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Evolution of the Routing Protocols from RIP (1969) to OSPF (1998)

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Abstract— ***The term routing can be defined as the act of packets being taken from one device and sending it through the network to another device on a different network. The logical and the hardware addresses play significant roles. The former is responsible for getting packets to a network through a routed network and the latter is used to deliver the packet from a router to the correct destination host. There are two main types of dynamic routing protocols: distance vector and link state. This paper presents the gradual advancement in routing technique highlighting the difference between RIP and OSPF in terms of metrics and other technical aspects.***

Keywords— ***RIP, OSPF, IGP, EGP, AS, LSA***

I. INTRODUCTION

In an internetwork routing occurs at the network layer of the OSI layer. The routers are responsible for determining the best path for the packets to be routed through the network. This is possible as routers use routing protocols such as RIP, OSPF and EIGRP etc. Routing helps to achieve the following:

- Stability: The information in the form of packets are routed by the optimal path which is selected by using the routing protocols and thus the chances of collision while routing is reduced.
- Provision of a robust network: During the routing process the protocols that we are using, take care of the various unusual factors like hardware failures and high load conditions etc.
- Dynamic updation of the network paths: The protocols that we are using are capable of updating the routing paths to the neighboring routers and after that the optimal path is decided.
- Security of information while transmission: It is the responsibility of the protocols that the packets are not accessed by the inter network routers. As the header of the packet contains the destination IP address, it is ensured by the protocols that the packets are delivered to the same address.

Dynamic routing unlike static routing finds network and update routing tables on routers automatically. Dynamic routing is easier than static but it will cost you in terms of router CPU processing and bandwidth of the network links. Interior gateway protocols (IGP) and Exterior gateway protocols (EGP) are the two types of routing protocols. The former is used in case of same Autonomous system (AS) and the latter is used in case of communication between different ASs.

II. ROUTING INFORMATION PROTOCOL (RIP)

Routing information protocol or RIP as it is more commonly called, is one of the oldest distance-vector routing protocols, which employs the hop count as a routing metric. RIP was first developed in 1969 as a part of ARAPNET. RIP became popularized on June 1988. It was developed by C. Hedrick of Rutgers University. There are four basic components of RIP : routing update process, RIP routing metrics, routing stability and routing timers. All those devices supporting RIP send routing-update message at regular intervals and also when the network topology changes.

RIP has advantages over static routing because the initial configuration is very simple and manual updation of the configuration is not required when the topology changes.

There are three versions of the Routing Information Protocol: *RIPv1*, *RIPv2*, and *RIPng* but the common characteristics of all the versions include:

- Hop count as metric: Rip selects the routing path based on the no. of hop counts.
- 15 hop count limit: Rip supports a 15 hop-count limit, i.e. when a packet reaches 16th hop while routing, it is dropped.
- Supports 6 equal cost path: The router balances the load among the six paths.

RIP version 1 is an out-dated protocol. Now we will compare the 2 versions of RIP. RIPv2 was created taking RIPv1 as the base. RIP version 2 (RIPv2) was developed in 1993 and last standardized in 1998.It was created to overcome the drawbacks of RIPv1. Thus RIpv2 has inherited the features of RIPv1. The following are some enhancements which makes RIPv2 more flexible:

1) MULTICASTING: RIPv2 supports multicast updates against the broadcast updates by RIPv1 to share the routing information.

2) TRIGGERED UPDATES**:** It uses triggered updates to share its routing information with the neighbour, when a change occurs.

3) CLASSLESS PROTOCOLS**:** It supports Variable length subnet masking (vlsm) that enables to provide more than 1 subnet mask value for a Class A,B or C network. RIPv1 is a classful addressing protocol.

4) AUTHENTICATION**:** It allows you to select the routers that you want to participate in RIPv2.

In RIP we have three types of messages which are given below:

1) HELLO MESSAGE: It helps in creating the neighbourships.
2) UPDATE MESSAGE: It helps in exchanging known information regarding the routing table.
3) ACKNOWLEDGEMENT MESSAGE: It is an acknowledgement to the reply.

RIP uses 4 timers to regulate its performance and keep track of the various routes connected. The various RIP timers are:

1) ROUTER UPDATE TIMER: The default value of this timer is of 30 seconds and the information is transmitted in routing updates. In this time interval the router sends its routing table information to the connected routers.

2) ROUTE INVALID TIMER: The default value of this timer is 180 seconds which determines the period after which the router declares a route as invalid. This happens only when the router does not get any updates from the route for a certain period.

3) HOLD DOWN TIMER: The default value of this timer is also 180 seconds. It determines the period for which the routing information is not passed to the neighbouring routers. The router starts the hold down timer when it receives an updated packet or when it is informed about an invalid path or a route breakdown. This indicates that the route is unreachable.

4) ROUTE FLUSH TIMER: After waiting for 180 seconds as in case of either the invalid timer or the hold-down timer, the router waits for another 60 seconds to flush the route from the routing table. Once the route is invalid and ready to be removed, the router broadcasts the route's condition in 240 seconds.

One of the drawbacks of RIP is that the convergence time is large. The update timer is 30 seconds. Within this period of 30 seconds there is a possibility that a particular router receives contradicting status of any other specific router from 2 neighbouring routers. This is known as looping. This looping remains for 15 hops. Until 16^{th} hop comes looping will exist. To avoid the looping there are some protocols added in RIP. These are mentioned below:

1)SPLIT HORIZON METHOD: If a router receives any status at any of its interface from its neighbouring router about any specific router then from that same interface it won't be able to send status of that router to its neighbour.

2) ROUTE POISONING: It is simply a message to show that the specific network is in 16^{th} hop. This avoids the looping.

3) POISON REVERSE: It contradicts the split horizon method. It is just a message to show that a specific network is down.

RIP can be configured using the *router rip* and *network* commands. One can also specify the RIP version number. The syntax for configuring the router to update and receive RIPv1 or RIPv2 only is:

router rip

version 2

network IP_network, where IP_network is a Class A,B or C network number.

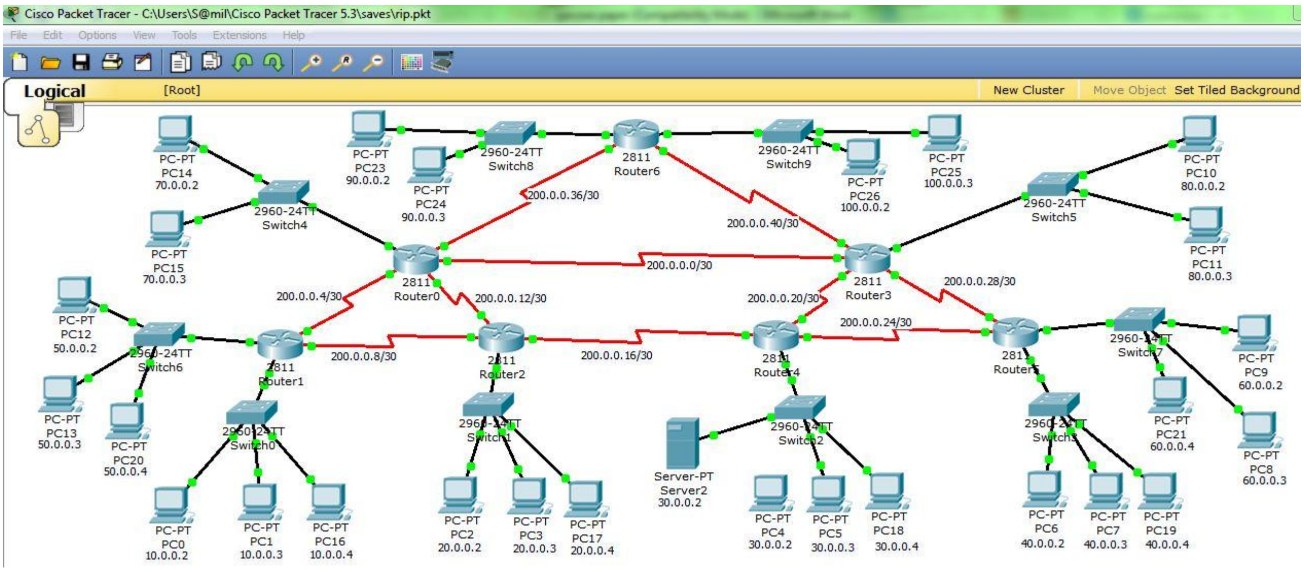

Fig. 1 A simulation of RIP in cisco packet tracer

III. OPEN SHORTEST PATH FIRST (OSPF)

Open shortest path first was developed by the Interior gateway protocol (IGP) working group of the Internet Engineering Task Force (IETF). This group was formed in 1988 to design an IGP based on the shortest path first algorithm for its use in the internet. RIP being incapable of serving large and heterogeneous internetworks, OSPF was developed in 1988.

As defined by RFC 1131 (781K PostScript file), OSPF is a link state algorithm that is in contrast to a distance-vector algorithm, where a router ``tells all neighbours about the world". Link-state routers ``tell the world about the neighbours." OSPF specifies a class of messages called link-state advertisements (LSAs) that allow routers to update each other about the LAN and WAN links to which they are connected. Whenever any kind of change is made to the network, LSAs flow between the routers.

On receiving link state updates, OSPF routers store them in a topology database in memory. In an OSPF database we have a representation of every link and router in the enterprise network. When there is a need of forwarding the received internetwork traffic, the routers use their topology database for the calculation of a table with the best route through an internet.

There are some drawbacks in RIP because of which the it is not preferred now days. The following are some of the major advancements in OSPF which is responsible for its acceptance:

1) In OSPF we have no limitation with respect to hop count.
2) OSPF adopts IP multicast to send link-state updates and this reduces the load on the routers that are not listening to OSPF packets.
3) OSPF supports VLSM so that we can efficiently allocate the IP addresses.
4) In contrast to RIP, OSPF has better convergence.
5) In compare to RIP, OSPF has better load-balancing ability.
6) IN OSPF the whole networks is divided defined where all the routers are divided in areas.
7) In OSPF there is a provision for security as it allows routing authentication by the use of different password authentication.
8) OSPF does not restrict the transfer and tagging of external routes that are injected into an Autonomous System and hence very efficiently we can keep track of the external routes that are injected by the exterior protocols like BGP.

OSPF has only one timer and it is hello timer which is used for creating adjacency. For fast interfaces the time is 10 seconds and the router dead interval is 40 seconds. For slower interfaces the hello timer is of 30 seconds and the dead interval is 120 seconds.

All OSPF packets begin with a 24-byte header as illustrated below:

Bytes - 1	1	2	4	4	2	2	8	Variable
Version number	type	Packet length	Router ID	Area ID	Check-sum	Authenticat ion- type	Authentication	data

The following descriptions summarize the header files:

1) Version number: It defines the version of the OSPF.
2) Type: It identifies the OSPF as one of the following-
    a) Hello: For establishing neighbor message.
    b) Database description: Describes topological database.
    c) Link-state request: This is sent after a router discovers that parts of its topological databases are outdated.
    d) Link-state update: This is sent in respond to link-state request packet. These are also used for dispersal of LSAs.
    e) Link-state acknowledgement: It acknowledges link-state update messages.
3) Packet-length: It signifies the packet-length, including the OSPF header in bytes.
4) Router-ID: It refers to the source of the packet.
5) Area ID: It signifies the area to which the packet belongs.
6) Check-sum: It is used for checking the entire packet contents whether any damage is suffered in transit.
7) Authentication-type: It contains the type of authentication which is configurable on per area basis.
8) Authentication: It contains the information of the authentication.
9) Data: It contains the information of the upper-layer which is encapsulated.

OSPF maintains a two-layer hierarchy consisting of following:

1) Backbone area (area 0): It is responsible for distributing the routing information among other areas of the system. The backbone area must be reachable to other areas either physically or via virtual links. This area is identified by 0.0.0.0
2) Off backbone area (areas 1-65535): these consist of areas other than the backbone area in a system. Every single packet that enters a system is sent to the backbone area. The backbone area enables intra routing and sends the packet to the required off backbone area.

The following are the advantages of dividing an OSPF network into areas:

1) Conservation of router resources: An OSPF configured router does not register a topology database of areas where it does not participate and hence the resources of the router are not exploited much.
2) Data hiding: OSPF implements route summarization at the area borders to reduce the display of information outside an area. If a prefix belonging to a summary changes then that information is not circulated outside the area, where the prefix exists. Hence the overall stability of the system is enhanced.

3) Dealing with the external routers: OSPF enables different area types to handle the external routes differently. Different area types like stub, totally stub and NSSA help to reduce the number of external routes in the network.

The syntax for configuring an OSPF are mentioned below:
router ospf process_id
network IP_address Wildcard_mask area area_#
where,

- Process_id: Provides an unique identification to OSPF process running on router.
- IP_address: It is the IP address of the particular interface of the OSPF configured router.
- Wildcard_mask: It specifies the router regarding the part of the address that should match. The values can be :
  a) Binary 0: It indicates that the match has to exist.
  b) Binary 1: It indicates that the match may or may not exist.
- Area: It specifies the area where the address on the router belongs.

After configuring OSPF on the routers, one can easily verify it by the following commands:
show ip ospf
show ip ospf database
show ip protocols

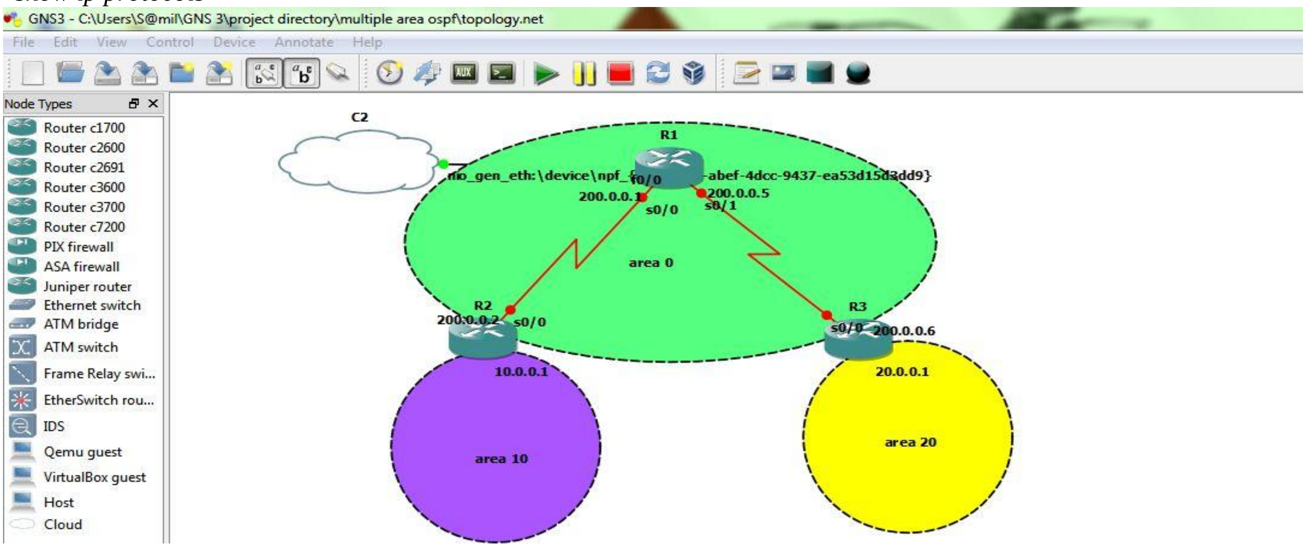

Fig. 2 A simulation of multi-area OSPF protocol in GNS 3

IV. SUMMARY OF COMPARISON BETWEEN RIP AND OSPF

For many OSPF is the first link state routing protocol and for this reason it is necessary that we summarize the fundamental differences between the two in tabular form as given below.

TABLE I: SUMMARY OF COMPARATIVE STUDY OF RIP AND OSPF

CHARACTERISTICS	OSPF	RIPv2	RIPv1
Protocol type	Link state	Distance vector	Distance vector
Ad value	110	120	120
Classless support	Yes	Yes	No
VLSM support	Yes	Yes	No
Auto-Summarization	No	Yes	Yes
Manual summarization	Yes	Yes	No
Path metric	Bandwidth	Hops	Hops
Route propagation	Multicast on change using the address 224.0.0.5 & 224.0.0.6	Periodic multicast Using the address 224.0.0.9	Periodic broadcast Using the address 255.255.255.255
Discontiguous support	Yes	Yes	No
Peer authentication	Yes	Yes	No
Hierarchial network requirement	Yes	No	No
Updates	Event triggered	Route table updates	Route table updates
Algorithm for Route computation	Dijkstra	Bellman-Ford	Bellman-Ford
Hop count limit	None	15	15

V. CONCLUSIONS

In this paper we have compared the RIP and OSPF from the theoretical point of view. We have highlighted the gradual development of the routing protocols in the field of networking. OSPF outperforms the RIP in terms of average throughput and instant packet delay in different sizes of network. OSPF can adjust the link and OSPF coverage network more quickly than RIP, but if RIP is enhanced by using FS-RIP, then RIP offers a better performance than OSPF.

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REFERENCES

[1] Todd Lammle, *Cisco Certified Network Associate*, 7th ed.
[2] Open Shortest Path First –Docwiki; docwiki.cisco.com/wiki/Open_Shortest_Path_First
[3] Cisco Networking Academy Program, Convergence, in: Chapter 3: Single-Area OSPF of CCNA3 & 4 Companion Guide (Third Edition), ISBN 1-58713-113-7..
[4] Ljiljana Trajkovic, Final Project OSPF, EIGRP, and RIP performance analysis based on OPNET, http://www.sfu.ca/~donx
[5] B. Fortz, J. Rexford, and M. Thorup, "Traffic engineering with traditional IP routing protocols," IEEE Communications Magazine, vol. 40, no. 10, pp. 118–124, Oct. 2002
[6] Behrouz A. Forouzan, *Data Communications and Networking*, fourth edition

