ABSTRACT:
In modern internet era, communication networks are growing very rapidly. To provide efficient routing in the network, routers play an important role. They take part in the network and forward the packets from source to destination and also keep an eye on the data so that it remains in control manner. Routing is the process of transferring data from source node to destination node. Routing selects appropriate path in the network and forward a packet through the network to a device on a different networks and it is based on routing protocols. Routing protocols play an important role in modern communication networks. Routing protocols provide the facility to exchange routing table information between the network devices. Each routing protocols have different configuration and different structure. A lot of comparison and evaluation between different routing protocols has been done on IPV4 using OPNET 9.1. Therefore we can do comparison or evaluation on different routing protocols on IPV6 using OPNET 14.5 simulator. This simulator is used for doing the work on IPV6 routing protocols such as RIPNG, OSPFV3, EIGRPV4 and BGPV4.

Keywords: OSPF, OSPFv3, RIP, RIPv2, RIPNG, IGRP, EIGRP.

[1] INTRODUCTION
In modern internet era, communication networks are growing very rapidly. To provide efficient routing in the network, routers play an important role. They take part in the network and forward the packets from source to destination and also keep an eye on the data so that it remains in control manner. Routing is the process of transferring data from source node to destination node. Routing selects appropriate path in a network and forward a packet through the network to a device on a different networks [1]. Routing protocols play an important role in modern communication networks. Routing protocols determine, how routers communicate with each other and forward the data through the data to the optimal path and how from source to destination. Each routing protocols have different configuration and different structure in comparison by others routing protocols. Routing protocols operate based on routing algorithms. The basic functionality of routing protocols is to move the traffic across the network and router must be aware of where routers forward the data in order to reach the destination [2]. There are two types of routing protocol-static routing and dynamic routing. In Modern communication network, dynamic routing protocol has been used instead of static routing protocol. In the Static routing, network is fixed means no nodes can be added or removed. Static routing occurs when manually add routes in each router in the routing table. It works well in small network, but not in large networks. Dynamic routing protocol plays a
vital role in today’s communication. In dynamic routing protocols are used in larger network and also provide the facility to exchange of routing information between routers. In dynamic routing protocols, routing dynamically share information and also automatically updates its routing table when topology changes and also able to maintain network operation when the failure of network configuration. These are different types of routing protocols in the IP networks. Three mainly classes which are used on IP networks [3, 4]:-

1) **Interior gateway routing over link state routing protocols** that communicate within an autonomous system. Link state routing protocol uses sophisticated algorithm that maintains database of internetwork topology. Example are OSPF, IS-IS.

2) **Interior gateway routing over distance vector routing protocols** use simple algorithms to calculate the distance value based upon hop count. Example of distance vector routing protocols are RIP, IGRP.

3) **Exterior gateway routing protocols** that communicate between the two or more autonomous system. Example of exterior routing protocol is BGP (Border Gateway Protocol). BGP is a routing protocol used on internet for exchange traffic between autonomous systems.

RIP (Routing Information System) is a distance vector protocol that uses hop count as its metrics and the maximum hop count is 15. It updates its routing tale after every 30 seconds. IGRP (Interior Gateway Routing Protocol) is also a distance vector routing protocol and also designed to be more scalable than RIP. There are three versions of RIP- RIPV1, RIPV2 and RIPNG. RIPNG (Routing Information Protocol for Next Generation) is suitable for IPv6. IGRP sends out the full routing table every periodic update every 90 seconds. IGRP metrics are based on bandwidth and delay. IGRP has the maximum hop count of 255(default as 100) [1]. OSPF (Open Shortest Path First) is a link state routing protocol. Each router works independently to calculate its own shorter path towards the destination. It uses bandwidth and delay as the metrics to route the packets. This protocol is used for large networks like internet [2]. OSPF uses SPF (Shortest Path First) algorithm to calculate the best path. OSPFv3 is next generation version suitable for IPv6. EIGRP (Enhanced Interior Gateway Routing Protocol) is a hybrid routing protocol. It covers all the advantages of distance vector and link state routing protocol. EIGRP is an enhanced version of IGRP. This routing protocol is developed by Cisco. EIGRP uses Diffusing Update Algorithm to calculate the best path. Maximum hop count is 255. The metrics used are bandwidth, delay, load and reliability. The difference between IPv4 (Internet Protocol Version 4) and IPv6 (Internet Protocol Version 6) [5]:-

<table>
<thead>
<tr>
<th>IP versions</th>
<th>Deployment year</th>
<th>Address Size</th>
<th>Number of addresses available</th>
<th>Format of address</th>
<th>Prefix notation</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPv4</td>
<td>1981</td>
<td>32</td>
<td>$2^{32} = \frac{4,294,967,296}{1}$</td>
<td>Dotted decimal notation</td>
<td>192.168.0.0/24</td>
</tr>
<tr>
<td>IPv6</td>
<td>1999</td>
<td>128</td>
<td>$2^{128} = \approx 3.4 \times 10^{38}$</td>
<td>Hexadecimal notation</td>
<td>2001:abcd:abcd::/48</td>
</tr>
</tbody>
</table>
[2] RELATED WORK

Fitigau et al. [6], the Network performance evaluation for RIP, OSPF and EIGRP routing protocols for real time application such as voice, video and HTTP using OPNET simulator and results show that EIGRP is better. Farhangi et al. [7], A comparative study of IS-IS and IGRP protocols for real time applications such as voice and video conferencing. They performed on three scenario such as IS, IGRP and IS-IGRP and the conclusion shows that combination of IS and IGRP is better than single IS or IGRP. Khan et al. [8], survey of EIGRP and OSPF protocols on Voice conferencing applications and they shows that EIGRP performs well than OSPF. Vetriselvan et al.[9], surveyed the performance evaluation of various routing protocol such as RIP, OSPF and EIGRP with certain criteria such as jitter, convergence time, end-to-end delay, throughput, queuing delay, utilization and the graphical results shows EIGRP is better in link utilization and IGRP has the maximum overload. OSPF has maximum throughput. Singh et al. [2], describes the simulation based comparative study of RIP, OSPF and EIGRP in OPNET (Optimized Network Engineering Tools) IT GURU ACADMIC EDITION 9.1. The result presented that EIGRP routing protocol to be used to deploy in small to medium network. EIGRP behaves well and its performance is better than others. Hinds et al. [10], studied the routing protocols by showing and explaining differences between IPv6 and IPv4 networks. Rakheja et al. [11], the performance of routing protocol such as RIP, OSPF, IGRP and EIGRP is analyzed using different parameters. The results have been show in graph that RIP performs better in jitter and IGRP performs the best in packet dropping, traffic received and end-to-end delay as compared to other protocols. Din et al. [12], performance Analysis of the Routing Protocols such as RIP, OSPF, IGRP, EIGRP in Real Time Transmission such as voice and video conferencing and the conclusion is that IGRP performs well in packets dropping, traffic received, and End-to-End delay as compared to its other companions (RIP, OSPF, and EIGRP), while in case of jitter; RIP performs a bit well than IGRP. Shah et al. [13],analyzed the performance of routing protocols that is RIP and OSPF in network using OPNET simulator and the finally shows that OSPF network convergence is faster as compared with RIP convergence. Kumar et al. [5], evaluated the performance of Enhanced Interior Gateway Routing Protocol (EIGRP) in IPv6 network using Cisco packet tracer software and finally its performance capability is better than others.

[3] CLASSIFICATION OF INTERIOR GATEWAY PROTOCOL

Interior gateway protocol is a type of protocol used for exchanging routing information between routers within an autonomous system means it communicates with in single autonomous system. [14].

[3.1] Routing Information System (RIP)

RIP is a distance vector routing protocol and uses hop count as it’s metrics for determining best path and also uses UDP (User Datagram Protocols) port for message
RIP and OSPF in IPv6 Network

encapsulation. Hop count measures the distance travelled by a data packet. The maximum number of hop count is 15, thereby preventing routing loops. This also limits the size of the network supported by it. A hop count of 16 is considered an infinite distance or the route is considered unreachable. RIP updates its routing table after every 30 seconds. Each router maintains its routing table by sending periodic updates to communicate with its neighbor routers. RIP uses Bellman-Ford Distance Vector algorithm to determine the best path. RIP has three versions:- RIPv1 (Routing Information Protocol Version), RIPv2 (Routing Information Protocol Version 2), RIPNG (Routing Information Protocol Next Generation) [3,15,16].

**RIPv1:** RIPv1 supports Classful routing. The periodic routing updates do not carry subnet mask, therefore variable length subnet mask (VLSM) cannot be used. This limitation makes impossible to have different –sized subnets inside the same network class. There is also no authentication mechanism.

**RIPv2:** RIPv2 supports Classless Inter-Domain Routing (CIDR). Thus does include the subnet mask with its routing updates. RIPv2 fully supports VLSMs (Variable Length Subnet Mask), allowing dis-contiguous networks and varying subnet masks to exist.

**RIPNG:** RIP is the extension of RIPv2 for support of IPv6. The main differences between RIPv2 and RIPNG are:

- Support of IPv6 networking
- RIPv2 allows attaching arbitrary tags to routers but RIPNG not.
- While RIPv2 supports RIPv1 updates authentication, RIPNG does not. IPv6 routers were, at the time, supposed to use IPsec for authentication.
- RIPv2 encodes the next-hop into each route entries; RIPNG requires specific encoding of the next hop for a set of route entries.

**Characteristics of Routing Information Protocol (RIP)**

- RIP is easy and efficient in smaller networks and thus require little management.
- RIP is mainly based on hop counts vector.
- A fixed subnet mask length is used.
- RIP supports IP and IPX routing.
- RIP routes have an administrative distance is 120.

**Advantages of Routing Information Protocol**

- Easy and efficient in smaller networks.
- Easy configuration.
- Low resource usage.

**Disadvantages of Routing Information protocol**

- Loop creation.
- Slow convergence.
- Scalability problem.
- Lack of metrics.

[3.2] **Open Shortest Path First (OSPF)**
OSPF is a routing protocol that was developed by IGP working group of the Internet Engineering Task Force for Internet Protocol (IP) networks. OSPF is a link state routing protocol that is used to distribute information within a single Autonomous System and performs routing calculations based upon data stored within a Link State Database (LSDB). The dijkstra’s algorithm is used to determine the best shortest path to transfer the packet from source to the destination within the LSDB. It uses cost as its metrics. The cost of the link is calculated based upon the bandwidth of the link. Higher the bandwidth allocated a lower cost means cost is inversely proportional to the bandwidth. OSPF routers inform the network of changes to the LSDB using Link State Advertisement (LSA), these are flooded to routers in the same area periodically. The OSPF protocol uses a hierarchical structure which is split into areas. The hierarchical structure also helps to ensure that network performance is not degraded in large OSPF domains by limiting routing traffic flooding and LSA to within the routers current area. Each area in OPSF is labeled with a unique 32 bit area ID, which are dotted decimal format and not compatible with IPv4 addresses, Area 0 is the backbone area of an OSPF domain, all OSPF areas need to connect to this backbone area which manages all inter-area routing.

Characteristics of Open Shortest Path First (OSPF)

- OSPF supports only IP routing.
- OSPF routes have an administrative distance is 100.
- OSPF uses cost as its metric, which is computed based on the bandwidth of the link.
- OSPF has no hop-count limit

Advantages of OSPF

- OSPF provides rapid convergence when a topology changes.
- If any changes occur in the network it updates fast.
- OSPF minimizes the routes and reduces the size of routing table by configuring area.
- Low bandwidth utilization.
- Multiple routes are supported.

Disadvantages of OSPF

- Difficult to configure.
- Link state scaling problem.
- More memory requirements.

OSPFv2 is used for IPV4 and OSPFv3 is specially designed to support IPv6. The core operation mechanisms of both OSPFv2 and OSPFv3 are very similar, with few major modifications. OSPFv3 maintains the same packet types as used in OSPFv2. Hello, Link State Request, Link State Update, Link State Acknowledgement and Database Description. Changes were made to some of the fields preventing backwards compatibility between the versions. OSPFv3 retains the domain and flooding scope area from OSPFv2; it also add a link local flooding scope; which is a requirement to support IPv6; routing both IPv4 and IPv6 traffic on the same network requires both versions of OSPF to be running simultaneously using dual-stack backbones. OSPFv3 drops packets whose instances IDs does not match by assigning an interface ID to the OSPF packets to differentiate between instances. OSPFv3 utilizes IPv6 IPSec extension Headers to provide authentication and encryption [3, 10, 17].

[6] CONCLUSION
In many papers, the performance evaluation of different routing protocols based on IPv4 using OPNET simulator and also comparison has been done. Some papers have evaluated the comparison between IPv4 and IPv6. Most papers are evaluating the performance of RIP, OSPF and EIGRP protocols, which are based on IPv4 and EIGRP performs best resulting in a hybrid protocol that is easy to configure, efficient and also has a faster Convergence. In Real Time Transmission, IGRP performs well in packets dropping, traffic received, and End-to-End delay as compared to its other companions (RIP, OSPF, and EIGRP), while in case of jitter IEGRP performance less than RIP. For the future work, we can do the comparison between different routing protocols RIPNG, OSPFv3, EIGRPv6 and BGP4 which are based on IPv6 by using OPNET v14.5 simulator.

REFERENCES


