Routing Information Protocol (RIP)

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RIP - History

- Late 1960s: Distance Vector protocols were used in the ARPANET
- Mid-1970s: XNS (Xerox Network system) routing protocol is the precursor of RIP in IP (and Novell's IPX RIP and Apple's routing protocol)
- 1982 Release of routed for BSD Unix
- 1988 RIPv1 (RFC 1058)
  - classful routing
- 1993 RIPv2 (RFC 1388)
  - adds subnet masks with each route entry
  - allows classless routing
- 1998 Current version of RIPv2 (RFC 2453 and STD 56)

RIP at a glance

- A simple intradomain protocol
- Straightforward implementation of Distance Vector Routing…
  - Distributed version of Bellman-Ford (DBF)

  …with well known issues
  - slow convergence
  - works with limited network size
- Strengths
  - simple to implement
  - simple management
  - widespread use

RIP at a glance

- Metric based on hop count
  - maximum hop count is 15, with “16” equal to “∞”
    - imposed to limit the convergence time
  - the network administrator can also assign values higher than 1 to a single hop
- Each router advertises its distance vector every 30 seconds (or whenever its routing table changes) to all of its neighbors
  - RIP uses UDP, port 520, for sending messages
- Changes are propagated across network
- Routes are timeout (set to 16) after 3 minutes if they are not updated

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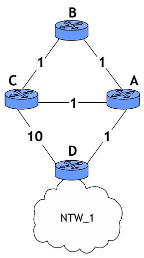
Recall: “counting to infinity” problem



Router A		
Dest	Next	Metric
NTW_1	D	2

Router B		
Dest	Next	Metric
NTW_1	A	3

Router C		
Dest	Next	Metric
NTW_1	A	3

Router D		
Dest	Next	Metric
NTW_1	dir	1

- Consider the entries in each routing table for network NTW_1
- Router D is directly connected to NTW_1

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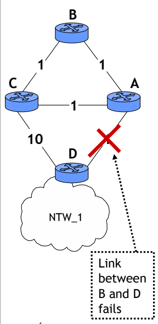
Recall: “counting to infinity” problem (2)



time →

Router A		
Dest	Next	Metric
NTW_1	Unr.	-

Router B		
Dest	Next	Metric
NTW_1	A	3

Router C		
Dest	Next	Metric
NTW_1	A	3

Router D		
Dest	Next	Metric
NTW_1	dir	1

Router A		
Dest	Next	Metric
NTW_1	C	4

Router B		
Dest	Next	Metric
NTW_1	C	4

Router C		
Dest	Next	Metric
NTW_1	B	4

Router D		
Dest	Next	Metric
NTW_1	dir	1

Router A		
Dest	Next	Metric
NTW_1	C	5

Router B		
Dest	Next	Metric
NTW_1	C	5

Router C		
Dest	Next	Metric
NTW_1	B	5

Router D		
Dest	Next	Metric
NTW_1	dir	1

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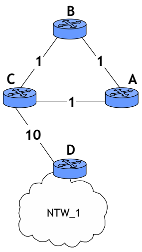
Recall: “counting to infinity” problem (3)



time →

…

Router A

Dest	Next	Metric
NTW_1	C	11

Router B

Dest	Next	Metric
NTW_1	C	11

Router C

Dest	Next	Metric
NTW_1	B	11

Router D

Dest	Next	Metric
NTW_1	dir	1

Router A

Dest	Next	Metric
NTW_1	C	12

Router B

Dest	Next	Metric
NTW_1	C	12

Router C

Dest	Next	Metric
NTW_1	D	11

Router D

Dest	Next	Metric
NTW_1	dir	1

RIP: solution to “counting to infinity”

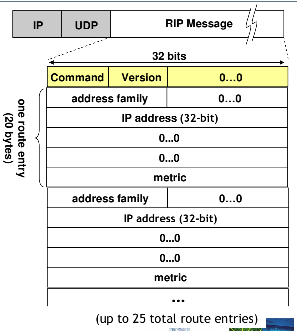
- Maximum number of hops bounded to 15
  - this limits the convergence time
- Split Horizon
  - simple
    - each node *omits* routes learned from one neighbor in update sent to that neighbor
  - with poisoned reverse
    - each node *include* routes learned from one neighbor in update sent to that neighbor, setting their metrics to infinity
      - drawback: routing message size greater than simple Split Horizon

RIP: solution to “counting to infinity” (cont’d)

- Triggered updates: nodes send messages as soon as they notice a change in their routing tables
  - only routes that has changed are sent
  - faster reaction…
  - …but more resources are used (bandwidth, processing)
    - cascade of triggered updates
  - superposition with regular updates

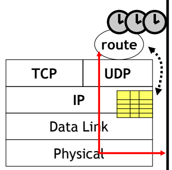
RIP: Message Format

- ❑ Command: 1=request 2=response
  - Updates are replies whether asked for or not
  - Initializing node broadcasts request
  - Requests are replied to immediately
- ❑ Version: 1
- ❑ Address family: 2 for IP
- ❑ IP address: non-zero network portion, zero host portion
  - Identifies particular network
- ❑ Metric
  - Path distance from this router to network
  - Typically 1, so metric is hop count



RIP procedures: introduction

- ❑ RIP routing tables are managed by application-level process
  - e.g., *routed* on UNIX machines
- ❑ Advertisements are sent in UDP packets (port 520)
- ❑ RIP maintains 3 different timers to support its operations
  - Periodic update timer (25-30 sec)
    - used to sent out update messages
  - Invalid timer (180 sec)
    - If update for a particular entry is not received for 180 sec, route is invalidated
  - Garbage collection timer (120 sec)
    - An invalid route in marked, not immediately deleted
    - For next 120 s. the router advertises this route with distance infinity

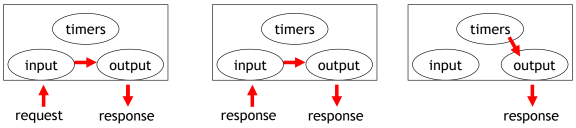


RIP procedures: input processing

- ❑ Request Messages
  - they may arrive from routers which have just come up
  - action: the router responds directly to the requestor's address and port
    - request is processed entry by entry
- ❑ Response Messages
  - they may arrive from routers that perform regular updates, triggered updates or respond to a specific query
  - action: the router updates its routing table
    - in case of new route or changed routes, the router starts a triggered update procedure

RIP procedures: output processing

- Output are generated
  - when the router comes up in the network
  - if required by the input processing procedures
  - by regular routing update
- Action: the router generates the messages according to the commands received
  - the messages contain entries from the routing table



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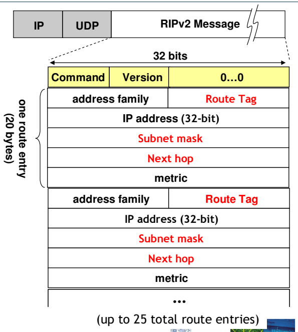
RIPv2: Message Format

- Version: 2
- Route Tag: used to carry information from other routing protocols
  - e.g., autonomous system number
- Subnet mask for IP address
- Next hop
  - identifies a better next-hop address on the same subnet than the advertising router, if one exists (otherwise 0….0)



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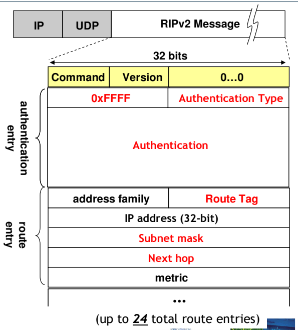
RIPv2: authentication

- Any host sending packets on UDP port 520 would be considered a router
- Malicious users can inject fake routing entries
- With authentication, only authorized router can send Rip packets
  - Authentication type
    - password
    - MD5
  - Authentication
    - plain text password
    - MD5 hash



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RIPv2: other aspects

- Explicit use of subnets
- Interoperability
  - RIPv1 and RIPv2 can be present in the same network since RIPv1 simply ignores fields not known
    - RIPv2 responds to RIPv1 Request with a RIPv1 Response
- Multicast
  - instead of broadcasting RIP messages, RIPv2 uses multicast address 224.0.0.9

RIP limitations: the cost of simplicity

- Destinations with metric more than 15 are unreachable
  - If larger metric allowed, convergence becomes lengthy
- Simple metric leads to sub-optimal routing tables
  - Packets sent over slower links
- Accept RIP updates from any device (if no security is implemented)
  - Misconfigured device can disrupt entire configuration