Computer Networks

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Recap

- Network Architecture
- Network Models

Unit 3

Network Layer

Contents

Static Routing

- Static Routing is also known as **non-adaptive routing** which doesn’t change the routing table unless the network administrator changes or modifies them manually.
- Static routing does not use complex routing algorithms
- It provides high or more security than dynamic routing.

Dynamic Routing

- Dynamic routing is also known as **adaptive routing** which changes the routing table according to the change in topology.
- Dynamic routing uses complex routing algorithms and it does not provide high security like static routing.
- When the network change(topology) occurs, it sends the message to the router to ensure that changes then the routes are recalculated for sending updated routing information.

Key	Static Routing	Dynamic Routing
Routing pattern	In static routing, user-defined routes are used in the routing table.	In dynamic routing, routes are updated as per the changes in network.
Routing Algorithm	No complex algorithm used to figure out the shortest path.	Dynamic routing employs complex algorithms to find the shortest routes.
Security	Static routing provides higher security.	Dynamic routing is less secure.
Automation	Static routing is a manual process.	Dynamic routing is an automatic process.
Applicability	Static routing is used in smaller networks.	Dynamic routing is implemented in large networks.
Protocols	Static routing may not follow any specific protocol.	Dynamic routing follows protocols like BGP, RIP and EIGRP.
Additional Resources	Static routing does not require any additional resources.	Dynamic routing requires additional resources like memory, bandwidth etc.

Distance Vector Routing

- A distance vector routing algorithm operates by having each router maintain a table (i.e., a vector) giving the best known distance to each destination and which link to use to get there.
- These tables are updated by exchanging information with the neighbors. Eventually, every router knows the best link to reach each destination.
- The distance vector routing algorithm is sometimes called the distributed Bellman-Ford routing algorithm

Distance Vector Routing Algorithm

- Let $d_x(y)$ be the cost of the least-cost path from node x to node y.
- $d_x(y) = \min_v\{c(x,v) + d_v(y)\}$

  Where

  C(X,V) = X's cost from each of its neighbor V

  $d_v(y)$. Distance of each neighbor from initial node

- With the Distance Vector Routing algorithm, the node x contains the following routing information:
  - For each neighbor v, the cost c(x,v) is the path cost from x to directly attached neighbor, v.
  - The distance vector x, i.e., Dx = [Dx(y) : y in N], containing its cost to all destinations, y, in N.
  - The distance vector of each of its neighbors, i.e., Dv = [Dv(y) : y in N] for each neighbor v of x.

DVR Algorithm

At each node x,

Initialization

for all destinations y in N:

$D_x(y) = c(x,y)$ // If y is not a neighbor then $c(x,y) = \infty$

for each neighbor

w $D_w(y)$ = ? for all destination y in N.

for each neighbor w

send distance vector $D_x = [\ D_x(y) : y \text{ in } N\ ]$ to w

loop

    wait(*until I receive any distance vector from some neighbor w*)

    for each y in N:

    $D_x(y) = \text{minv}\{c(x,v)+D_v(y)\}$

If $D_x(y)$ is changed for any destination y

Send distance vector $D_x = [\ D_x(y) : y \text{ in } N\ ]$ to all neighbors

forever

Routing Table

Two process occurs:

- Creating the Table

Initially, the routing table is created for each router that contains atleast three types of information such as Network ID, the cost and the next hop. <Destination, Vector, Hop>

- Updating the Table

Link State Routing

- Link state routing is a technique in which each router shares the knowledge of its neighborhood with every other router in the internetwork.

The three keys to understand the Link State Routing algorithm:

- Knowledge about the neighborhood: Instead of sending its routing table, a router sends the information about its neighborhood only. A router broadcast its identities and cost of the directly attached links to other routers.
- Flooding: Each router sends the information to every other router on the internetwork except its neighbors. This process is known as Flooding.
- Information sharing: A router sends the information to every other router only when the change occurs in the information.

Route Calculation

- Each node uses Dijkstra's algorithm on the graph to calculate the optimal routes to all nodes.

  - The Link state routing algorithm is also known as Dijkstra's algorithm which is used to find the shortest path from one node to every other node in the network.
  - The Dijkstra's algorithm is an iterative, and it has the property that after kth iteration of the algorithm, the least cost paths are well known for k destination nodes.

Link State Routing Algorithm

- $c(i, j)$: Link cost from node i to node j. If i and j nodes are not directly linked, then $c(i, j) = \infty$.
- $D(v)$: It defines the cost of the path from source code to destination v that has the least cost currently.
- $P(v)$: It defines the previous node (neighbor of v) along with current least cost path from source to v.
- N: It is the total number of nodes available in the network.

LS Algorithm

Initialization

N = {A} // **A is a root node**.
for all nodes v
if v adjacent to A
then D(v) = c(A,v)
else D(v) = infinity
loop
find w not in N such that D(w) is a minimum.
Add w to N
Update D(v) for all v adjacent to w and not in N:
D(v) = min(D(v) , D(w) + c(w,v))
Until all nodes in N

Thank you