Network Layer Routing - II
RIP

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Routing Information Protocol

RIP (RFC 1058 - http://www.ietf.org/)

- basically uses Distance Vector Routing Protocol.
- Algorithm being implemented is different than the one described in previous lecture.
- Previous algorithm assumes that all the information packets are exchanges simultaneously. - This is difficult.
  - Simultaneous exchange means, when information packet is not received from a neighbour, distance (cost) to it is made ∞.
- Previous algorithm will work even if the exchange of packets are done independtly.

- The neighbours should keep on sending the information packets.
- The node will maintain the latest copy of information received from all the neighbours.
- Periodically, node will compute minimum cost next node for every destination from these copies.
- With every computation, the routing table will be updated.

All the networks do'nt do routing. There are broadcast networks (e.g., Ethernet), point-to-point network, networks which have their own routing protocols.

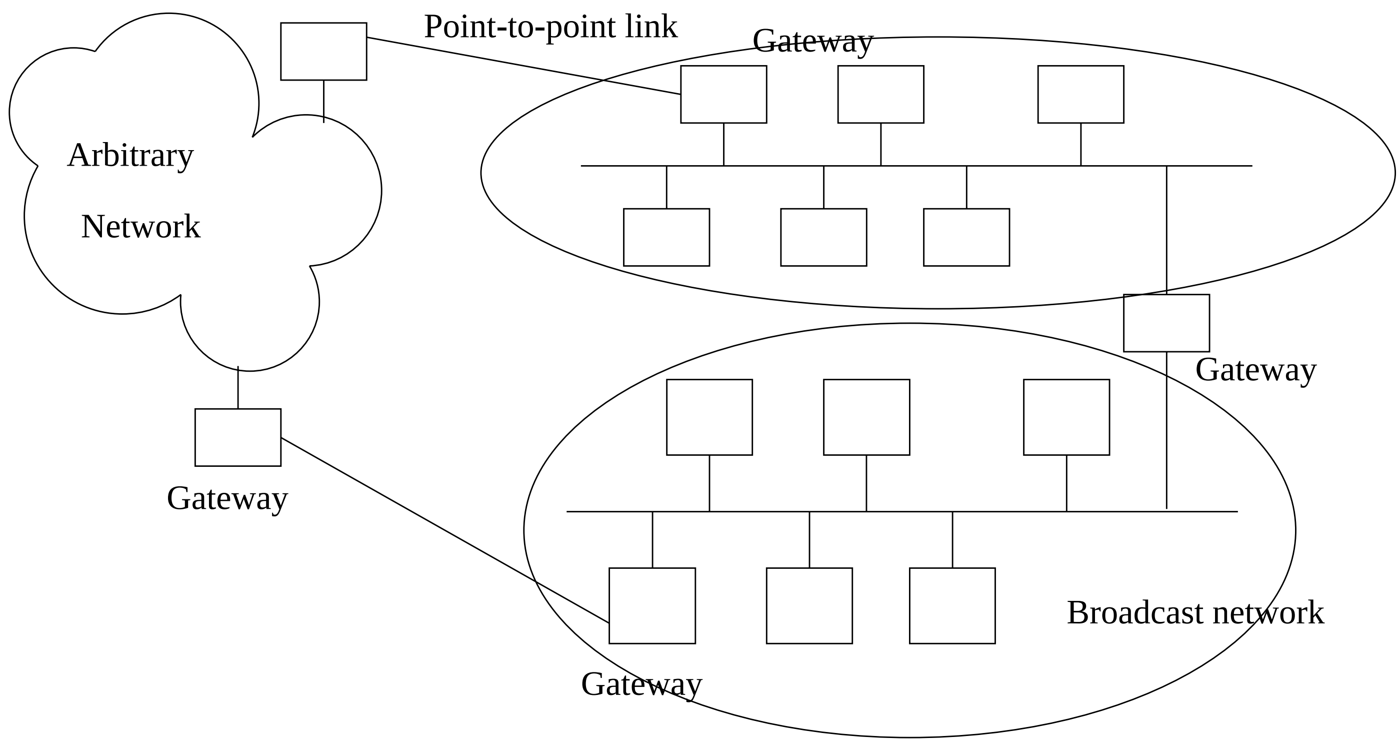

Fig.2.1

- within these networks, any host can communicate to any host. They are equidistance to each other.
- Only host which are connecting to other networks (i.e., gateways) need to participate in routing protocol.
  - Even if other host participate in routing protocol. Any packet to forwarded by them, has to go through the network twice.
  - Hence if cost of using a network is C. Using any host as next node on the network (other than gateways) will be costlier by at least C.

- So, only gateways need to participate in the routing protocol (send the information exchange packets).
- All other host can only listen to information exchange packet from gateways and create forwarding tables for their own packets.

* So link cost is cost from node to any host on the network.

Metric

- Meteric can be any parameter. But they should be fixed.
- Protocol cannot handle real time meterics (based on queueing delay, queue length, reliability etc.)
- Once choice of meteric is number of hops.
- Since, the protocol need to handle infinity (some large value of metric need to be defined as infinity).
- protocol takes 16 as infinity.
- Protocol design assumed that it will not be applied to network diameters more than 15.

Practical Algorithm

- The algorithm has been modified, since otherwise latest update of routing tables from all the neighbouring node need to be kept.
- Each node only remembers for each destination node the next node and distance.
- When any exchange packet gives s smaller distance the existing, the routing table entry is updated.

This gives the increamental update of routing entry.

- Previously, old entry was forgotten and new entry was computed from database. So, there was a mechanism for increasing the meteric.
- Now no mechanism is there for increamenting.
- Rule is made whenever higher value of meteric is received from current next gateway. It will replace the older value.
- This provides the mechanism for increamenting the meteric.

- If next node fails, then the routing table entry will freeze untill, metric through some other neighbouring router is lesser.
- A timer of 180 secs is used. If no update is received before timer expiry, the routing table entry is deleted.
- From other updates new routing table entry is maintained.
- As routers are supposed to send update every 30 secs, timer of 180 secs, makes system resilient to lost packets.

Count to infinity

Consider the network shown in Fig.2.2

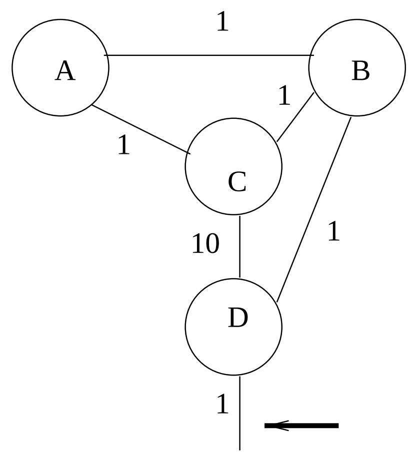

Fig.2.2

During stable operation the routing table for the network marked with arrow is

A	B	C	D
B 3	D 2	B 3	D 1

Now link BD fails.

The routing table updates will be as given below.

A		B		C		D	
B	3	D	2	B	3	dir	1
B	3	-	-	B	3	dir	1
C	4	A	4	A	4	dir	1
C	5	A	5	A	4	dir	1
				⋮			
C	10	A	10	A	10	dir	1
C	11	A	11	A	11	dir	1
C	12	A	12	D	11	dir	1
C	12	C	12	D	11	dir	1

(eight steps)

- Each routing entry increaments slowly till it get to appropriate value.
- Good news spreads fast, bad news spreads slowly (convergence is slow).

Split Horizon

- router will not announce route to the destination j, to the neighbour thorough which current path to j is there.

If this happenns, the routing table entries after failure of BD link changes as (four steps)

A		B		C		D	
B	3	D	2	B	3	dir	1
B	3	-	-	B	3	dir	1
C	4	-	-	A	4	dir	1
-	-	A	5	D	11	dir	1
C	12	C	12	D	11	dir	1
C	12	A	12	D	11	dir	1

Split Horizon with Poisoned Reverse

- The routers do announce the route to destination j to the next router in path to destination j. The distance to j is told as ∞.
- This is faster, as router need to not wait for time out before setting the destination unreachable.
- In previous case, after D becomes unreachable for B. B will get reachability information from A and C only after timeout happens. Route via B becomes invalid for A and C.
- While in current case, the A anc C send ∞ to B, causing the corresponding entry to become ∞. Which will be announce back to A and C, allowing them to find alternate route.

Triggered Updates

- Routing loop can exist and count to infinity will happen even with Split Horizon with Poisoned reverse.
- Split horizon with poisoned reverse can only break loop within two nodes. If three node make circular routing loop, count to infinity will happen.
- Convergence for count to infinity can be made fast.
  - Whenever and update leads to change in meteric value. The update packets should be send immediately (triggered update).

- In practical situation, the triggered update is slightly delayed (depends upon the protocol implementation).
- This avoids sudden outburst of traffic.
- The delay in triggered update is much less then the period between regular updates.
- The triggered updates will propogate in the parts of network which uses faulty route. Other part will remain unaffected.

• All count to infinity problem will converge faster.

RIP

- 'Routed' is an example implementation.
- entities use UDP port 520 to communicate with other RIP entities.
- assumes following in routing table
  - IP address of destination.
  - meteric - representing total cost from host to destination.(sum of costs of all networks which need to traversed to reach the destination.)

- IP address of next gateway in the path of destination. (not needed when destination is on directly connected network.)
- Flag: indicating the route has changed recently.
- timers: needed for the route.

Entries for directly connected network

- to be gathered by other means not specified by RIP.
- can be manually configured by administrator.

- Most RIP Implementation set meteric to directly connected network as 1. (RIP meteric - number of hops)
- All unsolicited messages are sent to UDP port 520 from UDP port 520.
- Response messages to a request are sent to port from which request has originated.
- Provision of silent RIP processes.
  - used by hosts that are not gateways.
  - want to listen to RIP messages to keep updating routing tables.

Format of RIP messages

```
 0                   1                   2                   3 3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| command (1)   | version (1)   |      must be zero (2)         |
+---------------+---------------+-------------------------------+
| address family identifier (2) |      must be zero (2)         |
+-------------------------------+-------------------------------+
|                         IP address (4)                        |
+---------------------------------------------------------------+
|                        must be zero (4)                       |
+---------------------------------------------------------------+
|                        must be zero (4)                       |
+---------------------------------------------------------------+
|                          metric (4)                           |
+---------------------------------------------------------------+
                                .
                                .
                                .
```

- command: defines command being sent in the packet.
  - 1 : request - to request the responding system to send routing table.
  - 2 : response - message containing the routing table. Can be send after receiving a request. Can be send as update packet.
  - 3 : traceon - obsolete
  - 4 : traceoff - obsolete
  - 5 : reserved - used by sun microsystems for its own purpose.

  All new command should start with 6 onward.
- version: version of RIP protocol being used. RFC 1058 describes version 1.

- address family identifier: Identifies the protocol family being used. For IP addresses, identifier - 2.
- meteric: number from 1 to 16. 16 means infinity.

Maximum datagram size - 512 bytes.

When a route is received

- The subnetwork address is meaning less untill the subnetmask is already known.
- subnet address should not be sent to those router who does not know the subnetmask of the subnets.
- Generally RIP is used within networks having multiple subnets with same subnetmasks.
- RIP does maintain routing tables within the network.
- RIP cannot handle the network with subnets having different subnetmasks.

- 0.0.0.0 IP address is used to signify the default route.
- Administrator makes one or more router as default routers. (These routers are connecting your network to Internet.)
- RIP work as if these routers are connected to network 0.0.0.0. The multiple default router might have different meteric to default route based on the preference.
- default route and route for internal subnets should not go beyond the network (AS - autonomous system). Border gateway will inform about the whole network by single meteric and network address.

Timers

- Every 30 secs, update is sent.
- If clock is processing load dependent, the routers will tend to synchronize.
- Will send the update as same instant leading to sudden load on the system.
- clock must be derived from source which is load independent.
- the time to send update is 30 secs $\pm$ some small random interval.

- Two timers associated with each route
  - timeout (180 secs) - upon expiry of timeout, route is not valid.
  - But the entry is still maintained in routing table, to notify the neighbour that routing entry has been dropped (distance is ∞.)
  - After garbage-collection timer (120 secs) expiry, the routing table entry is deleted.
  - Deletion of route can happens because
    * the timeout expires
    * meteric set to 16 due to update from next gateway.

- Two event happens in both the cases
  - garbage-collection timer set to 120 secs.
  - meteric is set to 16 causing route to go out of service.
  - flag is set to signal the entry change. This will trigger the response from output process. (Triggered update).

- Timeout is initialized when
  - route is established.
  - update for the route is received from next gateway.