

# Comparative Analysis of Dynamic Routing Protocol with Dynamic B/W using Cisco Packet Tracer 8.0

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**Abstract-** In this digital world, the transmission of data from source to destination is based on some routing protocol that chooses the best path between any two nodes. So, to compare Routing Protocols. We've Taken three typical types of routing protocols as the simulation model. RIP (Routing Information Protocol) is the oldest among OSPF & EIGR routing protocols. OSPF (open shortest path first) is the most widely used protocol and is based on Shortest Path First (SPF) Algorithm. EIGRP (Enhanced Interior Gateway Routing Protocol) is a Cisco proprietary routing protocol that runs on the Diffusion Algorithm (DUAL). And to demonstrate this in a Specific Network Environment. Cisco packet Tracer 8.0 is used to study and analyze the effect of Bandwidth, Delay, Communication Mode, and configuration.

**Index Terms-** IGP Routing Protocol, Networking, RIPv2, OSPF, EIGRP, IPv4, Cisco Packet Tracer 8.0

## 1. INTRODUCTION

Routing protocols are based on routing algorithms, which use a variety of parameters to determine the most efficient path for data transmission across networks. For Ex. Cost, bandwidth, maximum transmission unit (MTU), packet latency, and hop count are some of the metrics. The results of these metrics are stored in a routing table by routing protocols, based on whether the routing is within an Autonomous System (AS) Interior Gateway Protocols (IGP) or between ASs Exterior Gateway Protocols (EGP). Three commonly used IGPs are RIP, EIGRP, and OSPF. The Border Gateway Protocol is an example of an EGP (BGP).

The process of determining paths in a network is known as routing. Routing controls traffic forwarding of logically addressed packets through intermediary nodes from their source to their ultimate destination in packet switching networks. Routing protocols are used to find and pick the optimum path to each router in a network. Routers should learn how to send packets to the next hop. Data transmission should be quick. As a result, a protocol's routing selection significantly impacts network performance.

RIP, EIGRP, and OSPF are the most extensively used routing protocols among the numerous available protocols. In this study, we have implemented Packet Tracer 8.0 Modeler to simulate the performance of the TCP/IP Internet routing protocols RIP, EIGRP, and OSPF, and evaluate setup scenarios bandwidth, Maximum

Transmission Unit (MTU), HOP Count, Administrative Distance (AD value).

## 2. CLASSIFICATION OF ROUTING PROTOCOL

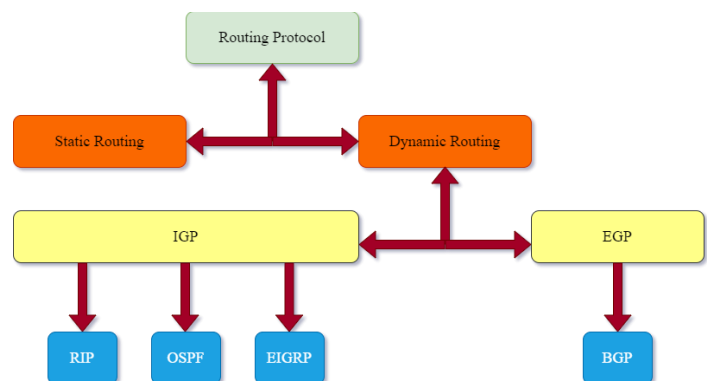


Figure: Classification of Dynamic Routing Protocol

The following figure 1 describes the routing protocol classification. When configuring routing tables in the router, certain dynamic routing protocols can be Implemented. Routing Information Protocol (RIP), and Enhanced Interior Gateway Protocol (EIGP) are examples of Interior Gateway Protocols (IGP) that should be used for routers in the same domain network. Both forms of routing systems have their benefits and drawbacks. EIGRP (Enhanced Interior Gateway Routing Protocol) will be utilized for the distance vector type. OSPF (Open Shortest Path First) will be used for the link-state type. Both IPv4 and IPv6 networks can benefit from these dynamic routing methods.

### 2.1. Dynamic Routing Protocol

In today's networks, dynamic routing protocols are important. They're used to make it easier for routers to share routing information. They dynamically share information between routers, update the routing table automatically when the topology changes, and select the optimum way to a target. Dynamic routing protocols have better scalability and adaptability than static routing methods and they need less administrative overhead. Routers can use dynamic routing protocols to advertise and learn routes, assess available routes, and find the most efficient paths to a destination. Dynamic routing protocols can keep the network running in the event of a failure or when the network configuration or topology changes <sup>[1]</sup>.

Routing protocols utilized by routers to forward packets are referred to as "distance vector" and "link state." There are two types of routing protocols: those that select the optimum routing path based on a distance metric (the distance) and an interface (vector), and those that calculate the state of each link in a path and locate the path with the lowest overall metric to the destination. Distance vector protocols determine the optimum path based on distance, which can be expressed in hops or as a combination of metrics. RIP and IGRP are the current IP Distance vector routing protocols in use. When it comes to link-state routing, every node creates a map of the network's connection in the form of a graph that shows how the nodes are connected to one another. The next best logical path to every feasible destination in the network is then calculated individually by each node<sup>[2]</sup>. The routing table of a node is made up of the optimal pathways. The routers broadcast their closest peers to all other routers in the network via link-state protocols. Only the portion of the table that pertains to its peers is shared. Link state routing protocols include EIGRP, OSPF, and Intermediate System-Intermediate System (IS-IS).

## 2.2. Routing Information Protocol

One of the most often used routing protocols for small homogenous networks is the Routing Information Protocol (RIP). Routers employ RIP as a distance-vector routing protocol to share topology information regularly by sending routing table contents to routers every 30 seconds<sup>[4]</sup>. Until they attain network convergence, these surrounding routers transfer the information to other routers. The hop count metric will be used by RIP, with a maximum of 15 hops; anything beyond that is unreachable. As a result, RIP is not appropriate for big, complicated networks. RIP includes two types: RIPv1 and RIPv2. RIP version 1 uses classful routing and does not include subnet information when sending out periodic routing table updates. RIPv2 is a classless protocol that contains subnet information for Classless-Inter Domain Routing (CIDR). Unlike RIPv1, RIPv2 uses the address 224.0.0.9 to multicast routing updates to nearby routers. RIPv2<sup>[4]</sup> allows for substantially faster network convergence.

### RIP – Advantages and Disadvantages

In small networks, the Routing Information Protocol offers its own set of benefits. It's simple to understand, configure, and use. Practically all routers support it. Because it's limited to 15 hops, any router beyond that point is considered infinite and so inaccessible. When used in a large network, RIP can cause a traffic bottleneck by multicasting all routing tables every 30 seconds, which consumes a lot of bandwidth. In vast networks, RIP has a sluggish network convergence. Routing updates consume a lot of bandwidth, leaving only a few resources for essential IT systems. Because RIP does not support numerous pathways on the same route, additional routing loops are likely to occur, resulting in data loss. RIP compares available routes using fixed hop count metrics, which cannot be employed when routes are chosen based on real-time data. As a result of the repeated activities, packet delivery times grow and network operations become overburdened.

## 2.3. Open Shortest Path First (OSPF) Protocol

Within a single AS, OSPF utilizes a link-state routing algorithm. In comparison to RIP, OSPF is an efficient IGP that may provide faster routing. RIP only maintains the routing table of the best path for each destination, whereas OSPF maintains the routing table for all connections in the network. With Link-State Advertisement (LSA), each OSPF router stores the local network connection state and broadcasts it to the entire AS. The LSA created by all routers in the AS is sent to each router. The Link-State Database is created from the LSA Database (LSDB). Each LSA is a description of a router's surrounding network structure. As a result, the AS network architecture is reflected in the LSDB<sup>[5]</sup>. When a new router is added to the network, it must be configured. Then, it will broadcast hello messages to all of its neighbors and will get feedback from them in the form of greeting messages. Routers eventually establish connections with new routers and synchronize their routing databases. When the network topology changes, every router transmits a link-state update message. As a result, all routers may store the same network topology information. For each transmission, each router determines the best pathways to all destinations and indicates the closest router. In big industrial networks, OSPF is the most generally deployed IGP<sup>[6]</sup>.

### Types of OSPF Messages

OSPF does not use UDP to deliver data. Instead, it creates IP datagrams from scratch, packaging them with IP protocol number 89. OSPF has a variety of message kinds.

- **Hello Packet** - Routers send this packet to establish relationships with neighbors and speak with them frequently to keep the connection alive. Hello, Packet discusses the key parameters for using OSPF in a network.
- **Database Description** - For autonomous systems, the description of the link-state database is sent from one router to the next.
- **Link-State Request** - When a component of the network needs to be updated with current information, this request is made. The message describes which links the device that wants more up-to-date information requests.
- **Link-State Update** - This offers the most recent information for the links that have been requested. In response to the LS request, it is sent.
- **Link-State Acknowledgement** — This recognizes the link-state update message's link-state exchange procedure.

### OSPF – Advantages and Disadvantages

Because OSPF has a thorough understanding of network structure, routers may calculate routes based on incoming requests. Furthermore, OSPF has no hop count constraints, converges quicker than RIP, and has better load balancing than RIP. One disadvantage of OSPF is that it does not scale as the number of routers in the network grows. This is due to the fact that it keeps

numerous copies of routing data. OSPF is inadequate for routing across the Internet due to its lack of scalability.

#### 2.4. Enhanced Interior Gateway Routing (EIGRP) Protocol

Cisco's proprietary routing protocol is EIGRP. It is based on the Diffusing Update Algorithm, a revolutionary route computation algorithm (DUAL). It has both distance vector and link-state protocol characteristics. Reliability, MTU, latency, load, and bandwidth are all factors in EIGRP measurements. The essential parameters for determining metrics are delay and bandwidth [4]. EIGRP gathers information from three tables. The first is the neighbors' table, which maintains information about surrounding routers that can be accessed directly through associated interfaces. The topology table, on the other hand, is an aggregation of routing tables gathered from all neighbors who are directly connected. It contains a list of EIGRP routed network destination networks as well as associated metrics. As a result, it can keep track of its topological table. Only when the new neighbors' adjacencies are identified is information to be routed communicated. The EIGRP router keeps track of its routing table as well as the tables of its peers [5]. If the EIGRP router detects another neighbor, it broadcasts to them. The actual routes to all destinations are stored in the third routing table. Because it does not rely on periodic route dumps, EIGRP differs from most distance vector protocols.

#### EIGRP Packets Types

When the EIGRP process is started on the router, the first message type transmitted is a hello packet. By default, the Hello packet finds neighbors and establishes adjacencies while being disseminated every 5 seconds (60 seconds on a low bandwidth network).

- **Update Packet** - This packet contains route information that is only forwarded when a change occurs. They're only sent to routes with incomplete updates. If a new neighbor is detected, the packet is delivered as a unicast to the router.
- **Acknowledgement** - This is a unicast response to an Update packet, indicating that they have received an update.
- **Query** - This packet is delivered to neighboring query routes. When a router loses a route while broadcasting a multicast, it sends a query packet to all surrounding routers to locate alternate paths.
- **Reply** — These are unicast messages sent by routers that are aware of alternate routes for neighboring routers on a network.

#### EIGRP Advantages and Disadvantages

EIGRP has several advantages, including quick network convergence, low CPU utilization, and ease of configuration. Everything is stored as routing table information by EIGRP routers so they can swiftly adapt to different routes. The variable-length subnet mask improves scalability and reduces network convergence time. MD5 route authentication is also included in EIGRP. In complex networks, EIGRP is more adaptable and versatile than RIP and OSPF. Many characteristics of both link-state and distance-vector are combined in EIGRP. Because EIGRP is mostly used in big networks, routers often delay providing information during the allocated period, causing surrounding routers to seek the information again, resulting in increased traffic.

### 3. SIMULATION METHODOLOGY AND NETWORK SCENARIO

Cisco Packet Tracer is a robust network simulation application that allows users to experiment with network behavior and pose "what if" scenarios. Packet Tracer aids the teaching and learning of complex technological topics by providing simulation, visualization, authoring, assessment, and collaboration capabilities. Packet Tracer augments physical equipment by enabling practice, discovery, and troubleshooting by establishing a network with an almost infinite number of devices. It allows practice with a command-line interface, albeit it is not a replacement for actual equipment. The capacity to "e-doing" is an important part of knowing how to configure routers and switches. The simulation model in Packet Tracer can reveal processes that were previously concealed. By offering tables, graphs, and other visual representations of core activities such as dynamic data transfers and packet content expansion, these simulation capabilities can aid in the learning process. The performance of the three dynamic routing protocols will be simulated using this network tool & software (Cisco Packet Tracer), with the results being used for authentication in a real-time situation using Terminal Emulator.

#### 3.1 Simulation Model and Platform

The Cisco Packet Tracer 8.0 simulation program is used in the research to evaluate and analyze the performance of various routing protocols such as RIP, OSPF, and EIGRP as well as investigate how IP packets transit in a network.

In this study, we used three different situations to test three different dynamic routing protocols on a network. The first is RIP, the second is OSPF, and the third is the EIGRP Routing protocol.

In this network scenario, we have six routers, each of which is connected through a cross-over cable to the end devices, which are connected via a switch with a straight-through cable. To explain a network scenario, the parameters relating to the network are listed in the table

Table 1: Specification of Network Devices

Sr. No	Devices	No. Devices	Device Version
1	Router	7	Cisco-2911
2	Switch	2	2960-24TT
3	Server	1	Facebook server
4	End device	3	Aditya - PC

Table 2: Router Configuration Specification

Sr No.	Router	Interface	IP Address	Bandwidth	Communication Mode
1	Mumbai Jio	G0/0	192.168.1.1	1Gbps	Full Duplex
2	Mumbai Jio	G0/1	10.1.1.1	1Gbps	Full Duplex
3	Mumbai Jio	G0/2	10.1.7.1	10Mbps	Full Duplex
4	Gujrat	G0/0	10.1.1.2	1Gbps	Full Duplex
5	Gujrat	G0/1	10.1.2.1	1Gbps	Full Duplex
6	Gujrat	G0/2	10.1.4.1	1Gbps	Full Duplex
7	Hyderabad	G0/0	10.1.2.2	1Gbps	Full Duplex
8	Hyderabad	G0/1	10.1.3.1	1Gbps	Auto
9	Kolkata	G0/0	10.1.3.2	1Gbps	Full Duplex
10	Kolkata	G0/1	10.1.5.2	1Gbps	Full Duplex
11	Kolkata	G0/2	10.1.6.1	1Gbps	Full Duplex
12	Chennai	G0/0	10.1.4.2	1Gbps	Full Duplex
13	Chennai	G0/1	10.1.5.1	1Gbps	Full Duplex
14	Delhi	G0/0	10.1.7.2	10Mbps	Auto
15	Delhi	G0/0	10.1.8.1	10Mbps	Full Duplex
16	Bangalore	G0/0	10.1.6.2	1Gbps	Auto
17	Bangalore	G0/1	172.16.1.1	1Gbps	Full Duplex
18	Bangalore	G0/2	10.1.8.2	10Mbps	Full Duplex

Table 3: Server/PC Configuration Specification

Sr. No	Server / PC	IP Address
1	Facebook NMS	172.16.1.2
2	Facebook Server	17.16.1.3
3	Aditya-MacBook	192.168.1.2
4	Shailesh-PC	192.168.1.3
5	Rohit Yadav-PC	192.168.1.4

On packet tracer 8.0, Figures 2(a) and 2(b) depict the suggested network scenario, while Figure 2(c) depicts the network feature that specifies QoS performance. Seven Cisco-2911 routers, two Cisco 2960-24TT switches, one Facebook server, and three PCs make up the network structure. In this scenario, we created a network with three end devices: Aditya's MacBook, Shailesh's PC, and Rohit's PC, all of which were connected to a computer network that allowed them to access Facebook services from anywhere in the world. During this scenario, the college switch

obtained a leased line from Reliance JIO and connected it to the Bhopal-based Reliance JIO router. End devices connect to the Facebook server through HTTP using the public IP given JIO and IP packets flow from router to router until they reach the Facebook server.

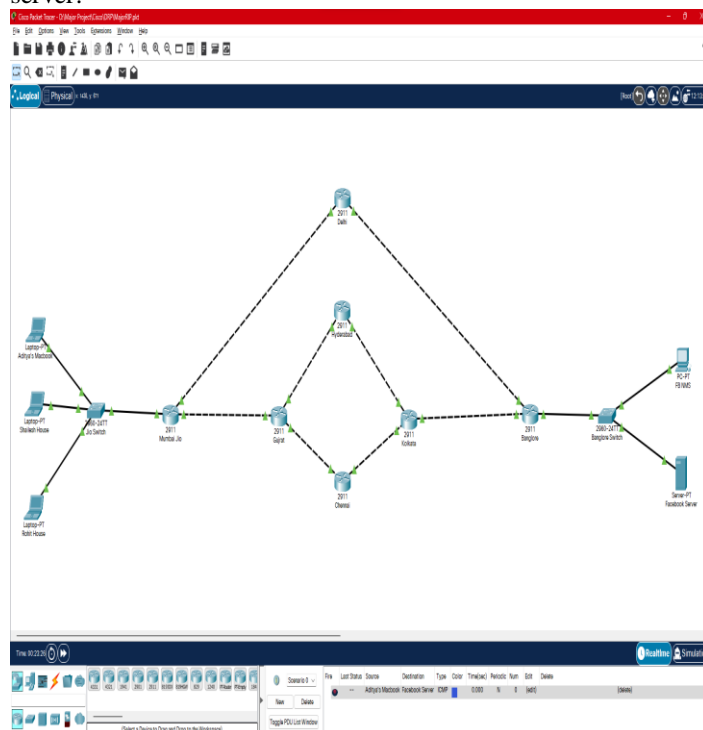


Figure 1 (A): Proposed Network Scenario



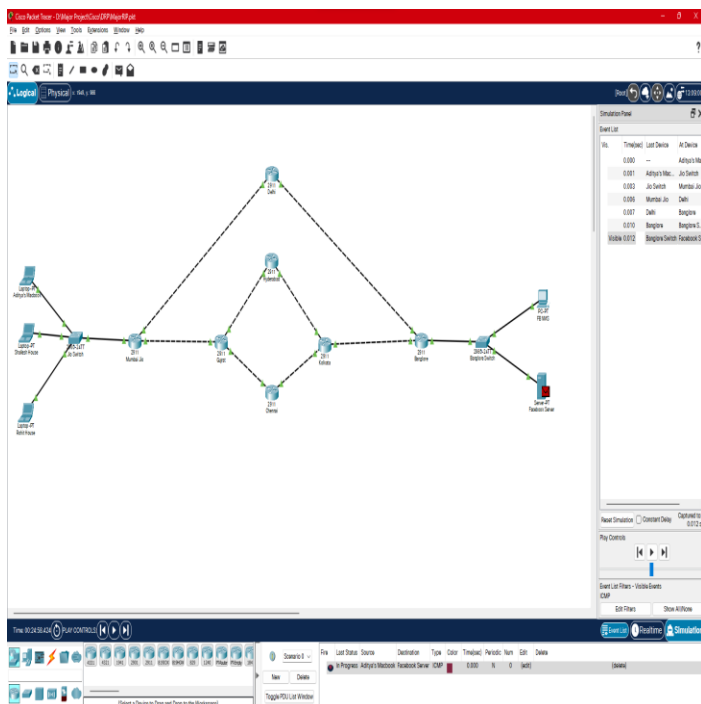


Figure 2(B): Real-Time Packet transmission from Aditya's MacBook to Facebook Server

The configuration of a network scenario can be divided into two steps:  
the first is to configure the hostname and assign an IP address to the connected interface device, and the second is to run the network protocol scenario.

### Step 1: Configuration of assigning hostname and IP address.

#### For Mumbai Jio Router: Assignment of Hostname and IP address

```
Router > enable
Router # configure terminal
Router (config) # hostname Mumbai Jio
Router (config) # interface GigabitEthernet 0/0
Router(config-if)# ip address 192.168.1.1 255.255.255.0
Router(config-if)# no shutdown
Router (config) # interface GigabitEthernet 0/1
Router(config-if)# ip address 10.1.1.1 255.255.255.0
Router(config-if)# no shutdown
Router (config) # interface GigabitEthernet 0/2
Router(config-if)# ip address 10.1.7.1 255.255.255.0
Router(config-if)# no shutdown
```

#### For Delhi Router: Assignment of Hostname and IP address

```
Router > enable
Router # configure terminal
Router (config) # hostname Delhi
Router (config) # interface GigabitEthernet 0/0
```

```
Router(config-if)# ip address 10.1.7.2 255.255.255.0
Router(config-if)# no shutdown
Router (config) # interface GigabitEthernet 0/1
Router(config-if)# ip address 10.1.8.1 255.255.255.0
Router(config-if)# no shutdown
```

#### For Gujrat Router: Assignment of Hostname and IP address

```
Router > enable
Router # configure terminal
Router (config) # hostname Gujrat
Router (config) # interface GigabitEthernet 0/0
Router(config-if)# ip address 10.1.1.2 255.255.255.0
Router(config-if)# no shutdown
Router (config) # interface GigabitEthernet 0/1
Router(config-if)# ip address 10.1.2.1 255.255.255.0
Router(config-if)# no shutdown
Router (config) # interface GigabitEthernet 0/2
Router(config-if)# ip address 10.1.4.1 255.255.255.0
Router(config-if)# no shutdown
```

#### For Hyderabad Router: Assignment of Hostname and IP address

```
Router > enable
Router # configure terminal
Router (config) # hostname Hyderabad
Router (config) # interface GigabitEthernet 0/0
Router(config-if)# ip address 10.1.2.2 255.255.255.0
Router(config-if)# no shutdown
Router (config) # interface GigabitEthernet 0/1
Router(config-if)# ip address 10.1.3.1 255.255.255.0
Router(config-if)# no shutdown
```

#### For Kolkata Router: Assignment of Hostname and IP address

```
Router > enable
Router # configure terminal
Router (config) # hostname Kolkata
Router (config) # interface GigabitEthernet 0/0
Router(config-if)# ip address 10.1.3.2 255.255.255.0
Router(config-if)# no shutdown
Router (config) # interface GigabitEthernet 0/1
Router(config-if)# ip address 10.1.5.2 255.255.255.0
Router(config-if)# no shutdown
Router (config) # interface GigabitEthernet 0/2
Router(config-if)# ip address 10.1.6.1 255.255.255.0
Router(config-if)# no shutdown
```

#### For Chennai Router: Assignment of Hostname and IP address

```
Router > enable
Router # configure terminal
Router (config) # hostname Chennai
Router (config) # interface GigabitEthernet 0/0
```

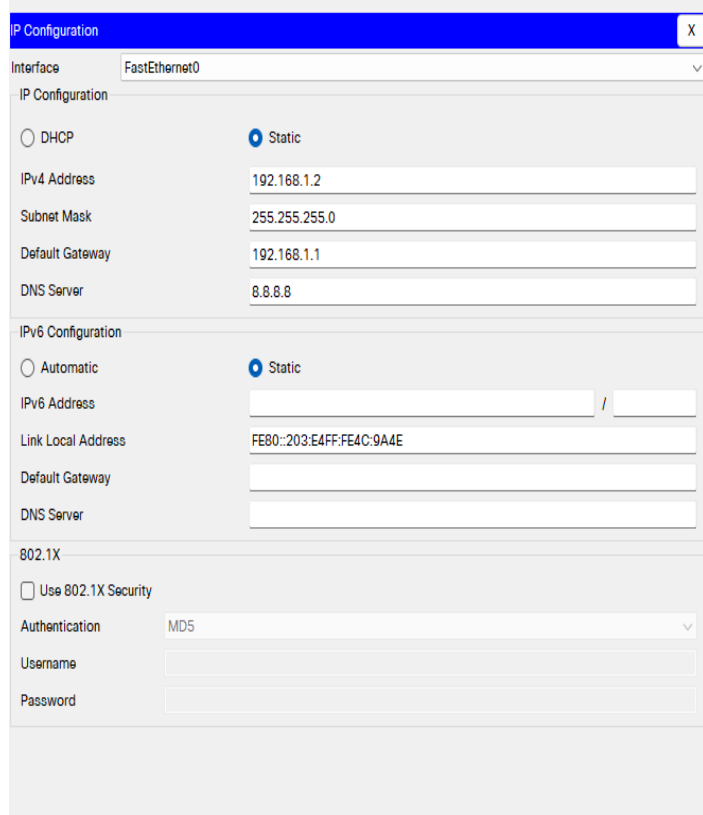
```
Router(config-if)# ip address 10.1.4.2 255.255.255.0
Router(config-if)# no shutdown
Router (config) # interface GigabitEthernet 0/1
Router(config-if)# ip address 10.1.5.1 255.255.255.0
Router(config-if)# no shutdown
```

#### For Bangalore Router: Assignment of Hostname and IP address

```
Router > enable
Router # configure terminal
Router (config) # hostname Bangalore
Router (config) # interface GigabitEthernet 0/0
Router(config-if)# ip address 10.1.6.2 255.255.255.0
Router(config-if)# no shutdown
Router (config) # interface GigabitEthernet 0/1
Router(config-if)# ip address 172.16.1.1 255.255.255.0
Router(config-if)# no shutdown
Router (config) # interface GigabitEthernet 0/2
Router(config-if)# ip address 10.1.8.2 255.255.255.0
Router(config-if)# no shutdown
```

#### Server/PC Configuration and assign IP Address

Manually assigning an IP address to a host is simple, rather than creating a DHCP server. In this case, a static method is used to assign an IP address to the host.



The screenshot shows the 'IP Configuration' window for a network device. The 'Interface' is set to 'FastEthernet0'. Under 'IP Configuration', the 'Static' radio button is selected. The fields are filled with: IPv4 Address: 192.168.1.2, Subnet Mask: 255.255.255.0, Default Gateway: 192.168.1.1, and DNS Server: 8.8.8.8. Under 'IPv6 Configuration', the 'Static' radio button is also selected. The fields are filled with: IPv6 Address: (empty), Link Local Address: FE80::203:E4FF:FE4C:9A4E, Default Gateway: (empty), and DNS Server: (empty). At the bottom, under '802.1X', the 'Use 802.1X Security' checkbox is unchecked. The 'Authentication' dropdown is set to 'MD5'. The 'Username' and 'Password' fields are empty.

Figure 2: IP Configuration on PC

#### Configuration of Routing information protocol on Network Configuration of RIP on Mumbai Jio router

```
Router (config) # router rip
Router(config-router)# version 2
Router(config-router)# network 192.168.1.0 255.255.255.0
Router(config-router)# network 10.1.1.0 255.255.255.0
Router(config-router)# network 10.1.7.0 255.255.255.0
```

#### Configuration of RIP on Gujrat router

```
Router (config) # router rip
Router(config-router)# version 2
Router(config-router)# network 10.1.2.0 255.255.255.0
Router(config-router)# network 10.1.1.0 255.255.255.0
Router(config-router)# network 10.1.4.0 255.255.255.0
```

#### Configuration of RIP on Delhi router

```
Router (config) # router rip
Router(config-router)# version 2
Router(config-router)# network 10.1.7.0 255.255.255.0
Router(config-router)# network 10.1.8.0 255.255.255.0
```

#### Configuration of RIP on Hyderabad router

```
Router (config) # router rip
Router(config-router)# version 2
Router(config-router)# network 10.1.2.0 255.255.255.0
Router(config-router)# network 10.1.3.0 255.255.255.0
```

#### Configuration of RIP on Chennai router

```
Router (config) # router rip
Router(config-router)# version 2
Router(config-router)# network 10.1.4.0 255.255.255.0
Router(config-router)# network 10.1.5.0 255.255.255.0
```

#### Configuration of RIP on Kolkata router

```
Router (config) # router rip
Router(config-router)# version 2
Router(config-router)# network 10.1.3.0 255.255.255.0
Router(config-router)# network 10.1.5.0 255.255.255.0
Router(config-router)# network 10.1.6.0 255.255.255.0
```

#### Configuration of RIP on Bangalore router

```
Router (config) # router rip
Router(config-router)# version 2
Router(config-router)# network 172.16.1.0 255.255.255.0
Router(config-router)# network 10.1.6.0 255.255.255.0
Router(config-router)# network 10.1.8.0 255.255.255.0
```

Figure 4.0 depicts the IP path on the Bhopal router. The administrative distance of RIP is 120, as shown in the diagram, where C denotes a directly connected route and RIP represents a router connected to the RIP routing protocol.

```
Mumbai(config-router)#exit
Mumbai(config)#exit
Mumbai#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
* - candidate default, U - per-user static route, o - ODR
P - periodic downloaded static route

Gateway of last resort is not set

10.0.0.0/8 is variably subnetted, 10 subnets, 2 masks
C    10.1.1.0/24 is directly connected, GigabitEthernet0/1
L    10.1.1.1/32 is directly connected, GigabitEthernet0/1
R    10.1.2.0/24 [120/1] via 10.1.1.2, 00:00:11, GigabitEthernet0/1
R    10.1.3.0/24 [120/2] via 10.1.1.2, 00:00:11, GigabitEthernet0/1
R    10.1.4.0/24 [120/1] via 10.1.1.2, 00:00:11, GigabitEthernet0/1
R    10.1.5.0/24 [120/2] via 10.1.1.2, 00:00:11, GigabitEthernet0/1
R    10.1.6.0/24 [120/2] via 10.1.7.2, 00:00:00, GigabitEthernet0/2
C    10.1.7.0/24 is directly connected, GigabitEthernet0/2
L    10.1.7.1/32 is directly connected, GigabitEthernet0/2
R    10.1.8.0/24 [120/1] via 10.1.7.2, 00:00:00, GigabitEthernet0/2
R    172.16.0.0/16 [120/2] via 10.1.7.2, 00:00:00, GigabitEthernet0/2
    192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C    192.168.1.0/24 is directly connected, GigabitEthernet0/0
L    192.168.1.1/32 is directly connected, GigabitEthernet0/0

Mumbai#
```

Figure 3: RIP IP route on Bhopal Router

Figure 5.0 depicts the traceroute from source Aditya's MacBook to the Facebook server, demonstrating that the best path selection is based on HOP count in RIP, and Figure 6.0 depicts that ping connectivity is proper and that the Facebook server is reachable from PC to the server.

```
Packet Tracer PC Command Line 1.0
C:\>tracert 172.16.1.3

Tracing route to 172.16.1.3 over a maximum of 30 hops:

  1  0 ms    0 ms    0 ms    192.168.1.1
  2  0 ms    0 ms    1 ms    10.1.7.2
  3  0 ms    0 ms    0 ms    10.1.8.2
  4  0 ms    0 ms    0 ms    172.16.1.3

Trace complete.
```

Figure 4: Traceroute from Aditya's MacBook to Facebook-Server using RIP

```
C:\>ping 172.16.1.3

Pinging 172.16.1.3 with 32 bytes of data:

Reply from 172.16.1.3: bytes=32 time<1ms TTL=125
Reply from 172.16.1.3: bytes=32 time=1ms TTL=125
Reply from 172.16.1.3: bytes=32 time=14ms TTL=125
Reply from 172.16.1.3: bytes=32 time<1ms TTL=125

Ping statistics for 172.16.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 14ms, Average = 3ms

C:\>|
```

Figure 5: ICMP ping connectivity from PC to Facebook-Server.

## Configuring Open Shortest Path First (OSPF) Protocol on Network

### Configuration of OSPF on Mumbai Jio router

```
Router (config) # router ospf 50
Router(config-router)# network 192.168.1.0 0.0.0.255 area 0
Router(config-router)# network 10.1.1.0 0.0.0.255 area 0
Router(config-router)# network 10.1.7.0 0.0.0.255 area 0
```

### Configuration of OSPF on Gujrat router

```
Router (config) # router ospf 50
Router(config-router)# network 10.1.2.0 0.0.0.255 area 0
Router(config-router)# network 10.1.1.0 0.0.0.255 area 0
Router(config-router)# network 10.1.4.0 0.0.0.255 area 0
```

### Configuration of OSPF on Delhi router

```
Router (config) # router ospf 50
Router(config-router)# network 10.1.7.0 0.0.0.255 area 0
Router(config-router)# network 10.1.8.0 0.0.0.255 area 0
```

### Configuration of OSPF on Hyderabad router

```
Router (config) # router ospf 50
Router(config-router)# network 10.1.2.0 0.0.0.255 area 0
Router(config-router)# network 10.1.3.0 0.0.0.255 area 0
```

### Configuration of OSPF on Chennai router

```
Router (config) # router ospf 50
Router(config-router)# network 10.1.4.0 0.0.0.255 area 0
Router(config-router)# network 10.1.5.0 0.0.0.255 area 0
```

### Configuration of OSPF on Kolkata router

```
Router (config) # router ospf 50
Router(config-router)# network 10.1.3.0 0.0.0.255 area 0
Router(config-router)# network 10.1.5.0 0.0.0.255 area 0
Router(config-router)# network 10.1.6.0 0.0.0.255 area 0
```

### Configuration of OSPF on Kolkata router

```
Router (config) # router ospf 50
Router(config-router)# network 172.16.1.0 0.0.0.255 area 0
Router(config-router)# network 10.1.6.0 0.0.0.255 area 0
Router(config-router)# network 10.1.8.0 0.0.0.255 area 0
```

The OSPF IP route on the Bhopal router is shown in Figure 7.0, with the route connecting from the Bhopal router indirectly represented by O and the route connecting directly represented by C. The AD value of OSPF is 110.

```
Mumbai>show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route
```

Gateway of last resort is not set

```
10.0.0.0/8 is variably subnetted, 10 subnets, 2 masks
C    10.1.1.0/24 is directly connected, GigabitEthernet0/1
L    10.1.1.1/32 is directly connected, GigabitEthernet0/1
O    10.1.2.0/24 [110/2] via 10.1.1.2, 00:18:00, GigabitEthernet0/1
O    10.1.3.0/24 [110/3] via 10.1.1.2, 00:18:00, GigabitEthernet0/1
O    10.1.4.0/24 [110/2] via 10.1.1.2, 00:18:00, GigabitEthernet0/1
O    10.1.5.0/24 [110/3] via 10.1.1.2, 00:17:50, GigabitEthernet0/1
O    10.1.6.0/24 [110/4] via 10.1.1.2, 00:18:00, GigabitEthernet0/1
C    10.1.7.0/24 is directly connected, GigabitEthernet0/2
L    10.1.7.1/32 is directly connected, GigabitEthernet0/2
O    10.1.8.0/24 [110/2] via 10.1.7.2, 00:18:00, GigabitEthernet0/2
O    172.16.0.0/16 [110/5] via 10.1.1.2, 00:18:00, GigabitEthernet0/1
    192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C    192.168.1.0/24 is directly connected, GigabitEthernet0/0
L    192.168.1.1/32 is directly connected, GigabitEthernet0/0
```

Mumbai>

Figure 6: OSPF IP route on Mumbai Jio router

Figure 8.0 represents the traceroute from Aditya's MacBook to the Facebook server, demonstrating that the best path selection in OSPF is based on cost, and Figure 9.0 depicts that ping connectivity is proper and that the Facebook server is reachable from PC to the server.

```
Packet Tracer PC Command Line 1.0
C:\>tracert 172.16.1.3

Tracing route to 172.16.1.3 over a maximum of 30 hops:

  0  0 ms    0 ms    0 ms    192.168.1.1
  1  0 ms    0 ms    0 ms    10.1.1.2
  2  0 ms    0 ms    0 ms    10.1.4.2
  3  0 ms    0 ms    10 ms   10.1.3.2
  4  0 ms    0 ms    0 ms    10.1.6.2
  5  0 ms    0 ms    12 ms   172.16.1.3

Trace complete.
```

Figure 7: Traceroute from Aditya's MacBook to Facebook Server

```
C:\>ping 172.16.1.3

Pinging 172.16.1.3 with 32 bytes of data:

Reply from 172.16.1.3: bytes=32 time<1ms TTL=123
Reply from 172.16.1.3: bytes=32 time<1ms TTL=123
Reply from 172.16.1.3: bytes=32 time<1ms TTL=123
Reply from 172.16.1.3: bytes=32 time<1ms TTL=123

Ping statistics for 172.16.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Figure 8: ICMP ping connectivity from Aditya's MacBook to Facebook Server

## Configuration of EIGRP (Enhanced interior gateway routing protocol) on Network

### Configuration of EIGRP on Mumbai Jio router

```
Router (config) # router EIGRP 50
Router(config-router)# network 192.168.1.0 0.0.0.255
Router(config-router)# network 10.1.1.0 0.0.0.255
Router(config-router)# network 10.1.7.0 0.0.0.255
Router(config-router)# no auto-summary
```

### Configuration of EIGRP on Gujrat router

```
Router (config) # router EIGRP 50
Router(config-router)# network 10.1.2.0 0.0.0.255
Router(config-router)# network 10.1.1.0 0.0.0.255
Router(config-router)# network 10.1.4.0 0.0.0.255
Router(config-router)# no auto-summary
```

### Configuration of OSPF on Delhi router

```
Router (config) # router EIGRP 50
Router(config-router)# network 10.1.7.0 0.0.0.255
Router(config-router)# network 10.1.8.0 0.0.0.255
Router(config-router)# no auto-summary
```

### Configuration of EIGRP on Hyderabad router

```
Router (config) # router EIGRP 50
Router(config-router)# network 10.1.2.0 0.0.0.255
Router(config-router)# network 10.1.3.0 0.0.0.255
Router(config-router)# no auto-summary
```

### Configuration of EIGRP on Mumbai router

```
Router (config) # router EIGRP 50
Router(config-router)# network 10.1.4.0 0.0.0.255
Router(config-router)# network 10.1.5.0 0.0.0.255
Router(config-router)# no auto-summary
```

### Configuration of EIGRP on Kolkata router

```
Router (config) # router EIGRP 50
Router(config-router)# network 10.1.3.0 0.0.0.255
Router(config-router)# network 10.1.5.0 0.0.0.255
Router(config-router)# network 10.1.6.0 0.0.0.255
Router(config-router)# no auto-summary
```

### Configuration of EIGRP on Bangalore router

```
Router (config) # router EIGRP 50
Router(config-router)# network 172.16.1.0 0.0.0.255
```



```
Router(config-router)# network 10.1.6.0 0.0.0.255
Router(config-router)# network 10.1.8.0 0.0.0.255
Router(config-router)# no auto-summary
```

```
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to up
%DUAL-5-NBRCHANGE: IP-EIGRP 50: Neighbor 10.1.1.2 (GigabitEthernet0/1) is up: new
adjacency

Router>SHOW IP ROUTE
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

 10.0.0.0/8 is variably subnetted, 10 subnets, 2 masks
C    10.1.1.0/24 is directly connected, GigabitEthernet0/1
L    10.1.1.1/32 is directly connected, GigabitEthernet0/1
D    10.1.2.0/24 [90/3072] via 10.1.1.2, 00:00:57, GigabitEthernet0/1
D    10.1.3.0/24 [90/3328] via 10.1.1.2, 00:00:57, GigabitEthernet0/1
D    10.1.4.0/24 [90/3072] via 10.1.1.2, 00:00:57, GigabitEthernet0/1
D    10.1.5.0/24 [90/3328] via 10.1.1.2, 00:00:57, GigabitEthernet0/1
D    10.1.6.0/24 [90/3584] via 10.1.1.2, 00:00:57, GigabitEthernet0/1
C    10.1.7.0/24 is directly connected, GigabitEthernet0/2
L    10.1.7.1/32 is directly connected, GigabitEthernet0/2
D    10.1.8.0/24 [90/29184] via 10.1.1.2, 00:00:57, GigabitEthernet0/1
D    172.16.0.0/16 [90/3840] via 10.1.1.2, 00:00:57, GigabitEthernet0/1
    192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C    192.168.1.0/24 is directly connected, GigabitEthernet0/0
L    192.168.1.1/32 is directly connected, GigabitEthernet0/0

Router>
```

Figure 9: EIGRP IP route on Mumbai Jio Router

The EIGRP IP route on the Mumbai Jio Router is depicted in Figure 10, with the route connected from the Mumbai Jio router indirectly represented by D and the directly connected router represented by C. The AD value of the EIGRP Protocol is 90 which is the lowest of all.

```
Packet Tracer PC Command Line 1.0
C:\>tracert 172.16.1.3

Tracing route to 172.16.1.3 over a maximum of 30 hops:

  0  0 ms    0 ms    0 ms    192.168.1.1
  1  0 ms    0 ms    0 ms    10.1.1.2
  2  0 ms    0 ms    0 ms    10.1.4.2
  3  0 ms    0 ms    0 ms    10.1.3.2
  4  0 ms    0 ms    0 ms    10.1.6.2
  5  0 ms    0 ms    0 ms    172.16.1.3

Trace complete.
```

Figure 10: Traceroute from Aditya's MacBook to Facebook Server

```
C:\>ping 172.16.1.3

Pinging 172.16.1.3 with 32 bytes of data:

Reply from 172.16.1.3: bytes=32 time<1ms TTL=123
Reply from 172.16.1.3: bytes=32 time<1ms TTL=123
Reply from 172.16.1.3: bytes=32 time<1ms TTL=123
Reply from 172.16.1.3: bytes=32 time<1ms TTL=123

Ping statistics for 172.16.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Figure 11: ICMP ping connectivity from Aditya's MacBook from Facebook Server

## 4. RESULTS AND DISCUSSION

The first three routes from Aditya's MacBook to the Facebook server are listed below in the suggested network scenario.

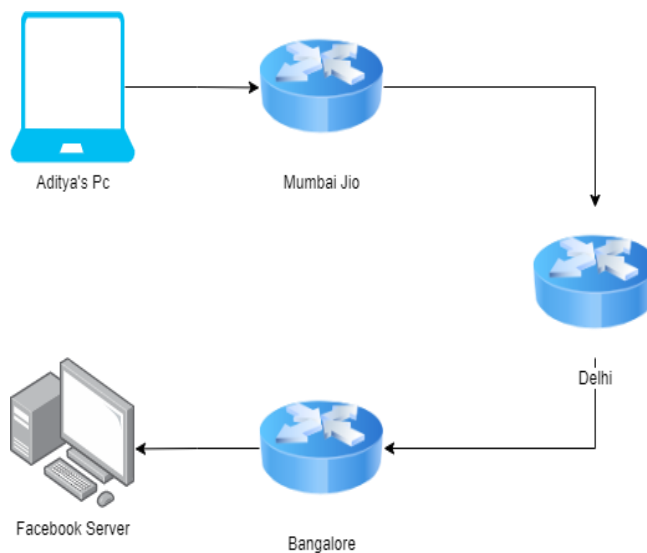


Figure 12: Route 1

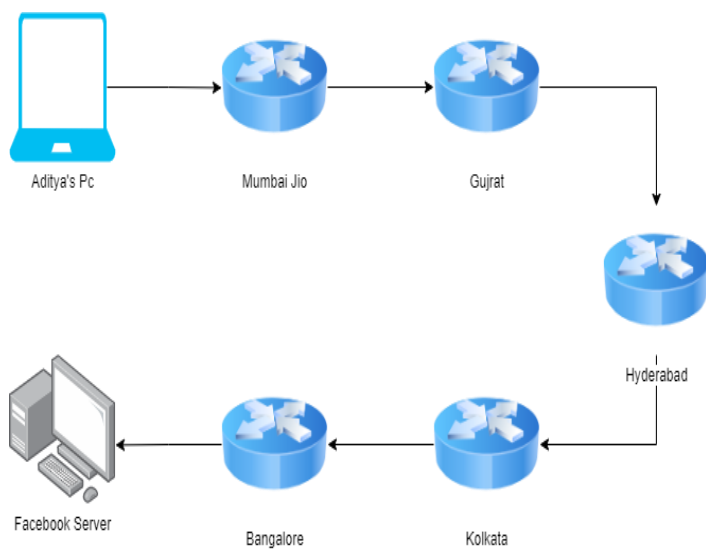


Figure 13: Route 2

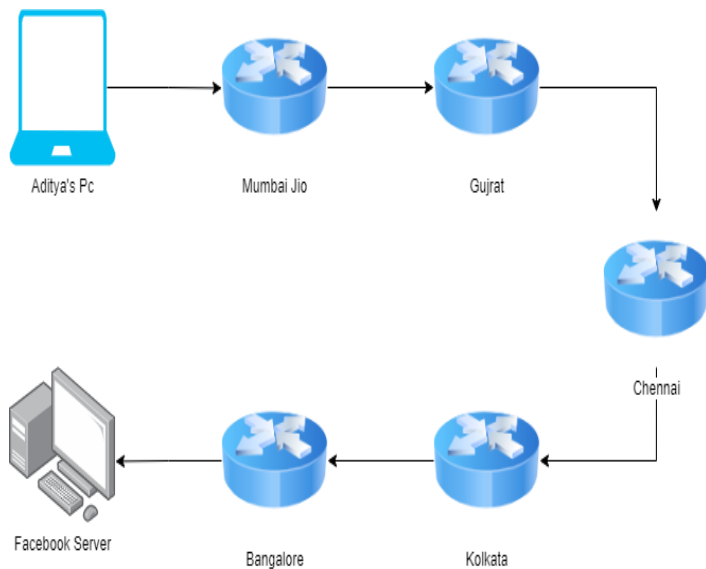


Figure 14: Route 3

## RIP

Figures 5,8 and 11 illustrate that the best path selection in the RIP routing protocol is based on HOP count, and the best path with the least number of HOPs will be the best way for the transmission of Packets. If we run the RIP Routing Protocol on a network, the best path will be.

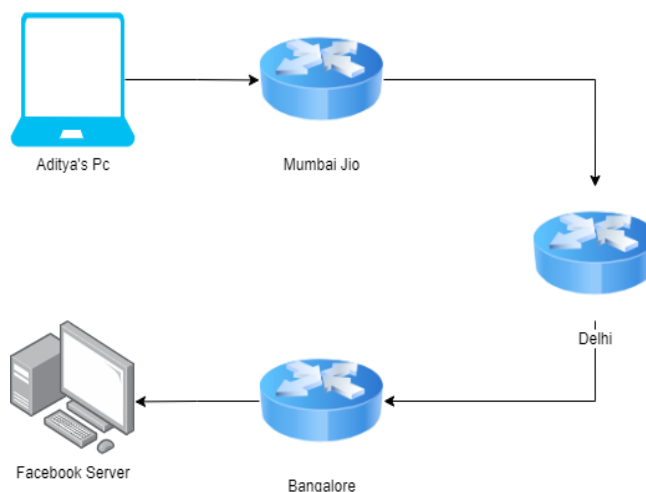


Figure 15: Best Path selection in RIP

## OSPF

In the case of OSPF, the optimum path is determined by the COST and AD values. i.e., Bandwidth, it is clear from the analysis that the best cost path will be the best path, as well as the best path in terms of Bandwidth. Because the bandwidth of the Mumbai Jio interfaces G0/0 and G0/2 is 10 Mb and the Delhi router Bandwidth is in the fast-ethernet range, the optimum path will be determined by the Bandwidth cost.

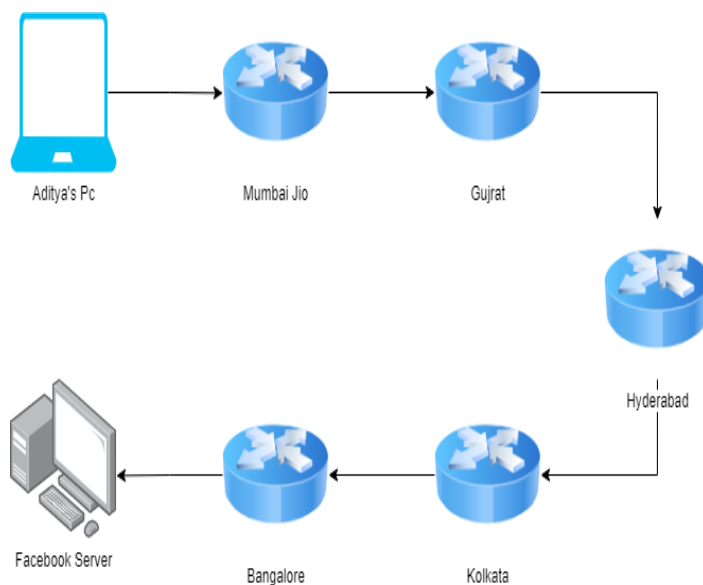


Figure 16: Best Path Selection in OSPF

## EIGRP

In EIGRP, the optimum path is chosen based on Five metrics: Bandwidth, Load, Delay, Reliability Maximum Transmission Unit (MTU), and most importantly AD value. So, on the basis of these parameters best path using EIGRP will be.

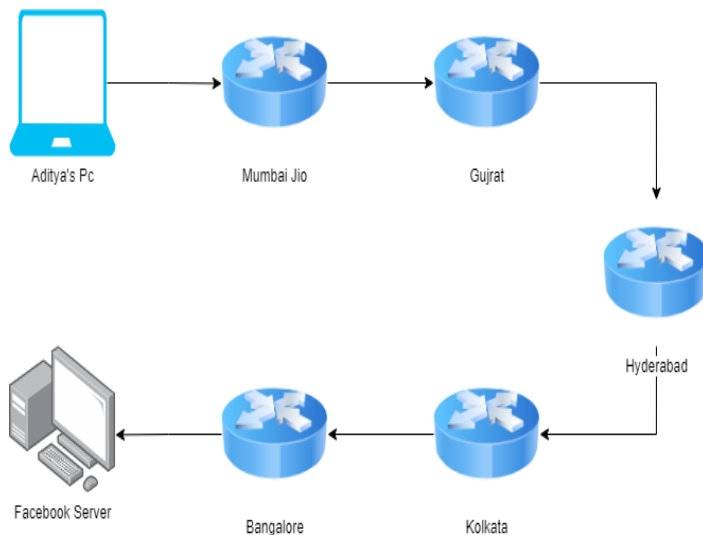


Figure 17: Best Path Selection in EIGRP

Based on the findings, it is apparent that **EIGRP** and **OSPF** routing protocol is more effective, stable, and adaptable in terms of selecting the most suitable path and maintaining a large network.

## 5. CONCLUSION

Using the Packet Tracer 8.0 simulator, we evaluated the performance of three IGP routing protocols: RIPv2, OSPF, and EIGRP. Following the analysis, it was discovered that the rip routing protocol selects the best path based on HOP count, the OSPF routing protocol selects the best path based on cost and Bandwidth, and the EIGRP routing protocol selects the best path based on five metrics: bandwidth, load, delay, reliability, and Maximum Transmission Unit (MTU). The results of the simulator reveal that EIGRP and OSPF routing protocols are superior to RIP routing protocols for small networks with less than 15 hops. Because both routing protocols communicate network, topology, and neighbour information between each router in the network, RIP is more flexible and faster to convergence than OSPF and EIGRP. However, OSPF and EIGRP outperform RIP in terms of overall performance.

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