Chapter 21

Routing Information Protocol

RIP Overview

- RIP is a distance-vector routing protocol
- RIP is based on the Bellman-Ford algorithm for generating routing protocols
- In distance-vector routing, routers periodically share information with their neighboring routers
  - Each shares its knowledge about the entire autonomous system
  - It shares its knowledge only with its immediate neighbors
  - Sharing occurs at regular intervals

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Routing Table

163.5.0.0	7	172.6.23.4	
197.5.13.0	5	176.3.6.17	
189.45.0.0	4	200.5.1.6	
115.0.0.0	6	131.4.7.19	

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Update Algorithm

- When a router sends its information, it includes its' routing table entries
- The neighboring routers receiving the information must act upon it as follows

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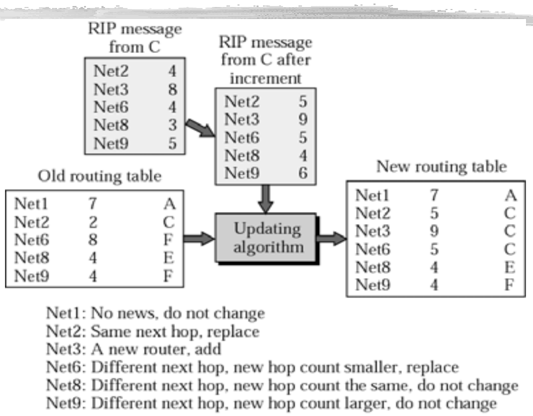
Update Algorithm

1. Add one hop to the hop count for each advertised destination
2. For each advertised destination received, do the following
   - If the destination in the message is not in the routing table, add it
   - If the destination in the message is in the routing table, then
     - If the next-hop field in the existing routing table is the same as the router sending the update
       - Replace the entry in the routing table with the advertised one
     - Else
       - If the advertised hop count is smaller than the one in the existing table,
         - Add it to the table
       - Else
         - Do nothing
3. Done

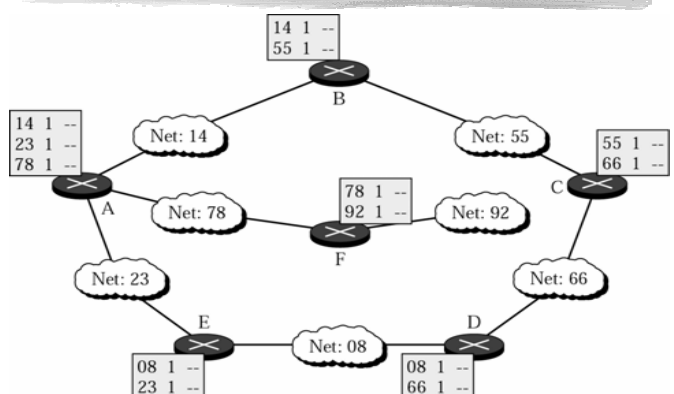
Updating the Routing Table



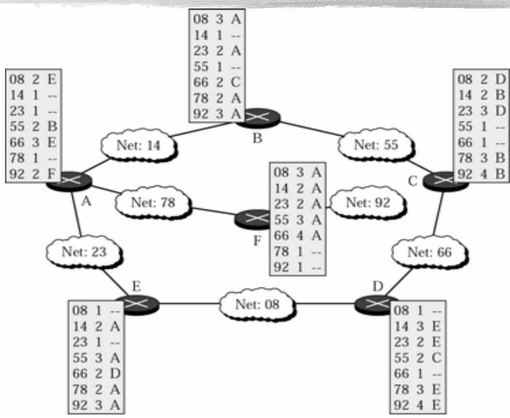
Initializing the Routing Table

- When a router is added to the network, the routing table first contains only the *directly connected networks*
- All hop counts are set to one
- Next hop values are initially cleared
  - In the examples shown, the next hop value is a router name
  - In a Cisco router, the next hop value is the IP address of the next hop router

Initializing the Routing Table



Final Routing Table



Routing Table Updates

- As RIP updates are sent between routers, they will update their routing tables
- After a few of updates, the routing tables will stabilize
  - The number of updates needed to stabilize depends on the network size
  - Larger networks take longer

RIP Message Format

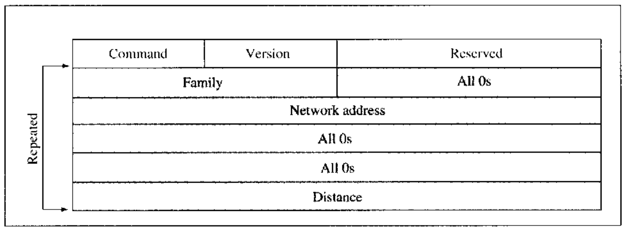
- Consider the message contents in the payload of a UDP datagram
- Fields
  - Command
    - Specifies whether message is request or response
  - Version
    - RIP version (either 1 or 2)
  - Family
    - Identifies the type of network protocol, i.e. TCP/IP
  - Address
    - Destination network address
  - Distance
    - Hop count from advertising router to the destination network

RIP Message Format

- Note:
  - In a RIP request or response, the TCP/IP payload will contain multiple RIP message *entries*
  - The advertising router will include a message *entry* for each network in its routing table

RIP Message Format

Figure 13.6 *RIP message format*



- B. Forouzan, TCP/IP Protocol Suite, Boston, McGraw-Hill, 2000

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Requests

- Requests are sent by routers that first boot up or by routers that experience timeouts for some of its routing table entries
- Requests can contain one or more entries asking about one or more destination networks

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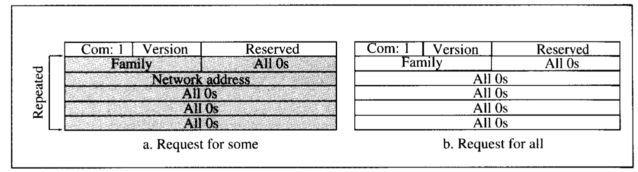
Request Messages

Figure 13.7 *Request messages*



- B. Forouzan, TCP/IP Protocol Suite, Boston, McGraw-Hill, 2000

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Responses

- Responses are either solicited or unsolicited
  - Solicited responses are sent only in response to a request
  - Unsolicited responses are sent periodically
    - Normally at 30 second intervals

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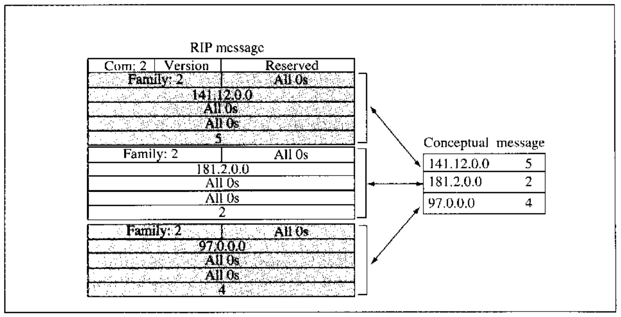
Response Message

Figure 13.8 *Response message*



- B. Forouzan, TCP/IP Protocol Suite, Boston, McGraw-Hill, 2000

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RIP Timers

- Periodic Timer
  - Controls the frequency of the unsolicited update responses
    - Supposed to be 30 seconds
    - Actually, routers choose a random time between 25 and 35 seconds to avoid synchronizing updates to another router
- Expiration Timer
  - Determines the validity of a route
    - When a router receives an update for a route, it sets the expiration timer for that route to 180 seconds
  - If a router does not receive an update for a route in its table before this timer expires, the route is expired
    - The hop count of expired routes is set to 16
    - The route is considered invalid

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RIP Timers

- Garbage Collection Timer
  - When a route expires, the router will continue to advertise the route (with a hop count of 16) until the GCT times out
  - As soon as a route expires, the GCT timer is set to 120 seconds
  - When the GCT expires the route is removed from the table

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Convergence

- RIP has slow convergence
  - A change in a route is propagated to a router's neighbor about 15 seconds on average (why not 30 seconds?)
    - Because all other routers will be sending their updates randomly between 0 and 30 seconds relative to a given router, averaging 15 seconds
  - This neighboring router then propagates the route information to its neighbor 15 seconds later on average
  - Thus it can take several minutes to propagate network changes to all routers
- How does this affect lost packets and retransmissions?
- To help with convergence, hop count is limited to 15
  - How does this affect the size of a network running RIP?

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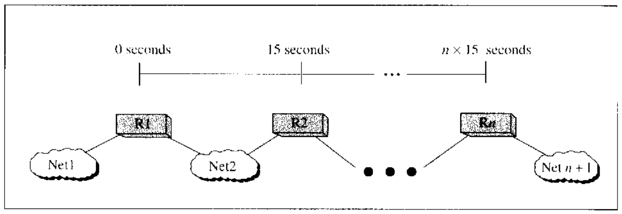
Slow Convergence

Figure 13.10 *Slow convergence*



◆ B. Forouzan, TCP/IP Protocol Suite, Boston, McGraw-Hill, 2000

Instability

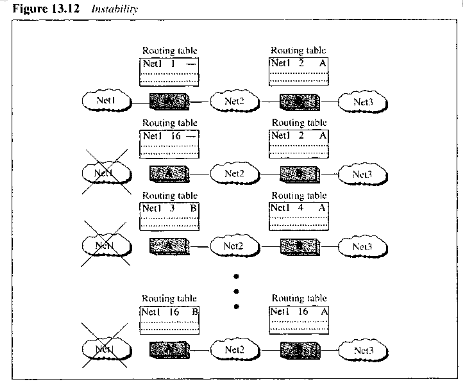
- RIP instability can result in packets circulating among routers
- Remedies
  - Triggered Update
    - Normally routers send updates every 30 seconds
    - However, if a router receives a change from one of its neighbors, it sends updates immediately and does not wait until the periodic timer expires
    - Helps reduce loop instability but does not help when a router fails
  - Split Horizons
    - A router receiving an update from one of its neighbors will not send the same information back out that interface

Instability

- Poison Reverse
  - Similar to split horizon
  - This time a router will send update information coming in one interface back out this interface
  - However, it will also set the hop count to 16 for network information received through that interface
  - That way the original router sending that information will not update its table

Instability

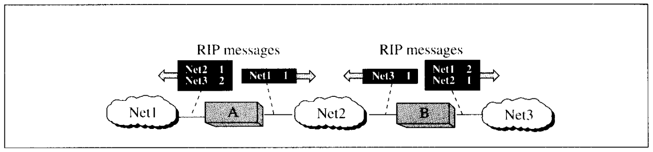
Figure 13.12 *Instability*



◆ B. Forouzan, TCP/IP Protocol Suite, Boston, McGraw-Hill, 2000

Split Horizon

Figure 13.13 *Split horizon*



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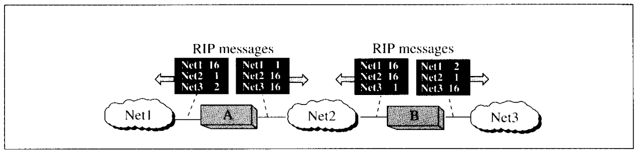
Poison Reverse

Figure 13.14 *Poison reverse*



- B. Forouzan, TCP/IP Protocol Suite, Boston, McGraw-Hill, 2000