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Bellman Ford algorithm-in RoutingInformation Protocol (RIP)

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Abstract. In a large scale network need a routing that can handle a lot number of users, one of the solutions to cope with large scale network is by using a routing protocol, There are 2 types of routing protocol that is static and dynamic, Static routing is manually route input based on network admin, while dynamic routing is automatically route input formed based on existing network. Dynamic routing is efficient used to network extensively because of the input of route automatic formed, Routing Information Protocol (RIP) is one of dynamic routing that uses the bellman-ford algorithm where this algorithm will search for the best path that traversed the network by leveraging the value of each link, so with the bellman-ford algorithm owned by RIP can optimize existing networks.

1. Introduction

Needs of people by use the technology gradually increasing so that it is reasonably necessary to the development of technology enhanced. Almost all of this technology is now using the internet access as communication media, good internet access and efficient can increase performance of the system that used the technology. For time efficiency and workmanship at the time of application usage on the network then need an optimal network performance. Network with large scale is usually between one and the other are not directly connected, but it went through some other network devices. A good design and architecture is necessary in anticipation of problems that may occur when the network traffic is solid. In heavy of network traffic may need to data packets can reach the destination by using the best line from every kind of path. Bellman-Ford algorithm is one of the best routes search algorithm utilizing the value of each existing link, this algorithm is used in routing protocol RIP, metric is hop i.e. value of each router are in her past. Routing Information Protocol (RIP) is a dynamic routing protocol where the entry route will automatically be formed if there are new routers that are not yet known. Routers connected usingRouting Information Protocol (RIP) will not suffered a looping because one of the links will be used as a backup link. By using the Bellman-Ford algorithm, then the best path that will be going through the package data will be achieved so that it can optimize existing networks

2. Review of literature

2.1 *Bellman-Ford Algorithm*

Bellman-Ford algorithm is a graph search algorithm for searching shortest route. Bellman-ford algorithm can find negative weights from each edge. In Figure 1 is an example of the bellman-ford algorithm, where there are 5 vertex i.e. A, B, C, D, and E. Each edge has a weight value i.e. directed edge A toward B is -3 and the other edge is one. N vertices Search iterations N – 1, in the example images there are 5 vertices so that there are 4 iteration, But if there's a vegative cyle or value weights are negative then it should be in iteration again called Nth [1][2][3].

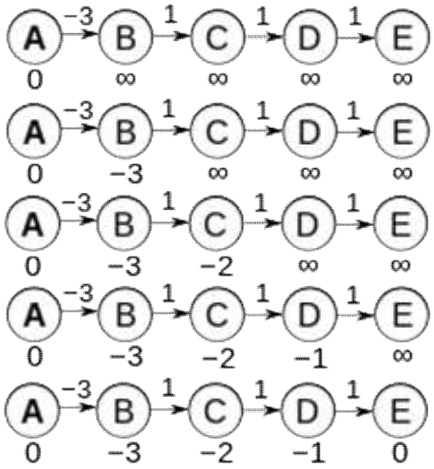

Figure 1. Example of Bellman-Ford algoritm.

As for the source code from the Bellman-ford algorithm is as follow:

```
function BellmanFord(list vertices, list edges, vertex source)
   ::distance[],predecessor[]
// Step 1: initialize graph
for each vertex v in vertices:
       distance[v] := inf
       predecessor[v] := null
   distance[source] := 0
// Step 2: relax edges repeatedly
for i from 1 to size(vertices)-1:
for each edge (u, v) with weight w in edges:
if distance[u] + w < distance[v]:
               distance[v] := distance[u] + w
               predecessor[v] := u
// Step 3: check for negative-weight cycles
for each edge (u, v) with weight w in edges:
if distance[u] + w < distance[v]:
error "Graph contains a negative-weight cycle"
return distance[], predecessor[]
```

2.2 Routing Information Protocol

The process of connecting two or more different network so-called routing. A device that connects two different network is called with a router. Each internet network requires protocol to process data communication, router has a protocol with routing protocol. Routing protocol served to regulate data

traffic in a network and can search for the best path for each of the data points in the network. Each Routing protocol has an entry route i.e. database storage route that will pass, entry route lies in the routing table that lists ip address all of the objectives that can it traversed.[4]
A Routing Protocol is divided into two, Static routing and Dynamic routing. Static routing is the process of connecting two or more different network with entry routes manually input, While the dynamic route process connects two or more different network where entry routes in the routing table is formed automatically.

There are several types of routing protocol, including:

1. Routing Information Protocol (RIP)
2. Interior Gateway Routing Protocol (IGRP)
3. Enhanced Interior Gateway Routing Protocol (EIGRP)
4. Open Shortest Path Firs (OSPF)
5. Intermediate System-to-Intermediate System (IS-IS)
6. Border Gateway Protocol (BGP)

Figure 2 the following is a division between the routing protocol:

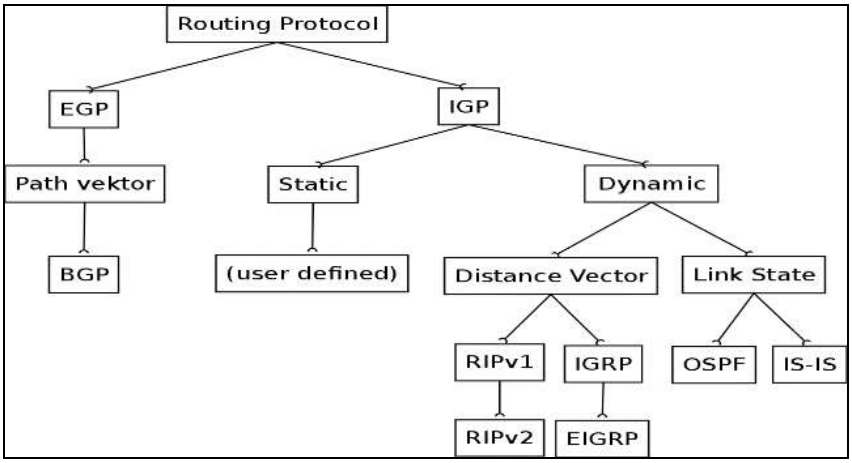

Figure 2. Types Of Routing Protocol.

Routing Information Protocol or collectively RIP is the routing protocol with dynamic types using the bellman-ford algorithm for searching shortest path. Metric of the RIP is using hop count i.e the number of routers that kind. Every router that is passed then the hop count will be calculated 1. In the RIP, the vertex is router, edge is the link, and weight of edge is the number of hop count from each track path. the number of Count hops that can be traversed routing protocol RIP is 15. [5][6]

3. Design of network

This research will use the 2 network topology, the first topology is trials for the bellman-ford algorithm and the second topology is a test for the Routing Information Protocol (RIP). Figure 3 and table 1 is the topology and addressing table for testing the network by using the Routing Information Protocol (RIP). Trials will be carried out by means of simulation, simulation program used is cisco packet tracer.

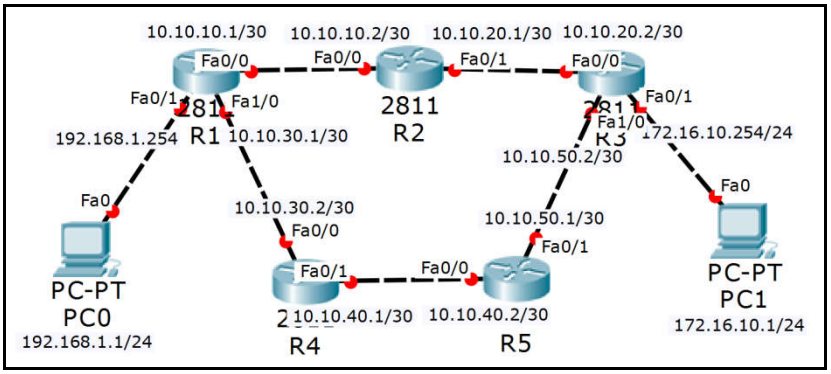

Figure 3. Topology Design.

Table 1. Addressing.

Device	Interface	IP address	Subnet Mask	Default Gateway
R1	Fa 0/0	10.10.10.1	255.255.255.252	N/A
	Fa 0/1	192.168.1.254	255.255.255.0	N/A
	Fa 1/0	10.10.30.1	255.255.255.252	N/A
R2	Fa 0/0	10.10.10.2	255.255.255.252	N/A
	Fa 0/1	10.10.20.1	255.255.255.252	N/A
R3	Fa 0/0	10.10.20.2	255.255.255.252	N/A
	Fa 0/1	172.16.10.254	255.255.255.0	N/A
	Fa 1/0	10.10.50.2	255.255.255.252	N/A
R4	Fa 0/0	10.10.30.2	255.255.255.252	N/A
	Fa 0/1	10.10.40.1	255.255.255.252	N/A
R5	Fa 0/0	10.10.40.2	255.255.255.252	N/A
	Fa 0/1	10.10.50.1	255.255.255.252	N/A
PC0	NIC	192.168.1.1	255.255.255.0	192.168.1.254
PC1	NIC	172.16.10.1	255.255.255.0	172.16.10.254

4. Results and discussion

4.1 *Bellman-Ford Testing*

Discussion of using 3 router as vertex, i.e. R1, R2 and R3, Search route u = 1. Each edge has a value does it weigh each which have been listed in table 1.

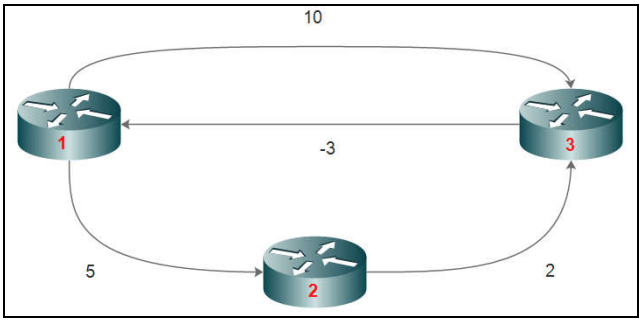

Figure 4. Vertex and weighting value.

Table 2. Weighting value.

Edge	Weight
1 – 2	10
1 – 3	5
2 – 1	- 3
3 – 2	2

Relax (u,v):
If v.d > u.d + w (u,v)
v.d = u.d + w (u,v)
v.p = u

ITERATION I

Table 3. Array d and p.

	1	2	3
D	0	∞	∞

	1	2	3
P	-	-	-

Calculate the edge 1 – 2
u.d = 1.d = 0
v.d = 2.d = ∞
w (u,v) = w (1,2) = 10

Relax (u,v):
2.d> 1.d + w (1,2)
∞> 0 + 10
TRUE
v.d = 2.d = 0 + 10 = 10
v.p = 2.p = 0

Table 4. Results of calculation edge 1 – 2.

	1	2	3
D	0	10	∞

	1	2	3
P	-	0	-

Calculate the edge1 – 3
u.d = 1.d = 0
v.d = 3.d = ∞
w (u,v) = w (1,3) = 5

Relax (u,v):
3.d> 1.d + w (1,3)
∞> 0 + 5
TRUE
v.d = 3.d = 0 + 5 = 5
v.p = 3.p = 0

Table 5. Results of calculation edge 1 – 3.

	1	2	3
d	0	10	5

	1	2	3
p	-	0	0

Calculate the edge2 – 1
u.d = 2.d = 10
v.d = 1.d = 0
w (u,v) = w (2,1) = -3

Relax (u,v):
1.d> 2.d + w (2,1)
0 > 10 + -3
ELSE
Next Edge

Calculate the edge3 – 2
u.d = 3.d = 5
v.d = 2.d = 10
w (u,v) = w (3,2) = 2

Relax (u,v):
2.d> 3.d + w (3,2)
10 > 5 + 2 = 7
TRUE
v.d =2.d = 5 + 2 = 7
v.p = 2.p = 5

Table 6. Results of calculation edge 3 – 2.

	1	2	3
D	0	7	5

	1	2	3
p	-	5	0

ITERATION II
Calculate the Edge 1 – 2
u.d = 1.d = 0
v.d = 2.d = 7
w (u,v) = w (1,2) = 10

Relax (u,v):
1.d> 2.d + w (2,1)
0 > 17
FALSE

Calculate the edge 1 – 3
u.d = 1.d = 0
v.d = 3.d = 5
w (u,v) = w (1,3) = 5

Relax (u,v):

3.d> 1.d + w (1,3)
5> 0 + 5
FALSE
Next Edge

Calculate the edge 2 – 1
u.d = 2.d = 7
v.d = 1.d = 0
w (u,v) = w (2,1) = -3

Relax (u,v):
1.d> 2.d + w (2,1)
0 > 7 + -3
FALSE
Next Edge

Calculate the edge 3 – 2
u.d = 3.d = 5
v.d = 2.d = 7
w (u,v) = w (3,2) = 2

Relax (u,v):
2.d> 3.d + w (3,2)
7> 5 + 2 = 7
FALSE

Final result :

Table 7. Result of last iteration.

	1	2	3
d	0	7	5

	1	2	3
p	-	5	0

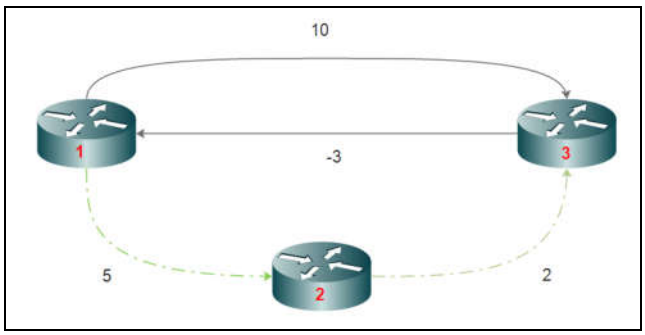

Figure 5. The shortest path is obtained.

Shortest path traveled from vertex 1 to other vertex is weighting value 5 and 2.

4.2 *RIP Testing*
Bellman-ford algorithm used in RIP will be on implementation of topology in Figure 6 below:

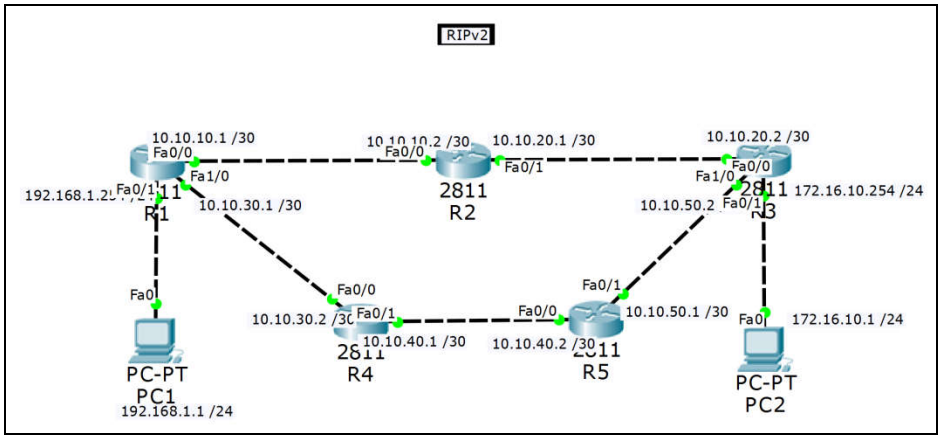

Figure 6. Shortest path.

The image of R1, R2, R3, R4 and R5 as the vertex and each link (edge) have metric i.e. hop count on RIP is the weights value from each edge.

R1#show ip route rip
10.0.0.0/30 is subnetted, 5 subnets
R 10.10.20.0 [120/1] via 10.10.10.2, 00:00:23, FastEthernet0/0
R 10.10.40.0 [120/1] via 10.10.30.2, 00:00:13, FastEthernet1/0
R 10.10.50.0 [120/2] via 10.10.30.2, 00:00:13, FastEthernet1/0
[120/2] via 10.10.10.2, 00:00:23, FastEthernet0/0
172.16.0.0/24 is subnetted, 1 subnets
R 172.16.10.0 [120/2] via 10.10.10.2, 00:00:23, FastEthernet0/0
From R1 look his pass routes to reach across a network is:

- From R1 to network 10.10.20.0 through ip10.10.10.2 (R2) with the number ofhop 1.
- From R1to network 10.10.40.0 throughip10.10.30.2 (R4) with the number ofhop 1.
- From R1 to network 10.10.50.0 through ip 10.10.30.2 (R4) with the number ofhop 2.
- From R1 to network 172.16.10.0 through ip 10.10.30.2 (R4) with the number ofhop 2.

From the trials obtained the optimum results to achieve throughout the network with routing protocol RIP which uses the Bellman-ford algorithm.

5. Conclusions and suggestions

The following is the conclusion from the results of this research are:

1. Bellman-Ford algorithm is used by the routing protocol RIP to search the best path in a network.
2. Weighting value of routing protocol RIP by default is worth 1.
3. The maximum number of vertices in the routing protocol RIP is 15.

The following is a suggestion from the results of this research are:

1. Can be expanded by using the others shortest path search algorithm.
2. Can be developed by using the others routing protocol.

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