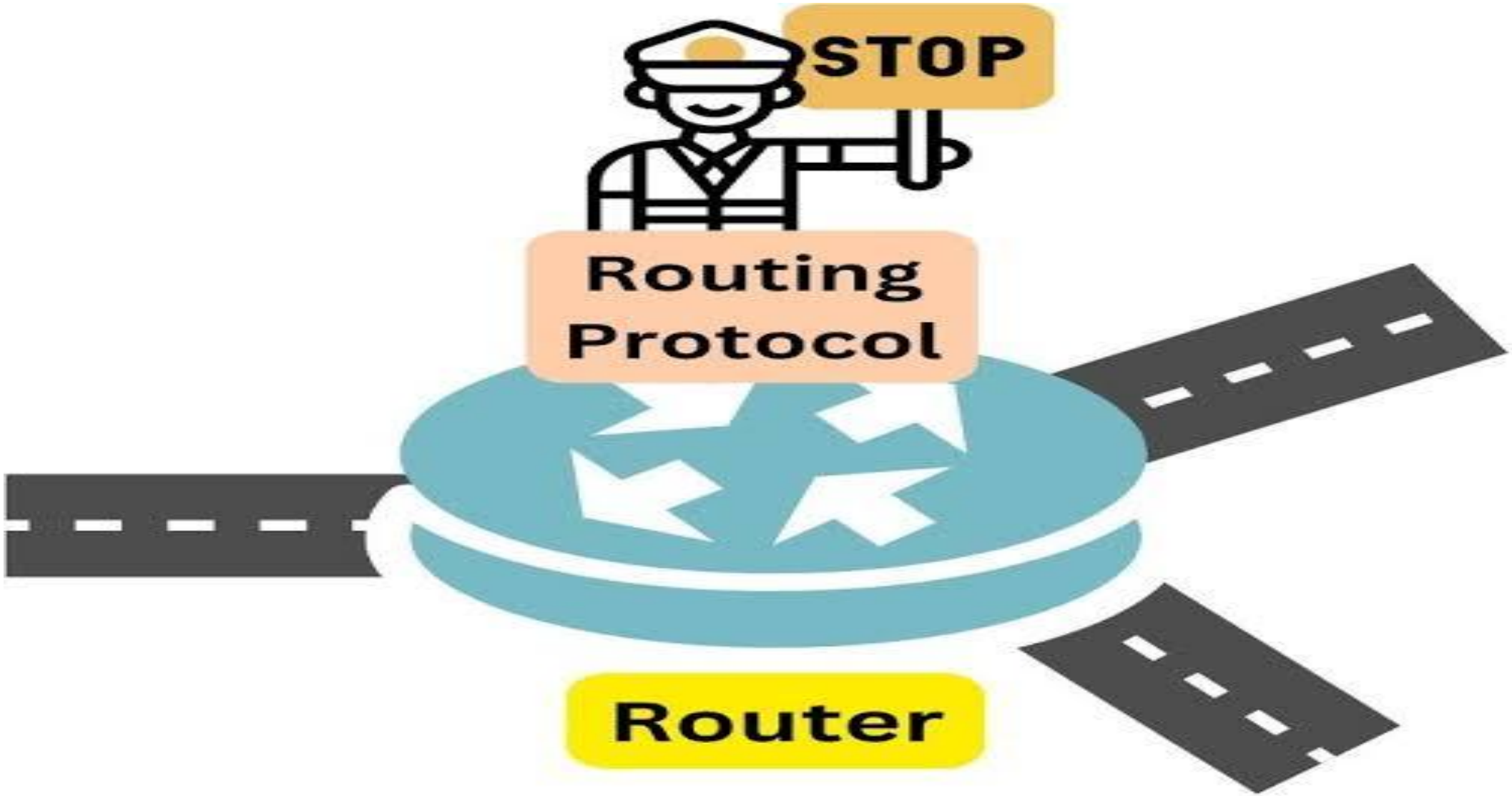
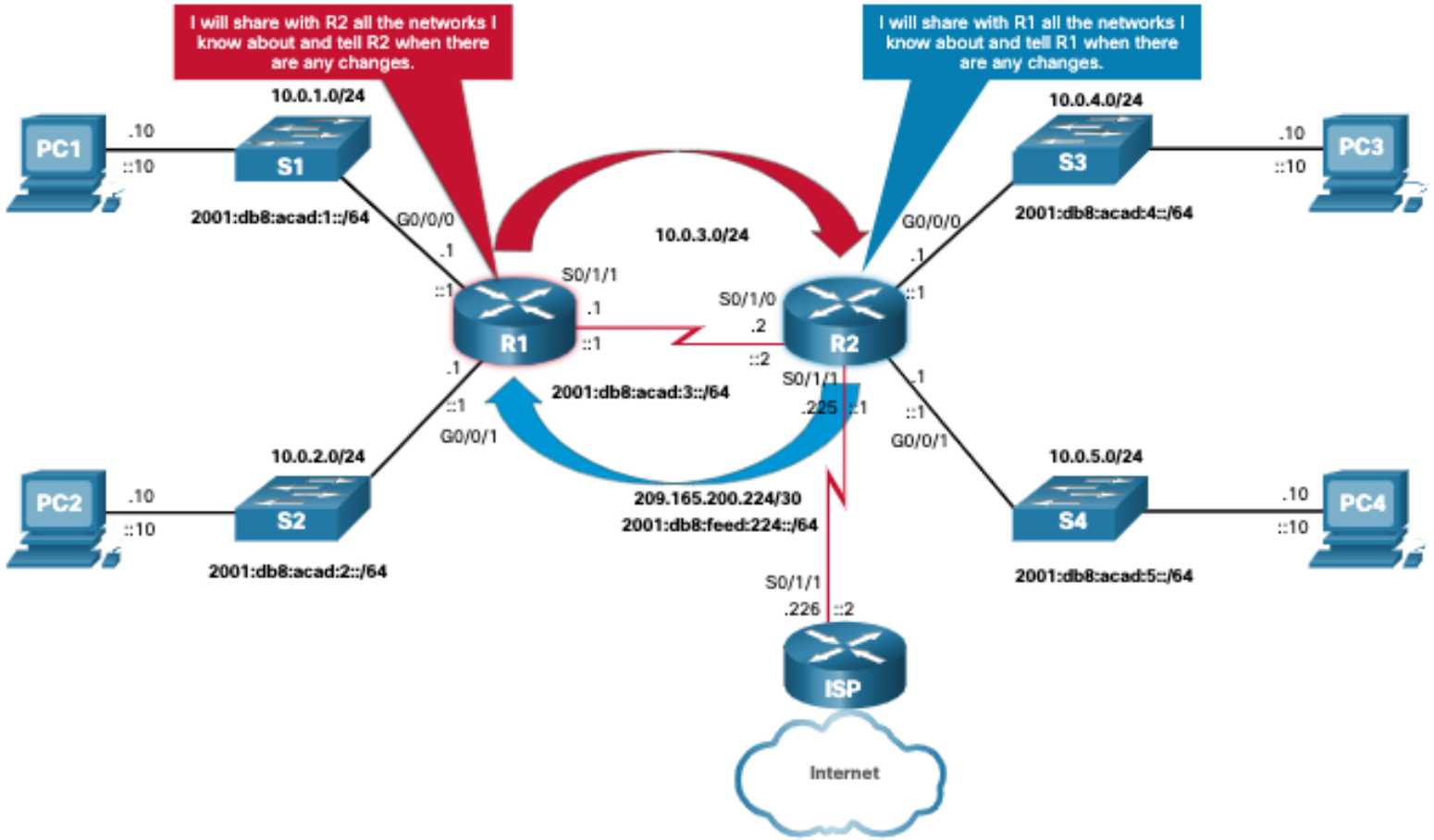

STOP
Routing
Protocol
Router

Dynamic Routing Protocols

Dynamic routing protocols are used by routers to automatically share information about the reachability and status of remote networks. Dynamic routing protocols perform several activities, including network discovery and maintaining routing tables.



```
R1# show ip route | begin Gateway
Gateway of last resort is 209.165.200.234 to network 0.0.0.0

S*  0.0.0.0/0 [1/0] via 209.165.200.234, Serial0/0/1
                    is directly connected, Serial0/0/1
    172.16.0.0/16 is variably subnetted, 5 subnets, 3 masks
C      172.16.1.0/24 is directly connected, GigabitEthernet0/0
L      172.16.1.1/32 is directly connected, GigabitEthernet0/0
R      172.16.2.0/24 [120/1] via 209.165.200.226, 00:00:12, Serial0/0/0
R      172.16.3.0/24 [120/2] via 209.165.200.226, 00:00:12, Serial0/0/0
R      172.16.4.0/28 [120/2] via 209.165.200.226, 00:00:12, Serial0/0/0
R   192.168.0.0/16 [120/2] via 209.165.200.226, 00:00:03, Serial0/0/0
    209.165.200.0/24 is variably subnetted, 5 subnets, 2 masks
C      209.165.200.224/30 is directly connected, Serial0/0/0
L      209.165.200.225/32 is directly connected, Serial0/0/0
R      209.165.200.228/30 [120/1] via 209.165.200.226, 00:00:12,
                          Serial0/0/0
C      209.165.200.232/30 is directly connected, Serial0/0/1
L      209.165.200.233/30 is directly connected, Serial0/0/1
R1#
```

- *Route source : letters in beginning of the line of route table, used to know the used protocol in routing table.*

```
R1# show ip route | begin Gateway
Gateway of last resort is 209.165.200.234 to network 0.0.0.0

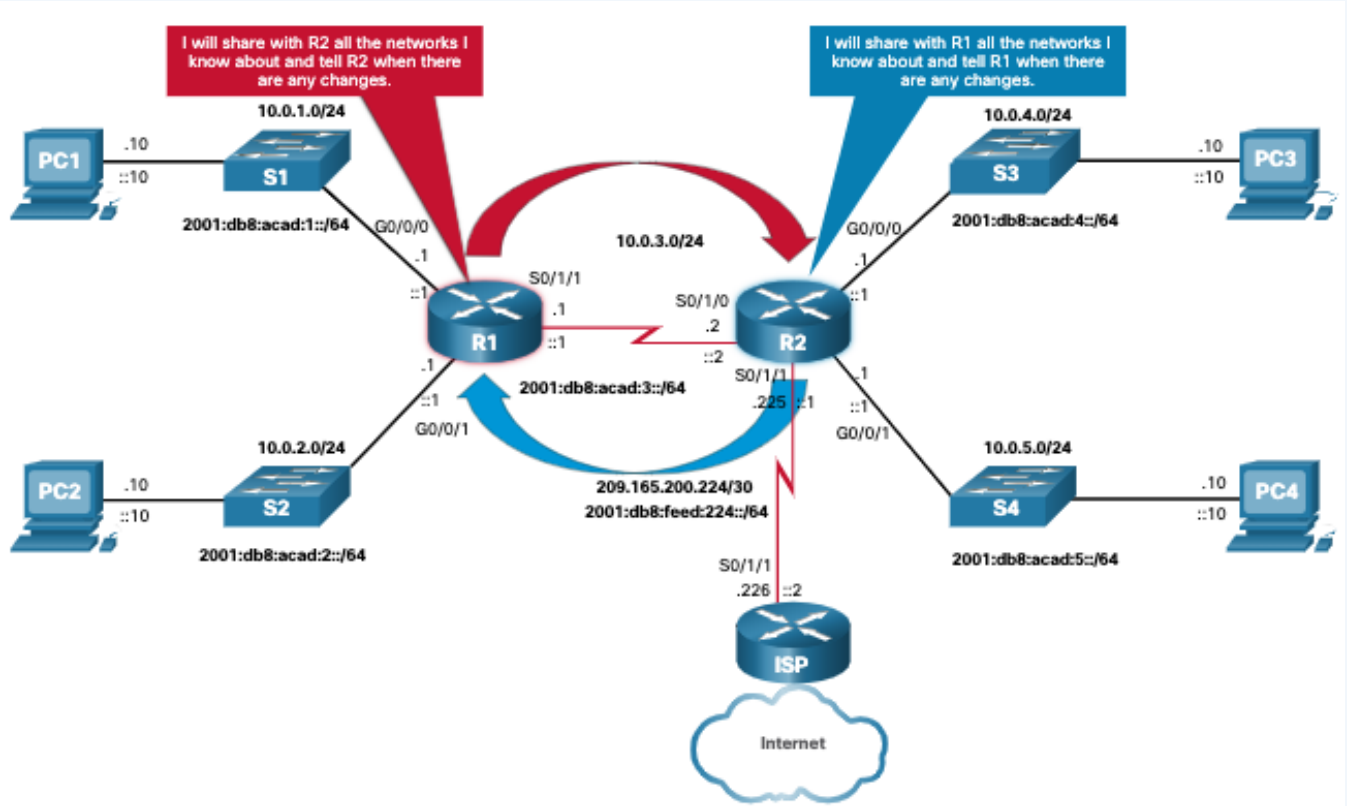
S*  0.0.0.0/0 [1/0] via 209.165.200.234, Serial0/0/1
                    is directly connected, Serial0/0/1
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                           Serial0/0/0
C       209.165.200.232/30 is directly connected, Serial0/0/1
L       209.165.200.233/30 is directly connected, Serial0/0/1
R1#
```

```
L - local, C - connected, S - static, R - RIP, M - mobile, B -
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS
ia - IS-IS inter area, * - candidate default, U - per-user sta
o - ODR, P - periodic downloaded static route, + - replicated
```

Types Of Dynamic Routing

	Interior Gateway Protocols (inside autonomous system)				Exterior Gateway Protocols (between autonomous systems)
	Distance Vector		Link-State		Path Vector
IPv4	RIPv2	EIGRP	OSPFv2	IS-IS	BGP-4
IPv6	RIPng	EIGRP for IPv6	OSPFv3	IS-IS for IPv6	BGP-MP

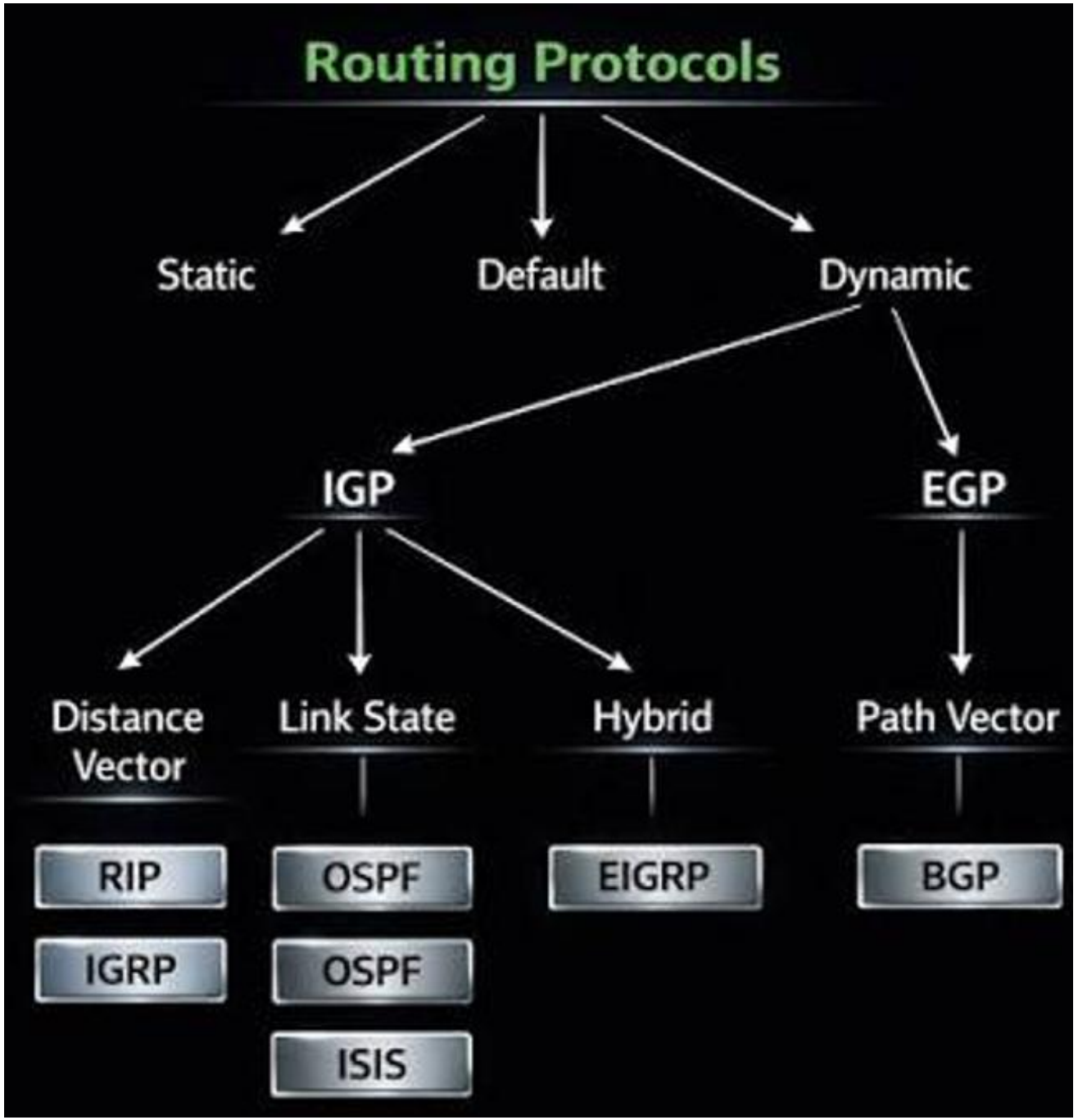
How dynamic routing works



1 — Discover neighbors

2 — Exchange routing info

3 — Calculate best paths

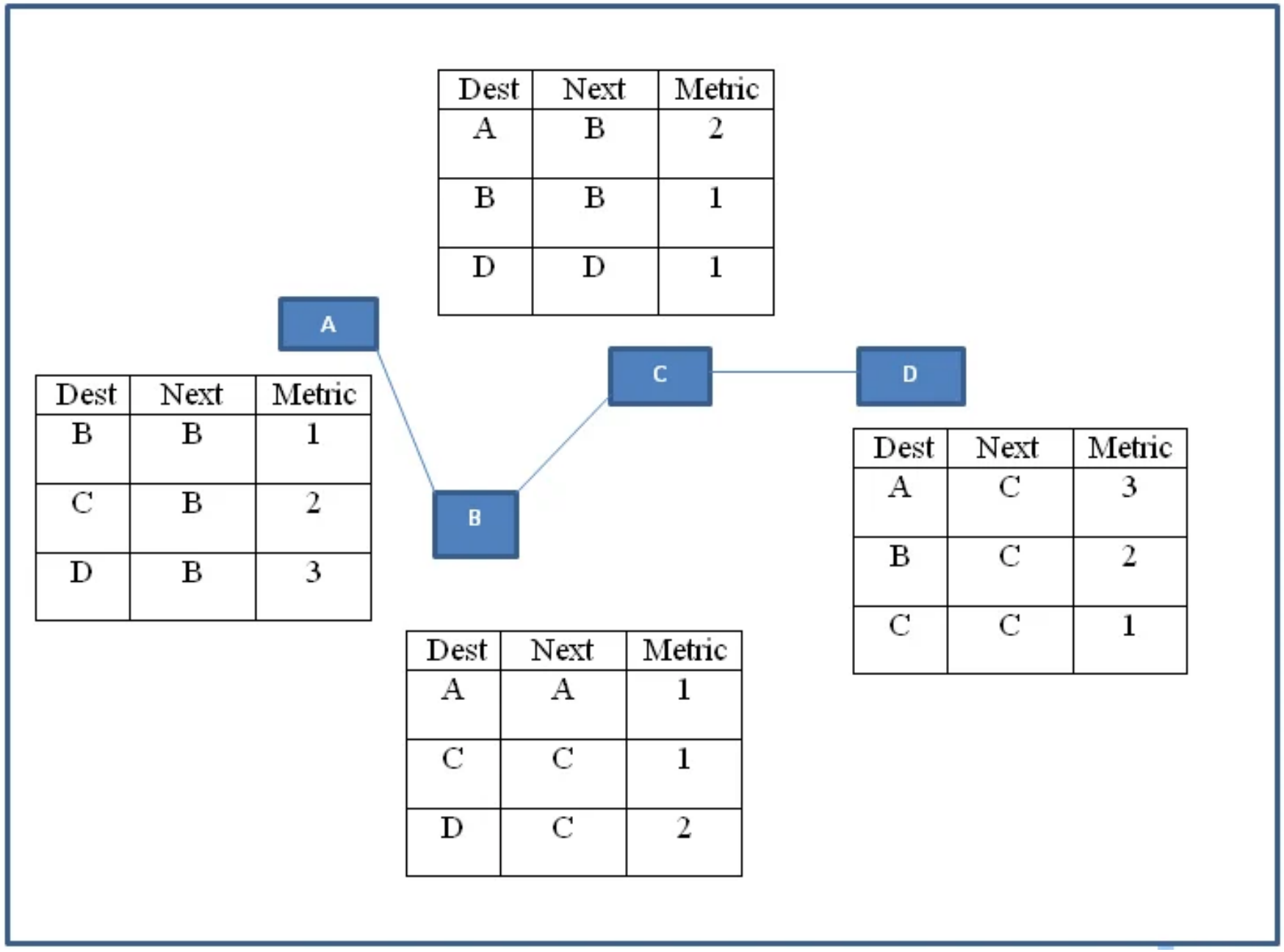

Routing Protocols
Static
Default
Dynamic
IGP
EGP
Distance Vector
Link State
Hybrid
Path Vector
RIP
IGRP
OSPF
OSPF
ISIS
EIGRP
BGP

Routing Information Protocol (RIP)

- The Routing Information Protocol (RIP) is designed to help routers determine the best path for sending data packets across a network. It uses hop count as its routing metric and is primarily used in small to medium-sized networks due to its scalability limitations.

- RIP operates at the Network Layer (Layer 3) of the OSI model and maintains routing tables on each router.
- Every 30 seconds, routers exchange their complete routing tables with neighbours using periodic updates.
- The hop count metric defines the **number of routers a packet must pass through to reach its destination (15 maximum hops).**

Distance vector



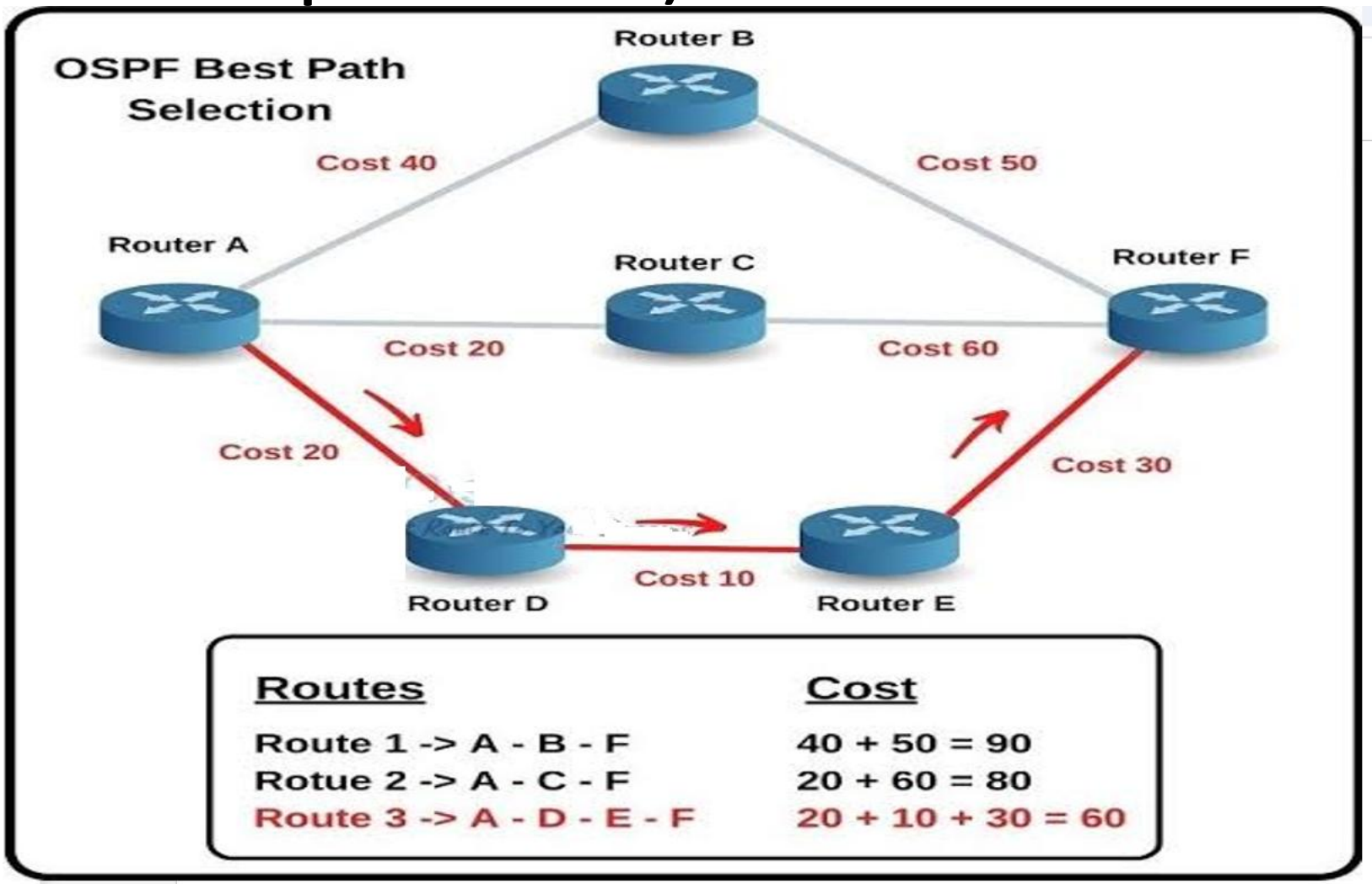
Configuration RIP protocol

```
Router(config)# router rip
Router(config-router)# version 2
Router(config-router)# network 192.168.1.0
```

OSPF (Open shortest path first)

OSPF (open shortest path first)

- OSPF: Calculates the total cost of each path and chooses the path with the lowest cost.



Components of OSPF

1.Packets

2. Database

3. Algorithm

OSPF PACKET TYPES

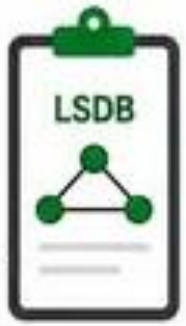
OSPF uses 5 types of packets to discover neighbors, build adjacency and exchange routing information.

OSPF Neighbor Communication



QUICK SUMMARY

- **Hello:** Find neighbors & maintain adjacency
- **DBD:** Compare LSDBs
- **LSR:** Request missing information
- **LSU:** Send the requested information
- **LSAck:** Confirm receipt of information



#	PACKET TYPE	DESCRIPTION	PURPOSE	SENT IN STATE
1	Hello	Discovered neighbors and maintains adjacency.	• Discover neighbors • Keep adjacency alive	Down, Init, 2-Way
2	Database Description	Describes the content of the sender's LSDB.	• Compare LSDB between neighbors	ExStart, Exchange
3	Link State Request	Requests specific LSAs from neighbor.	• Request missing information	Exchange, Loading
4	Link State Update	Contains one or more LSAs to update the LSDB.	• Send the requested LSA information	Exchange, Loading
5	Link State Acknowledgment	Acknowledges receipt of LSAs.	• Confirm reliable delivery	Loading, Full

Components of OSPF

- All routing protocols share similar components. They all use routing protocol messages to exchange route information. The messages help build data structures, which are then processed using a routing algorithm.
- Routers running OSPF exchange messages to convey routing information using five types of packets:

1. Hello packet
2. Database description packet (DD)
3. Link-state request packet (LSR)
4. Link-state update packet (LSU)
5. Link-state acknowledgment packet (LSACK)

- These packets are used to discover neighboring routers and also to exchange routing information to maintain accurate information about the network.

EIGRP

- **EIGRP (Enhanced Interior Gateway Routing Protocol)** is an advanced distance vector routing protocol. This protocol is an evolution of an earlier Cisco protocol called IGRP. EIGRP supports classless routing. It is a Cisco protocol, so all routers in a network that is running EIGRP must be Cisco routers.

- EIGRP uses the diffusing update algorithm (DUAL) to determine the best path to a remote network.

- EIGRP determines the value of the path using five metrics: bandwidth, load, delay, reliability.

Route Selection

$$\text{Metric} = \left[\left(K1 * BW_{min} + \frac{K2 * BW_{min}}{256 - \text{load}} + K3 * \text{delay}\right) * \frac{K5}{K4 + \text{reliability}}\right] * 256$$

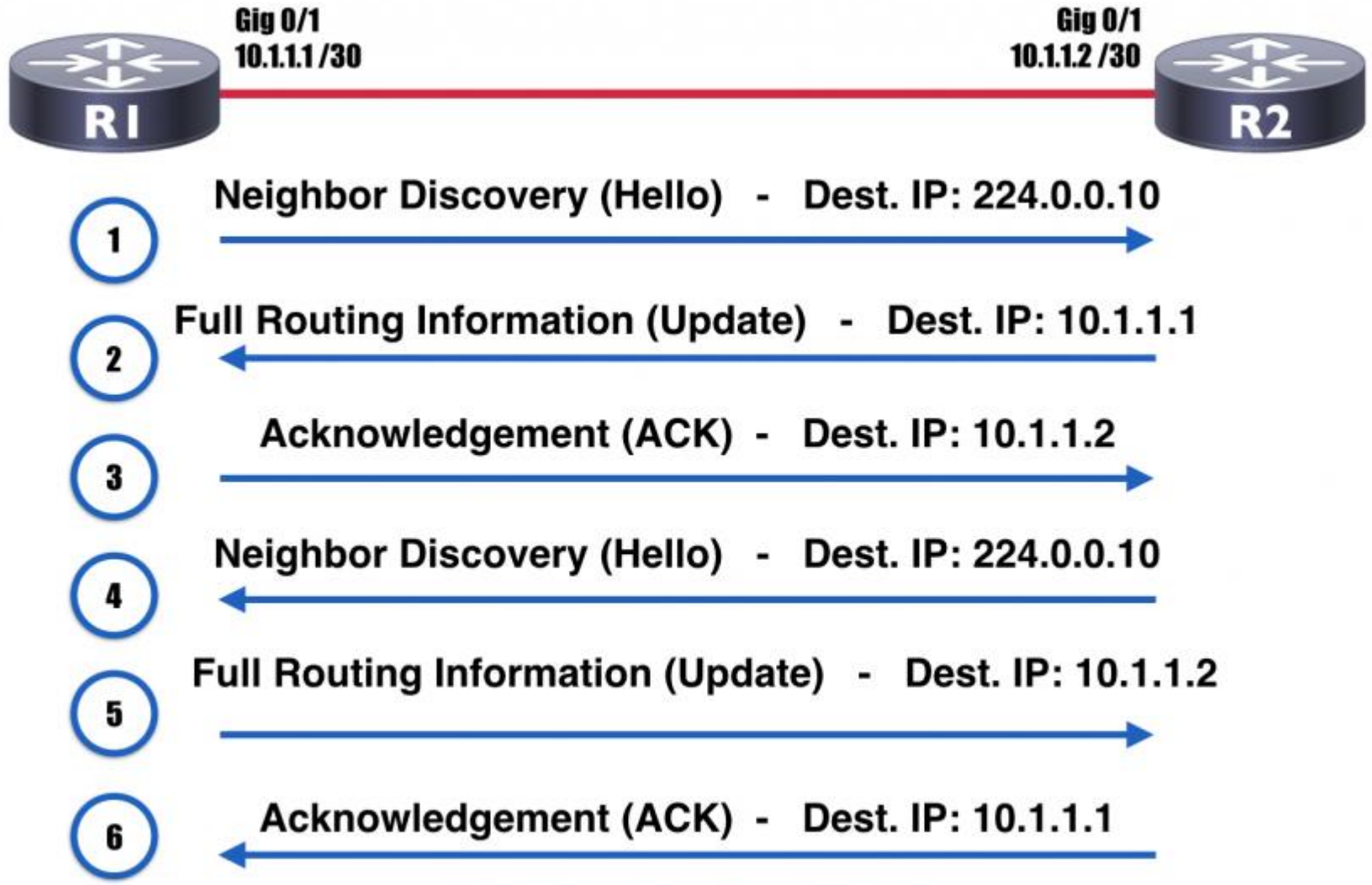
$$\text{where } BW_{min} = \frac{10^7}{\text{least-bandwidth}}$$

Specifically, the default K-values are:

K1 = 1
K2 = 0
K3 = 1
K4 = 0
K5 = 0

- Notice the metric calculation involves a collection of K-values, which are constants you can configure to be zero or some positive integer. The calculation also considers bandwidth, delay, load, and reliability.

EIGRP Messages



1. **Hello Packets** are used to establish and maintain **EIGRP Neighborship**. This Hello messages are sent as Multicast messages to Multicast Address 224.0.0.10.
2. **Update Packets** are used to send routing updates. With these Update messages, **Topology Tables** and **Routing Tables** are built. Update Messages are sent both Unicast and Multicast. If an update is sent to a new neighbor, it is sent as unicast. If this update is related to any route change, then it is sent as Multicast to 224.0.0.10 address.
3. **Query Packets** are used to ask for any **routing** update, requests an update. **EIGRP Query Messages** are sent as Multicast to 224.0.0.10 address.
4. **Reply Packets** are used as a response to the Query Packets. They include the alternate routes to the requested destination. Reply Messages are unicast messages.
5. **Ack Packets** are used as a feedback to the Update, Query or Reply packets as a feedback mechanism. They are sent as unicast.

- Q1: What are the primary activities performed by dynamic routing protocols?
- A) Assigning static IP addresses to end devices and configuring gateways
- B) Network discovery and maintaining routing tables
- C) Encrypting data packets at the Data Link layer
- D) Translating private IP addresses into public IP addresses (NAT)

- Q2: In a routing table output, what does a route beginning with the letter "C" represent?
- A) Candidate default route
- B) Static route
- C) Directly connected route
- D) OSPF inter-area route

- Q3: What metric does RIP use to determine the best path to a network?
- A) Bandwidth and delay combined
- B) Hop count
- C) Cumulative link cost based on speed
- D) Reliability and load

- Q5: What is the maximum hop count allowed by RIP before a route is considered unreachable?
- A) 10 hops
- B) 15 hops
- C) 30 hops
- D) 255 hops

- Q6: How frequently do RIP routers exchange their complete routing tables with neighbors?
- A) Every 10 seconds
- B) Every 30 seconds
- C) Every 60 seconds
- D) Only when a topology change occurs

- Q: What algorithm is utilized by OSPF to calculate the best path?
- A) DUAL (Diffusing Update Algorithm)
- B) Bellman-Ford algorithm
- C) Shortest Path First (SPF) / Dijkstra's algorithm
- D) Path Vector algorithm

- Q: Which EIGRP packet type is sent as a response to a Query packet and contains alternate routes?
- A) Update Packet
- B) Reply Packet
- C) Acknowledgment (ACK) Packet
- D) Hello Packet