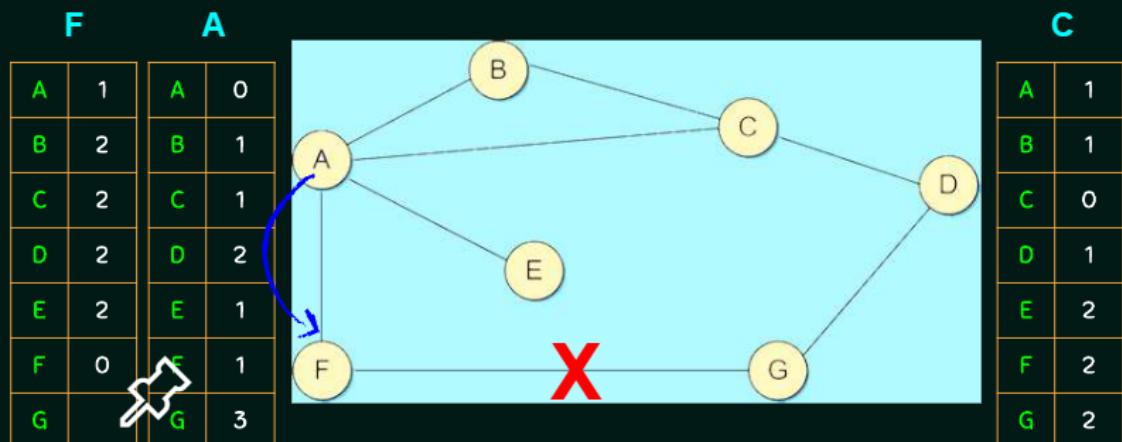
WHEN A NODE DETECTS A LINK FAILURE?



F decides it can reach G in 4 hops via A.

When a node detects a link failure? XF ∞ AC Neso Academy

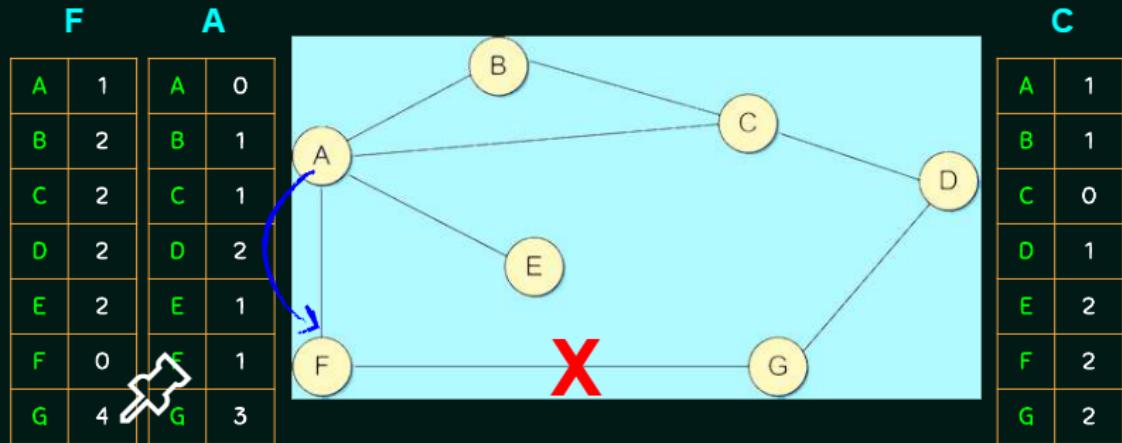
WHEN A NODE DETECTS A LINK FAILURE?



F decides it can reach G in 4 hops via A.

When a node detects a link failure? XFAC Neso Academy

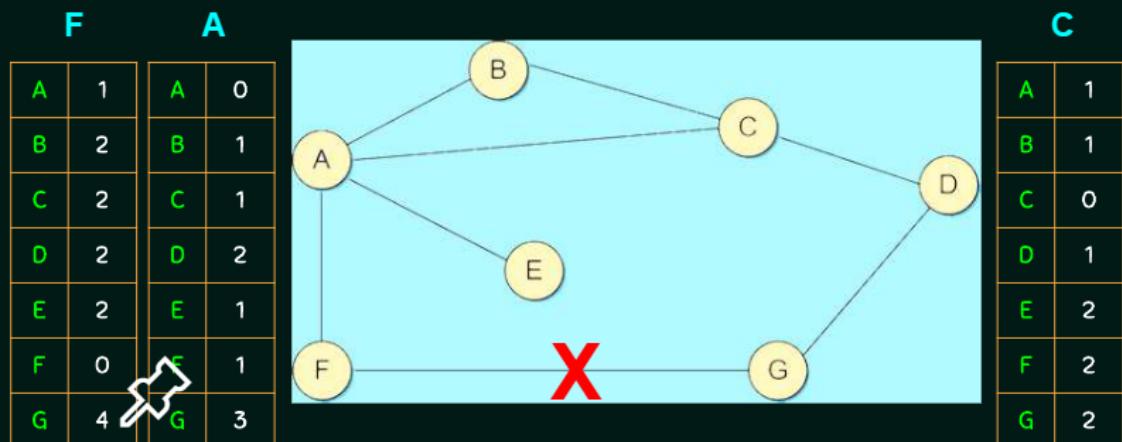
WHEN A NODE DETECTS A LINK FAILURE?



F decides it can reach G in 4 hops via A.

When a node detects a link failure? XFAC Neso Academy

WHEN A NODE DETECTS A LINK FAILURE?



F decides it can reach G in 4 hops via A.

When a node detects a link failure? XFAC Neso Academy

OUTCOMES

Upon the completion of this lecture, the learner will be able to

- ★ Understand Count-to-infinity problem.
- ★ Know the solutions for Count-to-infinity problem.

Outcomes ★ Neso Academy

COUNT-TO-INFINITY PROBLEM



A's Routing Table		
Dest	Cost	Next Hop
B	1	B
C	3	B

B's Routing Table		
Dest	Cost	Next Hop
A	1	A
C	2	C

C's Routing Table		
Dest	Cost	Next Hop
A	3	B
B	2	B

Count-to-infinity Problem X Neso Academy

COUNT-TO-INFINITY PROBLEM



A's Routing Table		
Dest	Cost	Next Hop
B	1	B
C	3	B

B's Routing Table		
Dest	Cost	Next Hop
A	1	A
C	2	C

C's Routing Table		
Dest	Cost	Next Hop
A		
B		

Count-to-infinity ProblemXNeso Academy

COUNT-TO-INFINITY PROBLEM



A's Routing Table		
Dest	Cost	Next Hop
B	1	B
C	3	B

B's Routing Table		
Dest	Cost	Next Hop
A	1	A
C	2	C

C's Routing Table		
Dest	Cost	Next Hop
A		
B		

Count-to-infinity ProblemXNeso Academy

COUNT-TO-INFINITY PROBLEM



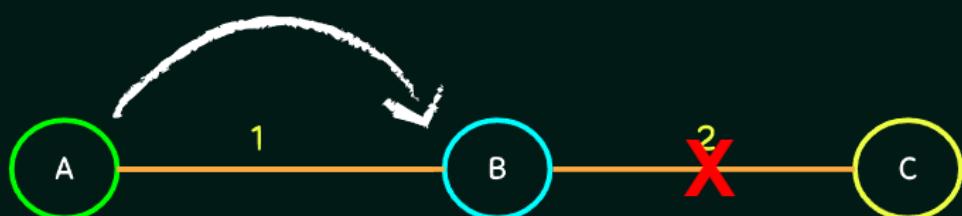
A's Routing Table		
Dest	Cost	Next Hop
B	1	B
C	3	B

B's Routing Table		
Dest	Cost	Next Hop
A	1	A
C		

C's Routing Table		
Dest	Cost	Next Hop
A		
B		

Count-to-infinity ProblemXNeso Academy

COUNT-TO-INFINITY PROBLEM



A's Routing Table		
Dest	Cost	Next Hop
B	1	B
C	3	B

B's Routing Table		
Dest	Cost	Next Hop
A	1	A
C		

C's Routing Table		
Dest	Cost	Next Hop
A		
B		

Count-to-infinity ProblemXNeso Academy

COUNT-TO-INFINITY PROBLEM



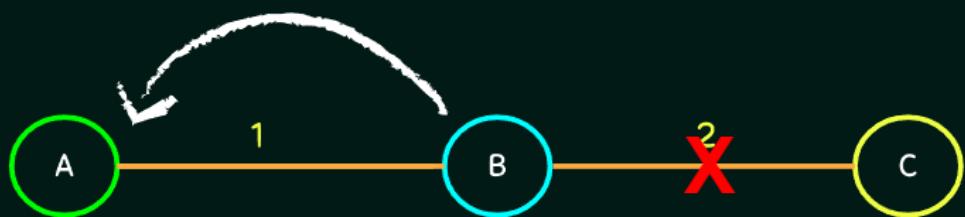
A's Routing Table		
Dest	Cost	Next Hop
B	1	B
C	3	B

B's Routing Table		
Dest	Cost	Next Hop
A	1	A
C	4	A

C's Routing Table		
Dest	Cost	Next Hop
A		
B		

Count-to-infinity ProblemXNeso Academy

COUNT-TO-INFINITY PROBLEM



A's Routing Table		
Dest	Cost	Next Hop
B	1	B
C	5	B

B's Routing Table		
Dest	Cost	Next Hop
A	1	A
C	4	A

C's Routing Table		
Dest	Cost	Next Hop
A		
B		

Count-to-infinity ProblemXNeso Academy

COUNT-TO-INFINITY PROBLEM



A's Routing Table		
Dest	Cost	Next Hop
B	1	B
C	5	B

B's Routing Table		
Dest	Cost	Next Hop
A	1	A
C	4	A

C's Routing Table		
Dest	Cost	Next Hop
A		
B		

Count-to-infinity ProblemXNeso Academy

COUNT-TO-INFINITY PROBLEM



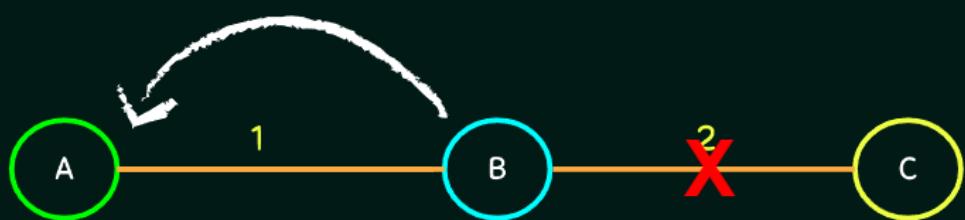
A's Routing Table		
Dest	Cost	Next Hop
B	1	B
C	5	B

B's Routing Table		
Dest	Cost	Next Hop
A	1	A
C	6	A

C's Routing Table		
Dest	Cost	Next Hop
A		
B		

Count-to-infinity ProblemXNeso Academy

COUNT-TO-INFINITY PROBLEM



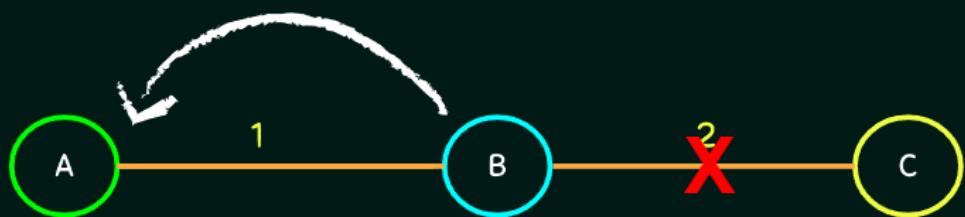
A's Routing Table		
Dest	Cost	Next Hop
B	1	B
C	5	B

B's Routing Table		
Dest	Cost	Next Hop
A	1	A
C	6	A

C's Routing Table		
Dest	Cost	Next Hop
A		
B		

Count-to-infinity Problem XNeso Academy

COUNT-TO-INFINITY PROBLEM



A's Routing Table		
Dest	Cost	Next Hop
B	1	B
C	7	B

B's Routing Table		
Dest	Cost	Next Hop
A	1	A
C	6	A

C's Routing Table		
Dest	Cost	Next Hop
A		
B		

Count-to-infinity Problem XNeso Academy

COUNT-TO-INFINITY PROBLEM



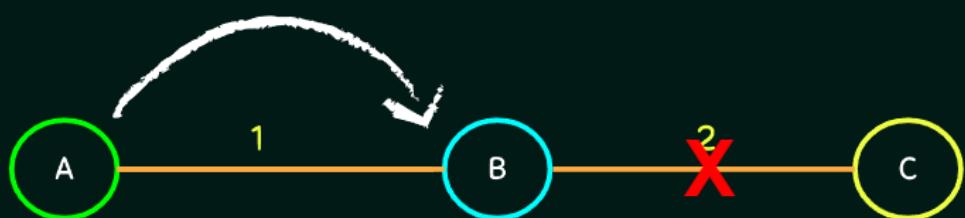
A's Routing Table		
Dest	Cost	Next Hop
B	1	B
C	7	B

B's Routing Table		
Dest	Cost	Next Hop
A	1	A
C	6	A

C's Routing Table		
Dest	Cost	Next Hop
A		
B		

Count-to-infinity ProblemXNeso Academy

COUNT-TO-INFINITY PROBLEM



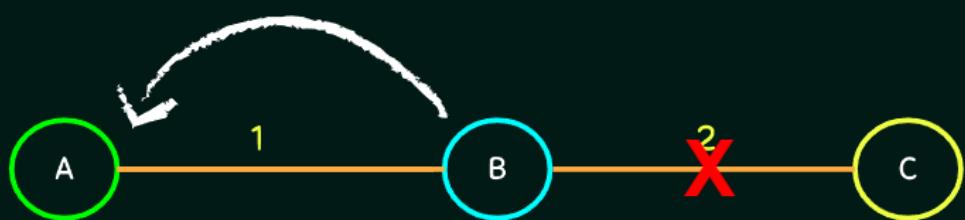
A's Routing Table		
Dest	Cost	Next Hop
B	1	B
C	7	B

B's Routing Table		
Dest	Cost	Next Hop
A	1	A
C	8	A

C's Routing Table		
Dest	Cost	Next Hop
A		
B		

Count-to-infinity ProblemXNeso Academy

COUNT-TO-INFINITY PROBLEM



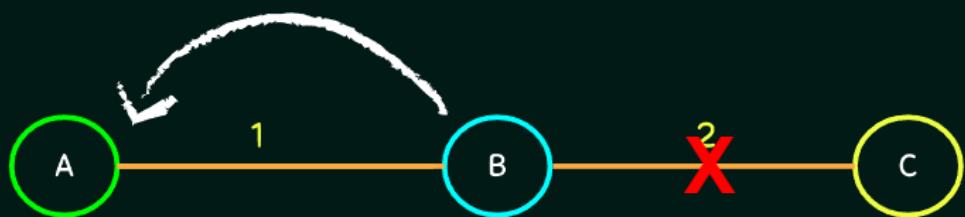
A's Routing Table		
Dest	Cost	Next Hop
B	1	B
C	7	B

B's Routing Table		
Dest	Cost	Next Hop
A	1	A
C	8	A

C's Routing Table		
Dest	Cost	Next Hop
A		
B		

Count-to-infinity Problem XNeso Academy

COUNT-TO-INFINITY PROBLEM



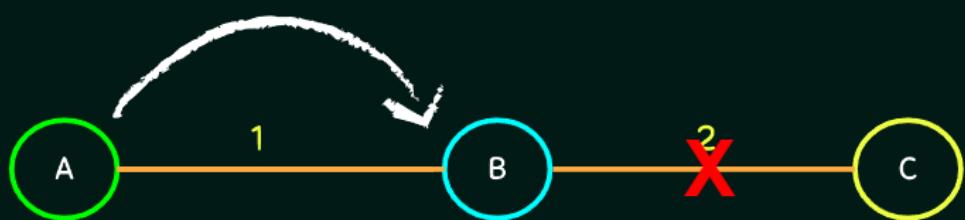
A's Routing Table		
Dest	Cost	Next Hop
B	1	B
C	9	B

B's Routing Table		
Dest	Cost	Next Hop
A	1	A
C	8	A

C's Routing Table		
Dest	Cost	Next Hop
A		
B		

Count-to-infinity Problem XNeso Academy

COUNT-TO-INFINITY PROBLEM



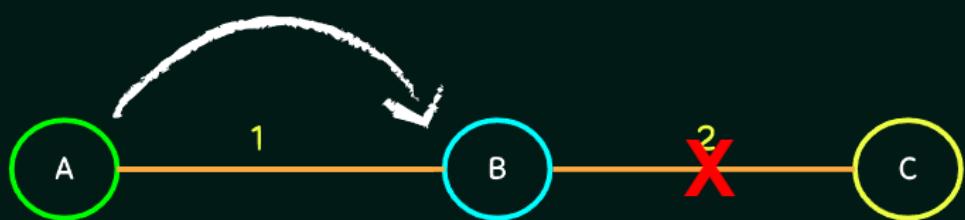
A's Routing Table		
Dest	Cost	Next Hop
B	1	B
C	9	B

B's Routing Table		
Dest	Cost	Next Hop
A	1	A
C	8	A

C's Routing Table		
Dest	Cost	Next Hop
A		
B		

Count-to-infinity Problem XNeso Academy

COUNT-TO-INFINITY PROBLEM



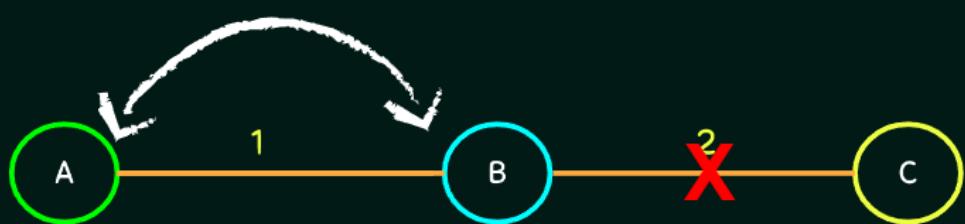
A's Routing Table		
Dest	Cost	Next Hop
B	1	B
C	9	B

B's Routing Table		
Dest	Cost	Next Hop
A	1	A
C	9	A

C's Routing Table		
Dest	Cost	Next Hop
A		
B		

Count-to-infinity Problem XNeso Academy

COUNT-TO-INFINITY PROBLEM



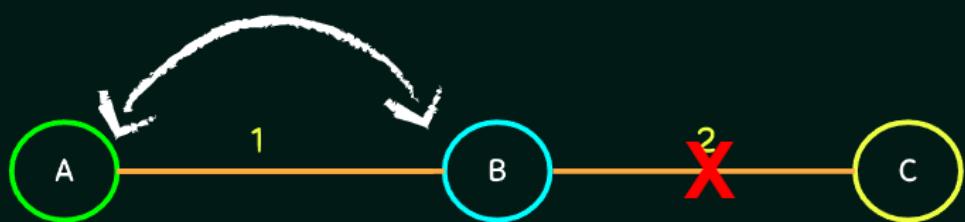
A's Routing Table		
Dest	Cost	Next Hop
B	1	B
C	9	B

B's Routing Table		
Dest	Cost	Next Hop
A	1	A
C	9	A

C's Routing Table		
Dest	Cost	Next Hop
A		
B		

Count-to-infinity Problem XNeso Academy

COUNT-TO-INFINITY PROBLEM



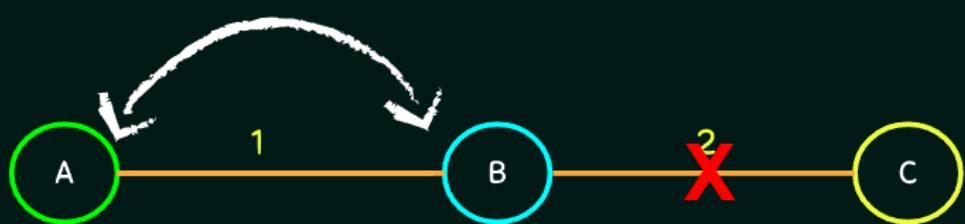
A's Routing Table		
Dest	Cost	Next Hop
B	1	B
C	9	B

B's Routing Table		
Dest	Cost	Next Hop
A	1	A
C	10	A

C's Routing Table		
Dest	Cost	Next Hop
A		
B		

Count-to-infinity Problem XNeso Academy

COUNT-TO-INFINITY PROBLEM



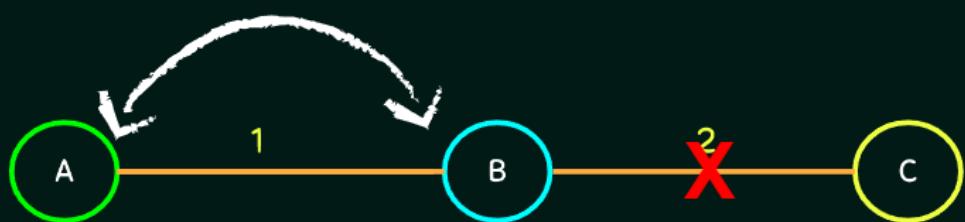
A's Routing Table		
Dest	Cost	Next Hop
B	1	B
C	11	B

B's Routing Table		
Dest	Cost	Next Hop
A	1	A
C	10	A

C's Routing Table		
Dest	Cost	Next Hop
A		
B		

Count-to-infinity Problem XNeso Academy

COUNT-TO-INFINITY PROBLEM



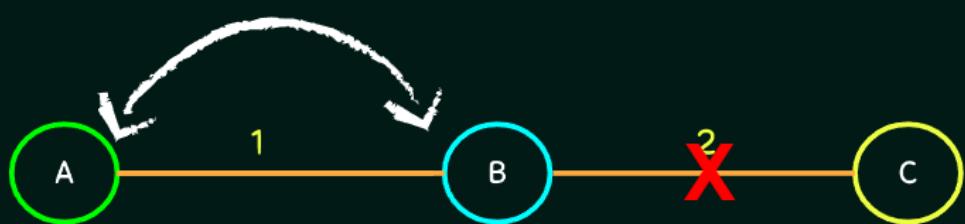
A's Routing Table		
Dest	Cost	Next Hop
B	1	B
C	11	B

B's Routing Table		
Dest	Cost	Next Hop
A	1	A
C	12	A

C's Routing Table		
Dest	Cost	Next Hop
A		
B		

Count-to-infinity Problem XNeso Academy

COUNT-TO-INFINITY PROBLEM



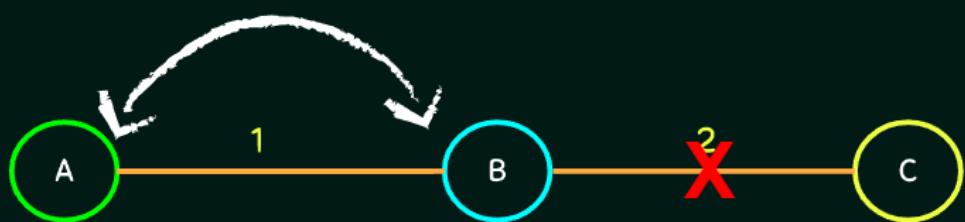
A's Routing Table		
Dest	Cost	Next Hop
B	1	B
C	13	B

B's Routing Table		
Dest	Cost	Next Hop
A	1	A
C	12	A

C's Routing Table		
Dest	Cost	Next Hop
A		
B		

Count-to-infinity Problem XNeso Academy

COUNT-TO-INFINITY PROBLEM



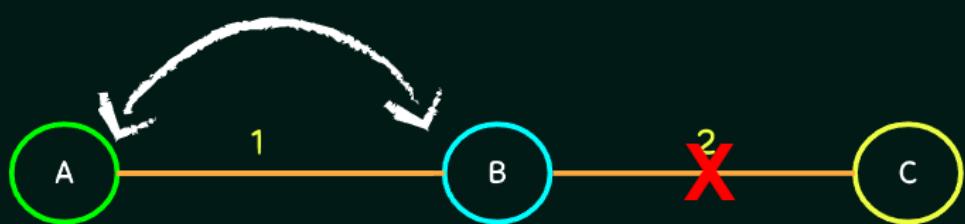
A's Routing Table		
Dest	Cost	Next Hop
B	1	B
C	13	B

B's Routing Table		
Dest	Cost	Next Hop
A	1	A
C	14	A

C's Routing Table		
Dest	Cost	Next Hop
A		
B		

Count-to-infinity Problem XNeso Academy

COUNT-TO-INFINITY PROBLEM



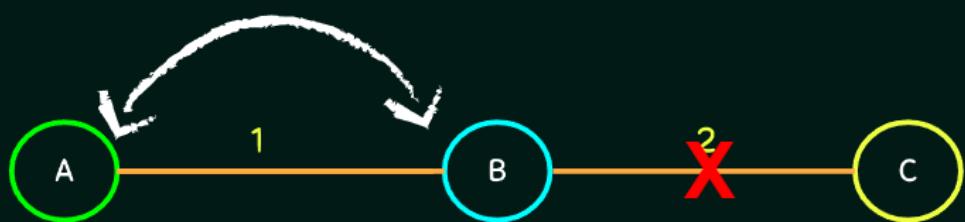
A's Routing Table		
Dest	Cost	Next Hop
B	1	B
C	15	B

B's Routing Table		
Dest	Cost	Next Hop
A	1	A
C	14	A

C's Routing Table		
Dest	Cost	Next Hop
A		
B		

Count-to-infinity Problem XNeso Academy

COUNT-TO-INFINITY PROBLEM



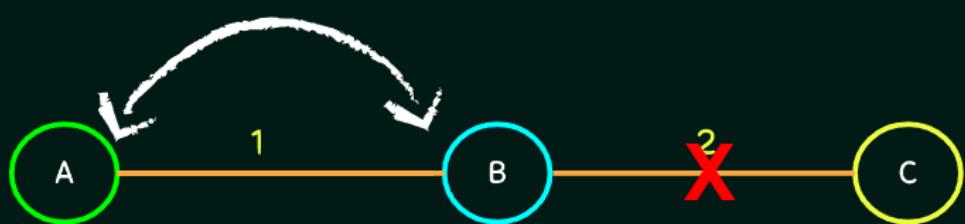
A's Routing Table		
Dest	Cost	Next Hop
B	1	B
C	15	B

B's Routing Table		
Dest	Cost	Next Hop
A	1	A
C	16	A

C's Routing Table		
Dest	Cost	Next Hop
A		
B		

Count-to-infinity Problem XNeso Academy

COUNT-TO-INFINITY PROBLEM



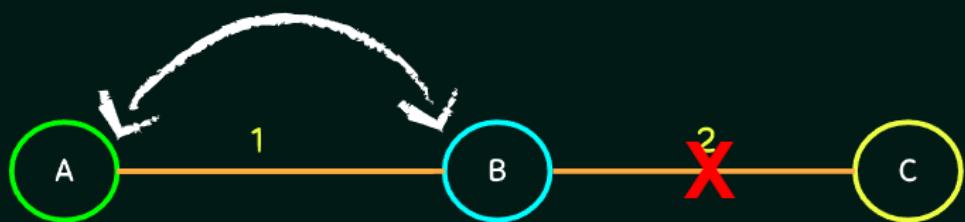
A's Routing Table		
Dest	Cost	Next Hop
B	1	B
C	17	B

B's Routing Table		
Dest	Cost	Next Hop
A	1	A
C	16	A

C's Routing Table		
Dest	Cost	Next Hop
A		
B		

Count-to-infinity Problem XNeso Academy

COUNT-TO-INFINITY PROBLEM



A's Routing Table		
Dest	Cost	Next Hop
B	1	B
C	3	B

B's Routing Table		
Dest	Cost	Next Hop
A	1	A
C		

C's Routing Table		
Dest	Cost	Next Hop
A		
B		

Count-to-infinity Problem XNeso Academy

COUNT-TO-INFINITY PROBLEM

SOLUTIONS

- ★ Split Horizon
- ★ Split Horizon with poison reverse

Count-to-infinity problem ★★ Neso Academy

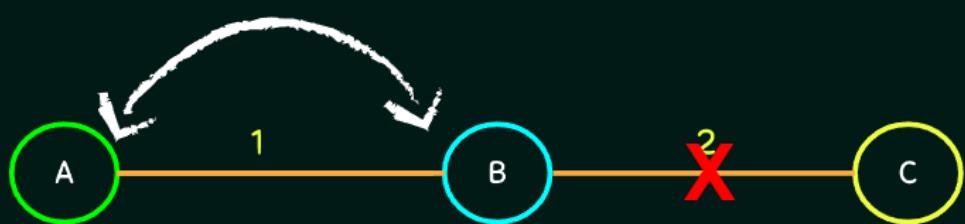
OUTCOMES

Upon the completion of this lecture, the learner will be able to

- ★ Understand Count-to-infinity problem.
- ★ Know about split horizon.
- ★ Know about split horizon with poison reverse.

Outcomes ★★★ Neso Academy

COUNT-TO-INFINITY PROBLEM



A's Routing Table		
Dest	Cost	Next Hop
B	1	B
C	17	B

B's Routing Table		
Dest	Cost	Next Hop
A	1	A
C	16	A

C's Routing Table		
Dest	Cost	Next Hop
A		
B		

Count-to-infinity Problem X Neso Academy

COUNT-TO-INFINITY PROBLEM

SOLUTIONS

- ★ Split Horizon
- ★ Split Horizon with poison reverse

Count-to-infinity Problem ★★ Neso Academy

SPLIT HORIZON

- ★ In computer networking, split-horizon route advertisement is a method of preventing routing loops in distance-vector routing protocols by prohibiting a router from advertising a route back onto the interface from which it was learned.
- ★ In other words, it is a method of preventing a routing loop in a network.
- ★ **The basic principle is simple:** Information about the routing for a particular packet is never sent back in the direction from which it was received.
- ★ With the split-horizon rule in place, this particular loop scenario cannot happen, improving convergence time in complex, highly-redundant environments.

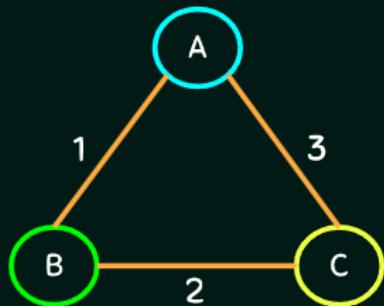
Split horizon★★★★Neso Academy

POISON REVERSE

- ★ Poison Reverse is an implemented algorithm that is often used within distance-vector routing.
- ★ The use of poison reverse is to solve the count-to-infinity problem.
- ★ Practically, poison reverse can be thought of as the reverse of split horizon.
- ★ With poison reverse, route advertisements that would be suppressed by split horizon are instead advertised with a distance of infinity.

Poison reverse★★★★Neso Academy

POISON REVERSE



Distance	A	B	C
A	0	1	3
B	1	0	2
C	3	2	0

As A routes via B to get to C and because of that have the cost 3. The poison reverse kicks in when we broadcast our distance vector to our neighbors: The distance tables we broadcast is:

To B: $[0, 1, \infty]$

To C: $[0, 1, 3]$

As we see in the distance vector that is broadcast to node B the end destination C has an infinity value. This solves the count-to-infinity problem since if the link between B and A will not bounce between each other and instead directly try another path.

Poison reverse∞Neso Academy

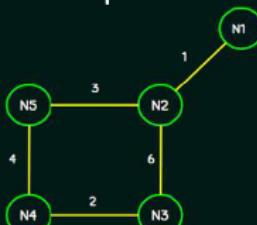
QUESTION

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 that 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 neighbours. 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. The cost of link N2–N3 reduces to 2 (in both directions). After the next round of update what will be the new distance vector at node, N3?

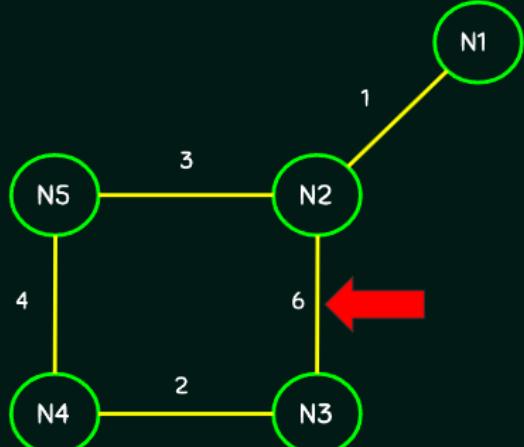
- (A) (3, 2, 0, 2, 5)
- (B) (3, 2, 0, 2, 6)
- (C) (7, 2, 0, 2, 5)
- (D) (7, 2, 0, 2, 6)



[GATE CS 2011]

QuestionNeso Academy

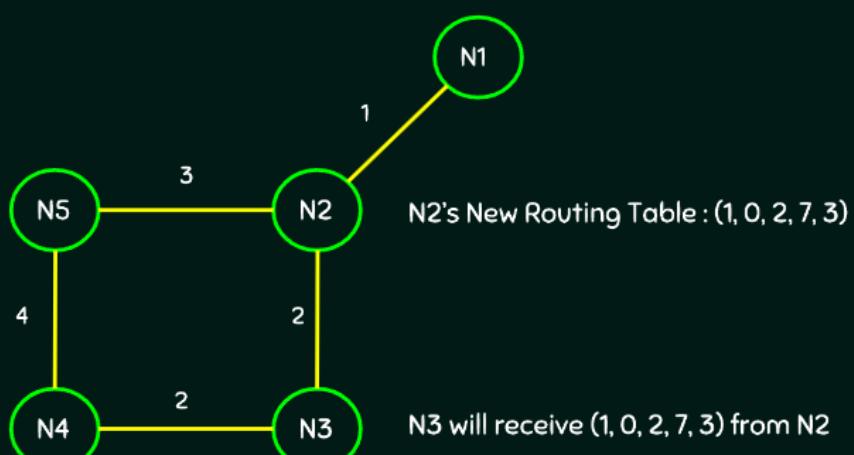
SOLUTION



Neso Academy

SolutionNeso Academy

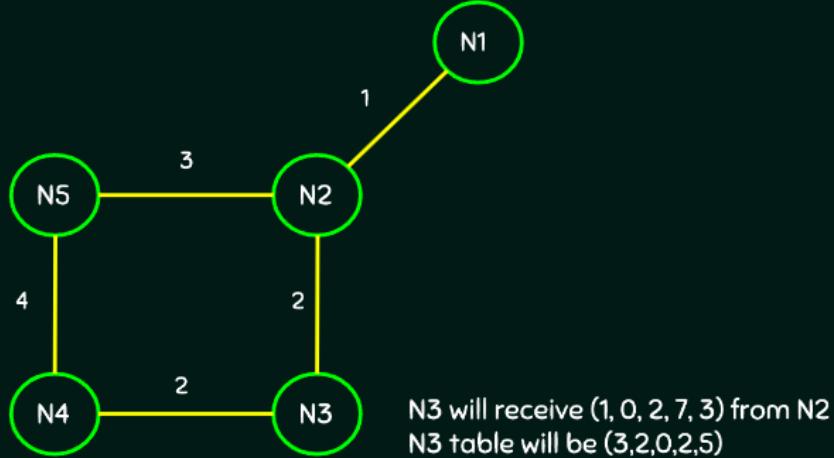
SOLUTION



Neso Academy

SolutionNeso Academy

SOLUTION



SolutionNeso Academy

QUESTION

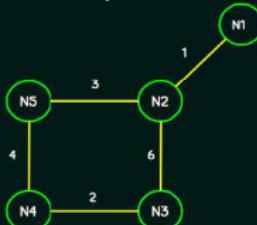
Consider a network with five nodes, N1 to N5, as shown below. The network uses a Distance Vector Routing protocol. Once the routes have stabilized, the distance vectors at different nodes are as following.

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 that 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 neighbours. 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. The cost of link N2–N3 reduces to 2 (in both directions). After the next round of update what will be the new distance vector at node, N3?

[GATE CS 2011]

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



Question✓Neso Academy

QUESTION

After the update in the previous question, the link N1-N2 goes down. N2 will reflect this change immediately in its distance vector as cost, ∞ . After the NEXT ROUND of update, what will be cost to N1 in the distance vector of N3?

[GATE CS 2011]

- (A) 3
- (B) 9
- (C) 10
- (D) ∞

Question∞∞Neso Academy

QUESTION

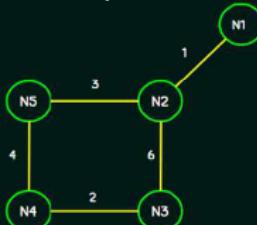
Consider a network with five nodes, N1 to N5, as shown below. The network uses a Distance Vector Routing protocol. Once the routes have stabilized, the distance vectors at different nodes are as following.

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 that 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 neighbours. 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. The cost of link N2-N3 reduces to 2 (in both directions). After the next round of update what will be the new distance vector at node, N3?

[GATE CS 2011]

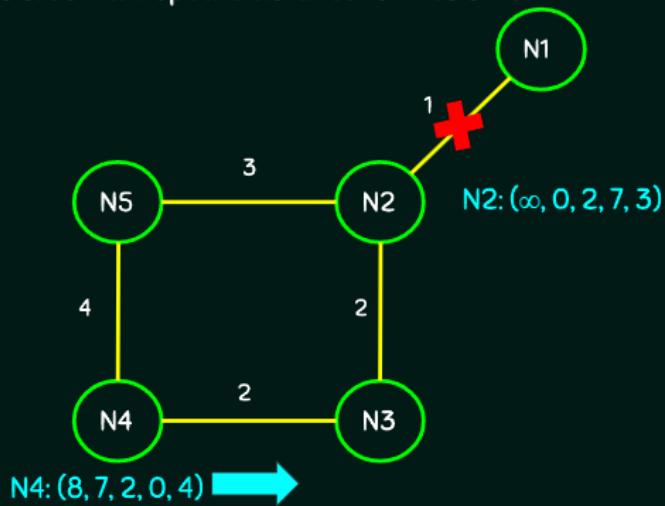
- (A) (3, 2, 0, 2, 5)
- (B) (3, 2, 0, 2, 6)
- (C) (7, 2, 0, 2, 5)
- (D) (7, 2, 0, 2, 6)



QuestionNeso Academy

SOLUTION

In the next round, N3 will receive distance from N2 to N1 as infinite. It will receive distance from N4 to N1 as 8. So it will update distance to N1 as $8 + 2$.



Solution∞Neso Academy

QUESTION

After the update in the previous question, the link N1-N2 goes down. N2 will reflect this change immediately in its distance vector as cost, ∞ . After the NEXT ROUND of update, what will be cost to N1 in the distance vector of N3?

[GATE CS 2011]

- (A) 3
- (B) 9
- (C) 10 ✓
- (D) ∞

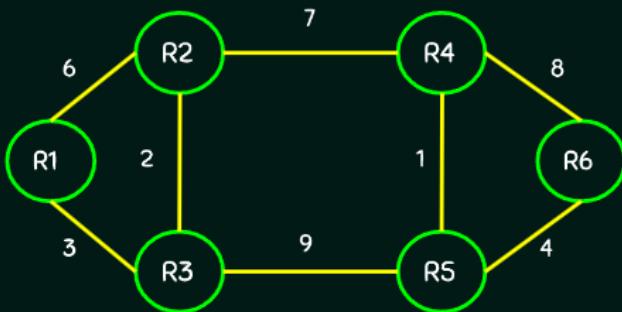
Question∞✓∞Neso Academy

QUESTION

Consider a network with 6 routers R1 to R6 connected with links having weights as shown in the following diagram. All the routers use the distance vector based routing algorithm to update their routing tables. Each router starts with its routing table initialized to contain an entry for each neighbour with the weight of the respective connecting link. After all the routing tables stabilize, how many links in the network will never be used for carrying any data?

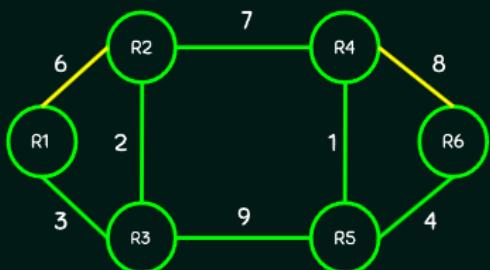
[GATE CS 2010]

- (A) 4
- (B) 3
- (C) 2
- (D) 1



QuestionNeso Academy

SOLUTION



Shortest Distances from R1 to R2, R3, R4, R5 and R6
R1 (5, 3, 12, 12, 16)

Links used: R1-R3, R3-R2, R2-R4, R3-R5, R5-R6

Shortest Distances from R2 to R3, R4, R5 and R6
R2 (2, 7, 8, 12)

Links used: R2-R3, R2-R4, R4-R5, R5-R6

Shortest Distances from R3 to R4, R5 and R6
R3 (9, 9, 13)

Links used: R3-R2, R2-R4, R3-R5, R5-R6

Shortest Distances from R4 to R5 and R6
R4 (1, 5)

Links used: R4-R5, R5-R6

Shortest Distance from R5 to R6
R5 (4)

Links Used: R5-R6

We can see that following links are never used.

R1-R2

R4-R6

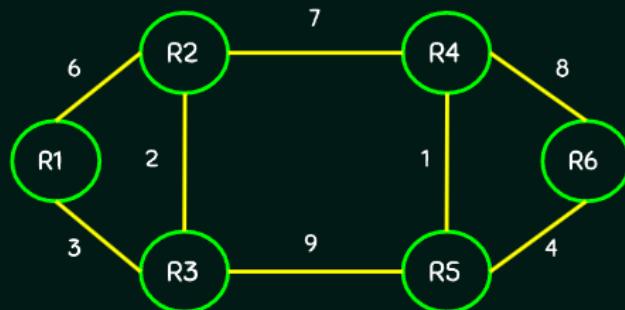
SolutionNeso Academy

QUESTION

Consider a network with 6 routers R1 to R6 connected with links having weights as shown in the following diagram. All the routers use the distance vector based routing algorithm to update their routing tables. Each router starts with its routing table initialized to contain an entry for each neighbour with the weight of the respective connecting link. After all the routing tables stabilize, how many links in the network will never be used for carrying any data?

[GATE CS 2010]

- (A) 4
- (B) 3
- (C) 2 ✓
- (D) 1



Question✓Neso Academy

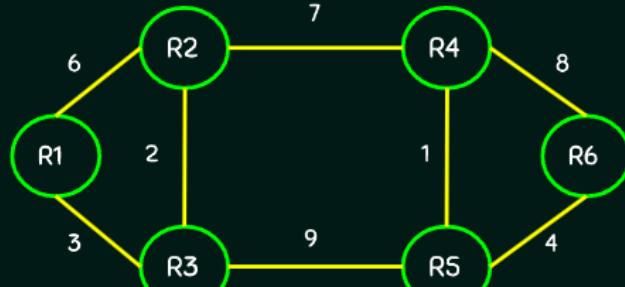
QUESTION

Consider a network with 6 routers R1 to R6 connected with links having weights as shown in the following diagram.

Suppose the weights of all unused links in the previous question are changed to 2 and the distance vector algorithm is used again until all routing tables stabilize. How many links will now remain unused?

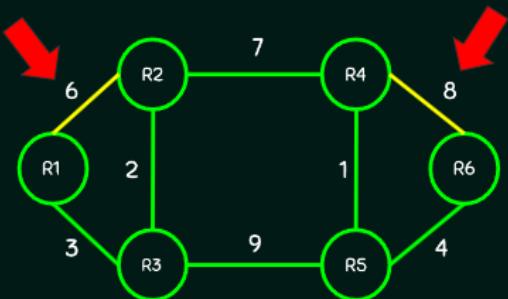
[GATE CS 2010]

- (A) 0
- (B) 1
- (C) 2
- (D) 3



QuestionNeso Academy

SOLUTION



Shortest Distances from R1 to R2, R3, R4, R5 and R6
R1 (5, 3, 12, 12, 16)
Links used: R1–R3, R3–R2, R2–R4, R3–R5, R5–R6

Shortest Distances from R2 to R3, R4, R5 and R6
R2 (2, 7, 8, 12)
Links used: R2–R3, R2–R4, R4–R5, R5–R6

Shortest Distances from R3 to R4, R5 and R6
R3 (9, 9, 13)
Links used: R3–R2, R2–R4, R3–R5, R5–R6

Shortest Distances from R4 to R5 and R6
R4 (1, 5)
Links used: R4–R5, R5–R6

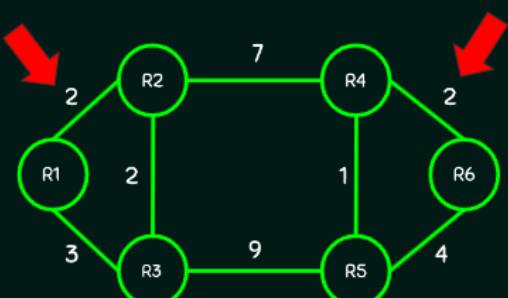
Shortest Distance from R5 to R6
R5 (4)
Links Used: R5–R6

We can see that following links are never used.
R1–R2
R4–R6

Neso Academy

SolutionNeso Academy

SOLUTION



Shortest Distances from R1 to R2, R3, R4, R5 and R6
R1 (5, 3, 12, 12, 16)
Links used: R1–R3, R3–R2, R2–R4, R3–R5, R5–R6

Shortest Distances from R2 to R3, R4, R5 and R6
R2 (2, 7, 8, 12)
Links used: R2–R3, R2–R4, R4–R5, R5–R6

Shortest Distances from R3 to R4, R5 and R6
R3 (9, 9, 13)
Links used: R3–R2, R2–R4, R3–R5, R5–R6

Shortest Distances from R4 to R5 and R6
R4 (1, 5)
Links used: R4–R5, R5–R6

Shortest Distance from R5 to R6
R5 (4)
Links Used: R5–R6

We can see that following links are never used.
R1–R2 (Shortest to reach R2 from R1)
R4–R6 (Shortest to reach R6 from R4)

Neso Academy

SolutionNeso Academy

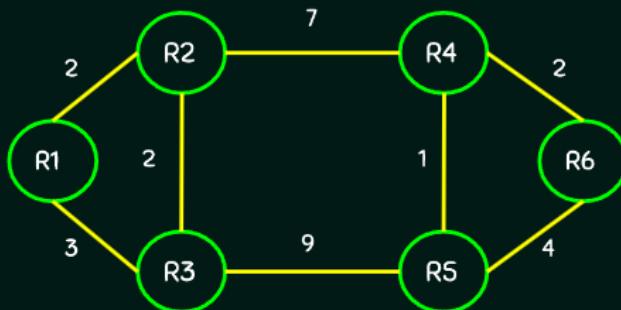
QUESTION

Consider a network with 6 routers R1 to R6 connected with links having weights as shown in the following diagram.

Suppose the weights of all unused links in the previous question are changed to 2 and the distance vector algorithm is used again until all routing tables stabilize. How many links will now remain unused?

- (A) 0 ✓
(B) 1
(C) 2
(D) 3

[GATE CS 2010]



Question✓Neso Academy

OUTCOMES

Upon the completion of this lecture, the learner will be able to

- ★ Understand the various RIP versions.
- ★ Compare RIPv1, RIPv2 and RIPvng.

Outcomes★★Neso Academy

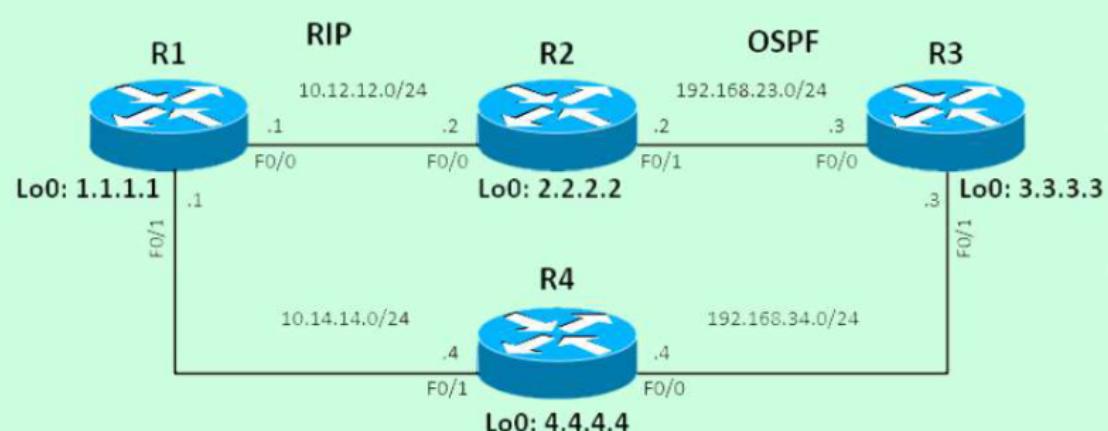
RIP MESSAGES

RIP defined two types of messages:

- ★ **Request Message:** Asking a neighbouring RIPv1 enabled router to send its routing table.
- ★ **Response Message:** Carries the routing table of a router.

RIP Messages ★★ Neso Academy

RIP MESSAGES



RIP Messages Neso Academy

RIP VERSIONS

- ★ RIPv1
- ★ RIPv2
- ★ RIPvng

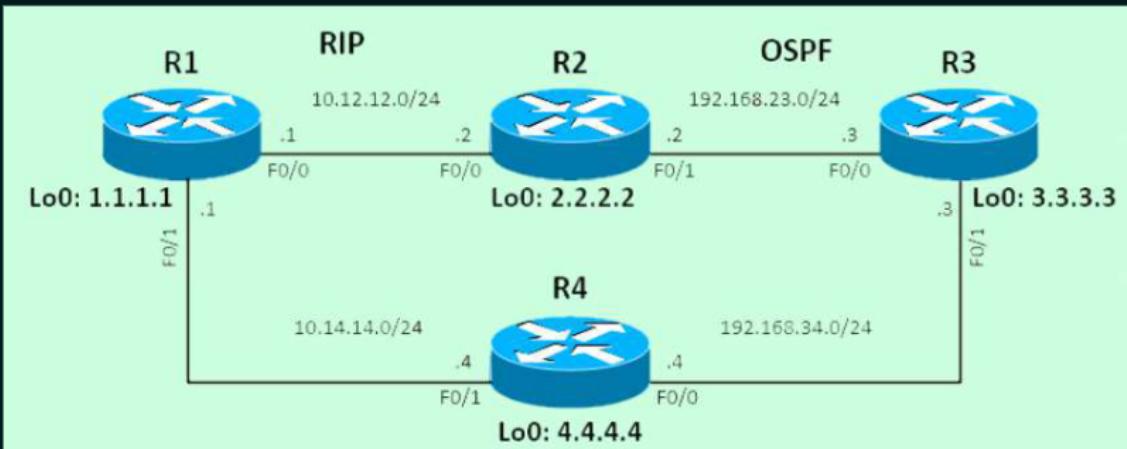
RIP Versions★★★Neso Academy

RIPv1

- ★ When starting up, and every 30 seconds thereafter, a router with RIPv1 implementation broadcasts to 255.255.255.255 a request message through every RIPv1 enabled interface.
- ★ RIPv1 enabled routers not only request the routing tables of other routers every 30 seconds, they also listen to incoming requests from neighbouring routers and send their own routing table in turn.
- ★ RIPv1 uses classful routing.
- ★ The periodic routing updates do not carry subnet information, lacking support for variable length subnet masks (VLSM).
- ★ This limitation makes it impossible to have different-sized subnets inside of the same network class. There is also no support for router authentication, making RIP vulnerable to various attacks.

RIPv1★★★★★Neso Academy

RIP MESSAGES



RIP Messages Neso Academy

RIPv2

- ★ It included the ability to carry subnet information, thus supporting Classless Inter-Domain Routing (CIDR).
- ★ To maintain backward compatibility, the hop count limit of 15 remained.
- ★ In an effort to avoid unnecessary load on hosts that do not participate in routing, RIPv2 multicasts the entire routing table to all adjacent routers at the address 224.0.0.9, as opposed to RIPv1 which uses broadcast.
- ★ Unicast addressing is still allowed for special applications.
- ★ In RIPv2, MD5 authentication was introduced.
- ★ Route tags were also added in RIPv2. This functionality allows a distinction between routes learned from the RIP protocol and routes learned from other protocols.

RIPv2 ★★★★★ Neso Academy

RIPNG

- ★ NG = Next Generation.
- ★ It is an extension of RIPv2 for support of IPv6, the next generation Internet Protocol.
- ★ The main differences between RIPv2 and RIPng are:
 - Support of IPv6 networking.
 - While RIPv2 supports authentication, RIPng does not. IPv6 routers were, at the time, supposed to use IPsec for authentication.
 - RIPv2 encodes the next-hop into each route entry, RIPng requires specific encoding of the next hop for a set of route entries.
 - RIPng sends updates on UDP port 521 using the multicast group FF02::9.

RIPng ★★★○○○ Neso Academy

OUTCOMES

Upon the completion of this lecture, the learner will be able to

- ★ Understand the RIP packet format.
- ★ Know various fields in RIP packet format.

Outcomes ★★ Neso Academy

RIP PACKET FORMAT

0 8 16 31

Command	Version	Must be Zero
Family of Net 1 (AFI)	Must be Zero	
IP Address of Network1		
Must be Zero		
Must be Zero		
Distance to Net 1		
Family of Net 2 (AFI)	Must be Zero	
IP Address of Network2		
Must be Zero		
Must be Zero		
Distance to Net 2		

Command: Indicates whether the packet is a request or a response

Version: Specifies the RIP version which can signal different potentially incompatible versions

Zero: This field is not actually used by RFC 1058 RIP; it was added solely to provide backward compatibility with prestandard varieties of RIP. Its name comes from its defaulted value: zero

Address-family identifier (AFI): Specifies the address family used. RIP is designed to carry routing information for several different protocols. Each entry has an addressfamily identifier to indicate the type of address being specified. The AFI for IP is 2

Address: Specifies the IP address for the entry

Metric: Indicates how many internetwork hops (routers) have been traversed in the trip to the destination. This value is between 1 and 15 for a valid route, or 16 for an unreachable route

RIP Packet FormatNeso Academy

OUTCOMES

Upon the completion of this lecture, the learner will be able to

- ★ Understand the concept of Link State Routing (LSR).
- ★ Know about LSP.
- ★ Know the 2 phases in LSR.

Outcomes★★★Neso Academy

LINK STATE ROUTING

- ★ Link + State.
- ★ LSR has a different philosophy from that of DVR.
- ★ In LSR, each node has the entire topology.

Link State Routing ★★★ Neso Academy

LINK STATE ROUTING

- ★ Link + State.
- ★ LSR has a different philosophy from that of DVR.
- ★ In LSR, each node has the entire topology.

Link State	Distance Vector
Complete Topology	Local Topology
Flooding	Exchange
Global	Decentralized
“Tell the world about neighbours”	“Tell the neighbours about the world”

Link State Routing ★★★ Neso Academy

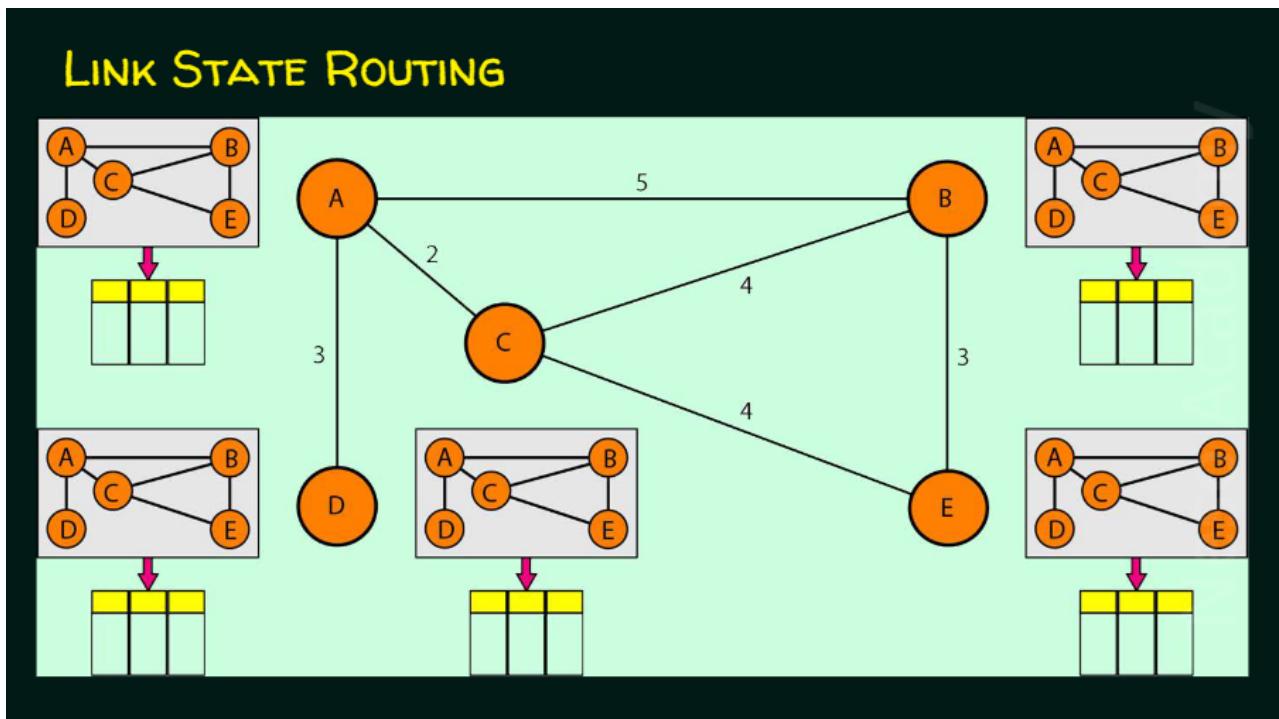
LINK STATE ROUTING

A link state packet can carry a large amount of information.

Link State Packet contains...

- ★ ID of the node that created the LSP
- ★ Cost of link to each directly connected neighbor
- ★ Sequence number (SEQNO)
- ★ Time-To-Live (TTL) for this packet

Link State Routing ★★★ Neso Academy



Link State Routing Neso Academy

LINK STATE ROUTING

Strategy: Send to all nodes (not just neighbors) information about directly connected links (not entire routing table).

Idea: LSR in Two Phases

Phase 1: Reliable flooding

Initial State: Each node knows the cost to its neighbors.

Final State: Each node knows the entire network topology.

Phase 2: Route Calculation

Each node uses Dijkstra's Algorithm on the graph to calculate optimal routes to all nodes.

Link State Routing★Neso Academy

OUTCOMES

Upon the completion of this lecture, the learner will be able to

- ★ Understand reliable flooding in LSR.
- ★ Know the fields of LSP and its features.

Outcomes★★Neso Academy

LINK STATE ROUTING

Link State Packet (LSP)

- ★ ID of the node that created the LSP
- ★ Cost of link to each directly connected neighbor
- ★ Sequence number (SEQNO)
- ★ Time-To-Live (TTL) for this packet

LSPs are generated on two occasions:

1. Triggered
2. Periodic

Link State Routing ★★★★ Neso Academy

LINK STATE ROUTING

Strategy: Send to all nodes (not just neighbors) information about directly connected links (not entire routing table).

Idea: LSR in Two Phases

Phase 1: Reliable flooding

Initial State: Each node knows the cost to its neighbors.

Final State: Each node knows the entire network topology.

Phase 2: Route Calculation

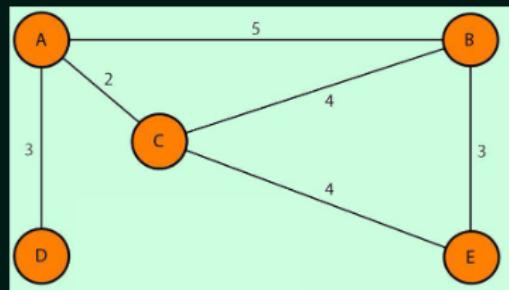
Each node uses Dijkstra's Algorithm on the graph to calculate optimal routes to all nodes.

Link State Routing Neso Academy

LINK STATE ROUTING

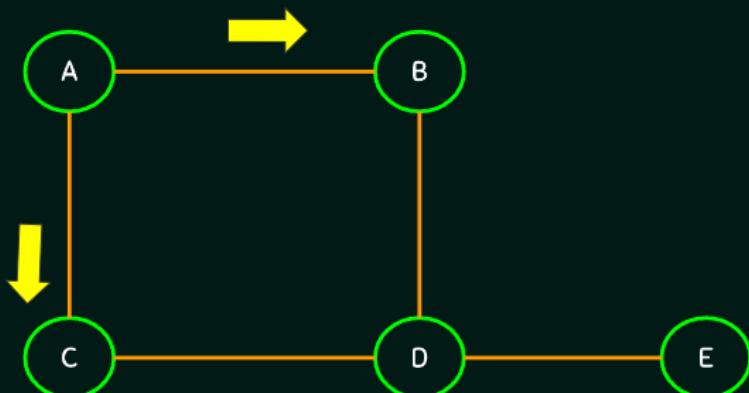
Phase 1: Reliable flooding

- ★ Store most recent LSP from each node.
- ★ Forward LSP to all nodes but one that sent it.
- ★ Generate new LSP periodically; increment SEQNO.
- ★ Start SEQNO at 0 when reboot.
- ★ Decrement TTL of each stored LSP; discard when TTL=0.



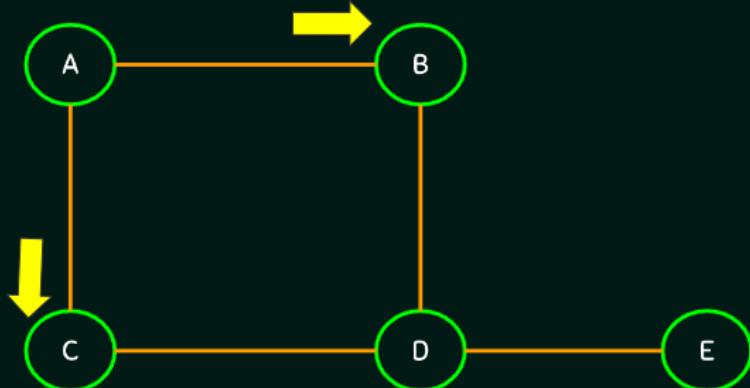
Link State Routing ★★★★ Neso Academy

RELIABLE FLOODING



Reliable flooding Neso Academy

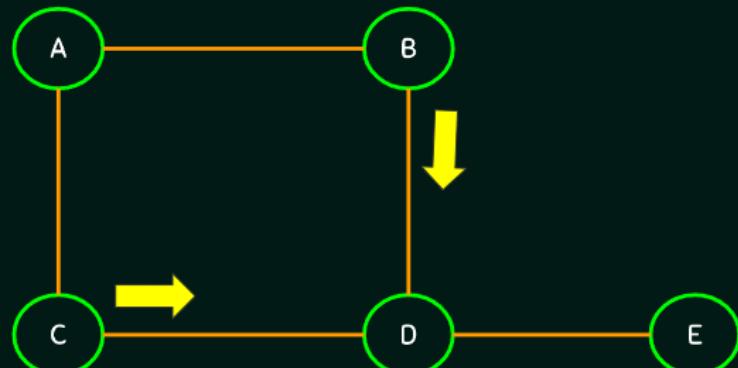
RELIABLE FLOODING



Neso Academy

Reliable floodingNeso Academy

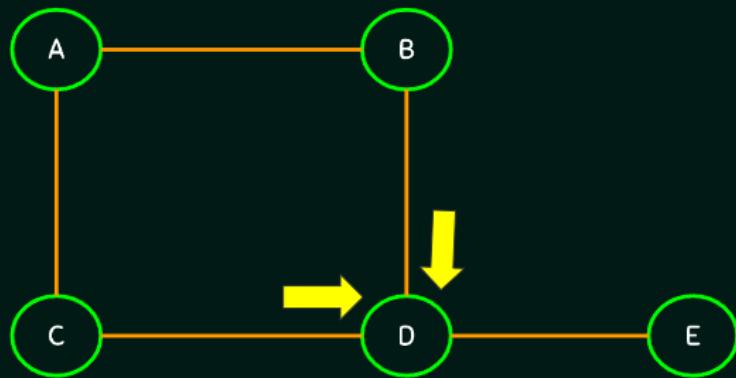
RELIABLE FLOODING



Neso Academy

Reliable floodingNeso Academy

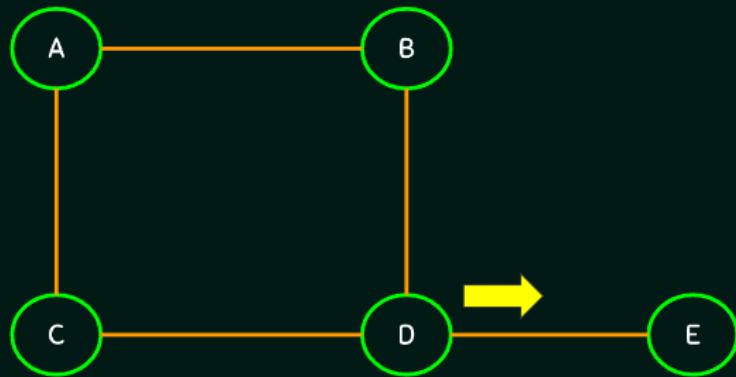
RELIABLE FLOODING



Neso Academy

Reliable floodingNeso Academy

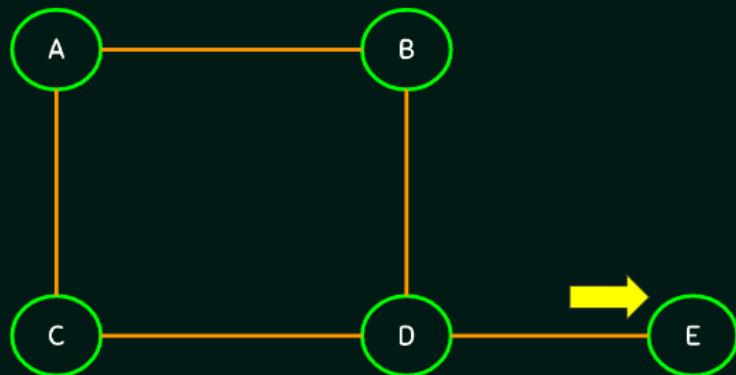
RELIABLE FLOODING



Neso Academy

Reliable floodingNeso Academy

RELIABLE FLOODING



Reliable flooding Neso Academy

FEATURES AND SOLUTIONS

FEATURE	RESPONSIBLE FIELD OF THE LSP
Minimize the number of messages and Detect Duplicates	ID field in the LSP
Newer information should precede older info	Sequence Number field in the LSP
Exhaust of sequence number	32 bits Sequence Number field in the LSP
Looping of LSPs	TTL field in the LSP

Features and Solutions Neso Academy

OUTCOMES

Upon the completion of this lecture, the learner will be able to

- ★ Understand the difference between LSR and DVR.

Outcomes ★ Neso Academy

LSR vs DVR

Features	Link State Routing	Distance Vector Routing
Topology	Complete Topology	Local Topology
Communication Type	Flooding	Exchange
Convergence	Fast	Slow
Routing Loops	Less prone	Highly Prone
Algorithm	Dijkstra's Algorithm	Bellman Ford Algorithm
Metric	Cost	Hop count
Updates	Triggered, Partial	Frequent, Periodic
Scalability	Highly scalable	Limited
Protocols	OSPF, IS-IS	RIP, IGRP

LSR vs DVR Neso Academy

OUTCOMES

Upon the completion of this lecture, the learner will be able to

- ★ Understand Dijkstra's Algorithm.

Outcomes ★ Neso Academy

LINK STATE ROUTING

Strategy: Send to all nodes (not just neighbors) information about directly connected links (not entire routing table).

Idea: LSR in Two Phases

Phase 1: Reliable flooding

Initial State: Each node knows the cost to its neighbors.

Final State: Each node knows the entire network topology.

Phase 2: Route Calculation

Each node uses Dijkstra's Algorithm on the graph to calculate optimal routes to all nodes.

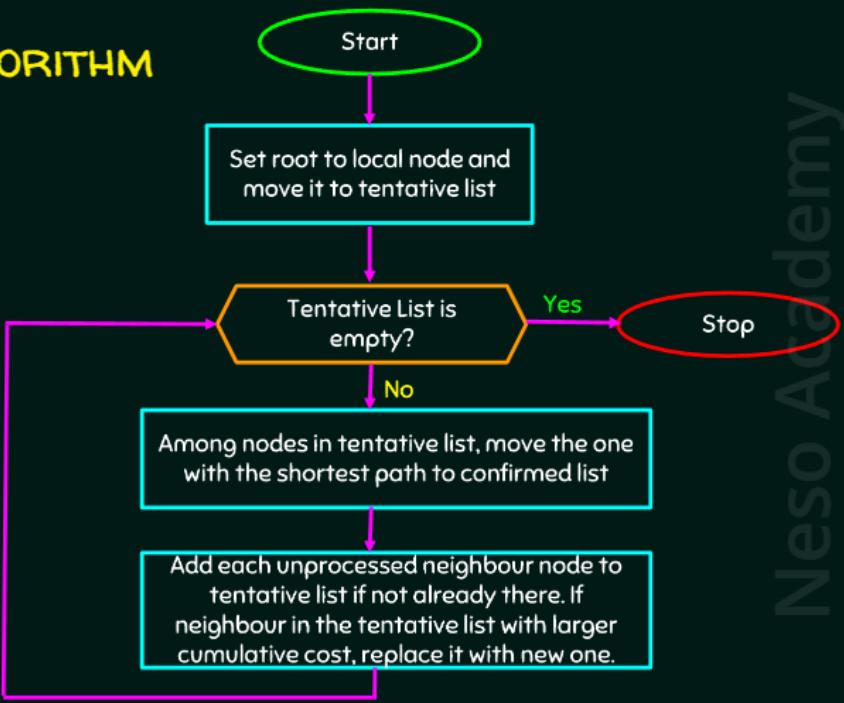
Link State Routing Neso Academy

SHORTEST PATH ROUTING

- ★ In practice, each router computes its routing table directly from the LSP's it has collected using a realization of Dijkstra's algorithm.
- ★ Specifically each router maintains two lists
 1. Tentative List
 2. Confirmed List
- ★ Each of these lists contains a set of entries of the form (Destination, Cost, NextHop)
- ★ Example (A,5,C)

Shortest Path Routing★★★Neso Academy

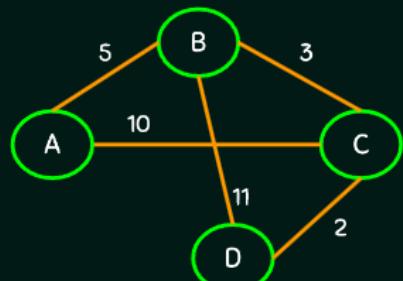
DIJKSTRA'S ALGORITHM



Dijkstra's AlgorithmNeso Academy

QUESTION

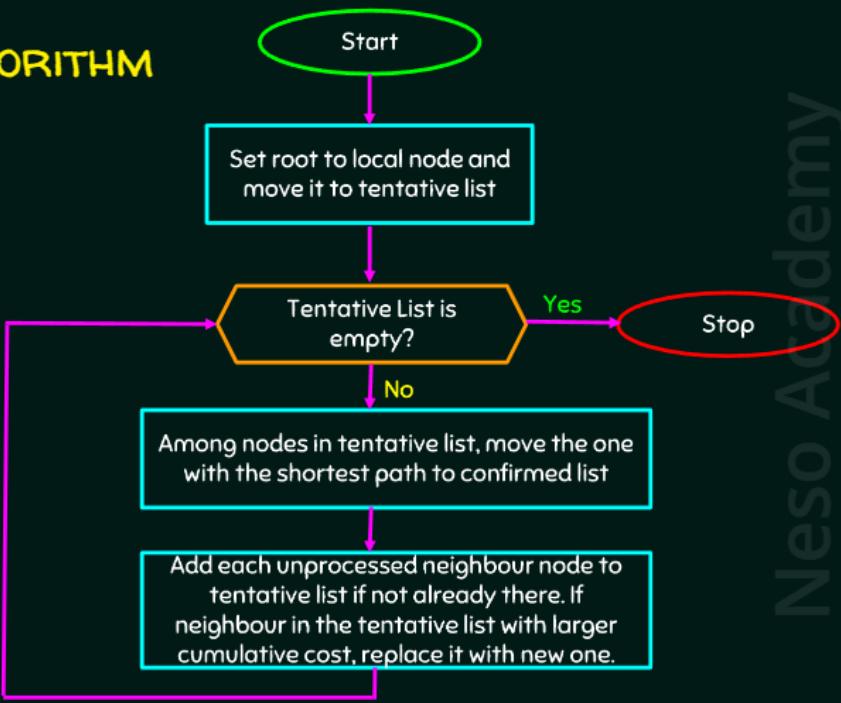
Find the shortest path routing for the following graph



Step	Confirmed	Tentative
1	(D,0,-)	
2	(D,0,-)	(B,11,B) (C,2,C)
3	(D,0,-) (C,2,C)	(B,11,B)
4	(D,0,-) (C,2,C)	(B,5,C) (A,12,C)
5	(D,0,-) (C,2,C) (B,5,C)	(A,12,C)
6	(D,0,-) (C,2,C) (B,5,C)	(A,10,C)
7	(D,0,-) (C,2,C) (B,5,C) (A,10,C)	

QuestionNeso Academy

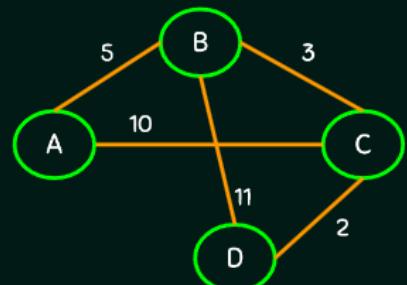
DIJKSTRA'S ALGORITHM



Dijkstra's AlgorithmNeso Academy

QUESTION

Find the shortest path routing for the following graph

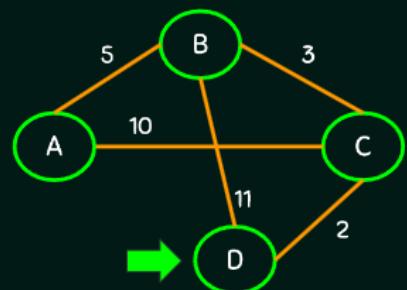


Neso Academy

QuestionNeso Academy

QUESTION

Find the shortest path routing for the following graph

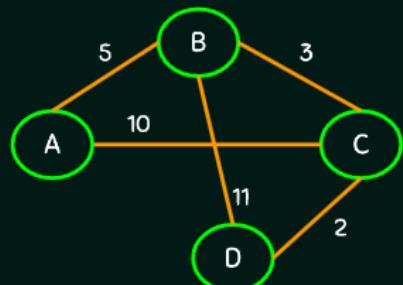


Neso Academy

QuestionNeso Academy

QUESTION

Find the shortest path routing for the following graph

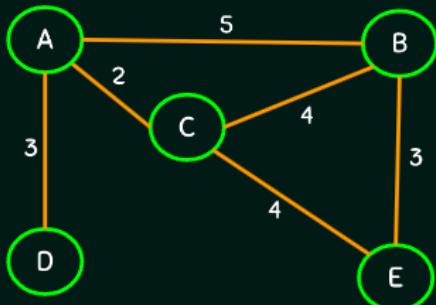


Step	Confirmed	Tentative
1	(D,0,-)	
2	(D,0,-)	(B,11,B) (C,2,C)
3	(D,0,-) (C,2,C)	(B,11,B)
4	(D,0,-) (C,2,C)	(B,5,C) (A,12,C)
5	(D,0,-) (C,2,C) (B,5,C)	(A,12,C)
6	(D,0,-) (C,2,C) (B,5,C)	(A,10,C)
7	(D,0,-) (C,2,C) (B,5,C) (A,10,C)	

QuestionNeso Academy

QUESTION

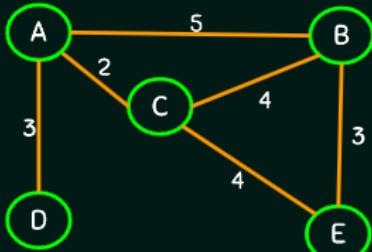
Find the shortest path routing for the following graph



QuestionNeso Academy

QUESTION

Find the shortest path routing for the following graph

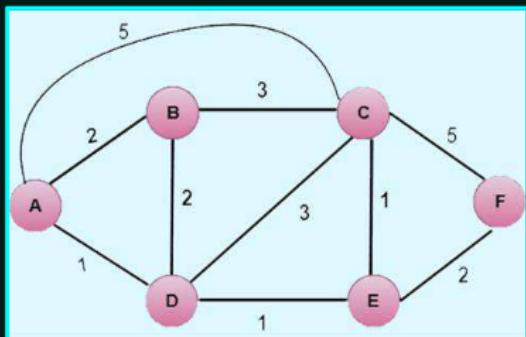


Step	Confirmed	Tentative
1	(A,0,-)	
2	(A,0,-)	
3	(A,0,-) (C,2,C)	(B,6,C)
4	(A,0,-) (C,2,C) (D,3,D)	
5	(A,0,-) (C,2,C) (D,3,D) (B,5,B)	(E,8,B)
6	(A,0,-) (C,2,C) (D,3,D) (B,5,B) (E,6,B)	

QuestionNeso Academy

HOMEWORK

Find the shortest path routing for the following graph



HomeworkNeso Academy

QUESTION

Two popular routing algorithms are Distance Vector (DV) and Link State (LS) routing. Which of the following are true?

- (S1) Count to infinity is a problem only with DV and not LS routing (**True**)
- (S2) In LS, the shortest path algorithm is run only at one node (**False**)
- (S3) In DV, the shortest path algorithm is run only at one node (**False**)
- (S4) DV requires lesser number of network messages than LS (**True**)

[GATE IT 2008]

- (A) S1, S2 and S4 only
- (B) S1, S3 and S4 only
- (C) S2 and S3 only
- (D) **S1 and S4 only ✓**

Question✓Neso Academy

QUESTION

Consider the following three statements about link state and distance vector routing protocols, for a large network with 500 network nodes and 4000 links.

- [S1] The computational overhead in link state protocols is higher than in distance vector protocols. [**True**]
- [S2] A distance vector protocol (with split horizon) avoids persistent routing loops, but not a link state protocol. [**False**]
- [S3] After a topology change, a link state protocol will converge faster than a distance vector protocol. [**True**]

Which one of the following is correct about S1, S2, and S3 ?

[GATE CS 2008]

- (A) S1, S2, and S3 are all true.
- (B) S1, S2, and S3 are all false.
- (C) S1 and S2 are true, but S3 is false.
- (D) **S1 and S3 are true, but S2 is false. ✓**

Question✓Neso Academy

OUTCOMES

Upon the completion of this lecture, the learner will be able to

- ★ Understand the theoretical aspects of OSPF.
- ★ Know about Autonomous System (AS).
- ★ Know about the use of hello packets.

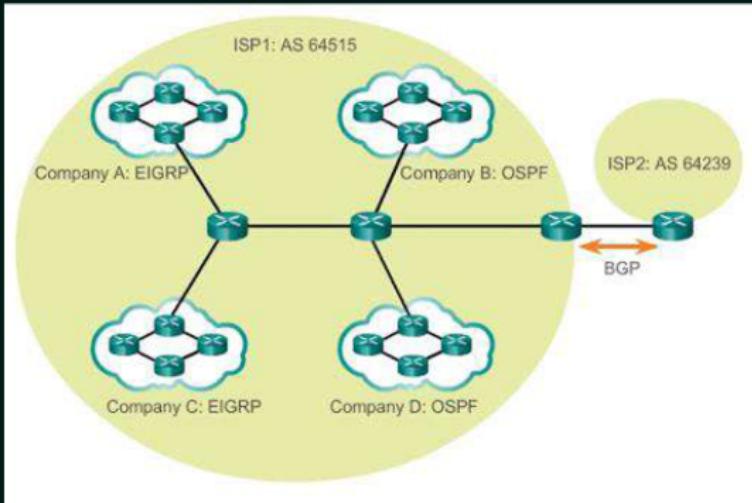
Outcomes ★★★ Neso Academy

OSPF

- ★ Open Shortest Path First (OSPF) is a routing protocol for IP networks.
- ★ It uses a link state routing (LSR) algorithm and falls into the group of interior gateway protocols (IGPs), operating within a single Autonomous System (AS).
- ★ RIP uses hop count as metric whereas OSPF uses cost as the metric.
- ★ OSPF was developed so that the shortest path through a network was calculated based on the cost of the route.
- ★ The link cost is calculated by taking bandwidth, delay and load into account .

OSPF ★★★★★ Neso Academy

AUTONOMOUS SYSTEM



Autonomous System Neso Academy

OSPF

- ★ Therefore OSPF undertakes route cost calculation on the basis of link-cost parameters, which can be weighted by the administrator.
- ★ OSPF is reliable even for large and complex networks.
- ★ As a link-state routing protocol, OSPF maintains link-state databases.
- ★ The state of a given route in the network is the cost, and OSPF algorithm allows every router to calculate the cost of the routes to any given reachable destination.

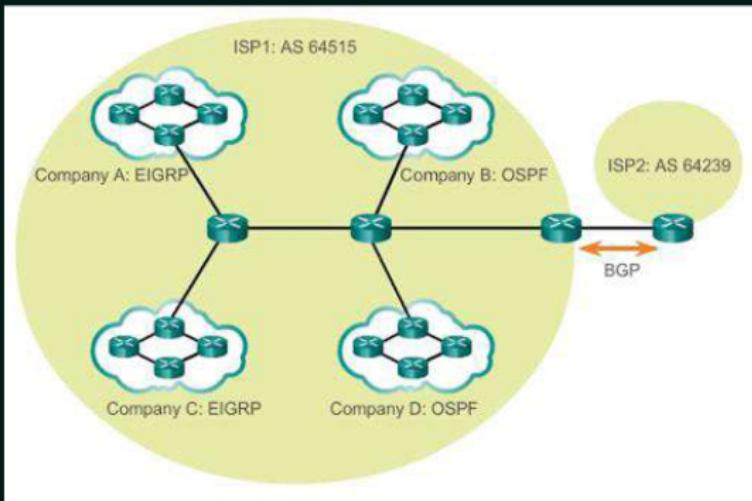
OSPF ★★★★ Neso Academy

OSPF HELLO PROCEDURE

- ★ A router interface with OSPF will then advertise its link cost to neighboring routers through multicast, known as the hello procedure.
- ★ All routers with OSPF implementation keep sending hello packets, and thus changes in the cost of their links become known to neighboring routers.

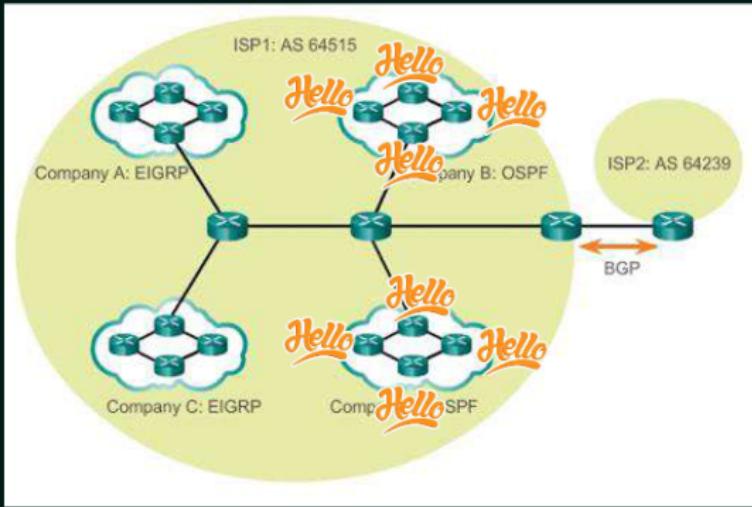
OSPF Hello Procedure ★★ Neso Academy

OSPF HELLO PROCEDURE



OSPF Hello Procedure Neso Academy

OSPF HELLO PROCEDURE



OSPF Hello Procedure Neso Academy

OSPF

- ★ The information about the cost of a link, that is the speed of a point to point connection between two routers, is then cascaded through the network because OSPF routers advertise the information they receive from one neighboring router to all other neighboring routers.
- ★ This process of flooding link state information through the network is known as synchronization.
- ★ Based on this information, all routers with OSPF implementation continuously update their link state databases with information about the network topology and adjust their routing tables.

OSPF ★★★ Neso Academy

QUESTION

Consider the following three statements about link state and distance vector routing protocols, for a large network with 500 network nodes and 4000 links.

[S1] The computational overhead in link state protocols is higher than in distance vector protocols.

[S2] A distance vector protocol (with split horizon) avoids persistent routing loops, but not a link state protocol.

[S3] After a topology change, a link state protocol will converge faster than a distance vector protocol.

Which one of the following is correct about S1, S2, and S3 ?

[GATE CS 2008]

- (A) S1, S2, and S3 are all true.
- (B) S1, S2, and S3 are all false.
- (C) S1 and S2 are true, but S3 is false
- (D) S1 and S3 are true, but S2 is false

QuestionNeso Academy

DJIKSTRA'S ALGORITHM

$M = \{S\}$

For each n in $N - \{S\}$

$$C(n) = l(S, n)$$

While ($N \neq M$)

$M = M \cup \{w\}$ such that $C(w)$ is the minimum for all w in $(N - M)$

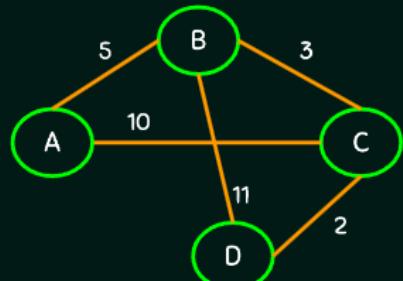
For each n in $(N - M)$

$$C(n) = \min(C(n), C(w) + l(w, n))$$

Dijkstra's Algorithm≠Neso Academy

QUESTION

Find the shortest path routing for the following graph



Step	Confirmed	Tentative
1	(D,0,-)	
2	(D,0,-)	(B,11,B) (C,2,C)
3	(D,0,-) (C,2,C)	(B,11,B)
4	(D,0,-) (C,2,C)	(B,5,C) (A,12,C)
5	(D,0,-) (C,2,C) (B,5,C)	(A,12,C)
6	(D,0,-) (C,2,C) (B,5,C)	(A,10,C)
7	(D,0,-) (C,2,C) (B,5,C) (A,10,C)	

QuestionNeso Academy

OUTCOMES

Upon the completion of this lecture, the learner will be able to

- ★ Understand OSPF areas.
- ★ Understand OSPF neighborship and OSPF adjacency.

Outcomes★★Neso Academy

OSPF

- ★ An OSPF network can be structured, or subdivided, into routing areas to simplify administration and optimize traffic and resource utilization.
- ★ Areas are identified by 32-bit numbers, expressed either simply in decimal, or often in the same dot-decimal notation used for IPv4 addresses.
- ★ By convention, area 0 (zero), or 0.0.0.0, represents the core or backbone area of an OSPF network.
- ★ While the identifications of other areas may be chosen at will; administrators often select the IP address of a main router in an area as the area identifier.

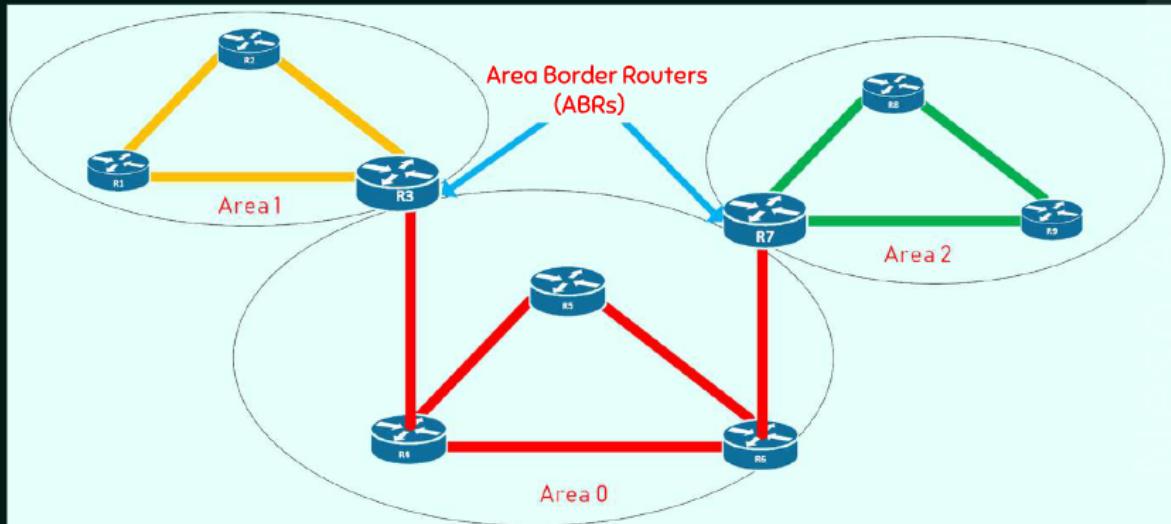
OSPF★★★★Neso Academy

OSPF

- ★ Each additional area must have a connection to the OSPF backbone area. Such connections are maintained by an interconnecting router, known as an area border router (ABR).
- ★ An ABR maintains separate link-state databases for each area it serves and maintains summarized routes for all areas in the network.
- ★ OSPF detects changes in the topology, such as link failures, and converges on a new loop-free routing structure within seconds
- ★ OSPF supports complex networks with multiple routers, including backup routers, to balance traffic load on multiple links to other subnets.

OSPF★★★★Neso Academy

OSPF



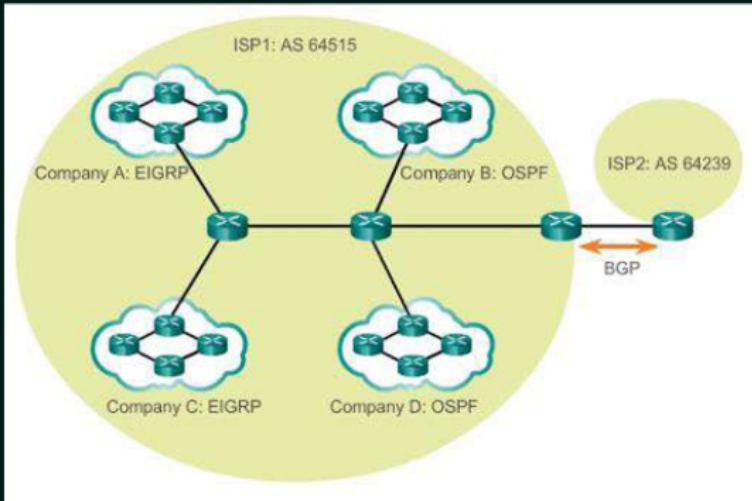
OSPFNeso Academy

OSPF

- ★ As a link-state routing protocol, OSPF establishes and maintains neighbor relationships for exchanging routing updates with other routers.
- ★ The neighbor relationship table is called an adjacency database.
- ★ Two OSPF routers are neighbors if they are members of the same subnet and share the same area ID, subnet mask, timers and authentication.
- ★ In essence, OSPF neighborship is a relationship between two routers that allow them to see and understand each other but nothing more.

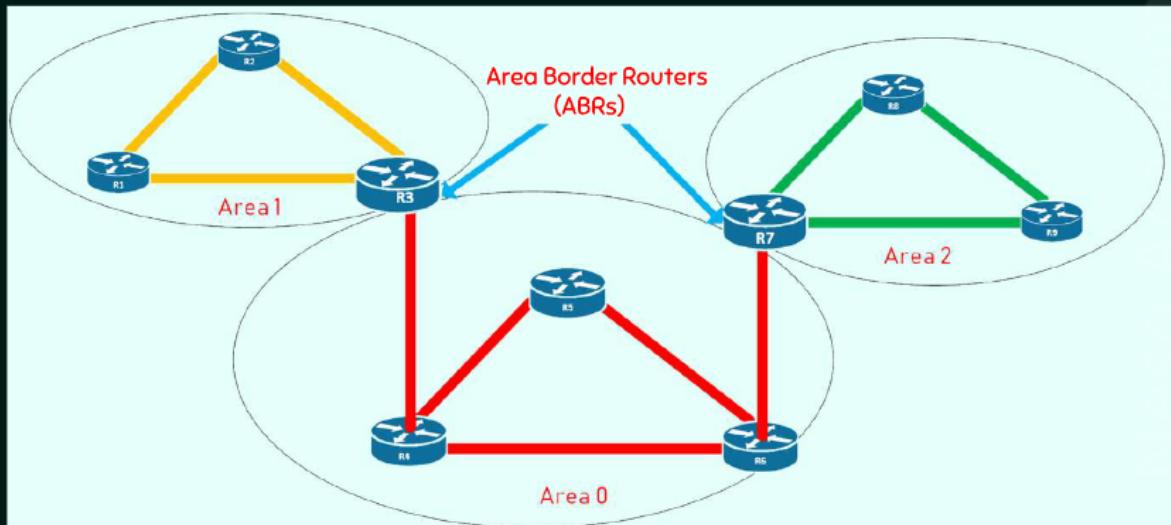
OSPF★★★★Neso Academy

OSPF HELLO PROCEDURE



OSPF Hello Procedure Neso Academy

OSPF



OSPF Neso Academy

OSPF

- ★ OSPF neighbors do not exchange any routing information – the only packets they exchange are Hello packets.
- ★ OSPF adjacencies are formed between selected neighbors and allow them to exchange routing information.
- ★ Two routers must first be neighbors and only then, can they become adjacent.
- ★ Two routers become adjacent if at least one of them is Designated Router or Backup Designated Router (on multiaccess type networks), or they are interconnected by a point-to-point or point-to-multipoint network type.

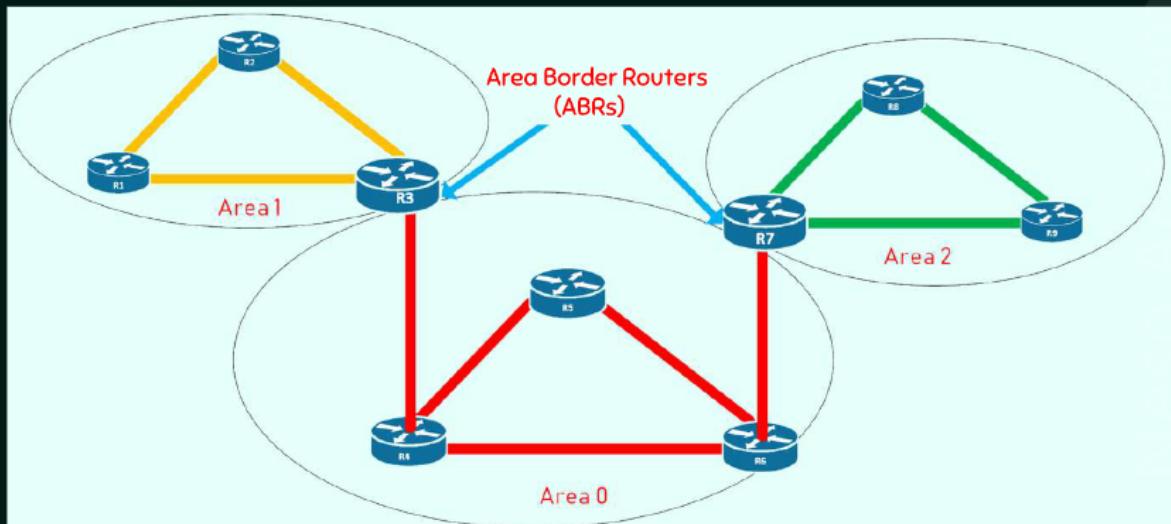
OSPF★★★★Neso Academy

OSPF

- ★ For forming a neighbor relationship between, the interfaces used to form the relationship must be in the same OSPF area.

OSPF★Neso Academy

OSPF



OSPFNeso Academy

OUTCOMES

Upon the completion of this lecture, the learner will be able to

- ★ Know various states in OSPF.
- ★ Understand the OSPF states.

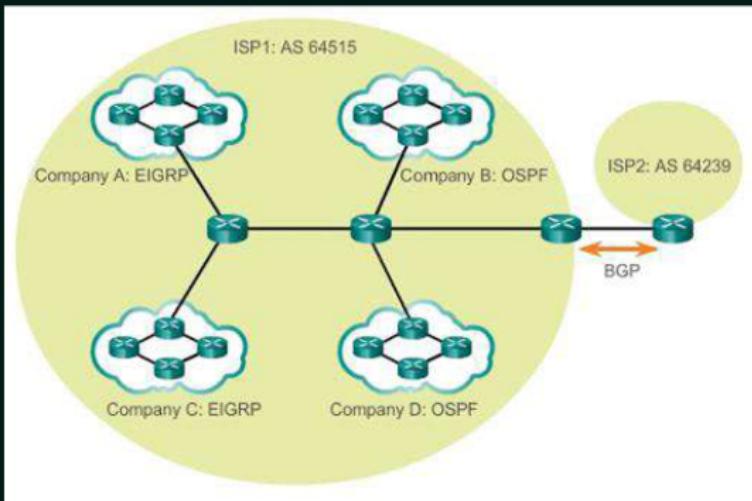
Outcomes ★★ Neso Academy

OSPF

- ★ Each OSPF router within a network communicates with other neighboring routers on each connecting interface to establish the states of all adjacencies.
- ★ Every such communication sequence is a separate conversation identified by the pair of router IDs of the communicating neighbors.
- ★ During its course, each router conversation transitions through a maximum of eight conditions defined by a state machine.

OSPF★★★Neso Academy

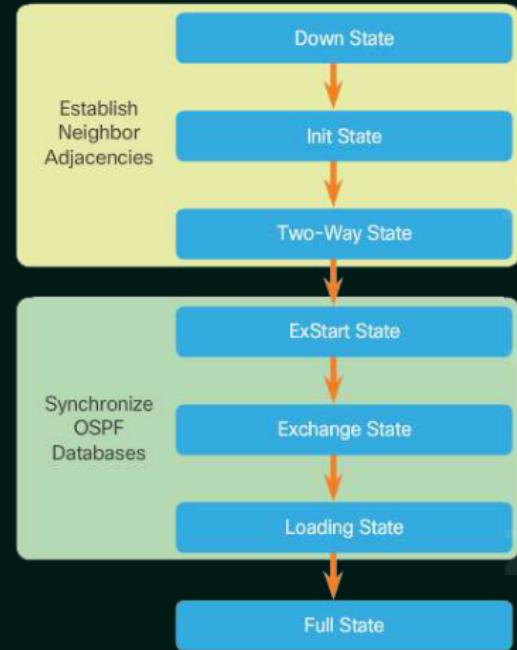
OSPF



OSPF
Neso Academy

OSPF STATES

1. Down
2. Attempt
3. Init
4. 2-Way
5. ExStart
6. Exchange
7. Loading
8. Full



OSPF StatesNeso Academy

OSPF STATES

1. **Down:** The state down represents the initial state of a conversation when no information has been exchanged and retained between routers with the Hello Protocol.
2. **Attempt:** The Attempt state is similar to the Down state, except that a router is in the process of efforts to establish a conversation with another router.
3. **Init:** The Init state indicates that a HELLO packet has been received from a neighbor, but the router has not established a two-way conversation.
4. **2-Way:** The 2-Way state indicates the establishment of a bidirectional conversation between two routers. This state immediately precedes the establishment of adjacency.

OSPF StatesNeso Academy

OSPF STATES

5. **ExStart:** The ExStart state is the first step of adjacency of two routers.
6. **Exchange:** In the Exchange state, a router is sending its link-state database information to the adjacent neighbor. At this state, a router is able to exchange all OSPF routing protocol packets.
7. **Loading:** In the Loading state, a router requests the most recent Link-state advertisements (LSAs) from its neighbor discovered in the previous state.
8. **Full:** The Full state concludes the conversation when the routers are fully adjacent, and the state appears in all router- and network-LSAs. The link state databases of the neighbors are fully synchronized.

OSPF StatesNeso Academy

OUTCOMES

Upon the completion of this lecture, the learner will be able to

- ★ Understand various OSPF messages.
- ★ Know various types of routers in OSPF.
- ★ Know about DR and BDR.

Outcomes★★★Neso Academy

OSPF MESSAGES

OSPF defines five different message types, for various types of communication:

Type 1	Hello	Neighbors
Type 2	Database Description (DBD)	Adjacencies
Type 3	Link State Request (LSR)	
Type 4	Link State Update (LSU)	
Type 5	Link State Acknowledgment (LSAck)	Reliable Update

OSPF Messages Neso Academy

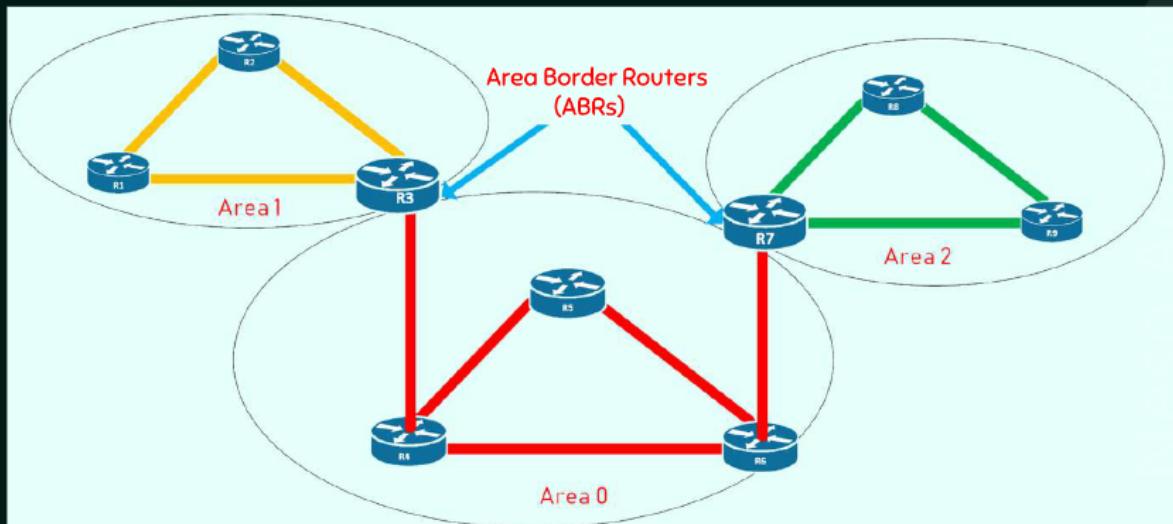
OSPF ROUTER TYPES

OSPF defines the following overlapping categories of routers:

- ★ **Internal Router (IR)** : An internal router has all its interfaces belonging to the same area.
- ★ **Area Border Router (ABR)**: An area border router is a router that connects one or more areas to the main backbone network. It is considered a member of all areas it is connected to.
- ★ **Backbone Router (BR)**: A backbone router has an interface to the backbone area. Backbone routers may also be area routers, but do not have to be.
- ★ **Autonomous System Boundary Router (ASBR)**: An ASBR connects One AS with another or the internet.

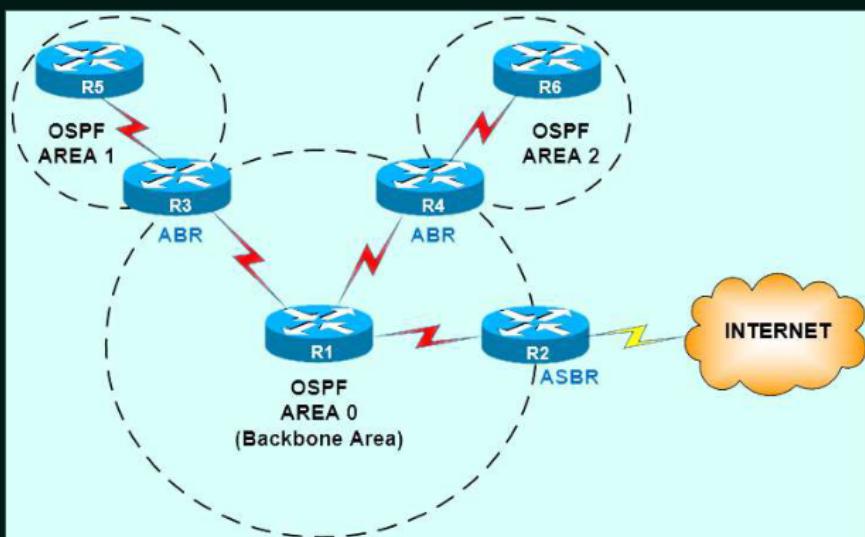
OSPF Router Types ★★★★ Neso Academy

OSPF



OSPFNeso Academy

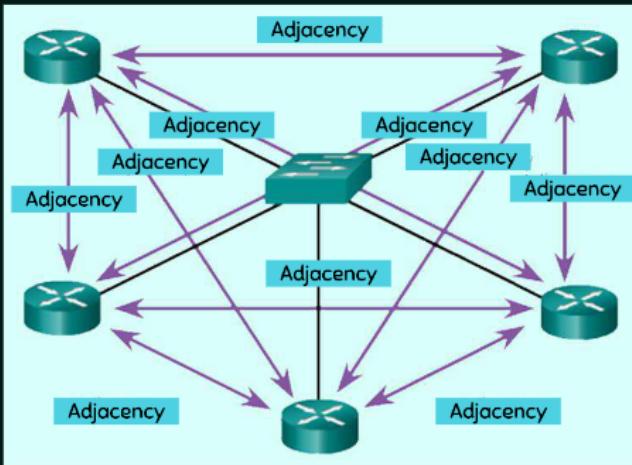
OSPF ROUTER TYPES



OSPF Router TypesNeso Academy

OSPF Router Types

- ★ Designated Router (DR)
- ★ Backup Designated Router (BDR)

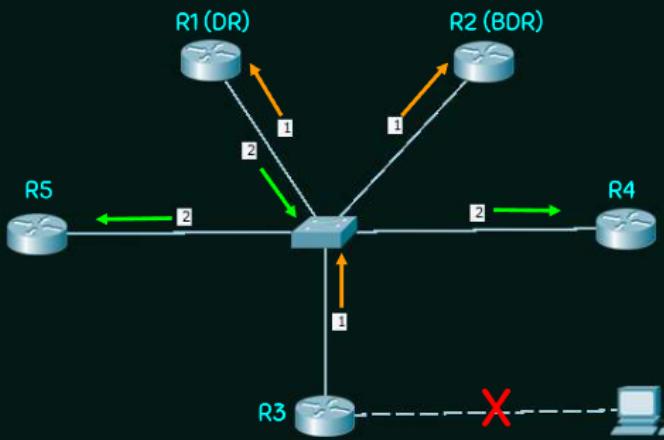


- ★ No. of routers: n
- ★ No. of Adjacencies: $n(n-1)/2$
- ★ Example: 5 routers: $5(5-1)/2$
10 adjacencies

OSPF Router Types ★★★★ Neso Academy

OSPF Router Types

- ★ Designated Router (DR)
- ★ Backup Designated Router (BDR)



OSPF Router Types ★★ Neso Academy

DR AND BDR

- ★ Based on the network type, OSPF router can elect one router to be a Designated Router (DR) and one router to be a Backup Designated Router (BDR).
- ★ For example, on multiaccess broadcast networks (such as LANs) routers defaults to elect a DR and BDR. DR and BDR serve as the central point for exchanging OSPF routing information.
- ★ Each non-DR or non-BDR router will exchange routing information only with the DR and BDR, instead of exchanging updates with every router on the network segment.
- ★ DR will then distribute topology information to every other router inside the same area, which greatly reduces OSPF traffic.
- ★ If DR fails, BDR takes over its role of redistributing routing information.

DR and BDR★★★★★Neso Academy

DR AND BDR

On LANs, DR and BDR have to be elected.

Rules for electing DR and BDR:

1. Router with the highest OSPF priority will become a DR. By default, all routers have a priority of 1.
2. If there is a tie, a router with the highest router ID wins the election. The router with the second highest OSPF priority or router ID will become a BDR.

DR and BDRNeso Academy

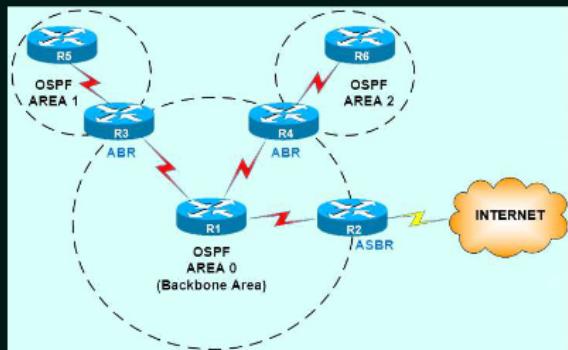
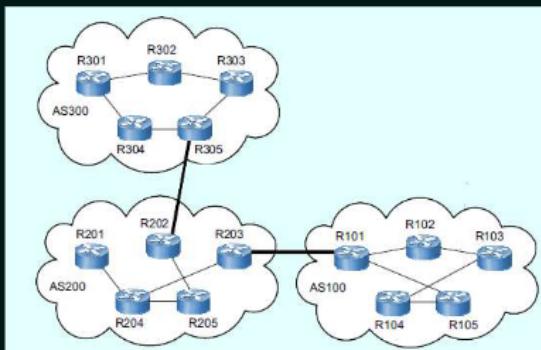
OUTCOMES

Upon the completion of this lecture, the learner will be able to

- ★ Understand various OSPF message types.
- ★ See all 5 OSPF message types captured using Wireshark.

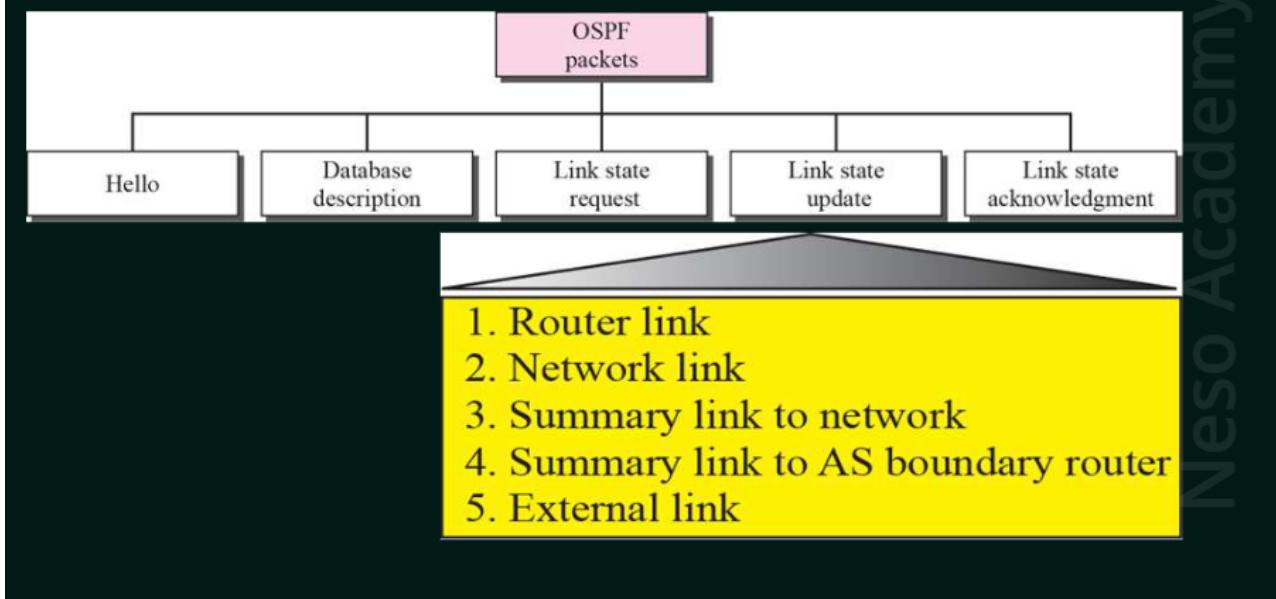
Outcomes ★ Neso Academy

OSPF



OSPF Neso Academy

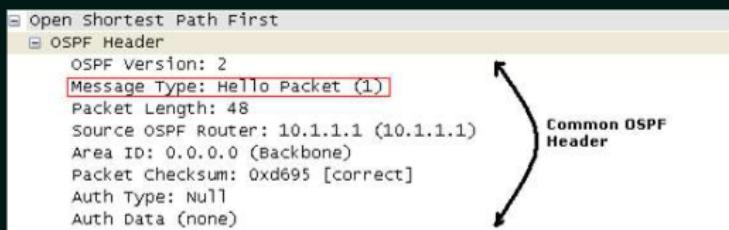
OSPF PACKETS



OSPF PacketsNeso Academy

OSPF COMMON HEADER

0	7 8	15 16	31
Version	Type	Message length	
		Source router IP address	
		Area Identification	
Checksum		Authentication type	
		Authentication (32 bits)	



OSPF Common HeaderNeso Academy

TYPE 1: HELLO PACKET

Repeated	OSPF common header 24 bytes Type: 1
	Network mask
	Hello interval All 0s E T Priority
	Dead interval
	Designated router IP address
	Backup designated router IP address
	Neighbor IP address

- ★ OSPF uses the hello message to create neighborhood relationship and to test the reachability of neighbors.
- ★ This is the first step in link state routing. Before a router can flood all of the other routers with information about its neighbors, it must first greet its neighbors.

Type 1: Hello Packet ★★Neso Academy

TYPE 1: HELLO PACKET

Repeated	OSPF common header 24 bytes Type: 1
	Network mask
	Hello interval All 0s E T Priority
	Dead interval
	Designated router IP address
	Backup designated router IP address
	Neighbor IP address

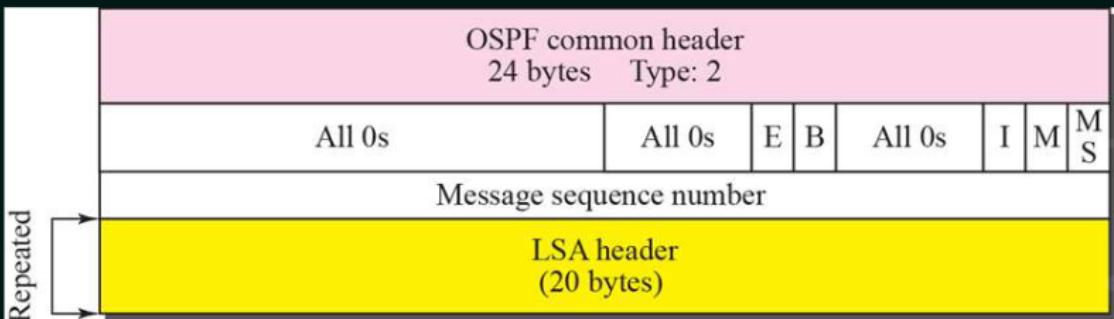
```

Open Shortest Path First
└ OSPF Header
  OSPF Version: 2
  Message Type: Hello Packet (1)
  Packet Length: 48
  Source OSPF Router: 10.1.1.1 (10.1.1.1)
  Area ID: 0.0.0.0 (Backbone)
  Packet Checksum: 0xd695 [correct]
  Auth Type: Null
  Auth Data (none)

└ OSPF Hello Packet
  Network Mask: 255.255.255.0
  Hello Interval: 10 seconds
  Options: 0x12 (L, E)
    0... .... = DN: DN-bit is NOT set
    .0. .... = O: O-bit is NOT set
    ..0 .... = DC: demand circuits are NOT supported
    ...1 .... = L: The packet contains LLS data block
    .... 0... = NP: NSSA is NOT supported
    .... .0.. = MC: NOT multicast capable
    .... ..1. = E: ExternalRoutingCapability
  Router Priority: 1
  Router Dead Interval: 40 seconds
  Designated Router: 0.0.0.0
  Backup Designated Router: 0.0.0.0
  Active Neighbor: 10.1.1.2
  
```

Type 1: Hello Packet Neso Academy

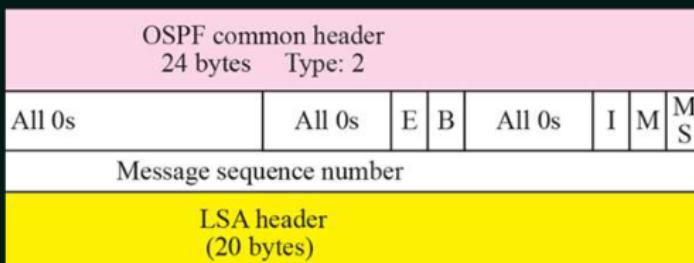
TYPE 2: DATABASE DESCRIPTION



- ★ When a router is connected to the system for the first time or after a failure, it needs the complete link state database immediately.
- ★ Therefore, it sends hello packets to greet its neighbors.
- ★ If this is the first time that the neighbors hear from the router, they send a database description message.
- ★ The database description packet does not contain complete database information; it only gives an outline, the title of each lines in the database.

Type 2: Database Description ★★★★ Neso Academy

TYPE 2: DATABASE DESCRIPTION



```

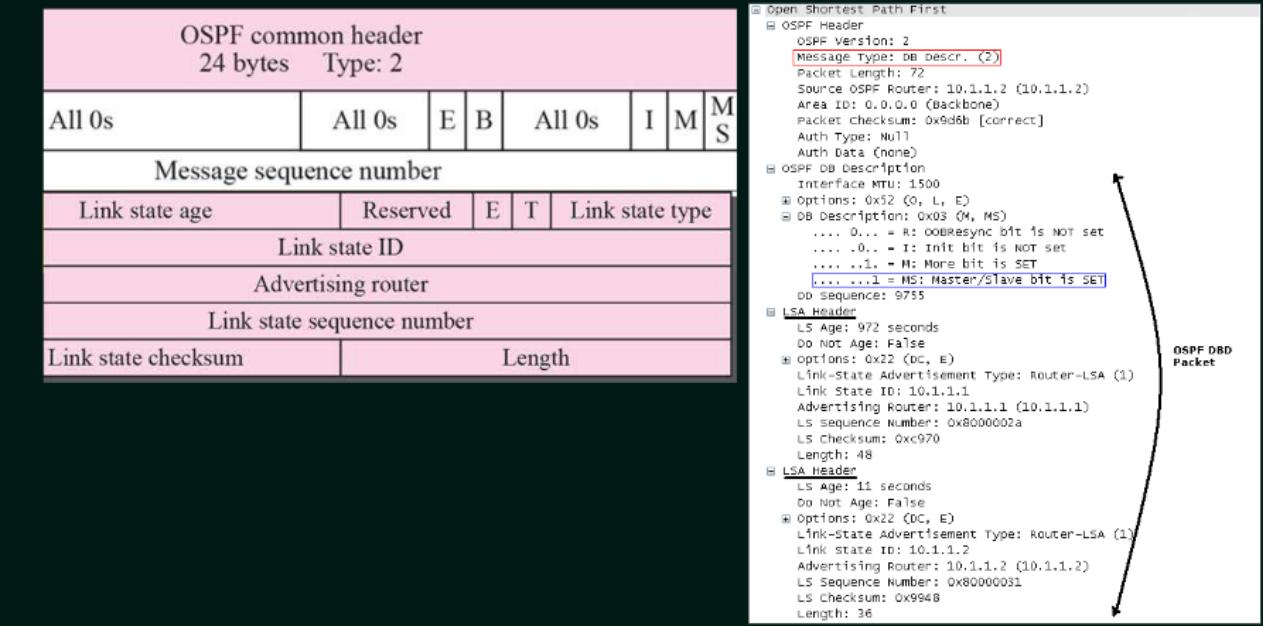
[+] Open Shortest Path First
[+] OSPF Header
  OSPF Version: 2
  Message Type: DB Descr. (2)
  Packet Length: 72
  Source OSPF Router: 10.1.1.2 (10.1.1.2)
  Area ID: 0.0.0.0 (backbone)
  Packet checksum: 0x9d6b [correct]
  Auth Type: Null
  Auth Data (none)
[+] OSPF DB Description
  Interface MTU: 1500
  Options: 0x52 (O, L, E)
  DB Description: 0x03 (M, MS)
    .... 0... = R: DBDesync bit is NOT set
    .... 0.. = I: Init bit is NOT set
    .... .1. = M: More bit is SET
    .... ..1 = MS: Master/Slave bit is SET
  DB sequence: 9755
[+] LSA Header
  LS Age: 972 seconds
  Do Not Age: False
  Options: 0x22 (DC, E)
  Link-State Advertisement Type: Router-LSA (1)
  Link State ID: 10.1.1.1
  Advertising Router: 10.1.1.1 (10.1.1.1)
  LS sequence Number: 0x8000002a
  LS Checksum: 0xc970
  Length: 48
[+] LSA Header
  LS Age: 11 seconds
  Do Not Age: False
  Options: 0x22 (DC, E)
  Link-State Advertisement Type: Router-LSA (1)
  Link State ID: 10.1.1.2
  Advertising Router: 10.1.1.2 (10.1.1.2)
  LS Sequence Number: 0x80000031
  LS Checksum: 0x9948
  Length: 36

```

OSPF DBD Packet

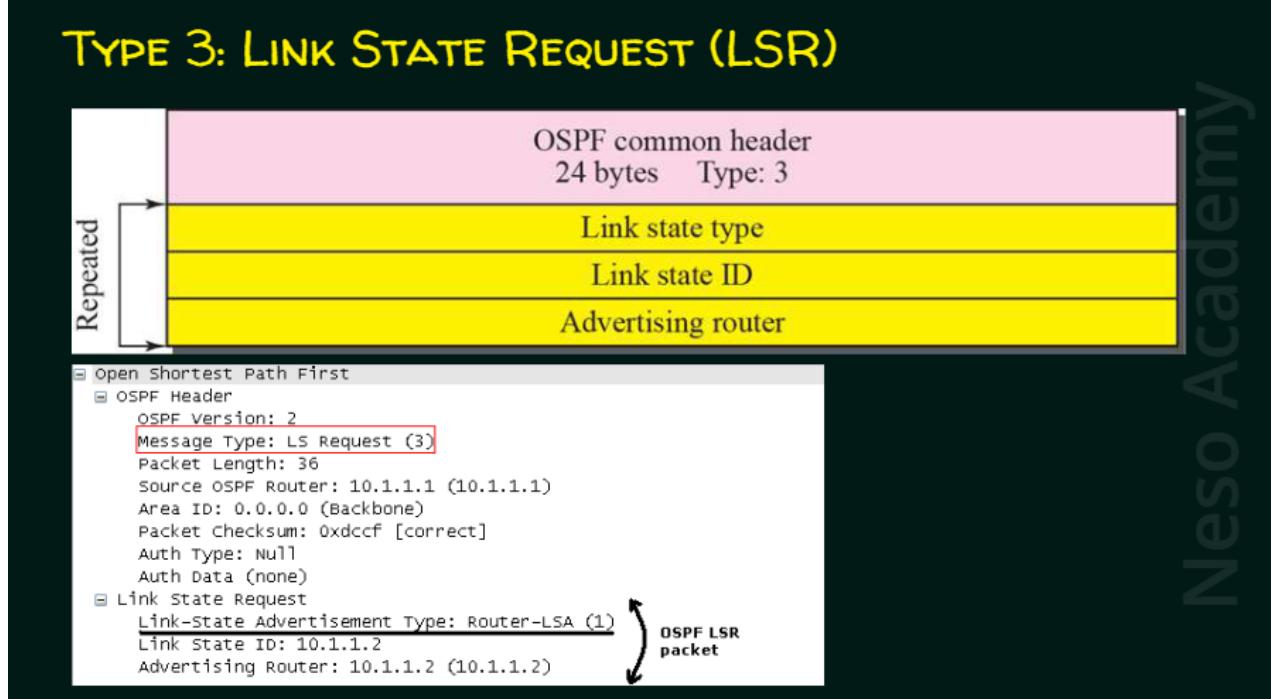
Type 2: Database Description Neso Academy

TYPE 2: DATABASE DESCRIPTION



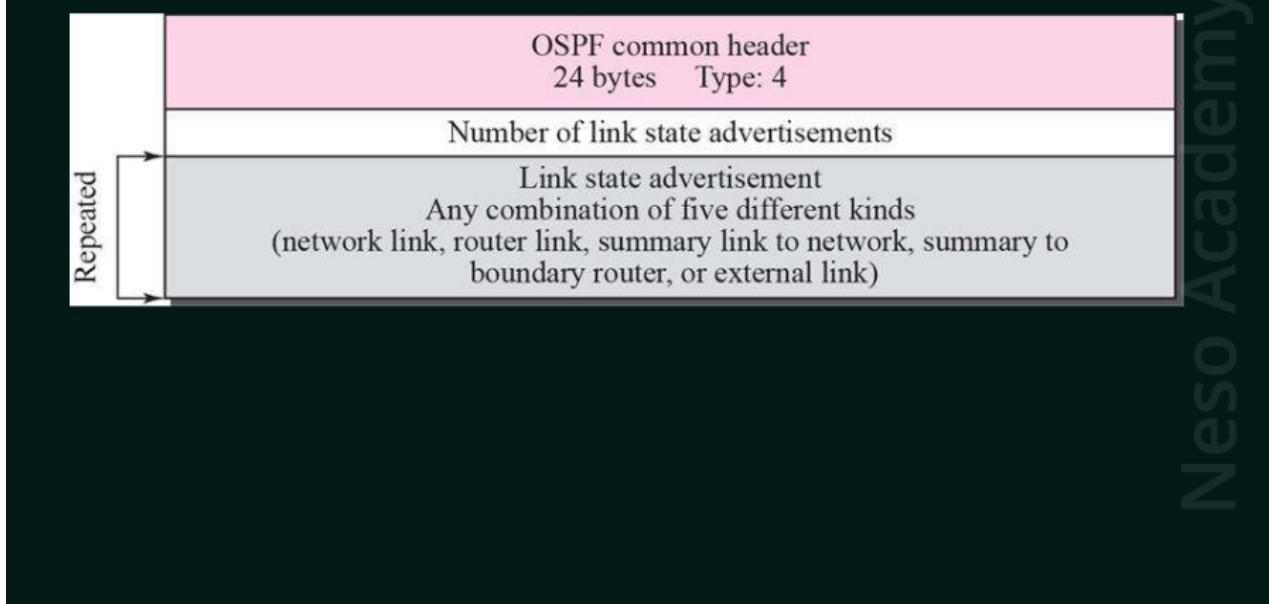
Type 2: Database Description Neso Academy

TYPE 3: LINK STATE REQUEST (LSR)

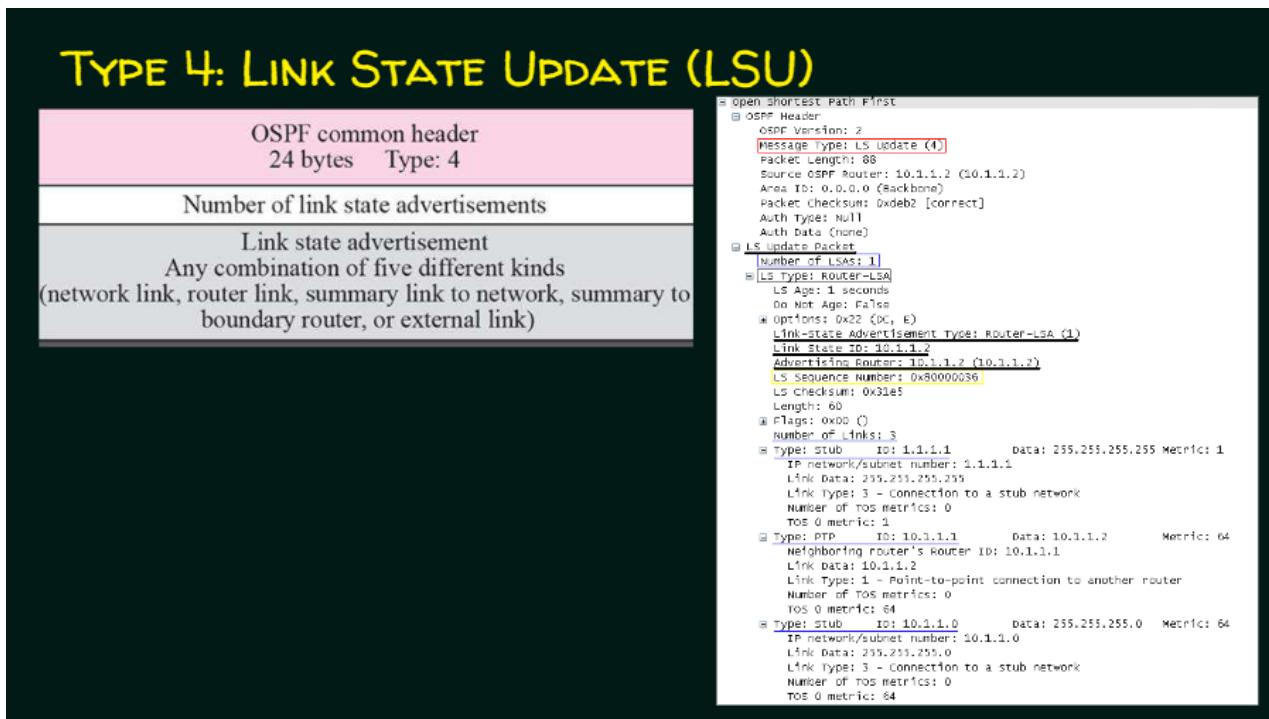


Type 3: Link State Request (LSR) Neso Academy

TYPE 4: LINK STATE UPDATE (LSU)



Type 4: Link State Update (LSU)Neso Academy



Type 4: Link State Update (LSU)Neso Academy

TYPE 4: LINK STATE UPDATE (LSU)

OSPF common header 24 bytes Type: 4			
Number of link state advertisements			
Link state age	Reserved	E	T
Link state ID			
Advertising router			
Link state sequence number			
Link state checksum	Length		

Open Shortest Path First

OSPF Header

OSPF Version: 2

Message Type: LS Update (4)

Packet Length: 88

Source OSPF Router: 10.1.1.2 (10.1.1.2)

Area ID: 0.0.0.0 (backbone)

Packer Checksum: 0xdeb2 [correct]

Auth Type: NULL

Auth Data (None)

LS update Packet

Number of LSAs: 1

LS Type: Router-LSA

LS Age: 1 seconds

Do Not Age: False

Options: 0x22 (PC, E)

Link-state advertisement type: Router-LSA (1)

Link State ID: 10.1.1.2

Advertising Router: 10.1.1.2 (10.1.1.2)

LS Sequence Number: 0x00000036

LS Checksum: 0x31ef

Length: 60

Flag: 0x00 (0)

Number of Links: 3

Type: STUB ID: 1.1.1.1 Data: 255.255.255.255 Metric: 1

IP network/subnet number: 1.1.1.1

Link Data: 255.255.255.255

Link Type: 3 - Connection to a stub network

Number of TOS metrics: 0

TOS 0 metric: 1

Type: PTP ID: 10.1.1.1 Data: 10.1.1.2 Metric: 64

Neighboring router's Router ID: 10.1.1.1

Link Data: 10.1.1.2

Link Type: 1 - Point-to-point connection to another router

Number of TOS metrics: 0

TOS 0 metric: 64

Type: STUB ID: 10.1.1.0 Data: 255.255.255.0 Metric: 64

IP network/subnet number: 10.1.1.0

Link Data: 255.255.255.0

Link Type: 3 - Connection to a stub network

Number of TOS metrics: 0

TOS 0 metric: 64

Type 4: Link State Update (LSU)Neso Academy

TYPE 5: LINK STATE ACKNOWLEDGMENT (LSAck)

OSPF common header 24 bytes Type: 5
LSA general header 20 bytes Corresponding type

Neso Academy

Type 5: Link State Acknowledgment (LSAck)Neso Academy

TYPE 5: LINK STATE ACKNOWLEDGMENT (LSAck)

OSPF common header 24 bytes Type: 5				
Link state age	Reserved	E	T	Link state type
Link state ID				
Advertising router				
Link state sequence number				
Link state checksum	Length			

Type 5: Link State Acknowledgment (LSAck)Neso Academy

TYPE 5: LINK STATE ACKNOWLEDGMENT (LSAck)

OSPF common header 24 bytes Type: 5				
Link state age	Reserved	E	T	Link state type
Link state ID				
Advertising router				
Link state sequence number				
Link state checksum	Length			

```

Open Shortest Path First
OSPF Header
OSPF Version: 2
Message Type: LS Acknowledge (5)
Packet Length: 44
Source OSPF Router: 10.1.1.1 (10.1.1.1)
Area ID: 0.0.0 (Backbone)
Packet Checksum: 0x086d [correct]
Auth Type: Null
Auth Data (none)
LSA Header
LS Age: 1 seconds
Do Not Age: False
Options: 0x22 (DC, E)
Link-State Advertisement Type: Router-LSA (1)
Link State ID: 10.1.1.2
Advertising Router: 10.1.1.2 (10.1.1.2)
LS Sequence Number: 0x80000036
LS Checksum: 0x31e5
Length: 60

```

Type 5: Link State Acknowledgment (LSAck)Neso Academy

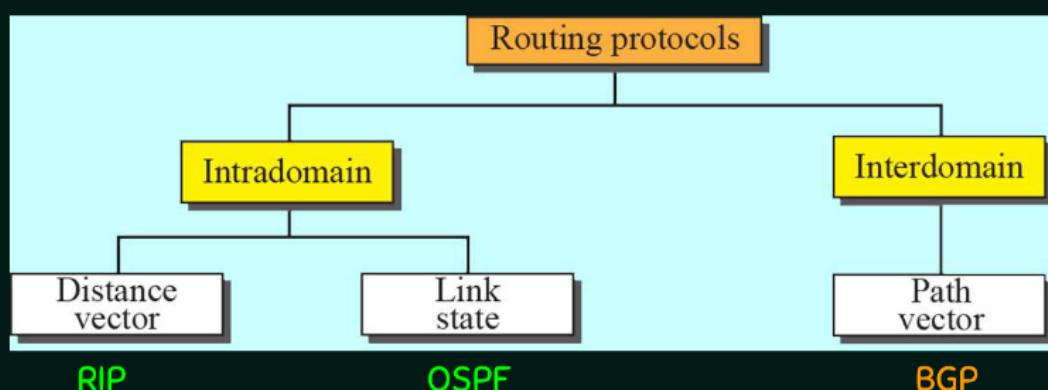
OUTCOMES

Upon the completion of this lecture, the learner will be able to

- ★ Understand the basics of BGP.
- ★ Understand the operation of BGP.

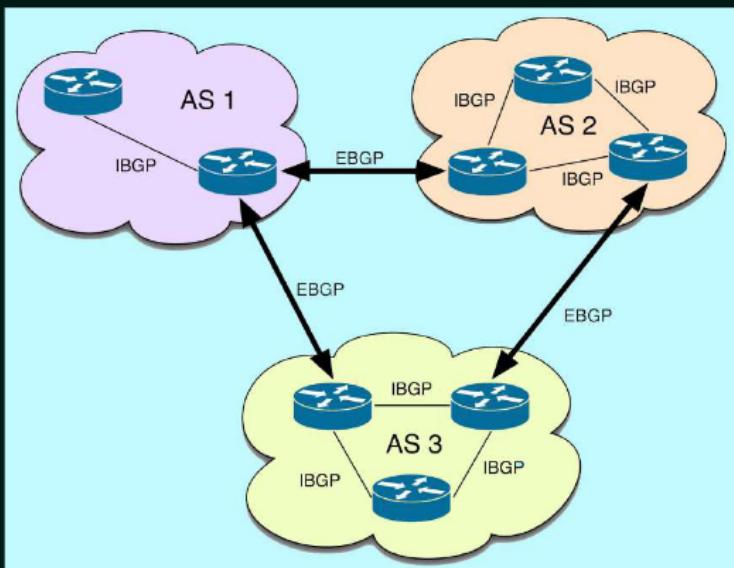
Outcomes ★ Neso Academy

ROUTING PROTOCOLS



Routing protocols Neso Academy

BGP



BGPNeso Academy

BGP

- ★ **Border Gateway Protocol (BGP)** is a standardized exterior gateway protocol designed to exchange routing and reachability information among autonomous systems (AS) on the Internet
- ★ BGP is classified as a path-vector routing protocol and it makes routing decisions based on paths, network policies, or rule-sets configured by a network administrator.
- ★ BGP used for routing within an autonomous system is called Interior Border Gateway Protocol or Internal BGP (iBGP).
- ★ In contrast, the Internet application of the protocol is called Exterior Border Gateway Protocol or External BGP (eBGP).

BGP★★★★Neso Academy

BGP

- ★ The current version of BGP is version 4.
- ★ The major enhancement was the support for Classless Inter-Domain Routing (CIDR) and use of route aggregation to decrease the size of routing tables.

BGP★★Neso Academy

OPERATION OF BGP

- ★ BGP neighbors, called peers, are established by manual configuration among routers to create a TCP session on port 179.
- ★ A BGP speaker sends 19-byte keep-alive messages every 60 seconds to maintain the connection.
- ★ Among routing protocols, BGP is unique in using TCP as its transport protocol and is the slowest routing protocol in the world.
- ★ When BGP runs between two peers in the same autonomous system (AS), it is referred to as **Internal BGP (i-BGP or Interior Border Gateway Protocol)**.
- ★ When it runs between different autonomous systems, it is called **External BGP (eBGP or Exterior Border Gateway Protocol)**.

Operation of BGP★★★★★Neso Academy

OPERATION OF BGP

- ★ Routers on the boundary of one AS exchanging information with another AS are called border or edge routers or simply eBGP peers and are typically connected directly, while i-BGP peers can be interconnected through other intermediate routers.
- ★ Other deployment topologies are also possible, such as running eBGP peering inside a VPN tunnel, allowing two remote sites to exchange routing information in a secure and isolated manner.
- ★ The main difference between iBGP and eBGP peering is in the way routes that were received from one peer are propagated to other peers.

Operation of BGP★★★Neso Academy