

Routing Information Protocol (RIP)

Background

The Routing Information Protocol (RIP) is a distance-vector protocol that uses hop count as its metric. RIP is widely used for routing traffic in the global Internet and is an *interior gateway protocol* (IGP), which means that it performs routing within a single autonomous system. Exterior gateway protocols, such as the Border Gateway Protocol (BGP), perform routing between different autonomous systems. The original incarnation of RIP was the Xerox protocol, GWINFO. A later version, known as *routed* (pronounced “route dee”), shipped with Berkeley Standard Distribution (BSD) Unix in 1982. RIP itself evolved as an Internet routing protocol, and other protocol suites use modified versions of RIP. The AppleTalk Routing Table Maintenance Protocol (RTMP) and the Banyan VINES Routing Table Protocol (RTP), for example, both are based on the Internet Protocol (IP) version of RIP. The latest enhancement to RIP is the RIP 2 specification, which allows more information to be included in RIP packets and provides a simple authentication mechanism.

IP RIP is formally defined in two documents: Request For Comments (RFC) 1058 and 1723. RFC 1058 (1988) describes the first implementation of RIP, while RFC 1723 (1994) updates RFC 1058. RFC 1058 enables RIP messages to carry more information and security features.

This chapter summarizes the basic capabilities and features associated with RIP. Topics include the routing-update process, RIP routing metrics, routing stability, and routing timers.

Routing Updates

RIP sends routing-update messages at regular intervals and when the network topology changes. When a router receives a routing update that includes changes to an entry, it updates its routing table to reflect the new route. The metric value for the path is increased by one, and the sender is indicated as the next hop. RIP routers maintain only the best route (the route with the lowest metric value) to a destination. After updating its routing table, the router immediately begins transmitting routing updates to inform other network routers of the change. These updates are sent independently of the regularly scheduled updates that RIP routers send.

RIP Routing Metric

RIP uses a single routing metric (hop count) to measure the distance between the source and a destination network. Each hop in a path from source to destination is assigned a hop-count value, which is typically 1. When a router receives a routing update that contains a new or changed destination-network entry, the router adds one to the metric value indicated in the update and enters the network in the routing table. The IP address of the sender is used as the next hop.

RIP prevents routing loops from continuing indefinitely by implementing a limit on the number of hops allowed in a path from the source to a destination. The maximum number of hops in a path is 15. If a router receives a routing update that contains a new or changed entry, and if increasing the metric value by one causes the metric to be infinity (that is, 16), the network destination is considered unreachable.

RIP Stability Features

To adjust for rapid network-topology changes, RIP specifies a number of stability features that are common to many routing protocols. RIP, for example, implements the split-horizon and hold-down mechanisms to prevent incorrect routing information from being propagated. In addition, the RIP hop-count limit prevents routing loops from continuing indefinitely.

RIP Timers

RIP uses numerous timers to regulate its performance. These include a *routing-update timer*, a *route timeout*, and a *route-flush timer*. The routing-update timer clocks the interval between periodic routing updates. Generally, it is set to 30 seconds, with a small random number of seconds added each time the timer is reset to prevent collisions. Each routing-table entry has a route-timeout timer associated with it. When the route-timeout timer expires, the route is marked invalid but is retained in the table until the route-flush timer expires.

Packet Formats

The following section focuses on the IP RIP and IP RIP 2 packet formats illustrated in Figure 44-1 and 44-2. Each illustration is followed by descriptions of the fields illustrated.

RIP Packet Format

Figure 44-1 illustrates the IP RIP packet format.

Figure 44-1 An IP RIP packet consists of nine fields.

Field Length,
in Bytes

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 2 | 2 | 2 | 4 | 4 | 4 | 4 |
| A | B | C | D | C | E | C | C | F |

- A = Command
- B = Version Number
- C = Zero
- D = Address Family Identifier
- E = Address
- F = Metric

The following descriptions summarize the IP RIP packet-format fields illustrated in Figure 44-1:

- *Command*—Indicates whether the packet is a request or a response. The request asks that a router send all or part of its routing table. The response can be an unsolicited regular routing update or a reply to a request. Responses contain routing table entries. Multiple RIP packets are used to convey information from large routing tables.
- *Version Number*—Specifies the RIP version used. This field can signal different potentially incompatible versions.
- *Zero*—Not used.
- *Address-Family Identifier (AFI)*—Specifies the address family used. RIP is designed to carry routing information for several different protocols. Each entry has an address-family identifier to indicate the type of address being specified. The AFI for IP is 2.
- *Address*—Specifies the IP address for the entry.
- *Metric*—Indicates how many internetwork hops (routers) have been traversed in the trip to the destination. This value is between 1 and 15 for a valid route, or 16 for an unreachable route.

Note Up to 25 occurrences of the AFI, address, and metric fields are permitted in a single IP RIP packet. (Up to 25 destinations can be listed in a single RIP packet.)

RIP 2 Packet Format

The RIP 2 specification (described in RFC 1723) allows more information to be included in RIP packets and provides a simple authentication mechanism. Figure 44-2 shows the IP RIP 2 packet format.

Figure 44-2 An IP RIP 2 packet consists of fields similar to those of an IP RIP packet.

Length of Field
in Octets

| | | | | | | | | |
|---------|---------|--------|---------------------------------|--------------|---------------|----------------|-------------|--------|
| 1 | 1 | 1 | 2 | 2 | 4 | 4 | 4 | 4 |
| Command | Version | Unused | Address Format Identifier | Route Tag | IP Address | Subnet Mask | Next Hop | Metric |

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The following descriptions summarize the IP RIP 2 packet format fields illustrated in Figure 44-2:

- *Command*—Indicates whether the packet is a request or a response. The request asks that a router send all or a part of its routing table. The response can be an unsolicited regular routing update or a reply to a request. Responses contain routing-table entries. Multiple RIP packets are used to convey information from large routing tables.
- *Version*—Specifies the RIP version used. In a RIP packet implementing any of the RIP 2 fields or using authentication, this value is set to 2.
- *Unused*—Value set to zero.

- *Address-Family Identifier (AFI)*—Specifies the address family used. RIP is designed to carry routing information for several different protocols. Each entry has an address-family identifier to indicate the type of address specified. The address-family identifier for IP is 2. If the AFI for the first entry in the message is 0xFFFF, the remainder of the entry contains authentication information. Currently, the only authentication type is simple password.
- *Route Tag*—Provides a method for distinguishing between internal routes (learned by RIP) and external routes (learned from other protocols).
- *IP Address*—Specifies the IP address for the entry.
- *Subnet Mask*—Contains the subnet mask for the entry. If this field is zero, no subnet mask has been specified for the entry.
- *Next Hop*—Indicates the IP address of the next hop to which packets for the entry should be forwarded.
- *Metric*—Indicates how many internetwork hops (routers) have been traversed in the trip to the destination. This value is between 1 and 15 for a valid route, or 16 for an unreachable route.

Note Up to 25 occurrences of the AFI, address, and metric fields are permitted in a single IP RIP packet. That is, up to 25 routing table entries can be listed in a single RIP packet. If the AFI specifies an authenticated message, only 24 routing table entries can be specified.
