Static Routing Configuration and Implementation in Cisco Packet Tracer

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Designation: Cloud and Network Security Engineer
Purpose: This project is self-initiated and built to master the core concepts of computer networking, routing mechanisms, and practical implementation using Cisco Packet Tracer.
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1. Introduction to Static Routing

Static routing is a routing technique where network routes are manually configured by the network administrator. Unlike dynamic routing protocols, static routes do not change unless manually modified. They are commonly used in small networks or in scenarios where a fixed, predictable routing path is required.

Static routing provides full control over the traffic path, improves security, and reduces overhead since no routing advertisements are exchanged. However, it requires manual updates, making it less scalable for complex networks.

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2. Objective of the Project

The objective of this project is to: Design a multi-router network in Cisco Packet Tracer . Assign IP addresses and configure interfaces . Implement static routing on all routers Achieve full end-to-end connectivity between end devices .Understand the importance of routing tables and next-hop IP configuration

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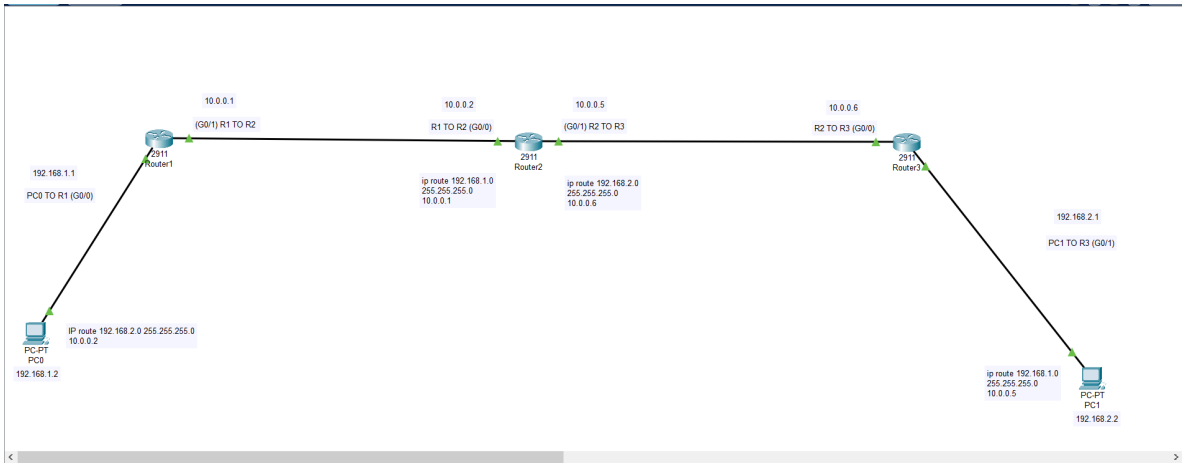
3. Network Topology Overview

This network consists of three routers connected in series with one PC on each end.



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4. IP Addressing Scheme

Device	Interface	IP Address	Subnet Mask	Description
PC0	NIC	192.168.1.2	255.255.255.0	Connected to Router1
Router1	G0/0	192.168.1.1	255.255.255.0	LAN Interface
Router1	G0/1	10.0.0.1	255.255.255.252	Link to Router2
Router2	G0/0	10.0.0.2	255.255.255.252	Link to Router1
Router2	G0/1	10.0.0.5	255.255.255.252	Link to Router3
Router3	G0/0	10.0.0.6	255.255.255.252	Link to Router2
Router3	G0/1	192.168.2.1	255.255.255.0	LAN Interface
PC1	NIC	192.168.2.2	255.255.255.0	Connected to Router3

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5. Devices and Interfaces Used

- **Router Model:** Cisco 2911 (x3)
- **End Devices:** PC (x2)
- **Connection Type:** Copper Straight-Through
- **Routing Method:** Static Routing

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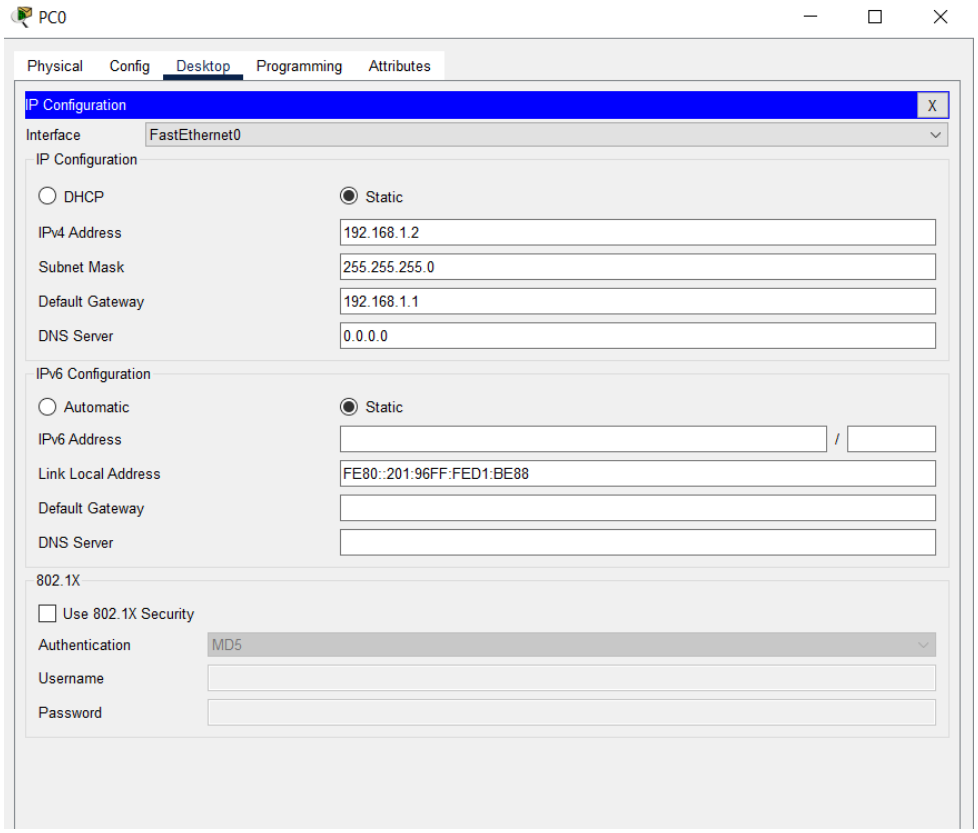
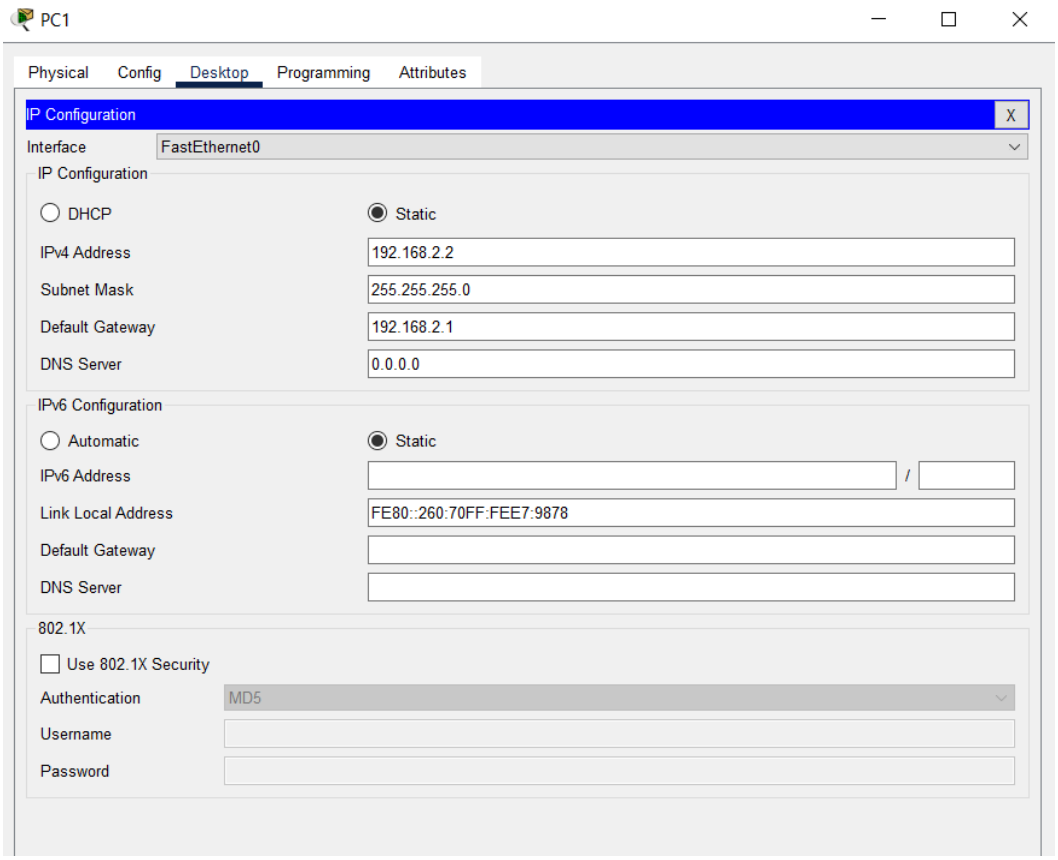
6. Step-by-Step Configuration Guide

6.1 Configuring PC IP Settings

- **PC0 IP: 192.168.1.2 / Gateway: 192.168.1.1**
- **PC1 IP: 192.168.2.2 / Gateway: 192.168.2.1**


PC0
Physical
Config
Desktop
Programming
Attributes
IP Configuration
X
Interface
FastEthernet0
IP Configuration
DHCP
Static
IPv4 Address
192.168.1.2
Subnet Mask
255.255.255.0
Default Gateway
192.168.1.1
DNS Server
0.0.0.0
IPv6 Configuration
Automatic
Static
IPv6 Address
/
Link Local Address
FE80::201:96FF:FED1:BE88
Default Gateway
DNS Server
802.1X
Use 802.1X Security
Authentication
MD5
Username
Password



6.2 Router Interface Configuration

Router1 Commands:

```
conf t
interface g0/0
ip address 192.168.1.1 255.255.255.0
no shutdown
!
interface g0/1
ip address 10.0.0.1 255.255.255.252
no shutdown
exit
```

```
Router>
Router>en
Router#config
Configuring from terminal, memory, or network [terminal]? term
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface g0/0
Router(config-if)#ip address 192.168.1.1 255.255.255.0
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to up

Router(config-if)#exit
Router(config)#interface g0/1
Router(config-if)#ip address 10.0.0.1 255.255.255.252
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to up

Router(config-if)#exit
Router(config)#ip route 192.168.2.0 255.255.255.0 10.0.0.2
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up

Router#exit
```

Router2 Commands:

```
conf t
interface g0/0
ip address 10.0.0.2 255.255.255.252
no shutdown
!
interface g0/1
ip address 10.0.0.5 255.255.255.252
no shutdown
exit
```

```
Router>en
Router#config
Configuring from terminal, memory, or network [terminal]? term
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface g0/0
Router(config-if)#ip address 10.0.0.2 255.255.255.252
Router(config-if)#no shutdwon
                   ^
% Invalid input detected at '^' marker.

Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to up

Router(config-if)#exit
Router(config)#interface g0/1
Router(config-if)#ip address 10.0.0.5 255.255.255.252
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to up

Router(config-if)#exit
Router(config)#ip route 192.168.1.0 255.255.255.0 10.0.0.1
Router(config)#ip route 192.168.2.0 255.255.255.0 10.0.0.6
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up

Router#exit
```

Router3 Commands:

```
conf t
interface g0/0
ip address 10.0.0.6 255.255.255.252
no shutdown
!
interface g0/1
ip address 192.168.2.1 255.255.255.0
no shutdown
exit
```

```
Router>en
Router#config
Configuring from terminal, memory, or network [terminal]? term
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface g0/0
Router(config-if)#ip address 10.0.0.6 255.255.255.252
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to up

Router(config-if)#exit
Router(config)#interface g0/1
Router(config-if)#ip address 192.168.2.1 255.255.255.0
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up

Router(config-if)#exit
Router(config)#ip route 192.168.1.0 255.255.255.0 10.0.0.5
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#
Router#exit
```

6.3 Static Route Configuration

Router1:

```
ip route 192.168.2.0 255.255.255.0 10.0.0.2
```

Router2:

```
ip route 192.168.1.0 255.255.255.0 10.0.0.1
ip route 192.168.2.0 255.255.255.0 10.0.0.6
```

Router3:

```
ip route 192.168.1.0 255.255.255.0 10.0.0.5
```

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7. Routing Table Verification

To verify static routes:

```
show ip route
```

ROUTER 1:

```
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, 2 subnets, 2 masks
C       10.0.0.0/30 is directly connected, GigabitEthernet0/1
L       10.0.0.1/32 is directly connected, 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
S    192.168.2.0/24 [1/0] via 10.0.0.2
```

ROUTER 2:

```
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, 4 subnets, 2 masks
C       10.0.0.0/30 is directly connected, GigabitEthernet0/0
L       10.0.0.2/32 is directly connected, GigabitEthernet0/0
C       10.0.0.4/30 is directly connected, GigabitEthernet0/1
L       10.0.0.5/32 is directly connected, GigabitEthernet0/1
S    192.168.1.0/24 [1/0] via 10.0.0.1
S    192.168.2.0/24 [1/0] via 10.0.0.6
```

ROUTER 3:

```
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, 2 subnets, 2 masks
C       10.0.0.4/30 is directly connected, GigabitEthernet0/0
L       10.0.0.6/32 is directly connected, GigabitEthernet0/0
S    192.168.1.0/24 [1/0] via 10.0.0.5
     192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.2.0/24 is directly connected, GigabitEthernet0/1
L       192.168.2.1/32 is directly connected, GigabitEthernet0/1
```

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8. Connectivity Testing (Ping Results)

Test end-to-end communication from PC0 to PC1 and vice versa using the ping command.

PC 0 To PC 1 (ping):

```
C:\>ping 192.168.2.2

Pinging 192.168.2.2 with 32 bytes of data:

Reply from 192.168.2.2: bytes=32 time<1ms TTL=125
Reply from 192.168.2.2: bytes=32 time<1ms TTL=125
Reply from 192.168.2.2: bytes=32 time<1ms TTL=125
Reply from 192.168.2.2: bytes=32 time<1ms TTL=125

Ping statistics for 192.168.2.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

PC 1 To PC 0 (ping):

```
C:\>ping 192.168.1.2

Pinging 192.168.1.2 with 32 bytes of data:

Reply from 192.168.1.2: bytes=32 time<1ms TTL=125
Reply from 192.168.1.2: bytes=32 time<1ms TTL=125
Reply from 192.168.1.2: bytes=32 time=1ms TTL=125
Reply from 192.168.1.2: bytes=32 time<1ms TTL=125

Ping statistics for 192.168.1.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

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9. Troubleshooting and Observations

- Initially, ping failed due to the missing **default gateway** on PCs.
- After configuring default gateway and static routes correctly, full connectivity was achieved.

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10. Conclusion and Key Learnings

This lab provided hands-on experience with static routing and deepened understanding of IP addressing, routing tables, and packet forwarding. It reinforced critical skills necessary for network engineering and enterprise network design.

Key Takeaways: Static routing gives full control over routing paths. Proper gateway configuration is essential for communication. Routing tables determine the path taken by packets.
