

# Routing Information Protocol

A simple distance vector scheme

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## RIP version 1

- ⦿ RFC 1058
  - ⦿ Charles Hedrick, Rutgers University, 1988
- ⦿ Based on Bellman-Ford distance vector
- ⦿ Also used as ARPANET routing protocol
- ⦿ Many implementations were already present
  - ⦿ differing in details (timers etc.)

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## RIP application

- ⦿ Homogeneous networks
- ⦿ Moderate size
- ⦿ Interior routing protocol
- ⦿ Maximum 15 hops
  - ⦿ Based on a cost (weight) of 1

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## Basic operation

- ⊗ Keep a table of routes to destination networks with
  - ⊗ distance (metric), gateway (next hop)
- ⊗ Periodically send out complete table (without gateway info) to neighbors
- ⊗ Update table with new information
  - ⊗ distance can only decrease
    - ⊗ unless info comes from gateway itself

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## Timers

- ⊗ Updates sent every 30 seconds
- ⊗ Routes time out after 180 seconds
- ⊗ Unreachable networks may be included in updates
  - ⊗ infinity =  $\infty$  = 16
- ⊗ Triggered updates
  - ⊗ send an update as soon as table changes

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## RIP packets

- ⊗ Are broadcast to 255.255.255.255 or
  - ⊗ to the directed broadcast address
  - ⊗ to individual host as response to request
- ⊗ Use UDP port 520
- ⊗ Maximum 512 bytes
  - ⊗ room for 25 route updates

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## Packet format (RIPv1)

command	version = 1	reserved
Address Family Identifier = 2		reserved
IP (network) address		
reserved		
metric		
... may repeat (25x) last 20 bytes ...		

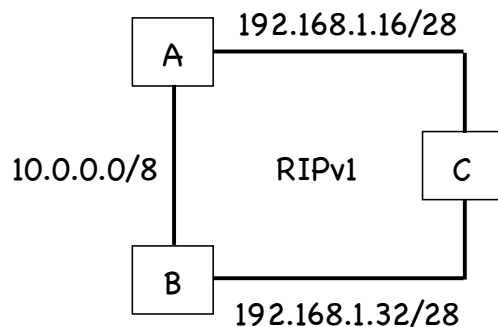
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## Subnets

- ⊗ RIPv1 supports (in retrospect) fixed length, one level deep, subnet masks
- ⊗ RIPv1 uses heuristics to derive the uniform subnet mask in use from its own directly connected subnets
- ⊗ RIPv1 differentiates between updates about subnets to neighbours
  - ⊗ on that same subnetted network
  - ⊗ on other networks

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## Subnet Behavior?



Exercise: find out how RIPv1 operates in this scenario

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## IGRP (1)

- ⦿ Interior Gateway Routing Protocol
- ⦿ Cisco proprietary
- ⦿ Distance vector protocol
  - ⦿ Same basics as RIP
- ⦿ Is now really obsolete (-> EIGRP)

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## IGRP (2)

- ⦿ Division into independent domains
  - ⦿ Confusingly called AS's
- ⦿ Uses three types of network routes:
  - ⦿ Interior route (with implicit subnet info)
  - ⦿ System route (summarized)
  - ⦿ Exterior route (candidate default)

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## IGRP (3)

- ⦿ RIP
  - ⦿ Metric is hop count
- ⦿ IGRP
  - ⦿ Metric is composite, based on:
    - ⦿ Bandwidth, Delay (default)
    - ⦿ Reliability, Load (optional)

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## EIGRP (1)

- ⦿ Enhanced Interior Gateway Routing Protocol
  - ⦿ Remembers all paths, not only best path
  - ⦿ Can carry subnet information (VLSM)
  - ⦿ Uses DUAL (Diffusing Update Algorithm) for fast convergence
  - ⦿ Can take MTU into account for metric

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## EIGRP (2)

- ⦿ No regular (periodic) routing table updates
  - ⦿ Only when routing table changes
  - ⦿ Uses hello packets to discover neighbors
- ⦿ Uses acks for reliable communication
- ⦿ Can summarize at arbitrary bit boundaries

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## RIP version 2

- ⦿ RFC 2453
  - ⦿ Gary Malkin, Bay Networks, 1998
- ⦿ Extensions for
  - ⦿ Subnet masks
  - ⦿ Alternate next hop, Authentication
  - ⦿ Multicasting, Route tags

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## New packet format (RIPv2)

command	version = 2	reserved
Address Family Identifier = 2		route tag
IP address		
subnet mask		
alternate next hop		
metric		
... may repeat (25x) last 20 bytes ...		

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## Authentication packet fragment (first entry)

AFI = 0xFFFF = authentication	authentication type
authentication information	

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## New additions (1)

- ⦿ Authentication field
  - ⦿ First AFI is 0xFFFF
  - ⦿ Simple password (type 2) 16 bytes
- ⦿ Route tag field
  - ⦿ Simply carried along
  - ⦿ Differentiates between internally and externally generated routes

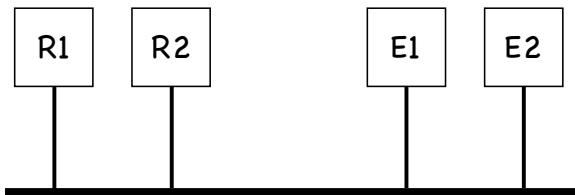
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## New additions (2)

- ⦿ Subnet mask field
  - ⦿ net/subnet/host route differentiation
- ⦿ Next hop field
  - ⦿ Used when best next hop does not speak RIP itself
- ⦿ Multicast (not a field) replaces broadcast
  - ⦿ destination 224.0.0.9 (not forwarded)

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## Next hop scenario



R1 and R2 speak RIP internally  
E1 and E2 speak other protocol externally  
E1 can speak RIP and represent E2 (next hop)

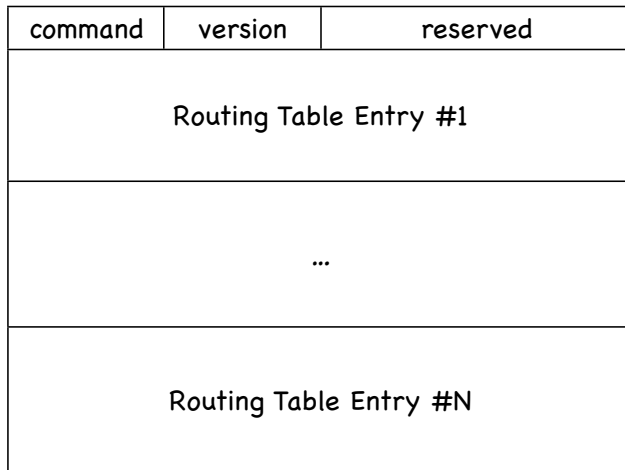
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## RIPng

- ⦿ Still runs over UDP
- ⦿ Uses a new port: 521
- ⦿ Packets can be any length that fits inside the network unfragmented
- ⦿ Supports IPv6 prefix, route tags, next hop
  - ⦿ No authentication (can be done at IP level)
- ⦿ Uses FF02::9, the all-rip-routers multicast

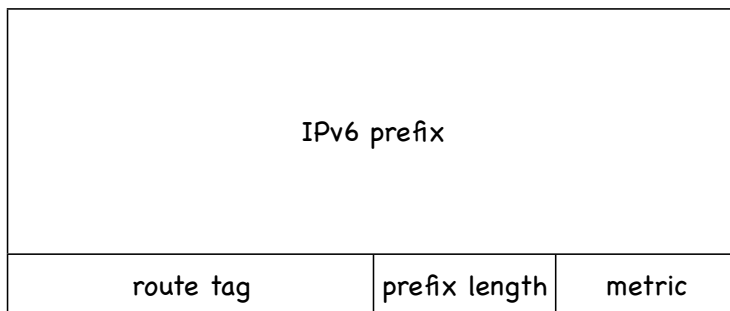
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# RIPng packet format



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# RTE format



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# Next hop hack

- ⦿ When the metric is 0xFF (otherwise illegal)
  - ⦿ The IP prefix is the next hop
  - ⦿ Must be link local address
  - ⦿ :: means use originator as next hop
  - ⦿ valid until next "next-hop-RTE"

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# RIP variants

- ⦿ There are also (incompatible) variants for RIP in other protocol stacks, for instance in IPX, RIP-IPX
  - ⦿ Other timers (60 update / 180 timeout)
  - ⦿ Triggered updates, split horizon with poison reverse are obligatory
  - ⦿ Uses two metrics
    - ⦿ ticks (for path selection)
    - ⦿ hops (for  $\infty$ )

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