



Chapter 5: Dynamic Routing



Scaling Networks

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Chapter 5 - Sections & Objectives

- 5.1 Dynamic Routing Protocols
 - Explain the features and characteristics of dynamic routing protocols.
- 5.2 Distance Vector Dynamic Routing
 - Explain how distance vector routing protocols operate.
- 5.3 Link-State Dynamic Routing
 - Explain how link-state protocols operate.



5.1 Dynamic Routing Protocol



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Dynamic Routing Protocols

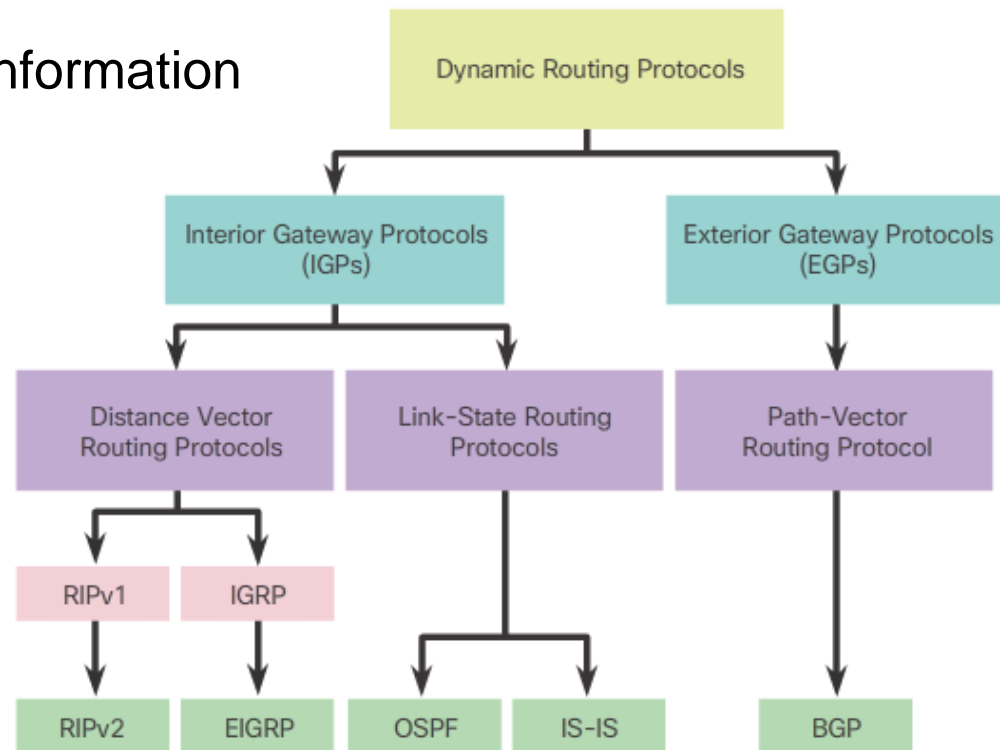
Types of Routing Protocols

■ Purpose of dynamic routing protocols

- Discovery of remote networks
- Maintaining up-to-date routing information
- Choosing the best path to destination networks
- Ability to find a new best path if the current path is no longer available

■ Types of Routing Protocols

- Link-State
- Distance Vector
- Path-Vector



**Practice with 5.1.1.9, 5.1.1.10
and 5.1.1.11**



5.2 Distance Vector Dynamic Routing



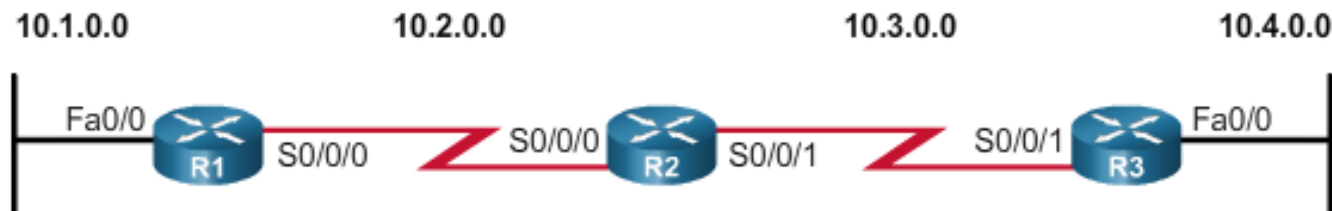
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Distance Vector Dynamic Routing

Distance Vector Fundamentals

- Dynamic Routing Protocol Operation
 - Router **sends and receives routing messages** on its interfaces
 - Router **shares routing messages and routing information** with other routers that are using the same routing protocol.
 - Routers exchange routing information to **learn about remote networks**.
 - When a router detects a **topology change**, the routing protocol can advertise this change to other routers.



- Describe the process to achieve **convergence** and build the routing table using the graphics above:
 - Which networks are directly connected (0 hop)?
 - Which networks are 1 hop or 2 hops away?



Distance Vector Dynamic Routing

Distance Vector Routing Protocol Operation

■ Distance Vector Technologies

- Neighbors are routers that share a link and are configured to use the same routing protocol.
- The router is only aware of the network addresses of its own interfaces and the remote network addresses it can reach through its neighbors.
- Routers using distance vector routing are **not aware of the network topology (they just know the distance and the direction)**.
- Some distance vector routing protocols send periodic updates.

■ Distance Vector Algorithm

- Sending and receiving routing information
- Calculating the best paths and installing routes in the routing table
- Detecting and reacting to topology changes
- **See the animation in 5.2.2.2 and practice with 5.2.2.3**



Distance Vector Dynamic Routing

Types of Distance Vector Routing Protocols

Characteristics and Features	RIPv1	RIPv2	IGRP	EIGRP
Metric	Both use hop count as a simple metric. The maximum number of hops is 15.		Both use a composite metric consisting of bandwidth and delay. Reliability and load can also be included in the metric calculation.	
Updates Forwarded to Address	255.255.255.255	224.0.0.9	255.255.255.255	224.0.0.10
Supports VLSM	✗	✓	✗	✓
Supports CIDR	✗	✓	✗	✓
Supports Summarization	✗	✓	✗	✓
Supports Authentication	✗	✓	✗	✓

- See 5.2.3.1 and 5.2.3.2 for the other enhancements...
- **Practice with 5.2.3.3**



5.3 Link-State Dynamic Routing



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Link-State Dynamic Routing

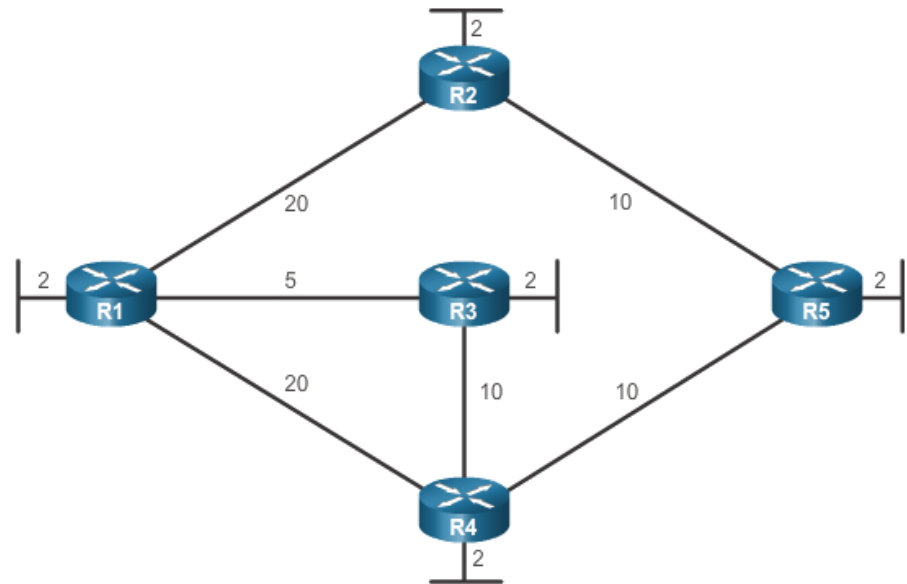
Link-State Routing Protocol Operation

■ Shortest Path First Protocols

- **OSPF** and IS-IS

■ Dijkstra's Algorithm

- Using the diagram, determine the shortest path for the scenarios below:
 - R1 to R4
 - R1 to R5
 - R2 to R3
 - R3 to R5
 - R4 to R2
 - R5 to R2





Link-State Dynamic Routing

Link-State Updates

- Link-State Routing Process (**see 5.3.2.1-8 and practice with 5.3.2.9**)
 - Each router learns its own links and directly connected networks
 - Each router discovers its neighbors on directly connected networks with Hello packets.
 - Each router builds a **link-state packet** containing the state of each directly connected link.
 - Each router **floods the LSP** to all neighbors, who then store all LSPs received in a database.
 - Each router uses the database to construct a **complete map of the topology** and **computes the best path to each destination network**.
- SPF Tree
 - Each router in the routing area uses the link-state database and SPF algorithm to construct the SPF tree.
 - Each router constructs its own SPF tree independently from all other routers.
 - The SPF trees must be identical on all routers.
 - The paths are added to the routing table.



Link-State Dynamic Routing

Link-State Routing Protocol Benefits

■ Advantages

- Builds a complete topological map of the network to determine the shortest path
- Floods the LSP immediately to achieve faster converge
- Only sends out LSP with new information when there is a change in the topology
- Uses the concept of areas and allows for summarization.

■ Disadvantages

- Requires additional memory to maintain the database and SPF tree
- Requires more CPU processing to calculate the SPF algorithm and create a complete map of the topology
- Requires more bandwidth during initial startups of the routers and could be an issue on unstable networks



5.4 Chapter Summary



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Chapter Summary

Summary

- Dynamic routing protocols are used by routers to facilitate the exchange of routing information between routers. They are used to discover remote networks, maintain up-to-date routing information, choose the best path to destination networks and has the ability to find a new best path when the topology changes.
- Dynamic routing protocols require more CPU and bandwidth resources.
- Networks typically use a combination of both static and dynamic routing. Dynamic routing is the best choice for large networks and static routing is better for stub networks.
- The process of bringing all routing tables to a state of consistency, where all of the routers in the same routing domain or area have complete and accurate information about the network, is called convergence. Some routing protocols converge faster than others.
- Metrics are used by routing protocols to determine the best path or shortest path to reach a destination network.
- Distance vector protocols do not have the actual map of the network topology. The routers only have knowledge reach remote networks through the neighbors. Periodic updates are send to keep the routing tables up-to date. Modern distance vector protocols are RIPv2, RIPv6 and EIGRP.
- A router configured with a link-state routing protocol can create a complete view or topology of the network by gathering information from all of the other routers. This information is collected using link-state packets (LSPs). Updates are send when topology changes.
- Link-state routing protocols apply Dijkstra's algorithm to calculate the best path route. The algorithm is commonly referred to as the shortest path first (SPF) algorithm. This algorithm uses accumulated costs along each path, from source to destination, to determine the total cost of a route. The link-state routing protocols are IS-IS and OSPF.

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