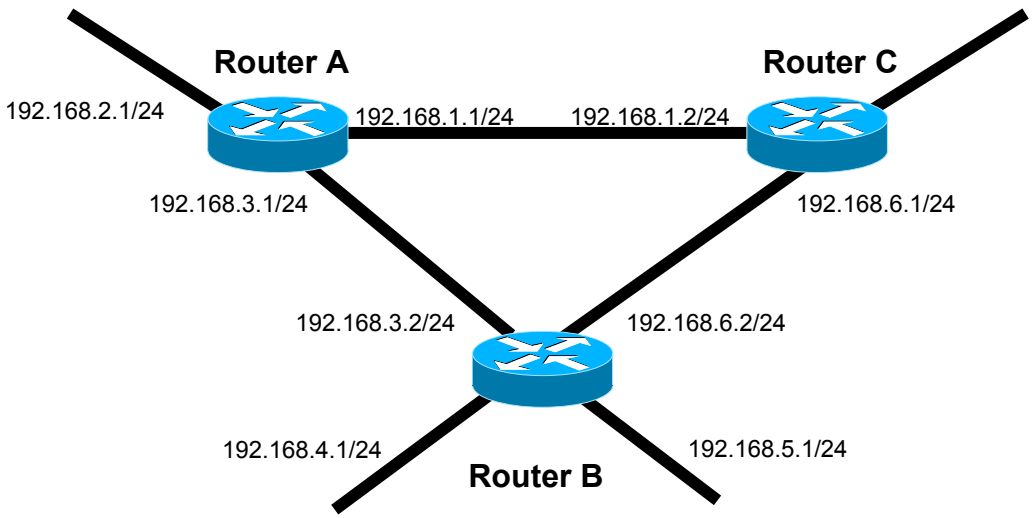
Routing Information Protocol - RIP

Internetworking - Module 11

RIP enables devices to exchange information about networks they are directly connected to as well as any other networks that they have learned from other RIP devices.



Routing Information Protocol (RIP) - RFC 1058

- An interior router protocol (IRP)
- Enables Routers to exchange Routing Information
- Distance Vector Routing Protocol
  - Sends update via broadcast every 30 secs
- Use Hop Count as Metric.
  - Maximum hop-count is 15 – 16 is unreachable in RIP
- Follows Split Horizon Rules
  - with Poison Reverse
- Variants exist for IPX, Appletalk, etc.
- Uses UDP (Port 520) – both for sending and receiving
- Does not support Discontiguous Networks or VLSM

Distance Vector Operation

- Neighboring routers periodically exchange routing tables that state the vector of known distances to other destinations
- Router calculates the best routes through its neighbors to every destinations
- Router updates its routing table
- When router starts, it knows only local knowledge (its address and link)
- It has only single entry for the node itself
- Router broadcasts this distance vector to all its neighbors on all of its local links
- Neighboring nodes will receive this information and update their tables to enlarge their knowledge
- After several updates, algorithm will converge and subsequent messages will not trigger any update in the routing table
- The nodes have discovered the topology of the network through "distributed" computations

Issues With Distance Vector

- Routing Loops
  - Split Horizon - Maximum hop count cannot prevent loops between neighbors
  - Router must not send routing information in the direction that it learned from
  - Split Horizon with Poisoned Reverse – sends more positive information rather than suppressing information
- Slow convergence

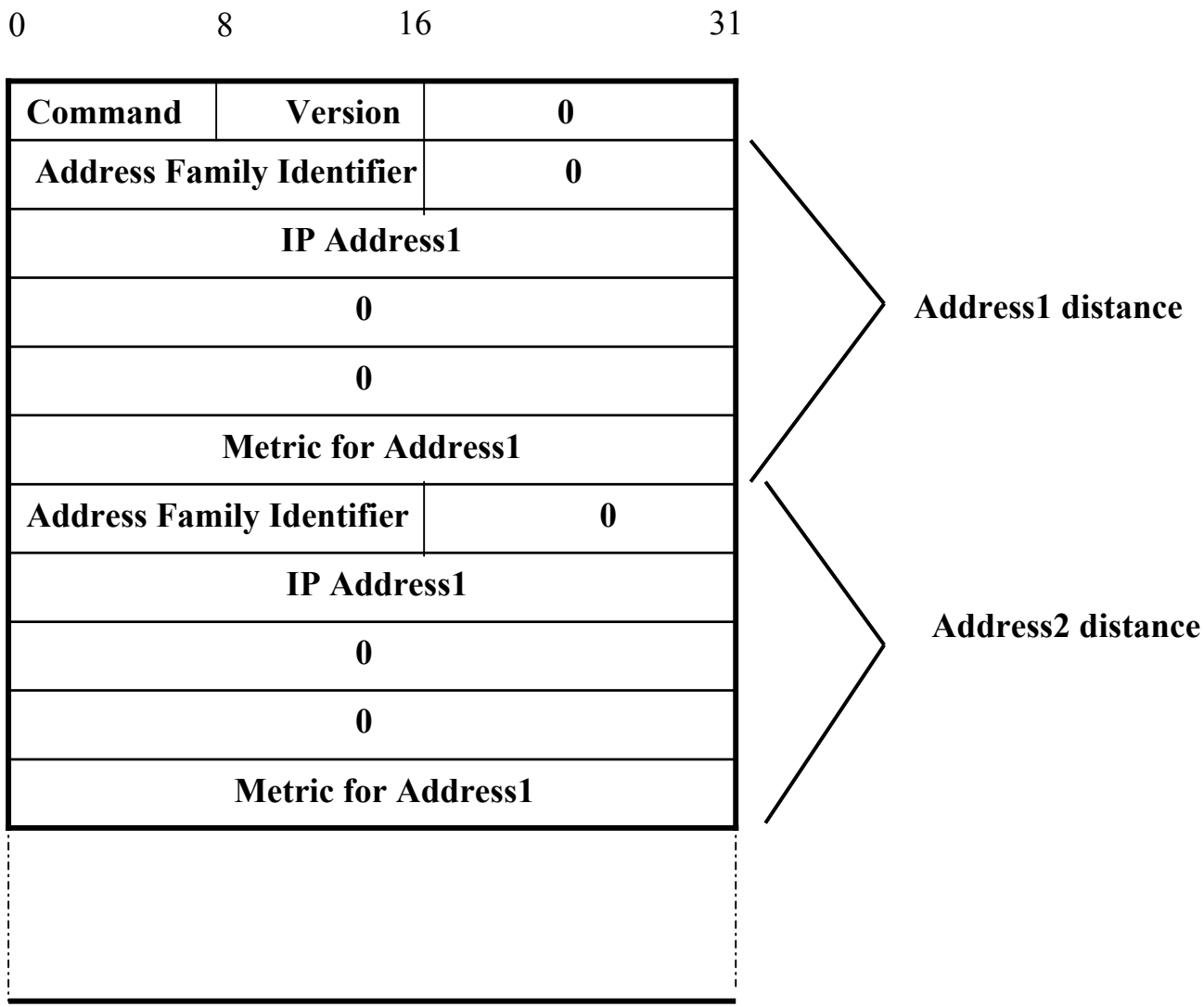
Count to Infinity Problem

- Count to infinity problem – split horizon cannot prevent loops in some situations so infinity must be defined to be small
- Count to infinity is stopped when the representation of infinity is some large value
  - In RIP, infinity is 16
  - Hop count of 16 means “network unreachable”
- If the value is too large
  - Slow convergence
- If the value is small
  - The network size is small

RIP Mechanism to Counter Instabilities

- **Split Horizon:** When sending a RIP Packet over a particular interface, never include routing information acquired over that interface
- **Split Horizon with Poison Reverse:** When sending a RIP update, include all routes, but set the metric to infinity for those routes acquired over that interface
- **Triggered Updates:** Whenever a gateway changes the metric for a route, it must send an update message to all its neighbors immediately without waiting for the usual periodic update cycle. This may speed-up convergence.
- **Hold Down:** Hold down forces a gateway to ignore information about a network for a fixed period of time following receipt of a message that claims the network is unreachable. In RIP the hold down period is set to 60 seconds.

RIP Packet Format



IP RIP packet has six fields:

- **Command:** Indicates whether the packet is a request or a response
- **Version Number:** Indicates the RIP version
- **Zero:** Must be zero field(field not used)
- **Address family identifier:** Specifies type of address being specified
- **Address:** Specifies the IP address for the entry
- **Metric:** Indicates how many hops there have been so far in the route

RIP - Characteristics

- When receiving a rip update, a device validates the source of the update.
- Check to see if route already exists. If so, compare metrics, etc.
- How do we know what the mask of the advertized network is?
  - Check to see if the advertized network is on the same major net as the interface which the update was received. If no, apply the “natural mask.
  - If yes, check to see if the advertized network (subnet) has bits set in the host portion of the address. If yes, apply a 255.255.255.255 mask. If no, apply the mask that the interface is using.

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.

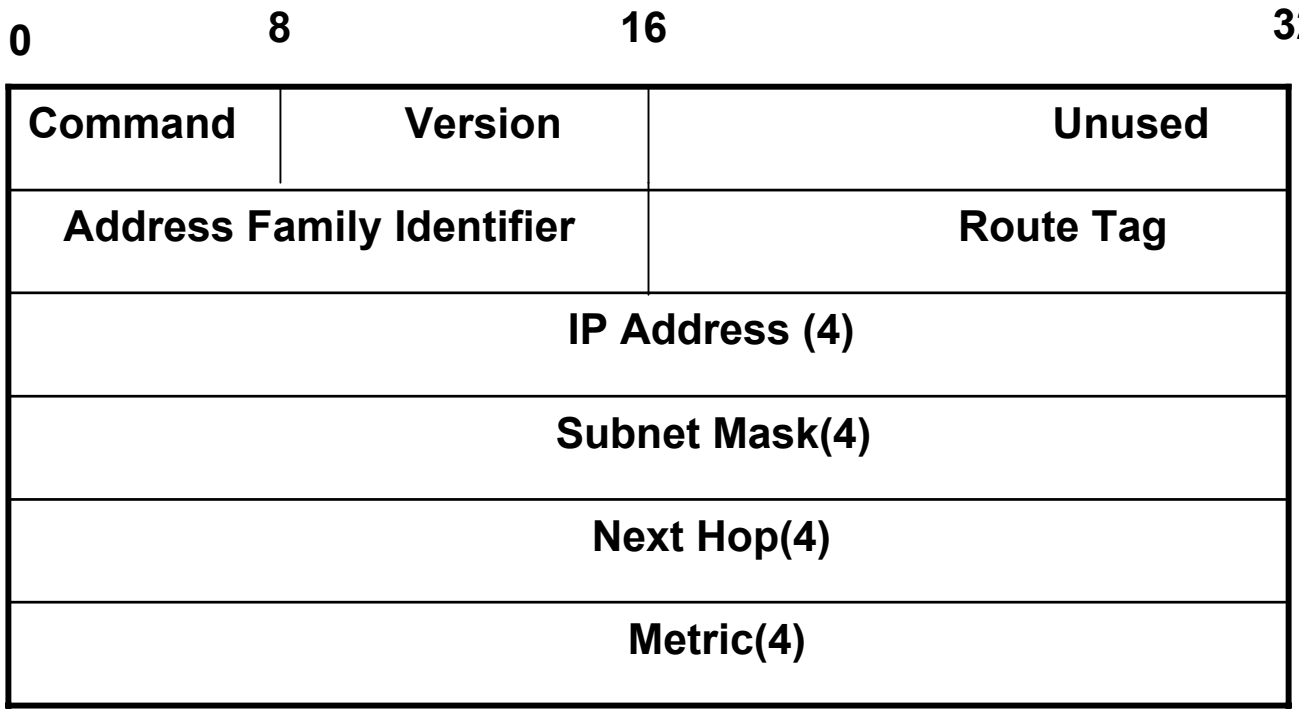
Problems with RIP

- Slow convergence
- Not 100% loop free
- Does not support VLSM and discontiguous network
- Periodic full routing updates - Updates every 30 seconds (quite chatty)
- RIP has hop count limitation - Maximum Number of Hops is 16
- Metric is simple
- Uses Broadcast
- Originally Classful (RIP V1) Now Classless (RIP V2)

RIP Version 2 (RFC 1723)

- Same as RIPv1 except it is classless
  - Carries mask info in updates
    - supports VLSM
    - supports Discontiguous Networks
- Does not send updates via Broadcast
  - Sends updates to multicast address 224.0.0.9
- Still restricted to a maximum 15 hop limit

RIP2 Message Format



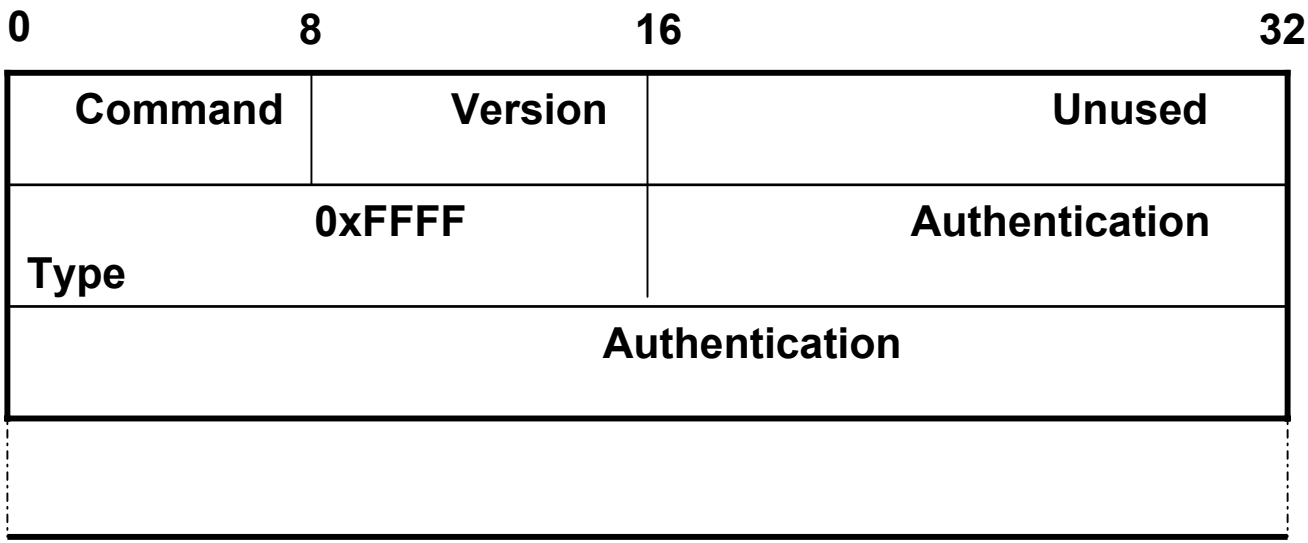
- *Command*—Indicates whether the packet is a request or a response. The request asks that a router send all or a part of its routing table. The response can be an unsolicited regular routing update or a reply to a request. Responses contain routing-table entries. Multiple RIP packets are used to convey 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.

RIP2 Message Format

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.

RIP2 Message Format when Authentication is used



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.

Basic RIP Commands (Zebra as well as Cisco IOS)

- `router rip`
- Enable a RIP routing process, which places you in router configuration mode.

- `network network-number`
- Associate a network with a RIP routing process.

- `neighbor ip-address`
- Define a neighboring router with which to exchange routing information

Basic RIP Commands (Zebra as well as Cisco IOS)

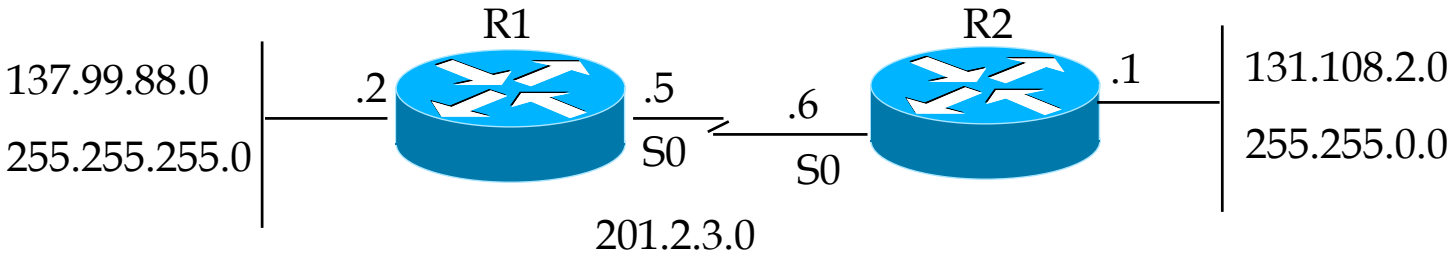
- `timers` *`basic update invalid holddown flush`*
- Adjust routing protocol timers.

- `ip split-horizon`
- Enable split horizon.

- `show ip route rip`
- Show all routes learned via RIP

- `debug ip rip`
- Show RIP debugging information

RIP Configuration



Interface e0

ip add 137.99.88.2/24

Interface s0

ip add 201.2.3.2/30

router rip

network 137.99.0.0

network 201.2.3.0

Interface e0

ip add 131.108.2.1/16

Interface s0

ip add 201.2.3.2/30

router rip

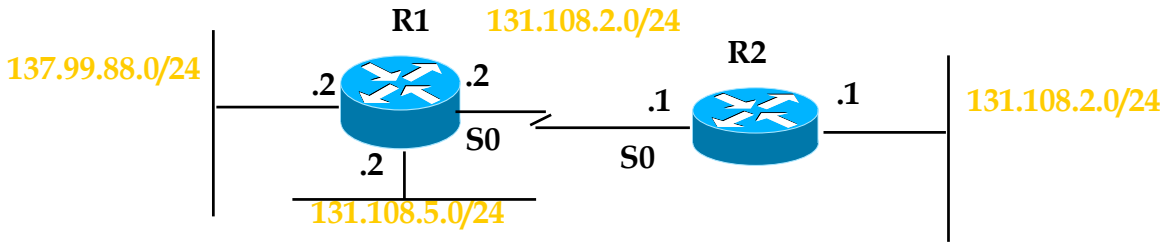
network 131.108.0

network 201.2.3.0

Passive Interfaces

- Only receive RIP and update routing table
- Do not send out RIP messages

RIP Characteristics - Sending out



Rules to follow, when sending out an update:

Is Subnet information, part of the same major net as the interface that will be sourcing the update?

No: **Summarize and advertise the summarized network**

Yes: **Does the network have same mask as interface that will be sourcing it?**

Yes: **Advertise the network**

No: **Drop the network. Do not advertise it. (except host routes)**

- Updates Sent from R1:
  - **RIP: sending v1 update to 25.255.255.255 via serial0 (131.108.2.2)**
  - **subnet 131.108.5.0, metric 1**
  - **network 137.99.0.0, metric 1**