Objectives

- Identify the characteristics of distance vector routing protocols.
- Describe the network discovery process
- Identify the conditions leading to a routing loop and explain the implications for router performance.
- Recognize that distance vector routing protocols are in use today

Distance Vector Routing Protocols

- Examples of Distance Vector routing protocols:
  - Routing Information Protocol (RIP)
  - Interior Gateway Routing Protocol (IGRP)
  - Enhanced IGRP (EIGRP)

- The meaning of Distance Vector:
  - A router using distance vector routing protocols knows 2 things:
    - Distance to final destination
    - Vector, or direction, traffic should be directed

Characteristics of Distance Vector routing protocols

- Periodic updates
- Neighbors
- Broadcast updates
- Entire routing table is included with routing update

Routing Protocol Characteristics

- Criteria used to compare routing protocols include:
  - Time to convergence
  - Scalability
  - Resource usage
  - Implementation & maintenance

Advantages and Disadvantages of Distance Vector

- Simple implementation and maintenance
- Slow convergence
- Low resource requirements
- Limited scalability
- Routing loops
Network Discovery
- Router initial start up (Cold Starts)
- Directly connected networks are initially placed in the routing table

Initial Exchange of Routing Information
If a routing protocol is configured then
- Routers will exchange routing information
- Routing updates received from other routers
- Router checks update for new information
- If there is new information:
  - Metric is updated
  - New information is stored in routing table

Network Convergence
- Network convergence is reached when
  - All routing tables in the network contain the same network information
- Routers continue to exchange routing information
- If no new information is found then Convergence is reached

Convergence Time
- Convergence must be reached before a network is considered completely operable
- The speed of achieving convergence depends on:
  - Speed of broadcasting routing information
  - Speed of calculating routes

Routing Table Maintenance
- Periodic Updates: RIPv1 & RIPv2
  - These are time intervals in which a router sends out its entire routing table.
- Bounded Updates: EIGRP
  - EIGRP routing updates are
    - Partial updates
    - Triggered by topology changes
    - Bounded
    - Non periodic
RIP Random Jitter

- **Synchronized updates**
  A condition where multiple routers on multi-access LAN segments transmit routing updates at the same time.

- **Problems with synchronized updates**
  - Bandwidth consumption
  - Packet collisions

- **Solution to problems with synchronized updates**
  - Used of random variable called RIP_JITTER

Routing Loops

- **A Routing Loop is a condition where a packet is continuously transmitted within a series of routers without ever reaching its destination.**
- **Routing Loops may be caused by:**
  - Incorrectly configured static routes
  - Slow convergence of the Routing Protocol
- **Routing Loops can create the following issues:**
  - Excess use of bandwidth
  - CPU resources may be strained
  - Routing updates may be lost or not processed in a timely manner

Routing Loops: Count to Infinity

Each round of updates continues to increase hop count.

Preventing Loops

- **By setting a maximum metric**
- **Distance Vector routing protocols set a specified metric value to indicate infinity.**

Once a router “counts to infinity” it marks the route as unreachable

Preventing loops with holddown timers

- **Holddown timers** allow a router to not accept any changes to a route for a specified period of time.
- **Point of using holddown timers**
  - Allows routing updates to propagate through network with the most current information.

Preventing Loops: Split Horizon Rule

- **Split Horizon rule:**
  A router should not advertise a network through the interface from which the update came.
Routing Loops

- **Split horizon with poison reverse**
  The rule states that once a router learns of an unreachable route through an interface, advertise it as unreachable back through the same interface.

IP & the Time-To-Live (TTL) field

- **Purpose of the TTL field**
  The TTL field is found in an IP header and is used to prevent packets from endlessly traveling on a network.
- **How the TTL field works**
  TTL field contains a numeric value.
  The numeric value is decreased by one by every router on the route to the destination.
  If numeric value reaches 0 then Packet is discarded.

Summary: Dealing with Routing Loops

- Distance Vector routing protocols are prone to causing **Routing Loops**
- The effects can be reduced by these methods:
  - Setting a maximum metric (“infinity”)
  - Hold down timers
  - Split horizon rule
  - Split horizon with poison reverse
- Some or all of these methods may be incorporated in the design of a **Distance Vector Routing Protocol**

Distance Vector Routing Protocols

- Factors used to determine whether to use RIP or EIGRP include
  - Network size
  - Compatibility between models of routers
  - Administrative knowledge

Summary: Features of RIP

- Supports split horizon & split horizon with poison reverse
- Capable of load balancing
- Easy to configure
- Works in a multi vendor router environment
- There are two versions:
  - Version 1 does not support VLSM, broadcasts routing information every 30 seconds
  - Version 2 does support VLSM, uses multicastrs

Summary: Features of EIGRP

- Triggered updates
- EIGRP hello protocol used to establish neighbor adjacencies
- Supports VLSM & route summarization
- Use of topology table to maintain all routes
- Classless distance vector routing protocol
- Cisco proprietary protocol