NETWORK DESIGN AND IMPLEMENTATIONS OF STATIC AND DYNAMIC ROUTING WITH PACKET TRACING

Report submitted to the SASTRA Deemed to be University as the requirement for the course

CSE 302: COMPUTER NETWORKS

Submitted by

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Bonafide Certificate

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Examiner 1 **Examiner 2**

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We take this Opportunity to thank all our lecturers who have directly or indirectly helped our project.

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Abbreviations

BW	Bandwidth
IP	Internet Protocol
DNS	Domain Name System
EIGRP	Enhanced Interior Gateway Routing Protocol
RIP	Routing Information Protocol
CPU	Central Processing Unit
PC	Personal Computer

Abstract

Computer networks have a significant impact on the working of an organization. An efficient network is essential to facilitate the systematic transfer of information in an organization in the form of messages, files, and resources. The project provides insights into various concepts such as topology design, IP address configuration, RIP and Static Routing.

This project aims to design the topology of the network using both Static and Dynamic Routing and analyse the performances of the network by using Cisco Packet Tracer.

This network consists of the following devices:

- Router-PT
- Switch 2960-24TT
- PC-PT
- Laptop-PT
- Different Wires

The design includes the following parts of the Network:

- Blocks A, B, C, D, E. F with two computers and a laptop in each block
- The main block of routers

KEYWORDS: RIP, STATIC ROUTING, TOPOLOGY

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CHAPTER - 1

INTRODUCTION

1.1 Routing

Routing is the process of selecting a path for traffic in a network or between or across multiple networks. Broadly, routing is conducted in many types of networks, including circuit-switched networks, such as computer networks and the public switched telephone network

Routers refer to internal routing tables to make decisions about how to route packets along network paths. A routing table records the paths that packets should take to reach every destination that the router is responsible for.

1.2 Routing Protocols

Routing Protocols are the set of defined rules used by the routers to communicate between source & destination. They do not transfer the information from the source to a destination, but only update the routing table that contains the information.

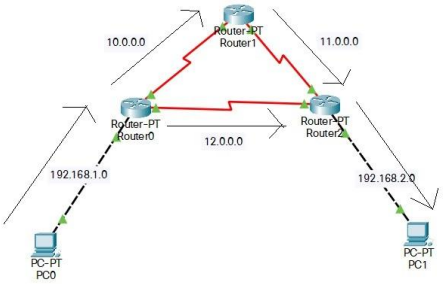


Figure 1.1– Simple network to illustrate the connection between two PC's

Network Router protocols help you to specify the way routers communicate with each other. It allows the network to select routes between any two nodes on a computer network.

1.3 Types of Routing Protocols

Although there are many types of routing protocols, three major classes are in widespread use on IP networks

1. Static
2. Dynamic
3. Default

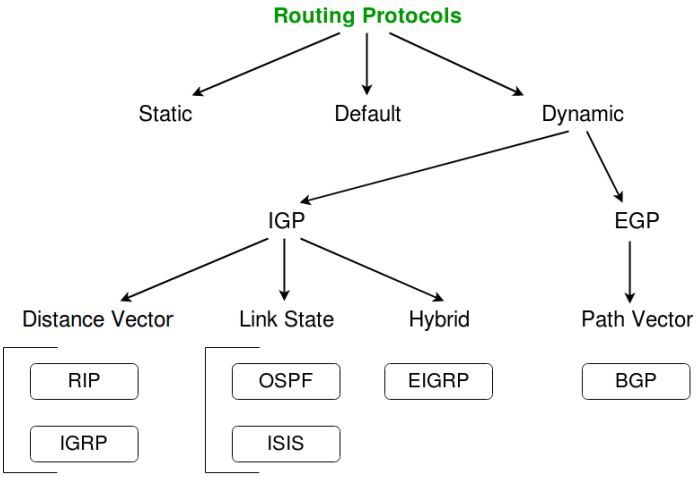


Figure 1.3– Flow Chart of Routing Protocols

1.4 Static Routing

Static routing is a type of network routing technique. Static routing is not a routing protocol; instead, it is the manual configuration and selection of a network route, usually managed by the network administrator. It is employed in scenarios where the network parameters and environment are expected to remain constant.

Static routing is only optimal in a few situations. Network degradation, latency and congestion are inevitable consequences of the non-flexible nature of static routing because there is no adjustment when the primary route is unavailable.

Advantages

- No overhead on router CPU.
- No unused bandwidth between links.
- Only the administrator can add routes

Disadvantages

- In large networks, configuring and adding a static route to the routing table is very difficult.
- Not an ideal option for large networks as it is time-intensive.

1.4.1Floating static route

A floating static route is a backup route to any static route or a dynamically learned route. This route is used only when the primary route fails or is unavailable.

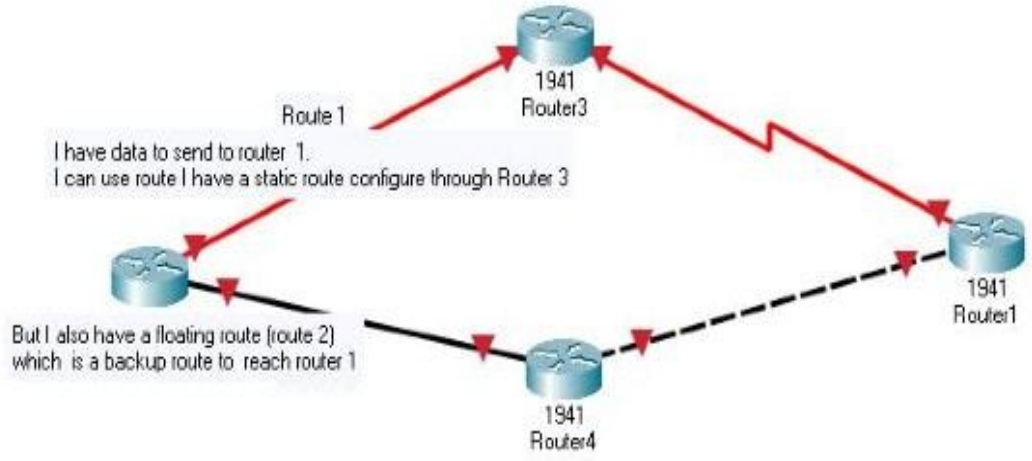


Figure 1.4– Illustration of Floating Static Route

1.5 Dynamic Routing

Dynamic routing is a networking technique that provides optimal data routing. Unlike static routing, dynamic routing enables routers to select route on basis of the real-time network changes. In dynamic routing, protocol operating on the routers is responsible for updating of the routing table. In static routing,everything is done manually by the system administrator or admin.
Dynamic routing is mainly classified into two different protocols Interior gateway protocol and Exterior Gateway Protocol

Dynamic routing uses multiple algorithms and protocols. Out of which two are Routing Information Protocol and Open Shortest Path First .

Advantages

- Easier to configure even on larger networks. It is widely used in a large network where many routers are being used.
- Knowledge on the network topology is not needed

Disadvantages

- Routing protocols puts an additional load on the router CPU or RAM.
- Table updates are shared between each routers, so it consumes large bandwidth.

1.5.1 Open Shortest Path First

Open Shortest Path First, commonly used in enterprise networks, uses shortest path first (SPF) technology to find and efficiently distribute routing information between routers on a local area network (LAN). OSPF routers are within the same network and will know about all the routers in that area. Those belonging to the same area will be able to pass along the information they've learned to adjacent routers, which are called neighbours.

An OSPF system will be able to calculate the shortest path to nearest destination or router by using Dijkstra's algorithm. This algorithm is used to find the shortest path between the source and the destination router.

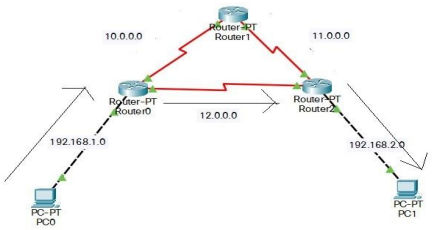


Figure 1.5– Illustration of OSPF

1.6 Routing Information Protocol

Routing Information Protocol is a dynamic routing that uses hop count as a metric to find the shortest path between the source and the destination network.

Hop Count:

Hop count is the number of routers ensuing in between the origin and destination network. The route with the lowest hop count is viewed as the best route to reach a network and accordingly placed in the routing table. RIP precludes routing loops by restricting the number of hops in a path from source and destination. The maximum hop count permitted for RIP is 15.

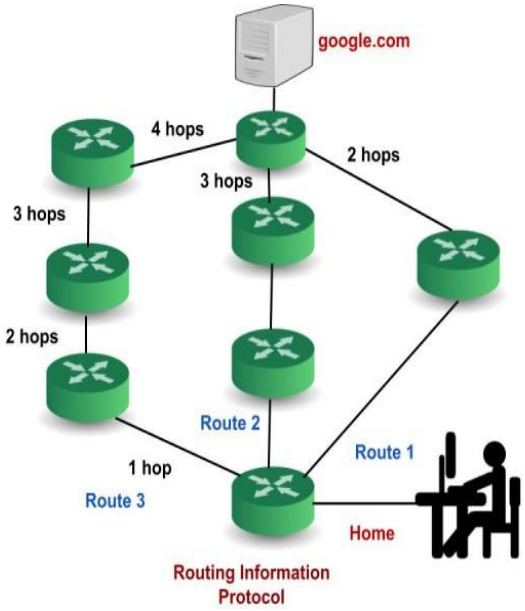


Figure 1.6– RIP and Hop Count

CHAPTER - 2

NETWORK DESIGN

2.1 Cisco Packet Tracer Interface

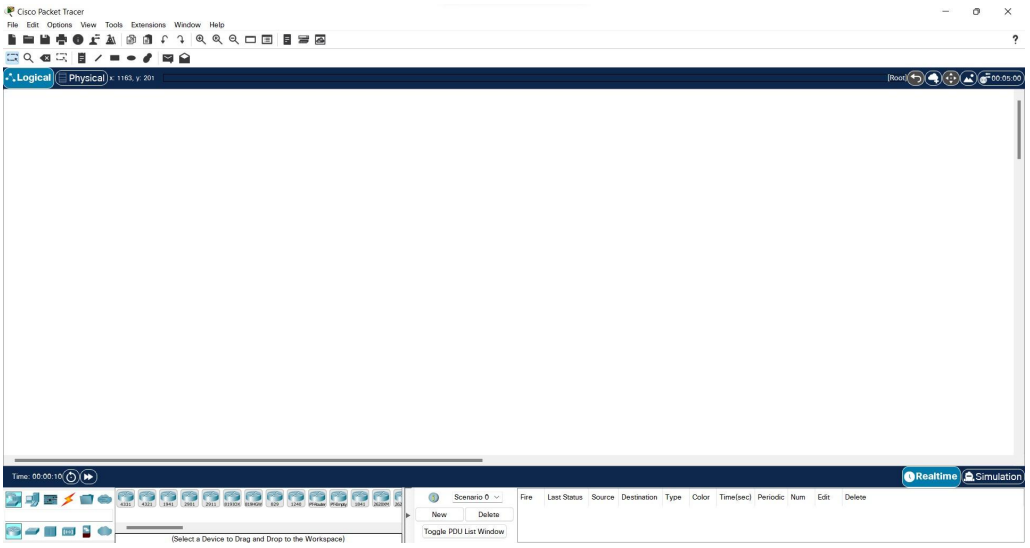


Figure 2.1– Cisco Packet Tracer Interface

Cisco Packet Tracer is free to use software where we can trace messages sent from one PC to another PC and trace back message delivery signals.

2.2 Project Design

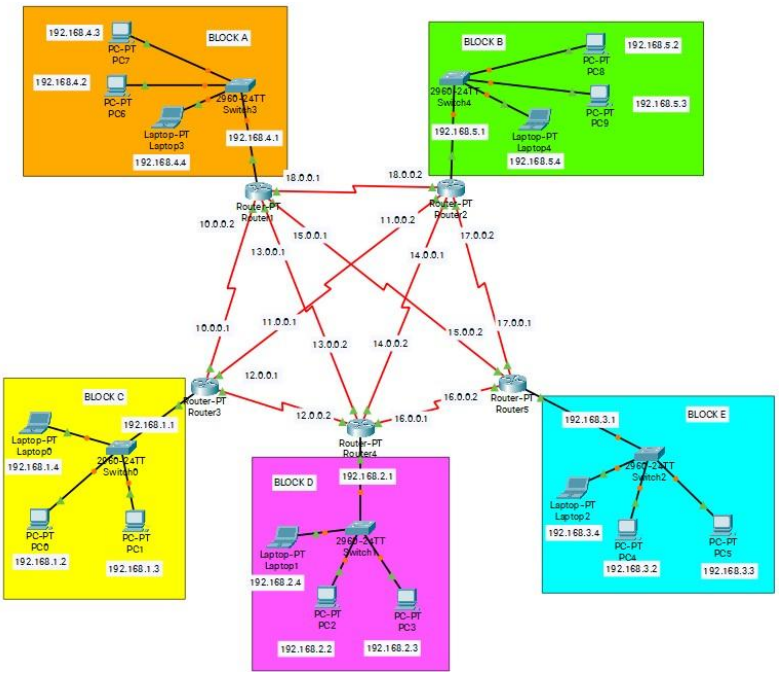


Figure 2.2 – Project Design

CHAPTER - 3

IP Configuration

Configuring all Ip's to their respective devices

3.1 Device: PC

IP: 192.168.x.y
Subnet Mask: 255.255.255.0
DNS: 192.168.x.1

Where "x" is the network and it is the same for the same block of PC's
and "y" is the host and greater than 1 and it's unique for the same set of computers in the block.

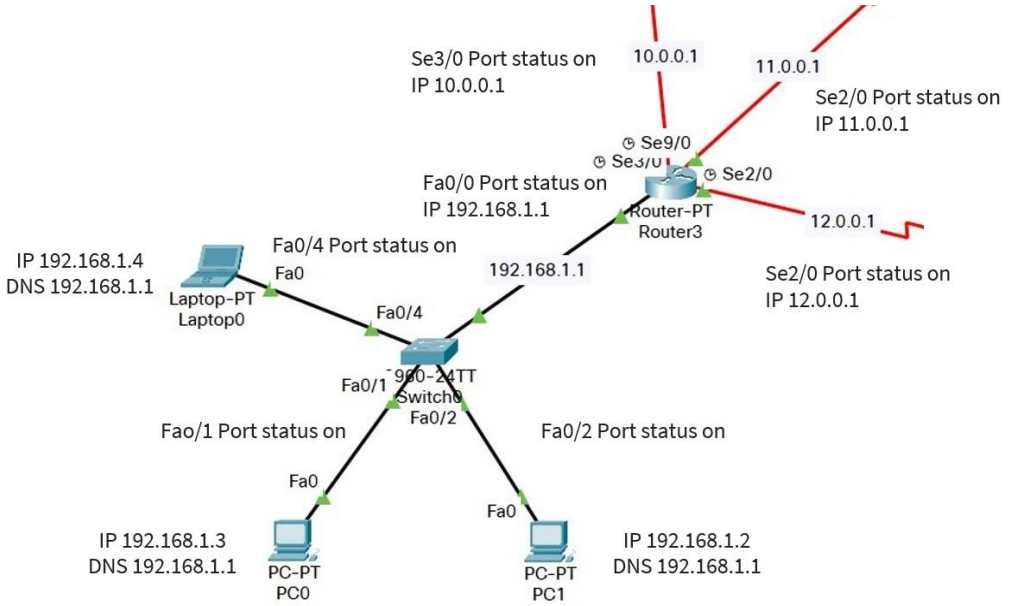


Figure 3.2– IP Configuration

3.2 Device: Router

Port status on for all fast ethernet and serial ports which is connected to the router, give respective ipv4 address to all ports

Fast Ethernet IPv4: 192.168.x.1
Serial IPv4: z.0.0.(1 or 2 respectively)
Where "z" is greater than 9
And "x" is the same used in PC and laptop

CHAPTER - 4

ROUTING INFORMATION PROTOCOL

Add all Network Addresses connected to the respective router and also add, block network addresses.

Example: 192.168.x.0 and z.0.0.0
Enhanced Interior Gateway Routing Protocol (EIGRP)
Network Performance can be calculated by using Bandwidth(BW) and Delay
It can be calculated by using,

EIGRP Metric = 256*[10^7/BW(min)] + [Sum of Delay]/10

Where BW is Bandwidth.

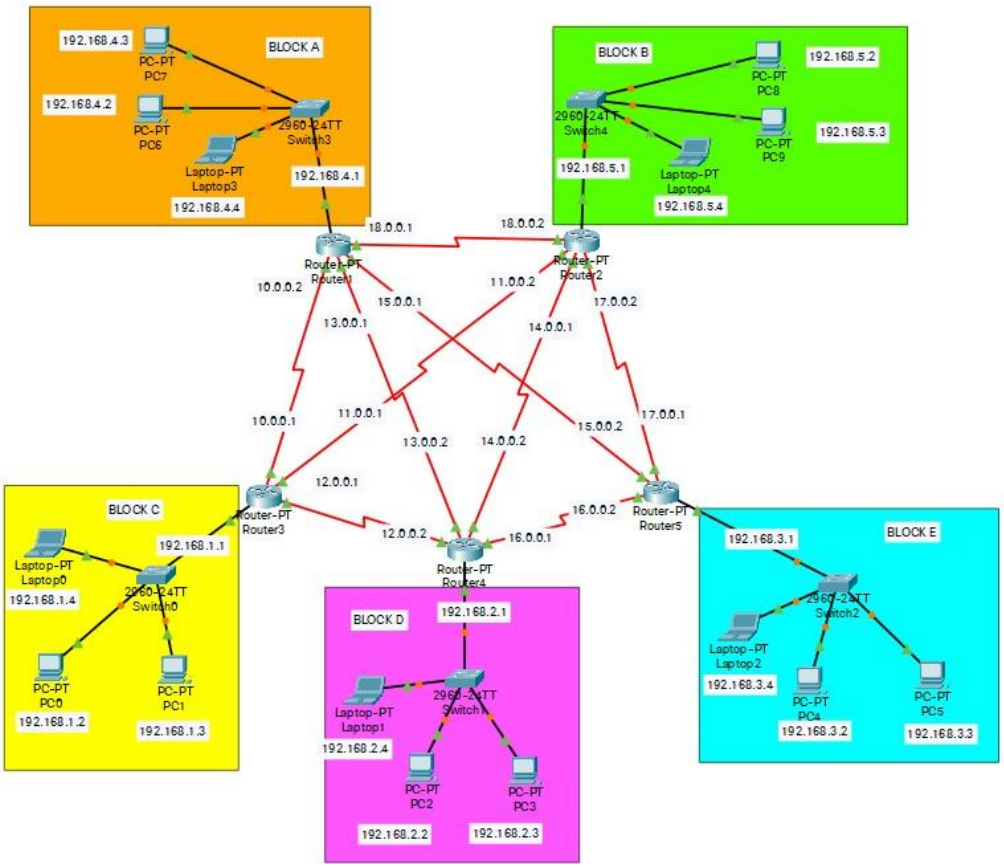


Figure 4– Network

Delay

Delay guides to the time-taken to send data from source to destination, this includes the time taken by a router to process and send a datagram to the receiving interface.

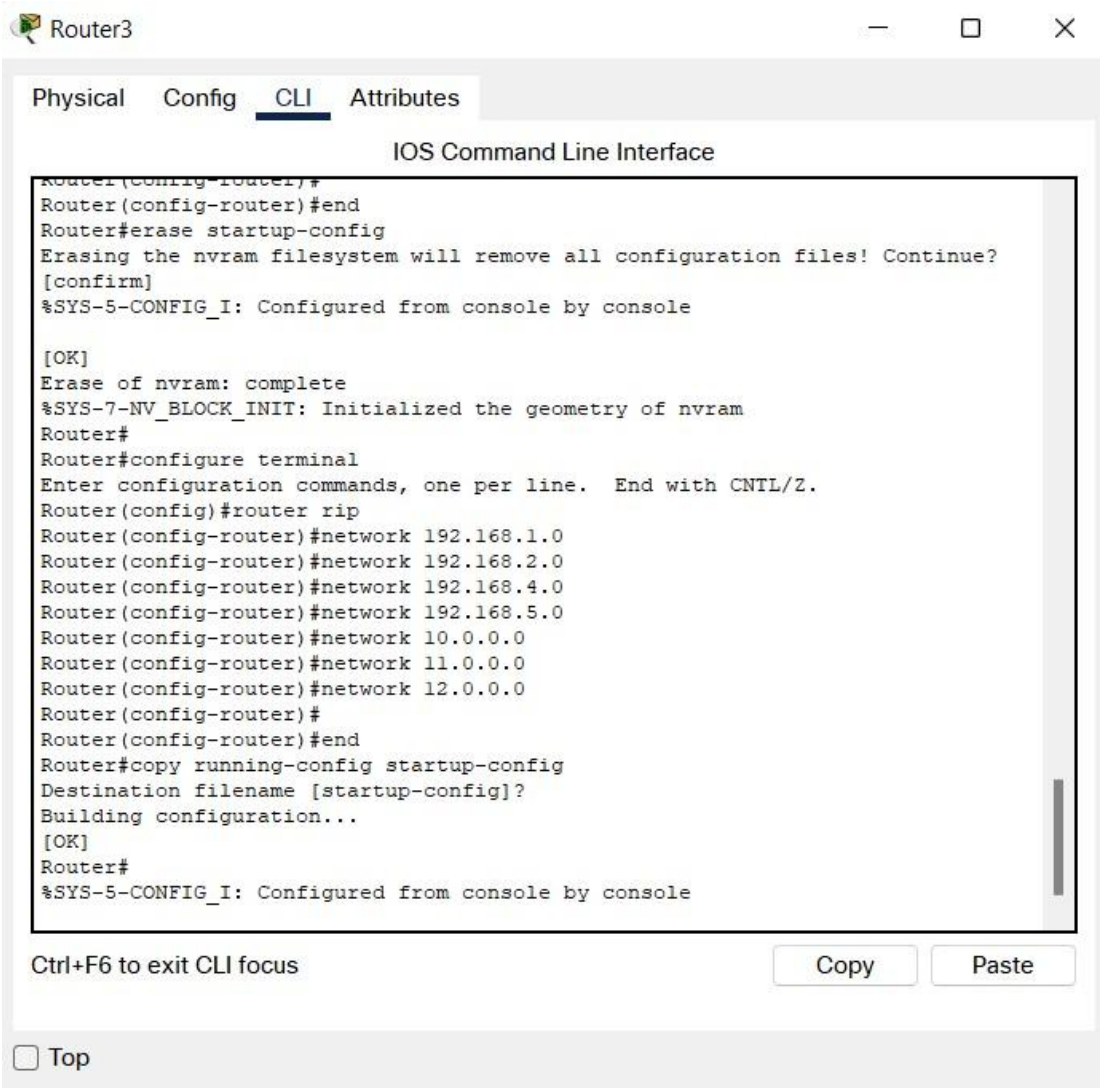
Bandwidth

Bandwidth is defined by the number of bits that a link between two devices can send per second.

4.1 Adding Network addresses to router specific

Example of Router 3 in Network

ROUTER 3 CLI



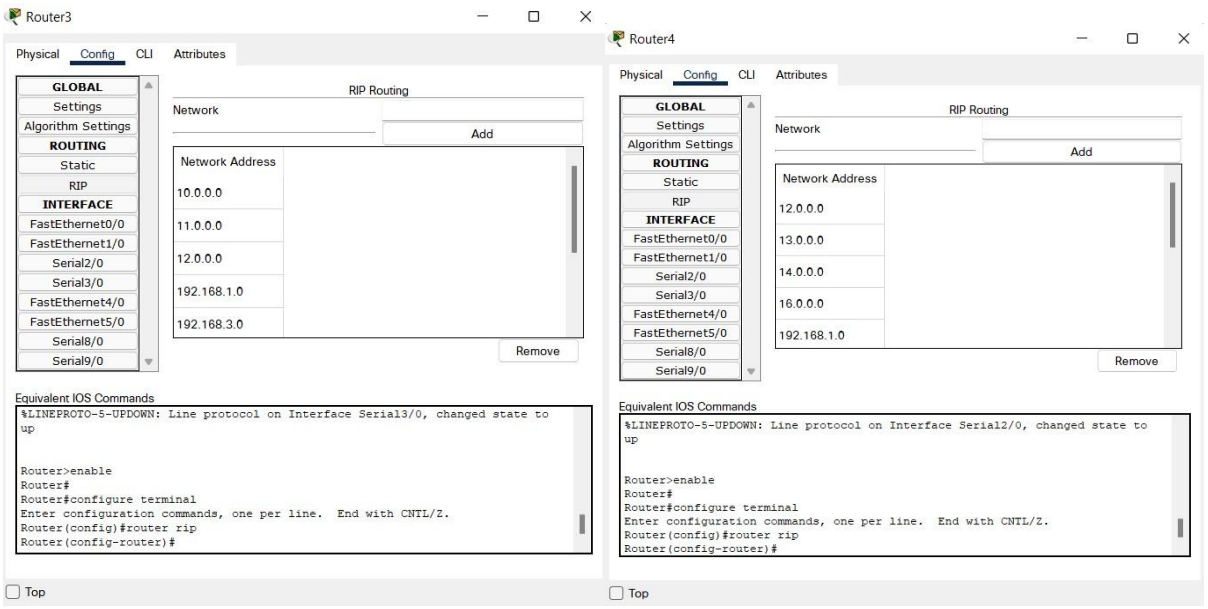


Figure 4.1– RIP adding Network Addresses

4.2 RIP Result

Router3

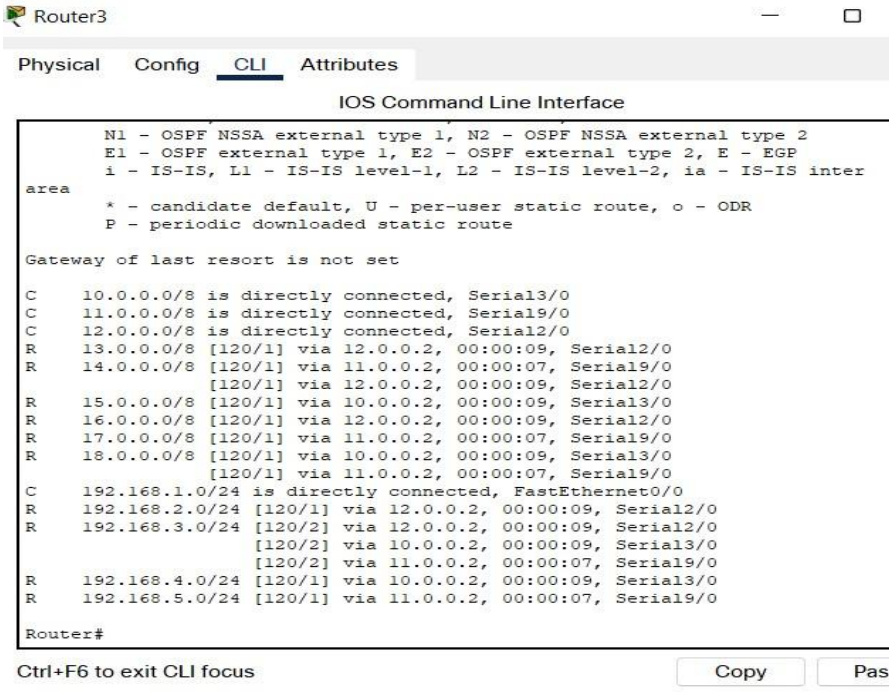


Figure 4.2– Checking Routes

To access Router2 from Router3 as shown from the above figure message will go via route 11.0.0.2

To access Router5 from Router3 as shown from the above figure message will go via route 11.0.0.2

Test Case 1

To send a message from PC0 to PC8 below calculations are considered

Path Metric from Router3-(Router1)-Router2

Bandwidth and Delay from switch0 to Router3

BW = 100,000 Kbit

DLY = 100 usec

Bandwidth and Delay from Router3 to Router1

BW = 128 Kbit

DLY = 2000 usec

Bandwidth and Delay from Router1 to Router2

BW = 128 Kbit

DLY = 2000 usec

Bandwidth and Delay from Router2 to switch4

BW = 100,000 Kbit

DLY = 100 usec

So, from the EIGRP Metric formula

EIGRP Metric = 256*[10^7/BW(min)] + [Sum of Delay]/10

= 256*[10^7/128] + [100+2000+2000+100]/10

EIGRP Metric = 710.353 Metric

Path Metric from Router3-Router2

Bandwidth and Delay from switch0 to Router3

BW = 100,000 Kbit

DLY = 100 usec

Bandwidth and Delay from Router3 to Router2

BW = 128 Kbit

DLY = 2000 usec

Bandwidth and Delay from Router2 to switch4

BW = 100,000 Kbit

DLY = 100 usec

So, from the EIGRP Metric formula

EIGRP Metric = 256*[10^7/BW(min)] + [Sum of Delay]/10

= 256*[10^7/128] + [100+2000+100]/10

EIGRP Metric = 510.353 Metric

Path Metric from Router3-(Router4-Router5)-Router2

Bandwidth and Delay from switch0 to Router3

BW = 100,000 Kbit
DLY = 100 usec

Bandwidth and Delay from Router3 to Router4
BW = 128 Kbit
DLY = 2000 usec

Bandwidth and Delay from Router4 to Router5
BW = 128 Kbit
DLY = 2000 usec

Bandwidth and Delay from Router5 to Router2
BW = 128 Kbit
DLY = 2000 usec

Bandwidth and Delay from Router2 to switch4
BW = 100,000 Kbit
DLY = 100 usec

So, from the EIGRP Metric formula
EIGRP Metric = 256*[10^7/BW(min)] + [Sum of Delay]/10
= 256*[10^7/128] + [100+2000+2000+2000+100]/10
EIGRP Metric = 910.353 Metric

So, the EIGRP Metric value is low for Path Router3-Router2 so a message is sent through this route.

Test Case 2

To send a message from PC0 to PC6 below calculations are considered
Path Metric from Router3-Router4-Router1
Bandwidth and Delay from switch0 to Router3
BW = 100,000 Kbit
DLY = 100 usec

Bandwidth and Delay from Router3 to Router4
BW = 128 Kbit
DLY = 2000 usec

Bandwidth and Delay from Router4 to Router1
BW = 128 Kbit
DLY = 2000 usec

Bandwidth and Delay from Router1 to switch3

BW = 100,000 Kbit
DLY = 100 usec

So, from the EIGRP Metric formula

EIGRP Metric = 256*[10^7/BW(min)] + [Sum of Delay]/10
= 256*[10^7/128] + [100+2000+2000+100]/10
EIGRP Metric = 710.353 Metric
Path Metric from Router3-Router1
Bandwidth and Delay from switch0 to Router3
BW = 100,000 Kbit
DLY = 100 usec

Bandwidth and Delay from Router3 to Router1
BW = 128 Kbit
DLY = 2000 usec

Bandwidth and Delay from Router1 to switch3
BW = 100,000 Kbit
DLY = 100 usec

So, from the EIGRP Metric formula

EIGRP Metric = 256*[10^7/BW(min)] + [Sum of Delay]/10
= 256*[10^7/128] + [100+2000+100]/10
EIGRP Metric = 510.353 Metric

So, the EIGRP Metric value is low for Path Router3-Router1 so a message is sent through this route.

From Both Test cases, a Message is sent where the Metric value is considerably low compared to all routes.

CHAPTER - 5

STATIC ROUTING

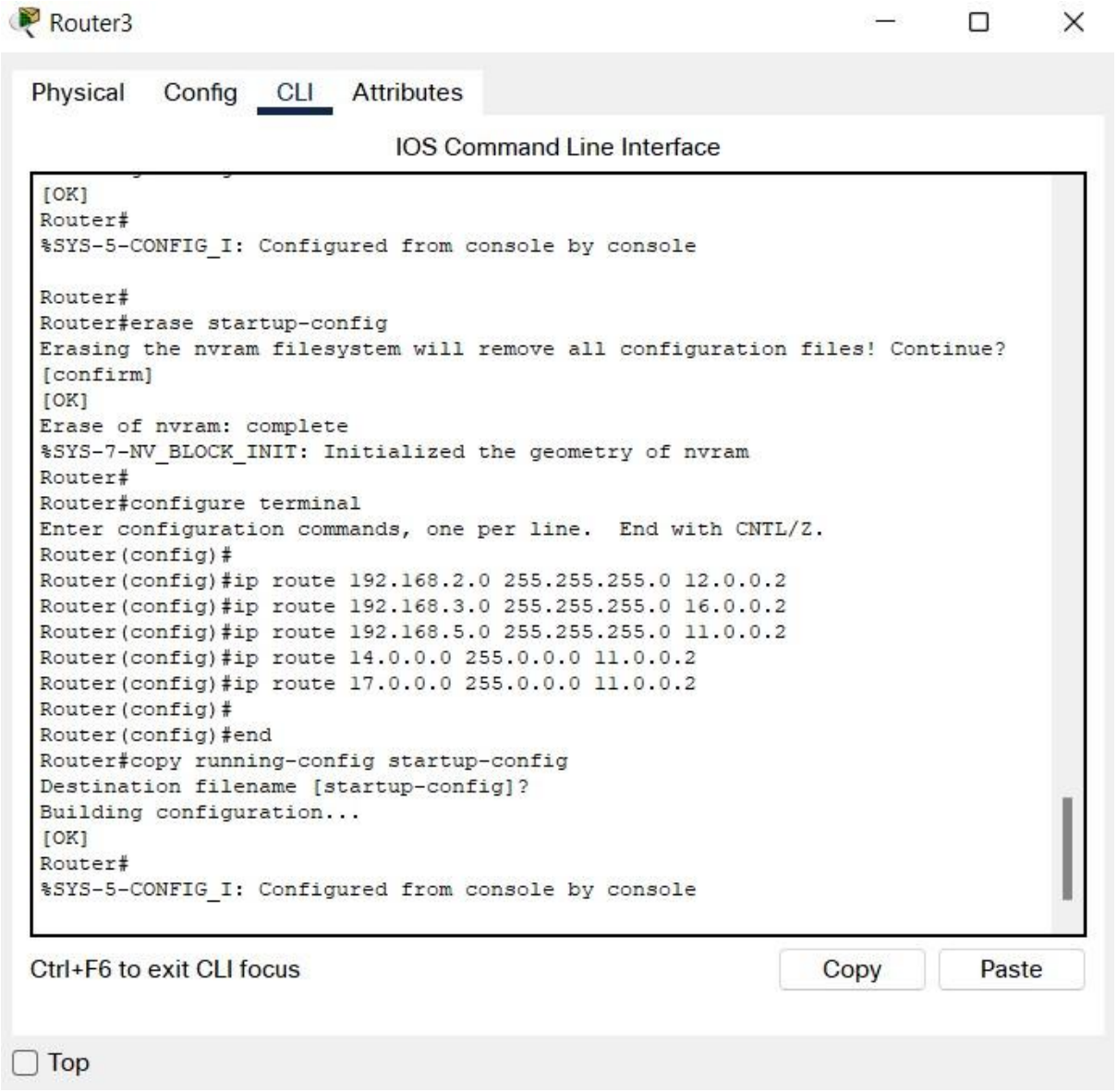
Adding network address it's mask and next-hop details

Example: 192.168.x.0, 255.255.255.0 and z.0.0.(1 or 2)
z.0.0.(1 or 2), 255.0.0.0 and next-hop

5.1 Adding Static Routes to Router Specific

CLI:

Example of Router 3 in Network



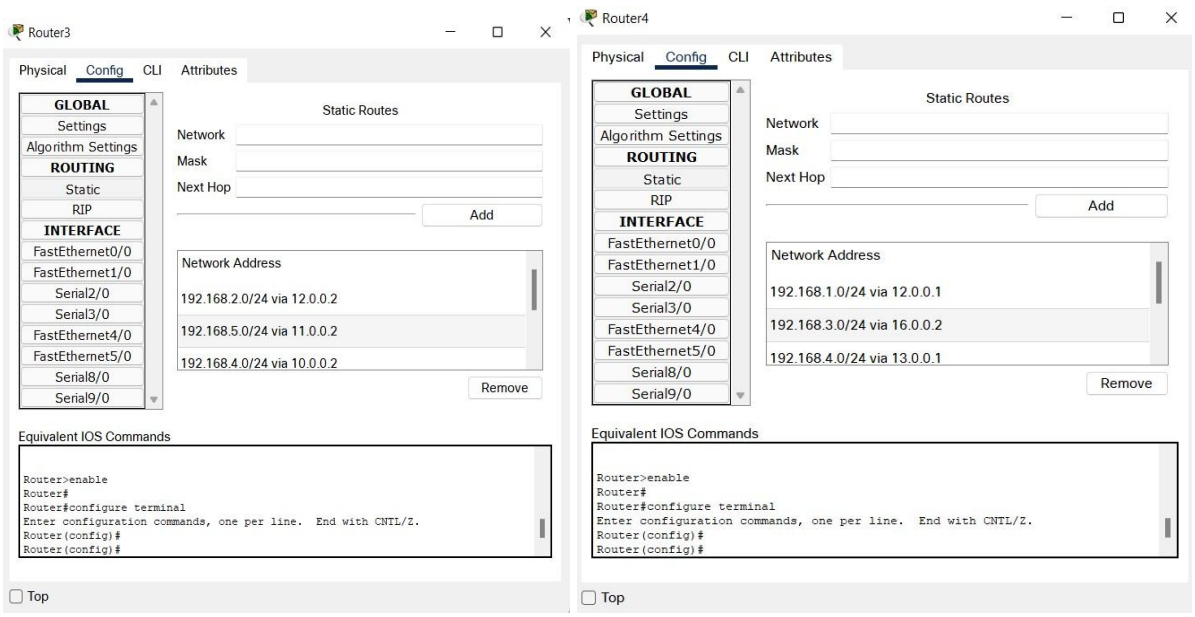


Figure 5.1– Adding Network Static Routes

CHAPTER - 6

COMPARING DYNAMIC AND STATIC ROUTING

DYNAMIC	STATIC ROUTING
Paths are updated automatically to the Hop count	Paths are defined by admin.
It uses EIGRP to calculate routing operation	It does not use any protocol.
Less secure	Highly secure
It uses complex routing algorithms.	It does not use any complex routing algorithms.
Applying to a large network is difficult	Can be Applied to Any Large Networks

CHAPTER - 7

CONCLUSION

Based on the results obtained, we can conclude by saying how Dynamic routing, RIP uses EIGRP and update their routing table according to that route and comparing to that Static routing does not use any other protocol but it is harder to implement in a large network.

We have also discussed about EIGRP metric calculation and comparing each another possibility that a packet can send and calculating the lowest value and verifying in the cisco packet tracer

Here we have implemented both static and dynamic routing in the same network design separately and packet traced with cisco packet tracer.

CHAPTER - 8

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[2] Sharmin, Mohammad & Hossain, Anwar Md.,2019. Analysis and Comparative Study for Developing Computer Network in Terms of Routing Protocols Having IPv6 Network Using Cisco Packet Tracer. 7. 16-29. 10.11648/j.se.20190702.11.

[3] The plans for this project is implementing rip and static protocols wherever needed in a full-scale network which is compatible with wireless devices

[4] Static Routing - Video By Sikandar Shaik || Dual CCIE (RS/SP) # 35012

https://youtu.be/IVMkDs3U7fs