7.2.2 Routing Protocol Characteristics Facts

Routers use a routing protocol to assign a metric to a network path and exchange information about paths with other routers. In this lesson, you will learn about:

- Routing metrics
- Routing protocol categories
- Distance vector protocols
- Link state protocols
- Hybrid protocols
- Administrative distance
- Configure a static route

Routing Metrics

If there are multiple paths to a distant network, a routing protocol will assign a metric to each directly connected network link. The metric value can be thought of as the cost of sending a packet over that link. The metric is used when determining the best path to a network.

A routing protocol can use one or more of the following characteristics:

Characteristic	Description
Hop Count	The distance between networks can be measured in hop counts, or the number times a router forwards an IP packet from one network to another. For a directly connected link, the hop count will be zero.
Bandwidth	Network bandwidth measures the capacity of a link. If bandwidth is a factor in the cost, a link with a lower capacity link will have a higher cost than a link with a high bandwidth link.
Throughput	Although the advertised bandwidth is the maximum capacity of a link, its actual throughput will be less due to latency and other network overhead. If used in the cost calculation, larger throughput will contribute to a lower cost.
Link Utilization	Link utilization is the percentage of a network's bandwidth that is currently being consumed by network traffic. If utilization is used, the cost will be less for links with low utilization.
Load	The load on a router refers to the amount of computational work that it performs. If load is a factor in the cost, links for routers that are performing under heavy load will have a higher cost.
MTU	The maximum transmission unit (MTU) setting on a router determines the maximum payload size for a frame. While this characteristic is not usually included in a metric, it is sometimes used as a tie-breaker when two links or paths have the same cost.
Packet Loss	Packet loss occurs when IP packets fail to reach their destination. If it is used in calculating cost, a link that experiences greater packet loss will have a higher cost.
Latency	Latency is the delay in transmissions over the path. If latency is used in the cost, a path with higher latency will have a higher cost.
Reliability	Reliability is measured by how often the path is down. If it is used in cost calculations, a highly reliable path will have a lower cost.

Routing Protocol Categories

There are two primary categories of gateway protocols, distance vector protocols and link state protocols. A third category is a combination of these two, hybrid protocols. There is only one popular exterior routing protocol, and it is a hybrid protocol.

The difference in these categories of routing protocols is:

- How metric values are calculated
- How path information is shared between routers

Distance Vector Routing Protocols

Distance vector routing protocols:

- Set a metric value or cost based on how far away a network is.
  - Are generally measured by hop count.
  - May measure distance by delay, packets lost, or something similar.
- Set a direction that is associated with the distance.
  - Direction refers to the network interface that is used to forward the IP packet to the distant network.

When using a distance vector protocol, a router:

- Will only share information with its direct neighbors (the next hop routers).
- Will share all route information that it knows about.
  - Directly connected routes
  - Routes learned from its direct neighbors
- Will send route information at a regularly scheduled time.

Convergence occurs when all routers share a consistent view of the network. Each router will used converged path information to insert next hop information for each learned path into the routing table. It does this by choosing the route with the lowest metric.

Link State Routing Protocols

1. Link state protocols are also known as shortest path first protocols. The following is the general process employed by a router that uses link state protocols for finding best hop information.
2. The router examines its directly connected network links and assigns a metric value.
   - The metric value is based on the status and connection type of the link.
   - The metric value may also include other factors, such as bandwidth and delay.
3. The router determines the neighbor routers that are connected by each direct network link.
4. The router builds a link-state packet (LSP) that contains a list of its neighbors and the metric value of the link to that neighbor.
5. Through a process called flooding, the router sends the LSP to its neighbor routers.
6. Neighboring routers, in turn, sends the LSP to its neighbors, and so on.
   - To eliminate looping, each router forwards the packet to every neighbor except the one it received the packet from.
   - A smart flooding algorithm prevents looping when there are circular routing paths.
7. Using converged route information, the router constructs a complete map of the routing topology.
8. From this map, the router will calculate the best path to each destination network.
   - Best path is determined using Dijkstras's algorithm, which calculates the shortest path first.
9. Using the link-state protocol, the router uses the best path information to insert next hop information for each network path into the routing table.

Administrative Distance

When more than one protocol is enabled on a router, each protocol is given an administrative distance. When the best path is being determined, protocols with a lower administrative distance are chosen over those with a higher administrative distance.

Most routers have a default administrative distance assigned to each routing protocol.

Source of the Route	Default Administrative Distance
Connected interface or static route to an interface	0
Static route to an IP address	1
EIGRP summary	5
BGP external	20
EIGRP internal	90
IGRP	100
OSPF	110
IS-IS	115
RIP	120
EIGRP external	170
BGP internal	200

Unknown source	255

Configure a Static Route

To configure a static route, enter the following commands at the prompt:

SFO>**enable**
SFO#**configure terminal**
SFO(config)#**ip route** ***network_address subnet gateway***
SFO(config)#**ip route 0.0.0.0 0.0.0.0** ***gateway***
SFO(config)#**exit**
SFO#**copy run start**