Performance Analysis of Layer Three Protocols

Rupali bansal **[1], Pooja sharma [2]**

Student, Dept. Of ECE, GGGI,Dinarpur,Ambala Haryana,India[1],rupaalibansal@gmail.com

Assistant professor,Dept.of ECE, GGGI,Dinarpur,Ambala Haryana,India[2],Pooja.211086 @gmail.com

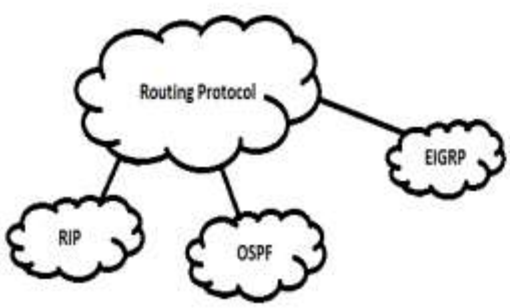
ABSTRACT

In this paper we have made an effort to calculate the performance of network using the packet tracer. The results have been derived using self created network scenario for different routing protocols. The performance metrics used for evaluation are packet delivery ratio, average end to end delay, normalized routing load and packet loss percentage.

Keywords: - *Computer network, Routing Protocols, RIP, OSPF, EIGRP, Performance metrics.*

1.INTRODUCTION

Routing is the process of learning all the paths through the network (routes) and using routes to forward data from one network to another. A protocol is a standardized way to perform a task. So, a routing protocol would be a standardized way of learning routes and moving data from one network to another. Performance is the amount of useful work accomplished by a network compared to the time and resources used. There are many different ways to measure the performance of a network, as each network is different in nature and design .In this paper the different formulas for calculating the performance of different routing protocols are used. Routing protocols are used by routers to dynamically learn all paths through a set of networks and forward data between the networks. Routers are specialized computer devices designed to perform routing.



Performance Metrics

A number of quantitative metrics that can be used for evaluating the performance of a routing protocol

a) Packet Delivery Fraction (PDF) The packet delivery fraction is defined as the ratio of number of data packets received at the destinations over the number of data packets sent by the sources as given in equation.

Packet Delivery Fraction =(Total Data Packets Sent÷Total Data Packets Received) X 100

b) Average End-to-End Delay

This is the average time involved in delivery of data packets from the source node to the destination node. To compute the average end-to-end delay, add every delay for each successful data packet delivery and divide that sum by the number of successfully received data packets .
Average End to End Delay =∑(Time Received - Time Sent)÷ Total Data Packets Received

c) Normalized Routing Load (NRL)

The normalized routing load is defined as the fraction of all routing control packets sent by all nodes over the number of received data packets at the destination nodes. This metric discloses how efficient the routing protocol is. The bigger this fraction is the less efficient the protocol.
Normalized Routing Load = Total Routing Packets Sent ÷ Total Data Packets Received

d)Packet Loss (PL)

Packet loss occurs when one or more packets being transmitted across the network fail to arrive at the destination. It is defined as the number of packets dropped by the routers during transmission.
Packet Loss = Total Data Packets Dropped
Packet Loss = Total Data Packets Sent – Total Data Packets Received
Packet Loss (%age) =(Total Packets Dropped X 100)÷ Total Data Packets Sent

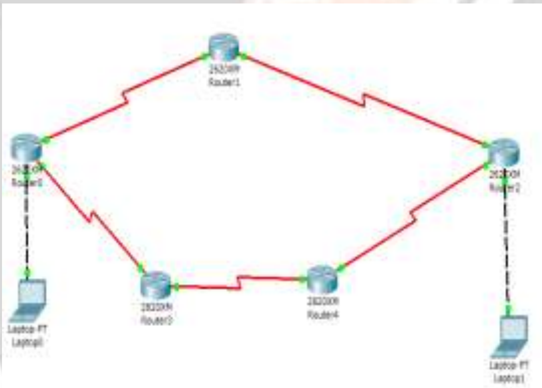


Fig 1: Scenario 1

Performance measurement

a) RIP

Routing Information Protocol (RIP) is a simple distance vector routing protocol. RIP uses only hop count to find the best path to a remote network.It works well only in small networks

```
Reply from 50.0.0.2: bytes=32 time=16ms TTL=125
Reply from 50.0.0.2: bytes=32 time=16ms TTL=125
Reply from 50.0.0.2: bytes=32 time=17ms TTL=125
Reply from 50.0.0.2: bytes=32 time=16ms TTL=125
Reply from 50.0.0.2: bytes=32 time=14ms TTL=125
Reply from 50.0.0.2: bytes=32 time=9ms TTL=125
Reply from 50.0.0.2: bytes=32 time=16ms TTL=125
Reply from 50.0.0.2: bytes=32 time=9ms TTL=125
Reply from 50.0.0.2: bytes=32 time=9ms TTL=125
Reply from 50.0.0.2: bytes=32 time=17ms TTL=125
Reply from 50.0.0.2: bytes=32 time=7ms TTL=125
Reply from 50.0.0.2: bytes=32 time=17ms TTL=125
Reply from 50.0.0.2: bytes=32 time=7ms TTL=125
Reply from 50.0.0.2: bytes=32 time=21ms TTL=125
Reply from 50.0.0.2: bytes=32 time=16ms TTL=125
Reply from 50.0.0.2: bytes=32 time=17ms TTL=125
Reply from 50.0.0.2: bytes=32 time=9ms TTL=125

Ping statistics for 50.0.0.2:
    Packets: Sent = 52, Received = 51, Lost = 1
Approximate round trip times in milli-seconds:
    Minimum = 7ms, Maximum = 21ms, Average = 13m

Control-C
^C
PC>tracert 50.0.0.2

Tracing route to 50.0.0.2 over a maximum of 30 h

  1   4 ms      5 ms      6 ms      30.0.0.1
  2   8 ms      8 ms      9 ms      20.0.0.2
  3   11 ms     7 ms      12 ms     40.0.0.1
  4   14 ms     20 ms     16 ms     50.0.0.2
```

a)PDF=(Total Data Packets Sent÷Total Data Packets Received) X 100
PDF=(51/52)*100
PDF=98.07
b)Average End-to-End Delay=∑(Time Received - Time Sent)÷ Total Data Packets Received
Average End-to-End Delay=120/51
Average End-to-End Delay =2.35
c) Normalized Routing Load = Total Routing Packets Sent ÷ Total Data Packets Received

Normalized Routing Load=52/51
Normalized Routing Load =1.01
d) Packet Loss = Total Data Packets Dropped
Packet Loss = Total Data Packets Sent – Total Data Packets Received
Packet Loss =52-51
Packet Loss=1
Packet Loss (%age) = (Total Packets Dropped X 100)÷ Total Data Packets Sent
Packet Loss (%age) = (1/52)*100
Packet Loss (%age) =1.92
EIGRP

Enhanced Interior Gateway Routing Protocol - (EIGRP) is a Cisco proprietary routing protocol loosely based on their original IGRP and combines the best features from link-state and distance-vector protocols.It works on Reliable Transport Protocol. The EIGRP routers exchange messages that contain information about bandwidth, delay, load, reliability and MTU of the path to each destination as known by the advertising router. Each router uses these parameters to compute the resulting distance to a destination

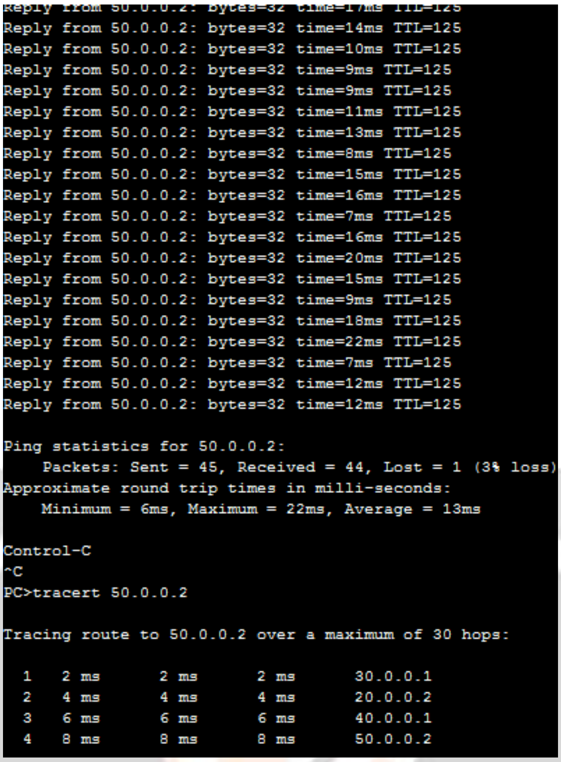
```
Reply from 50.0.0.2: bytes=32 time=13ms TTL=125
Reply from 50.0.0.2: bytes=32 time=20ms TTL=125
Reply from 50.0.0.2: bytes=32 time=11ms TTL=125
Reply from 50.0.0.2: bytes=32 time=20ms TTL=125
Reply from 50.0.0.2: bytes=32 time=12ms TTL=125
Reply from 50.0.0.2: bytes=32 time=19ms TTL=125
Reply from 50.0.0.2: bytes=32 time=10ms TTL=125
Reply from 50.0.0.2: bytes=32 time=14ms TTL=125
Reply from 50.0.0.2: bytes=32 time=12ms TTL=125
Reply from 50.0.0.2: bytes=32 time=7ms TTL=125
Reply from 50.0.0.2: bytes=32 time=11ms TTL=125
Reply from 50.0.0.2: bytes=32 time=9ms TTL=125
Reply from 50.0.0.2: bytes=32 time=10ms TTL=125
Reply from 50.0.0.2: bytes=32 time=11ms TTL=125
Reply from 50.0.0.2: bytes=32 time=7ms TTL=125
Reply from 50.0.0.2: bytes=32 time=15ms TTL=125
Reply from 50.0.0.2: bytes=32 time=8ms TTL=125
Reply from 50.0.0.2: bytes=32 time=12ms TTL=125
Reply from 50.0.0.2: bytes=32 time=20ms TTL=125
Reply from 50.0.0.2: bytes=32 time=11ms TTL=125

Ping statistics for 50.0.0.2:
    Packets: Sent = 50, Received = 50, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 7ms, Maximum = 21ms, Average = 13ms

Control-C
^C
PC>tracert 50.0.0.2

Tracing route to 50.0.0.2 over a maximum of 30 hops:

  1   3 ms      1 ms      4 ms      30.0.0.1
  2   5 ms      8 ms      7 ms      20.0.0.2
  3   12 ms     14 ms     10 ms     40.0.0.1
  4   18 ms     17 ms     20 ms     50.0.0.2
```

a)PDF=(Total Data Packets Sent ÷Total Data Packets Received) X 100
PDF= (50/50)*100
PDF=100
b) Average End-to-End Delay=∑(Time Received - Time Sent)÷ Total Data Packets Received
Average End-to-End Delay=119/50
Average End-to-End Delay =2.38
c) Normalized Routing Load = Total Routing Packets Sent ÷ Total Data Packets Received

Normalized Routing Load=50/50
Normalized Routing Load =1
d) Packet Loss = Total Data Packets Dropped
Packet Loss = Total Data Packets Sent – Total Data Packets Received
Packet Loss =50-50
Packet Loss=0
Packet Loss (%age) = (Total Packets Dropped X 100)÷ Total Data Packets Sent
Packet Loss (%age) = (0/50)*100
Packet Loss (%age) =0

OSPF

Open Shortest Path First (OSPF) is an open standard routing protocol. It works by using the Dijkstra algorithm. First, a shortest path tree is constructed, and then the routing table is populated with the resulting best paths. it does support both IP and IPv6 routed protocols



```
Reply from 50.0.0.2: bytes=32 time=17ms TTL=125
Reply from 50.0.0.2: bytes=32 time=14ms TTL=125
Reply from 50.0.0.2: bytes=32 time=10ms TTL=125
Reply from 50.0.0.2: bytes=32 time=9ms TTL=125
Reply from 50.0.0.2: bytes=32 time=9ms TTL=125
Reply from 50.0.0.2: bytes=32 time=11ms TTL=125
Reply from 50.0.0.2: bytes=32 time=13ms TTL=125
Reply from 50.0.0.2: bytes=32 time=8ms TTL=125
Reply from 50.0.0.2: bytes=32 time=15ms TTL=125
Reply from 50.0.0.2: bytes=32 time=16ms TTL=125
Reply from 50.0.0.2: bytes=32 time=7ms TTL=125
Reply from 50.0.0.2: bytes=32 time=16ms TTL=125
Reply from 50.0.0.2: bytes=32 time=20ms TTL=125
Reply from 50.0.0.2: bytes=32 time=15ms TTL=125
Reply from 50.0.0.2: bytes=32 time=9ms TTL=125
Reply from 50.0.0.2: bytes=32 time=18ms TTL=125
Reply from 50.0.0.2: bytes=32 time=22ms TTL=125
Reply from 50.0.0.2: bytes=32 time=7ms TTL=125
Reply from 50.0.0.2: bytes=32 time=12ms TTL=125
Reply from 50.0.0.2: bytes=32 time=12ms TTL=125

Ping statistics for 50.0.0.2:
    Packets: Sent = 45, Received = 44, Lost = 1 (3% loss)
Approximate round trip times in milli-seconds:
    Minimum = 6ms, Maximum = 22ms, Average = 13ms

Control-C
^C
PC>tracert 50.0.0.2

Tracing route to 50.0.0.2 over a maximum of 30 hops:

  1   2 ms      2 ms      2 ms      30.0.0.1
  2   4 ms      4 ms      4 ms      20.0.0.2
  3   6 ms      6 ms      6 ms      40.0.0.1
  4   8 ms      8 ms      8 ms      50.0.0.2
```

a) PDF= (Total Data Packets Sent ÷Total Data Packets Received) X 100
PDF = (44/45)*100
PDF=97.77

b)Average End-to-End Delay=□□(Time Received - Time Sent) ÷ Total Data Packets Received
Average End-to-End Delay = 60/44
Average End-to-End Delay =1.36
c)Normalized Routing Load = Total Routing Packets Sent ÷ Total Data Packets Received

Normalized Routing Load=45/44
Normalized Routing Load =1.02
d) Packet Loss = Total Data Packets Dropped
Packet Loss = Total Data Packets Sent – Total Data Packets Received
Packet Loss =45-44
Packet Loss=1
Packet Loss (%age) = (Total Packets Dropped X 100)÷ Total Data Packets Sent
Packet Loss (%age)=(1/45)*100
Packet Loss (%age)=2.22

Conclusion

Based on the scenario 1, all the calculations have been made regarding the performance of different routing protocols. The packet delivery fraction (PDF) generated by EIGRP is the best among the three protocols discussed. Average End-to-End Delay of OSPF protocol id the least. Whereas the Normalized Routing Load of OSPF is the most. Packet loss percentage is minimum for EIGRP.

References
[1] Sunil Taneja & Ashwani Kush Energy Efficient, Secure and Stable Routing Protocol for MANET, Global Journal of Computer Science and Technology Network,Web & Security
[2] *Mandeep Singh , Kusum Sorout , Vineet Garg, Dheeraj Kumar, Implementation of Privilege level and Access-control mechanism for Network Security*
[3] Wiley Publishing, Inc . Cisco Certified Network Associate,Todd Lammle