AICTE - CISCO VIRTUAL INTERNSHIP

PROJECT REPORT - 2024

Sri Eshwar
College of Engineering
An Autonomous Institution
Affiliated to Anna University, Chennai

NETPATH ILLUMINATOR

Submitted by

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COMPUTER NETWORKS

Department of Electronics and Communication Engineering

SRI ESHWAR COLLEGE OF ENGINEERING

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Coimbatore - 641 202

LEVEL 1:

- Here we use ping command to test the reachability from a source device to destination device.

- Here the 2 PC's are connected in a same network with ip address 10.1.1.1 for PC0 and 10.1.1.2 for PC1. Each PC has its own Mac address. After the first ping on 10.1.1.1 ARP request and reply is performed.

- ARP(Address Resolution Protocol) is used to map an Ip address to a Mac address(a unique address of hardware interface)

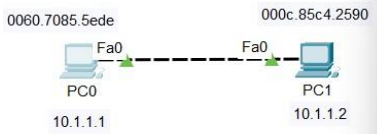
- PC0 sends data to PC1 .It knows IP address but not Mac address.

- PC0 sends an ARP Request to all devices on the network. This is called broadcasting asking "who has Ip address

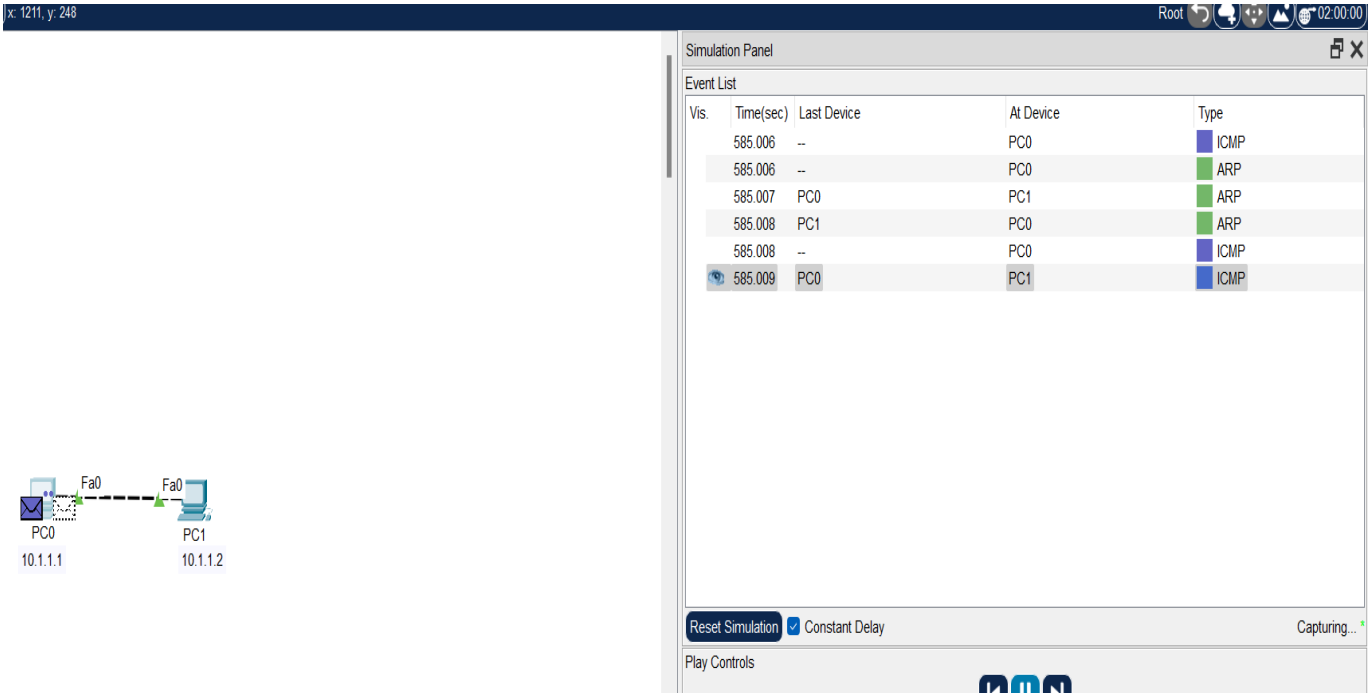
10.1.1.2? Tell 10.1.1.1".

- PC1 receives the ARP request and responds directly to PC0 with an ARP Reply. This reply includes PC1's Mac address.

- The command arp –a is used to display Mac address of the devices on the network/ARP cache, arp –d is used to delete the entries from the ARP cache.




```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 10.1.1.2

Pinging 10.1.1.2 with 32 bytes of data:

Reply from 10.1.1.2: bytes=32 time=2ms TTL=128
Reply from 10.1.1.2: bytes=32 time<1ms TTL=128
Reply from 10.1.1.2: bytes=32 time=21ms TTL=128
Reply from 10.1.1.2: bytes=32 time=1ms TTL=128

Ping statistics for 10.1.1.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 21ms, Average = 6ms

C:\>arp -a
  Internet Address      Physical Address      Type
  10.1.1.2              000c.85c4.2590        dynamic

C:\>arp -d
C:\>arp -a
No ARP Entries Found
C:\>
```

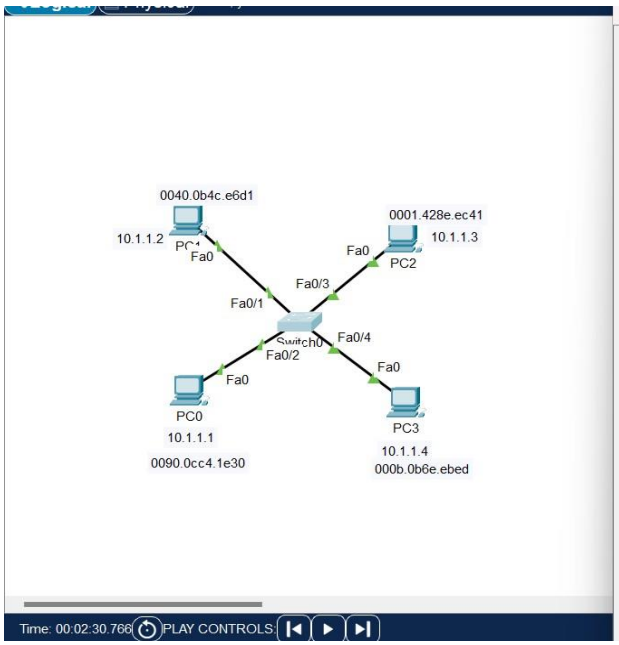


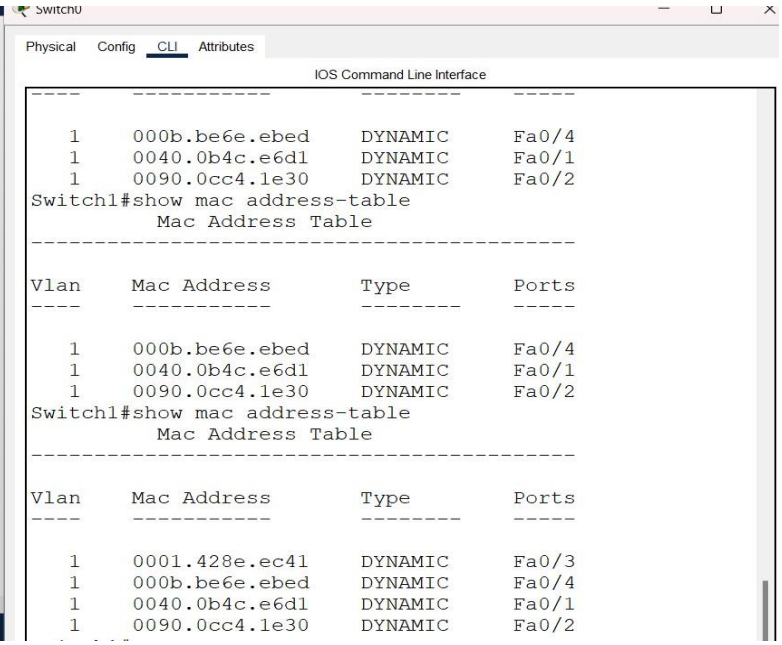
LEVEL 2:

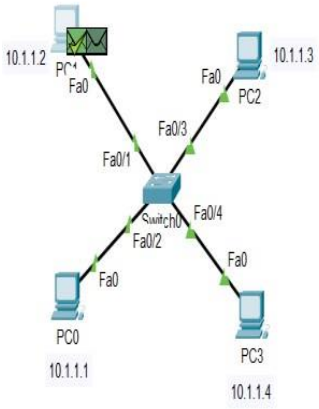
- PC1 sends frame through it's network interface card(NIC), which is connected to Switch0.
- Lets say PC1 **src ip**: 10.1.1.2, **dst ip**:10.1.1.4,**src mac:** 0040.0b4c.e6d1 **Dst mac:** ffff.ffff.ffff(unknown).Our goal is to find destination Mac with the help of known destination Ip address
- After SW0 receives it , it looks at the source mac address field of the frame and then uses that information to learn where the PC1 is.
- ARP request is used to discover the Layer 2 address(Mac address) of a known layer 3 address(Ip address)
- The mac address of pc1 is learned by the Switch0 and updated in mac address table .this address is known as dynamic mac addresss

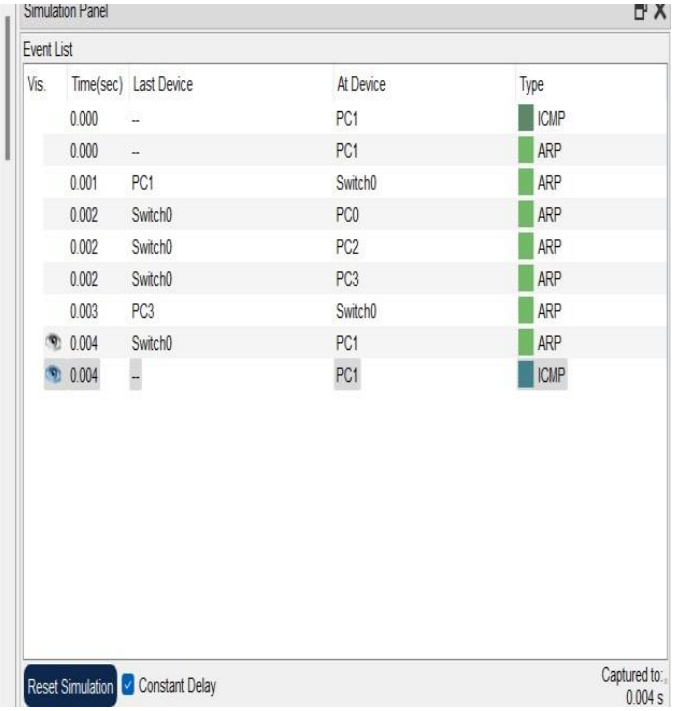
Mac address	Interface
0040.0b4c.e6d1	F0/1

- The Switch now uses **ARP request** to broadcast to other devices in the network except the one it is received on.
- The other devices receives and check whether their destination Ip address match , if not it just ignores, if so the respective PC accepts the request and tries to send an ARP reply with in 5 mins. Here the receiver is PC3. These dynamic Mac address are removed from the mac address table after 5 mins if the PC didn't get ARP reply is known as **AGING.**


0040.0b4c.e6d1
10.1.1.2
PC1
Fa0
0001.428e.ec41
10.1.1.3
Fa0
PC2
Fa0/3
Fa0/1
Switch0
Fa0/4
Fa0/2
Fa0
Fa0
PC0
10.1.1.1
0090.0cc4.1e30
PC3
10.1.1.4
000b.0b6e.ebed
Time: 00:02:30.766
PLAY CONTROLS:


Switch0
Physical
Config
CLI
Attributes
IOS Command Line Interface
1 000b.be6e.ebed DYNAMIC Fa0/4
1 0040.0b4c.e6d1 DYNAMIC Fa0/1
1 0090.0cc4.1e30 DYNAMIC Fa0/2
Switch1#show mac address-table
Mac Address Table
Vlan Mac Address Type Ports
1 000b.be6e.ebed DYNAMIC Fa0/4
1 0040.0b4c.e6d1 DYNAMIC Fa0/1
1 0090.0cc4.1e30 DYNAMIC Fa0/2
Switch1#show mac address-table
Mac Address Table
Vlan Mac Address Type Ports
1 0001.428e.ec41 DYNAMIC Fa0/3
1 000b.be6e.ebed DYNAMIC Fa0/4
1 0040.0b4c.e6d1 DYNAMIC Fa0/1
1 0090.0cc4.1e30 DYNAMIC Fa0/2


10.1.1.2
PC1
Fa0
10.1.1.3
Fa0
PC2
Fa0/3
Fa0/1
Switch0
Fa0/4
Fa0/2
Fa0
Fa0
PC0
10.1.1.1
PC3
10.1.1.4

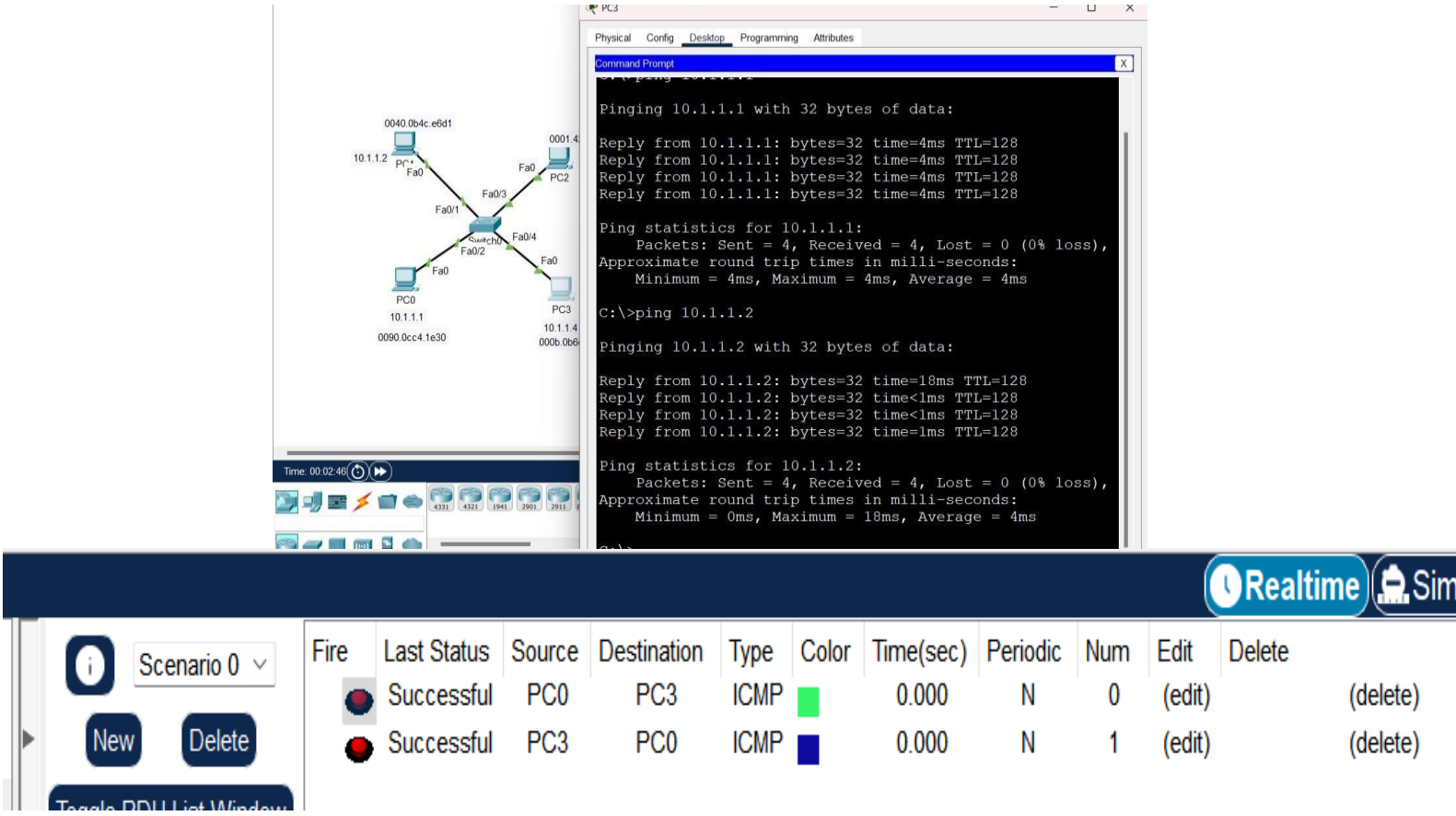

Simulation Panel
Event List
Vis. Time(sec) Last Device At Device Type
0.000 -- PC1 ICMP
0.000 -- PC1 ARP
0.001 PC1 Switch0 ARP
0.002 Switch0 PC0 ARP
0.002 Switch0 PC2 ARP
0.002 Switch0 PC3 ARP
0.003 PC3 Switch0 ARP
0.004 Switch0 PC1 ARP
0.004 -- PC1 ICMP
Reset Simulation
Constant Delay
Captured to:
0.004 s

- Now we know source mac address, destination mac address, source ip address and destination ip address of PC3.
- **Src ip**: 10.1.1.4, **dst ip**: 10.1.1.2, **src mac**:000b.bebe.ebed.d91d, **dst mac**: 0040.0b4c.e6d1. Now PC3 sends the data out of its interface Fa 0/3. The switch learns the mac address of PC3 , records it on the mac address table and sends the data to destination PC1 without broadcasting because here both source and destination mac address are known.

Here the frame is **known unicast frame** while the frame which was sent from PC1 to PC3 without knowing the destination mac address is known as **unknown unicast frame.**

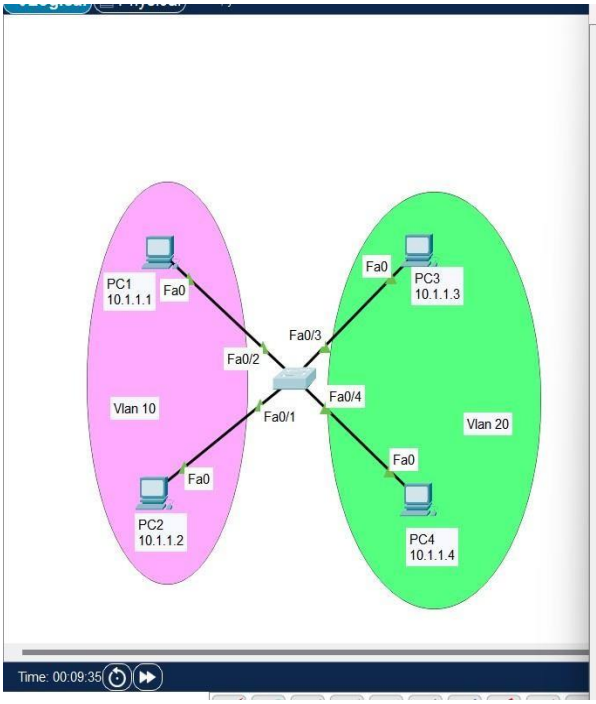
Mac address	interface
0001.6470.d91d	Fa 0/4

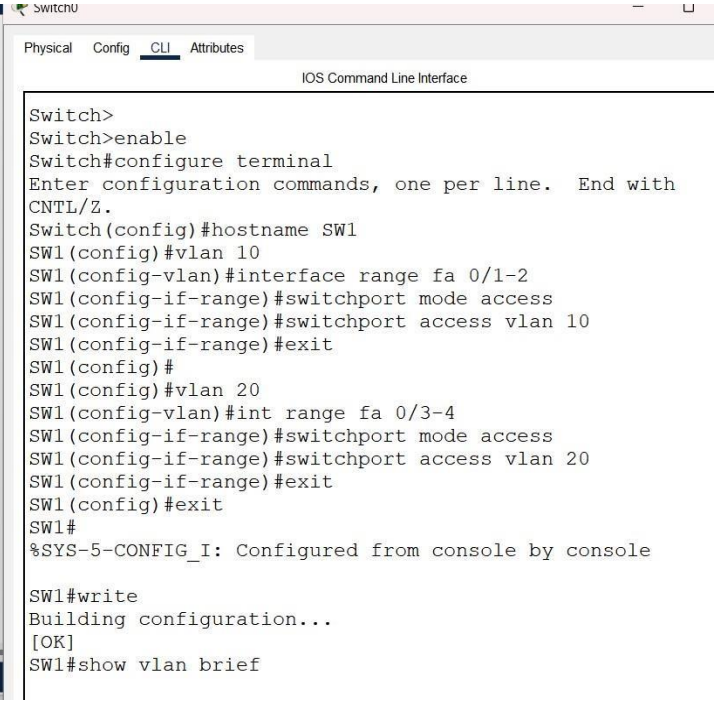
- The below picture depicts about the successful transformation of packets from PC1 to PC3 and PC3 to PC1.



Vlan(Virtual Area Network)

- VLAN is a logical group of devices that havaing same requirements are put in a single broadcast domain, that appears to be working on the same LAN, they in different geographical locations.
- It can be spread across multiple switches in a network or even managed in a single switch.
- Vlan ranges from (1 to 4095) , Normal range(1 to 1005) ,Extended range(1006 to 4095)
- Here the pcs are connected into separate vlans named vlan 10 and vlan 20.
- The devices in that particular vlan only can communicate each other not with other vlan.
- In this above figure Vlan ports are configured on the Switch1(SW1) by accessing ports for the vlan.
- For vlan 10 fastethernet 0/1 for pc2 and fastethernet 0/2 for pc1 are configured as access port to allow only traffic of vlan 10 using command ‘switchport mode access’ and ‘switchport access vlan 10’ on the switch.
- For vlan 20 fa 0/3 for pc3 and fa0/4 for pc4 are configured as access port.



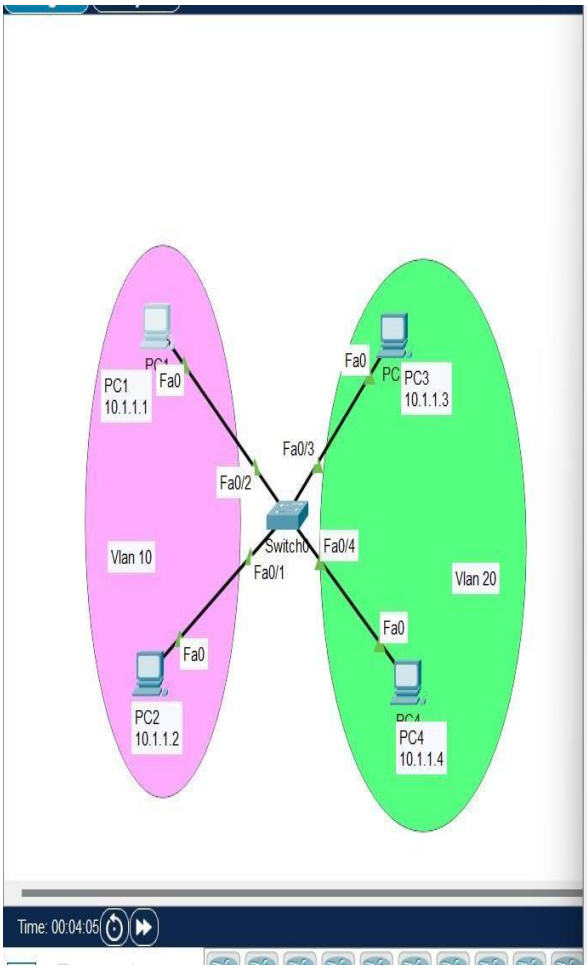


```
[OK]
SW1#show vlan brief

VLAN Name                                Status    Ports
---- ----------------------------------- --------- -------------------------------
1    default                             active    Fa0/5,
Fa0/6, Fa0/7, Fa0/8
                                                   Fa0/9,
Fa0/10, Fa0/11, Fa0/12
                                                   Fa0/13,
Fa0/14, Fa0/15, Fa0/16
                                                   Fa0/17,
Fa0/18, Fa0/19, Fa0/20
                                                   Fa0/21,
Fa0/22, Fa0/23, Fa0/24
                                                   Gig0/1,
Gig0/2
10   VLAN0010                            active    Fa0/1,
Fa0/2
20   VLAN0020                            active    Fa0/3,
Fa0/4
1002 fddi-default                        active
1003 token-ring-default                  active
1004 fddinet-default                     active
1005 trnet-default                       active
SW1#
```

- After configuring accessport on Switch 1 ping PC2(10.1.1.2) from PC1. PC2 broadcasts within the vlan 10 to reach PC1. The connection is successful.
- Now ping PC4(10.1.1.4) from PC2. The ping is failed because that PC is in vlan 10 for which PC1 doesn't have access to that port.
- We can also check vlans connectivity to the ports using command called "show vlan brief" in privilege exec mode.

Significance of Vlan:

Unlike LAN, the broadcast message is not sent to entire network. It is only sent to the particular hosts of that respective vlans, which helps in network performance



Physical Config Desktop Programming Attributes

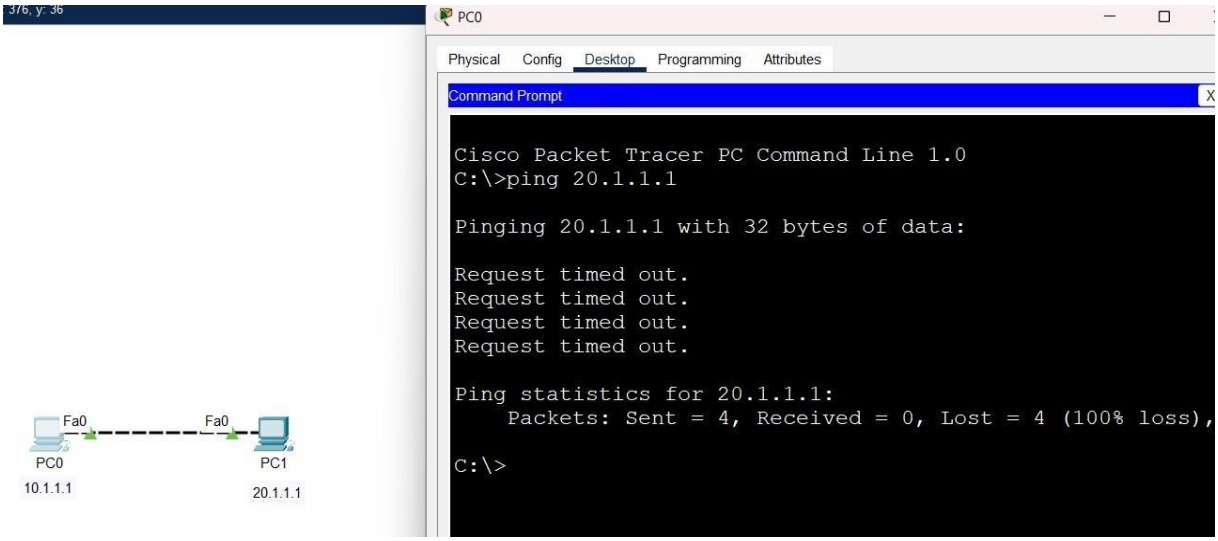
Command Prompt

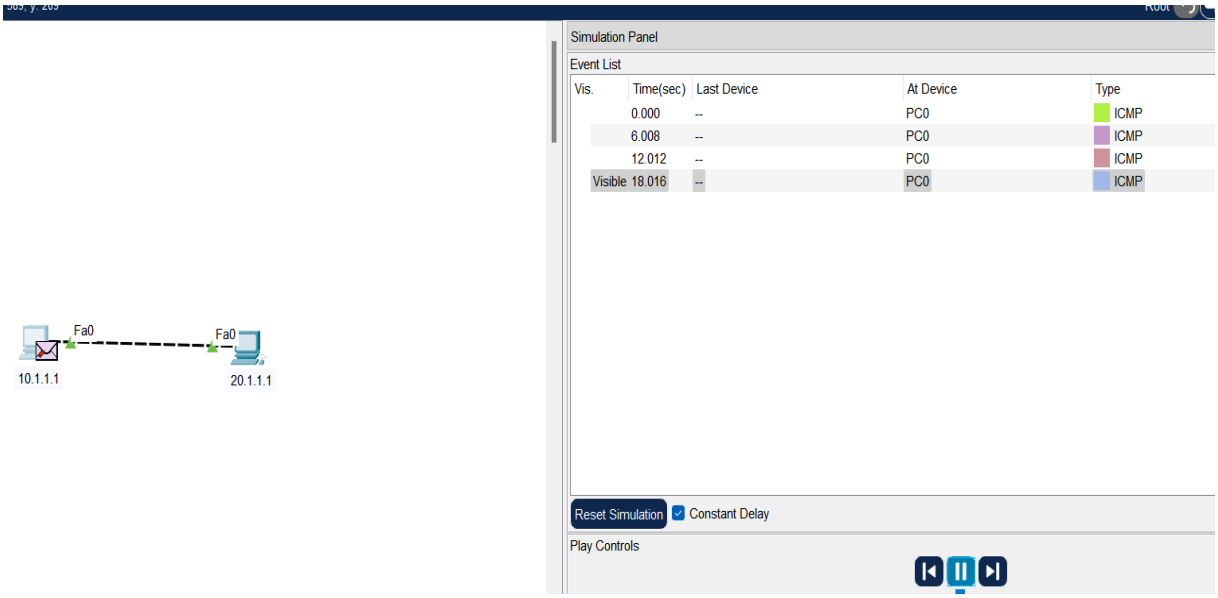
```
C:\>ping 10.1.1.2

Pinging 10.1.1.2 with 32 bytes of data:

Reply from 10.1.1.2: bytes=32 time<1ms TTL=128
Reply from 10.1.1.2: bytes=32 time<1ms TTL=128
Reply from 10.1.1.2: bytes=32 time<1ms TTL=128
Reply from 10.1.1.2: bytes=32 time<1ms TTL=128

Ping statistics for 10.1.1.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 10.1.1.4

Pinging 10.1.1.4 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 10.1.1.4:
    Packets: Sent = 4, Received = 0, Lost = 4 (100%
loss),
```

LEVEL 3:

- End hosts can not be communicated to different networks unless it is connected to a Layer 3 device whichis router.
- In this case the figure depics there are 2 PCs which are connected to different network directly.
- When PC0 sends data to PC1 .The ARP fails because it is only applicable to find mac address of another device on the same network when it is connected directly to hosts or through switch.
- When there is different network we need Router.

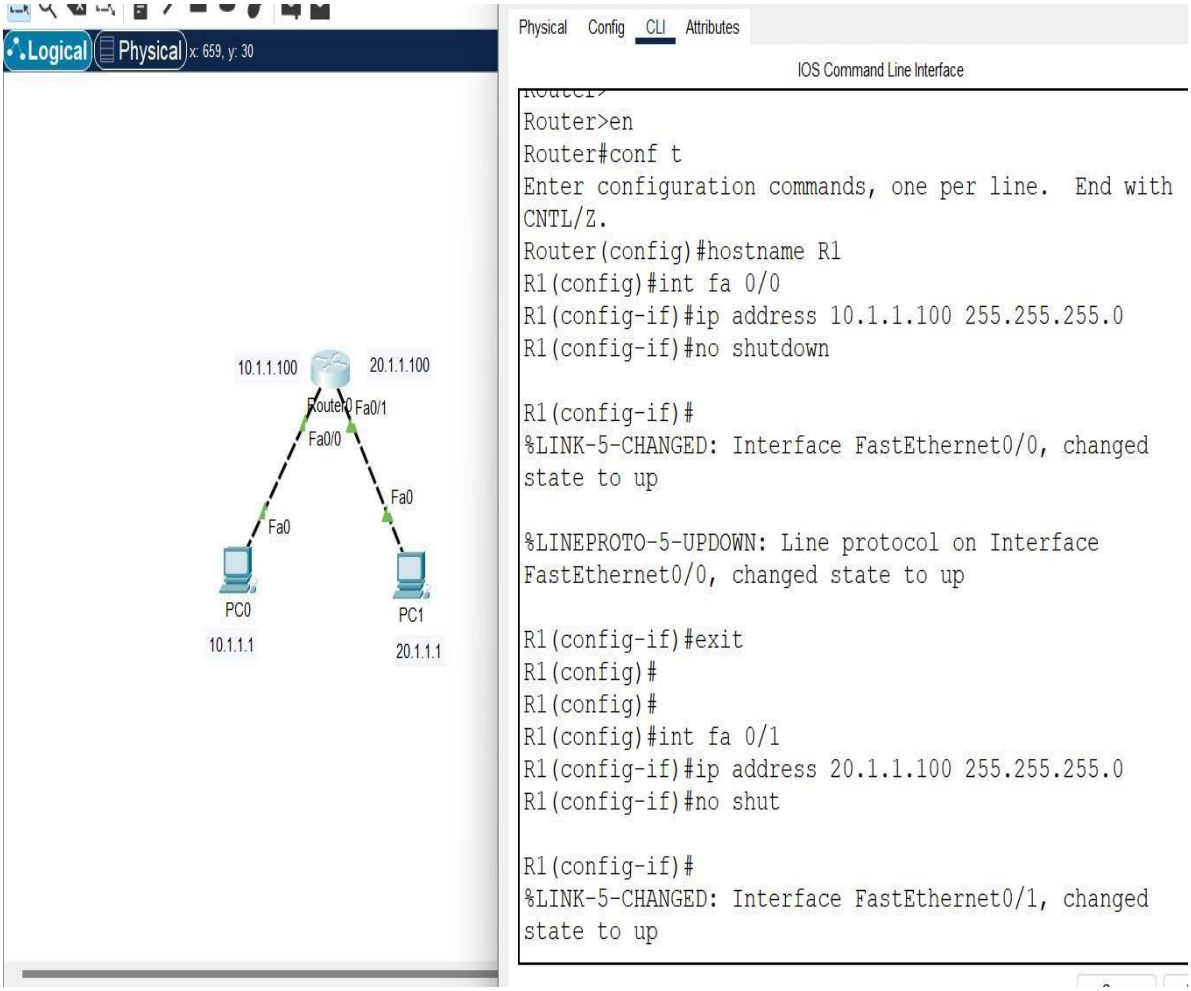
Router is a Layer 3 device which is used to distribute data to different networks by choosing an efficient path on its own. It keeps record on Ip address and routing table



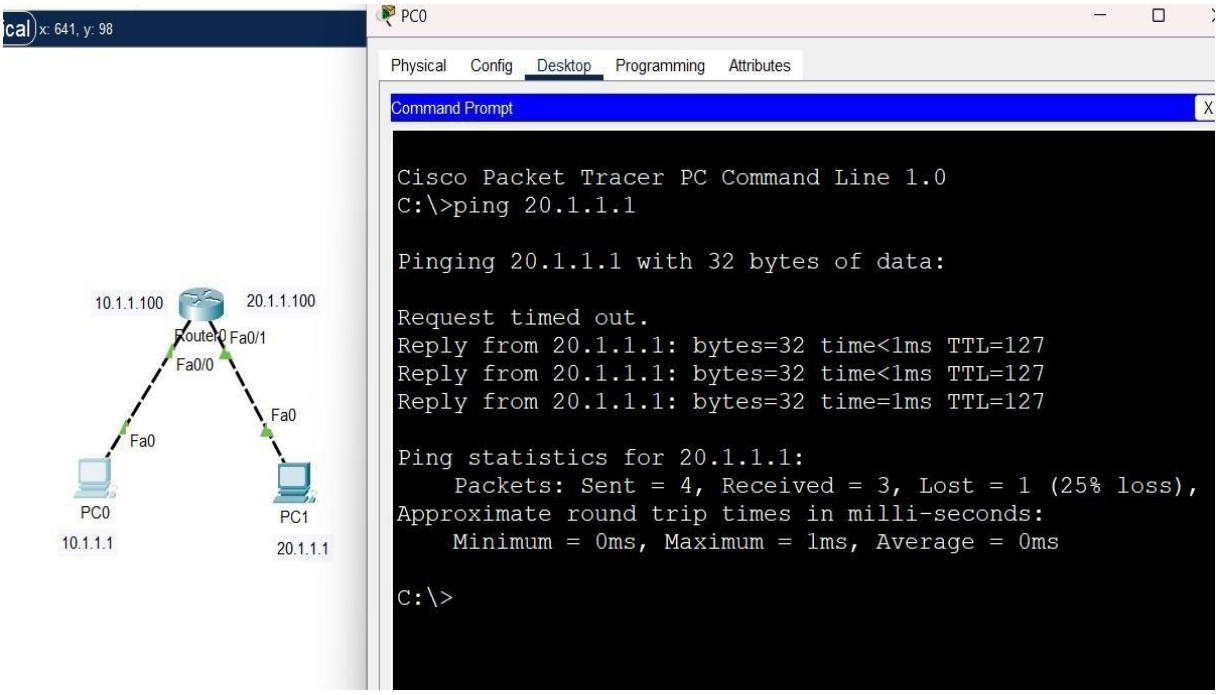


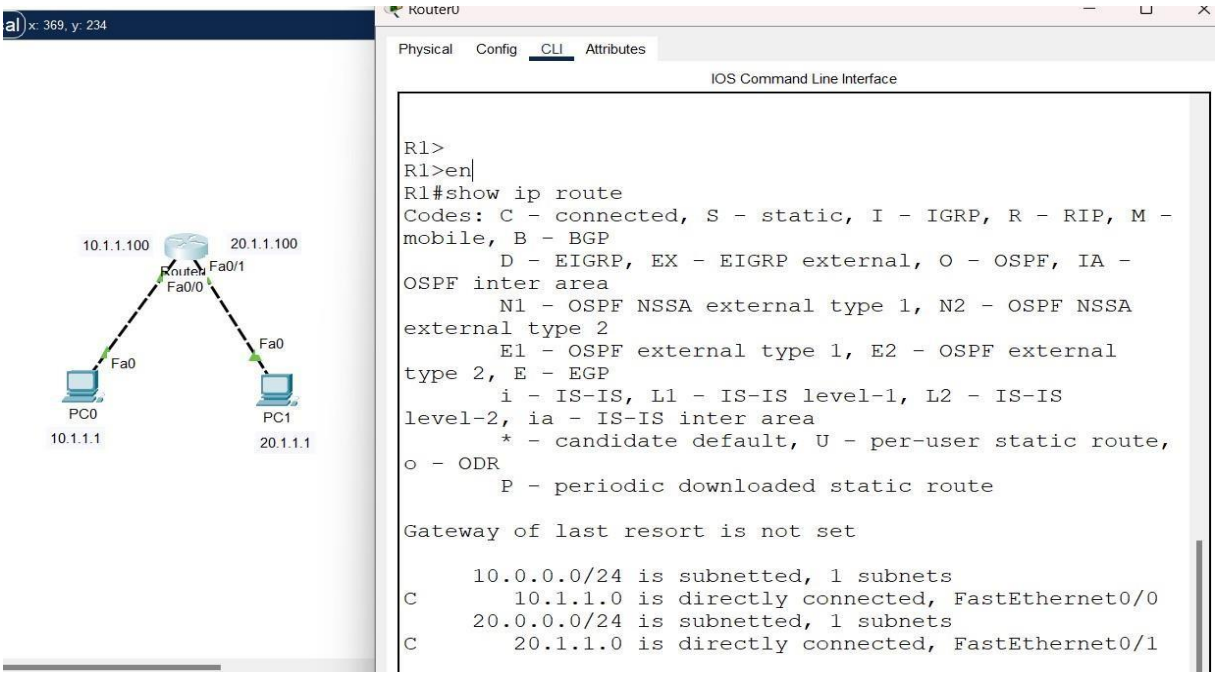
LEVEL 4:

- In the given figure there are PC0 and PC1 connected with a Router to communicate with each other.
- Also PC0 and PC1 are connected to different networks 10.1.1. and 20.1.1.1. here the subnetmask is **255.0.0.0**
- PC0 is connected to fa0/0 interface on the Router while PC1 to fa0/1 interface on the Router.
- Now we give ip addresses for both the PC and additionally we need to provide a default gateway for both networks.
- Default gateway is known as Routers Ip address.
- The default gateway is the node that forwards the packet from the source to other networks when there is no routing information about the destination i.e. host (or router) does not know where the destination is present.
- A default gateway is a route to which information is passed when the device does not know where the destination is present.
- It is used when there is no routing information available about the destination.
- We enable the PCs connection to Router by performing basic configurations of the router.



- We assign default gateway on both the ports of router fa0/0 and fa0/1 as 10.1.1.100 along with its subnetmask 255.255.255.0. and 20.1.1.100 255.255.255.0 and turns up the router by using command “no shutdown”.
- Assign ip addresses and default gateways for PC0 and PC1 as mentioned in the figure on its desktop option.
- Now ping PC1(20.1.1.1) from PC0(10.1.1.1).
- The connection is successful because of router.
- We can also use command “show ip route” on privilege exec mode of the router to know the connected routes


x: 641, y: 98
10.1.1.100
20.1.1.100
Router0
Fa0/1
Fa0/0
Fa0
Fa0
PC0
10.1.1.1
PC1
20.1.1.1
PC0
Physical
Config
Desktop
Programming
Attributes
Command Prompt
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 20.1.1.1
Pinging 20.1.1.1 with 32 bytes of data:
Request timed out.
Reply from 20.1.1.1: bytes=32 time<1ms TTL=127
Reply from 20.1.1.1: bytes=32 time<1ms TTL=127
Reply from 20.1.1.1: bytes=32 time=1ms TTL=127
Ping statistics for 20.1.1.1:
Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 1ms, Average = 0ms
C:\>


x: 369, y: 234
10.1.1.100
20.1.1.100
Router0
Fa0/1
Fa0/0
Fa0
Fa0
PC0
10.1.1.1
PC1
20.1.1.1
Router0
Physical
Config
CLI
Attributes
IOS Command Line Interface
R1>
R1>en
R1#show ip route
Codes: C - connected, S - static, I - IGRP, 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
10.0.0.0/24 is subnetted, 1 subnets
C 10.1.1.0 is directly connected, FastEthernet0/0
20.0.0.0/24 is subnetted, 1 subnets
C 20.1.1.0 is directly connected, FastEthernet0/1

LEVEL 5:

- The objective is to establish connectivity between multiple computers by utilizing two separate networks, a router, and a switch. The setup involves connecting the computers to the switch, which in turn is connected to the router, thereby enabling communication between the two networks.

- In Switch0 three PCs are connected with ip address PC0:10.1.1.1

PC1:10.1.1.2

PC2:10.1.1.3 having common default gatway 10.1.1.100

- In Switch1 three PCs are connected with ip address PC3:20.1.1.1

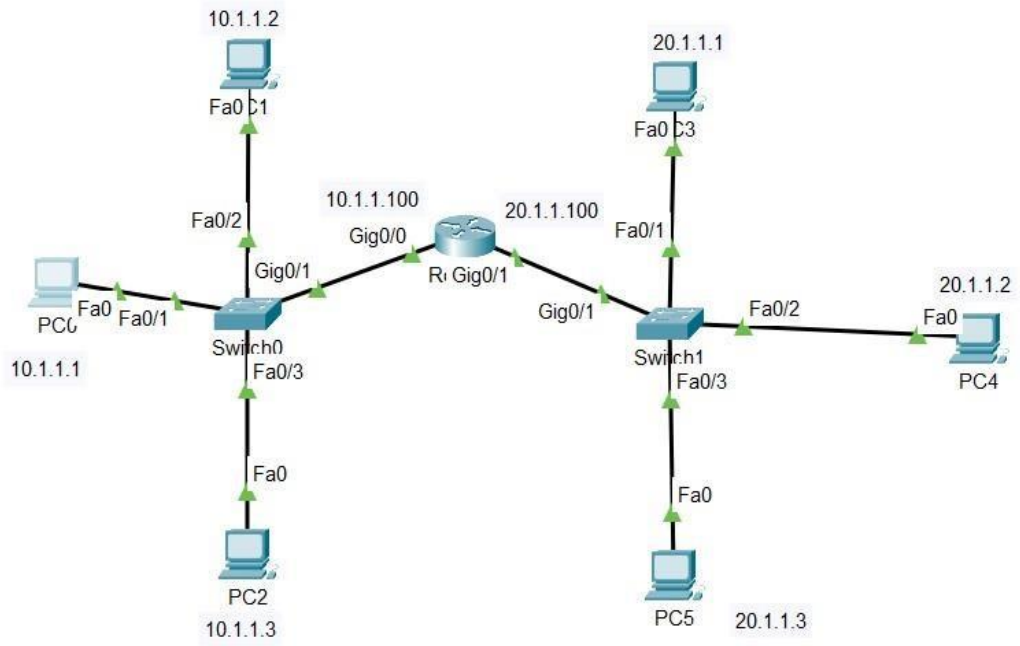
PC4:20.1.1.2

PC5:20.1.1.3 having common default gatway 20.1.1.100

- We connect these L2 devices with the help of L3 device(Router) to establish connectivity with other networks.

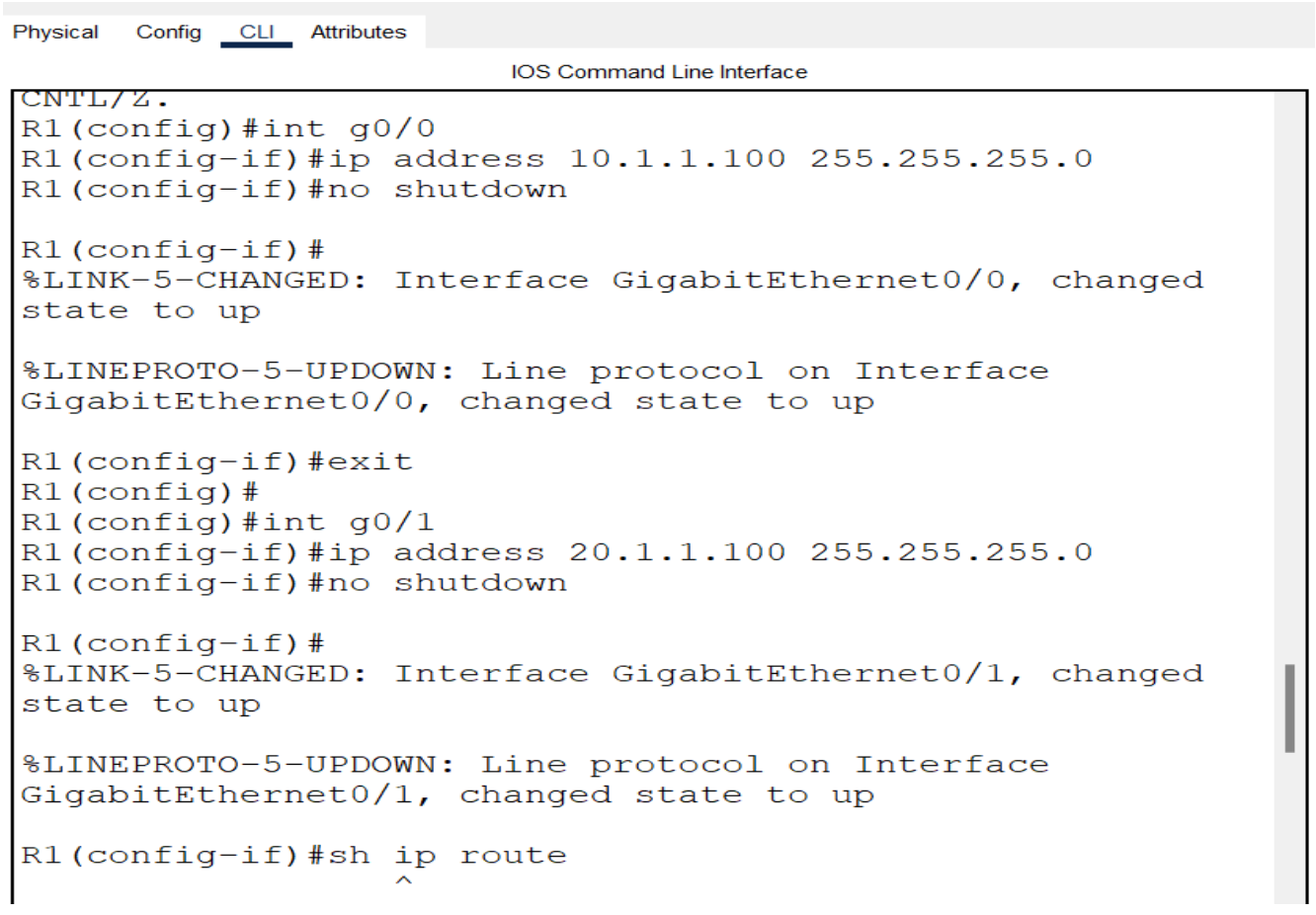
- Now configure the port connection on the router.

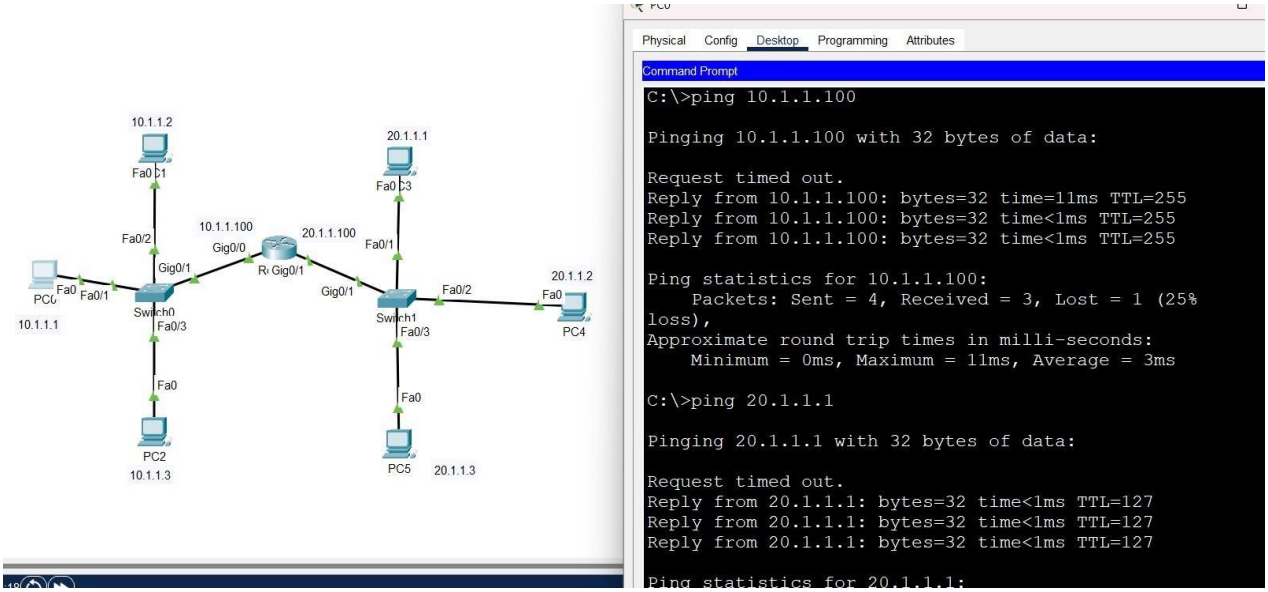
- Router has 2 ports Gigabit 0/0 for network 10.1.1.0/24 and Gigabit 0/1 for 20.1.1.0/24 network.




```
Router>
Router>en
Router#conf t
Enter configuration commands, one per line.  End with
CNTL/Z.
Router(config)#
Router(config)#hostname R1
```

- Name the router as R1 by giving a host name to the router.
- Enter Global configuration mode and assign default gateway (10.1.1.100) with subnet mask 255.0.0.0 the interface g0/0
- And assign default gateway (20.1.1.100) with subnet mask 255.0.0.0 on the interface g0/1. Now we have established the connection.
- Lets ping the PC0(10.1.1.1) to PC3(20.1.1.1) . The ping is successful that means both the networks are ready to exchange information.
- Thus, we can examine the functionality of inter-network communication.
- Routing table keeps record on destination network, destination network mask and next-hop address.
- Next hop address is the address of the nextpath of the router or any device's network which is connected to.
- Detailed explanation of routing table will be given in the next level.

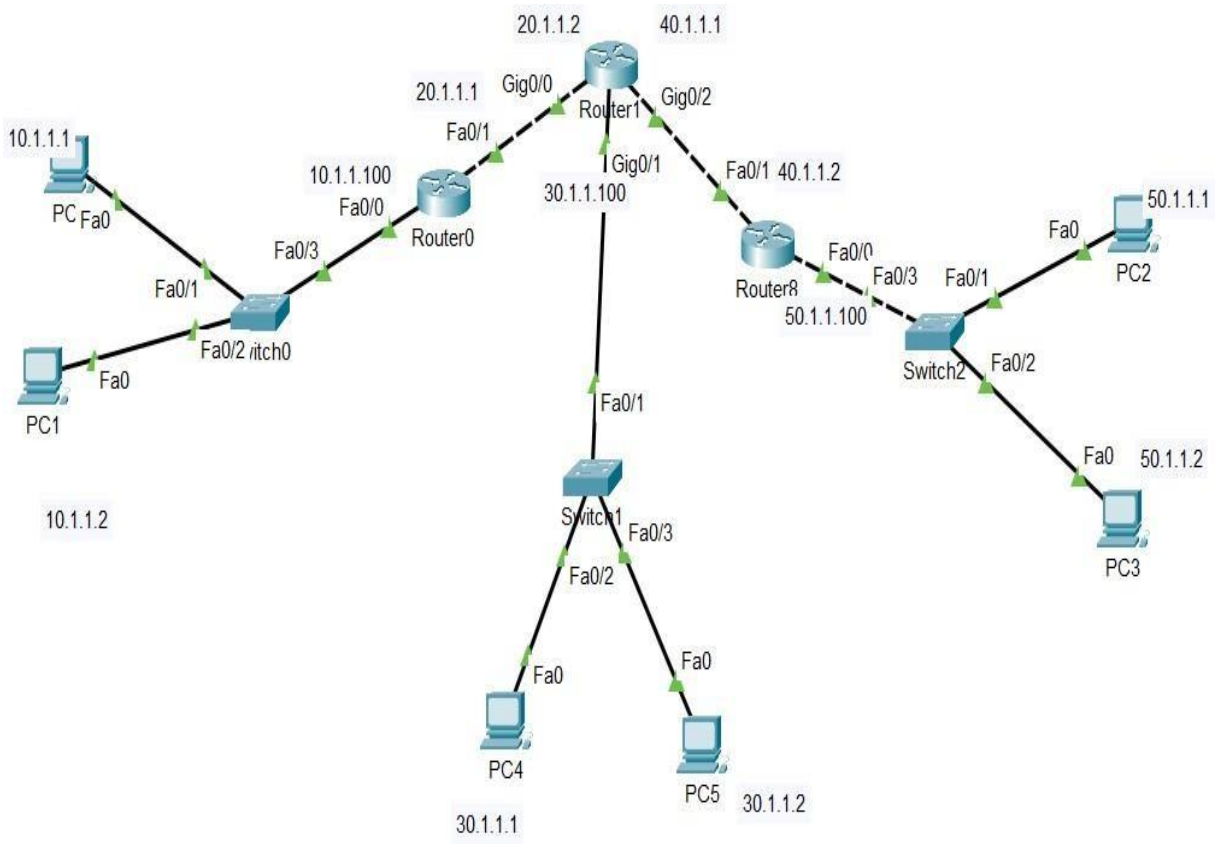




LEVEL 6:

- The objective is to establish connectivity between different networks using routers. We will configure static routes to connect multiple networks. By utilizing the appropriate router commands, we can configure static routes and examine their configuration using the "show ip route" command.
- We need to ping PC1 network to PC2 and PC5 networks using static routing.Connecting to different networks is done by router.
- PC0 ip add: 10.1.1.1/8 subnetmask:255.0.0.0 PC1 ip add: 10.1.1.2/8 subnetmask: 255.0.0.0
- Default gateway for R1 : 10.1.1.100 sbmask:255.0.0.0
- PC4 ip add: 30.1.1.1/8 subnetmask:255.0.0.0 PC5 ip add: 30.1.1.2/8 subnetmask: 255.0.0.0
- Default gateway for R2 : 30.1.1.100 sbmask:255.0.0.0
- PC2 ip add: 50.1.1.1/8 subnetmask:255.0.0.0 PC3 ip add: 50.1.1.2/8 subnetmask: 255.0.0.0
- Default gateway for R1 : 50.1.1.100 sbmask:255.0.0.0

Static Routing



- Lets say PC1 wants to communicate with PC3. Both the PCs are present in different network . The one way it can communicate through is Routers.
- Routers maintain routing table contains destination address and nexthop address
- Lets have a look on it for better understanding on routing table.

Router	Destination	Next-hop
R1	10.1.1.100/8	connected
	50.0.0.0/8	20.1.1.2
	30.0.0.0/8	20.1.1.2
R2	10.0.0.0/8	20.1.1.1
	50.0.0.0/8	40.1.1.2
R3	40.0.0.0/8	40.1.1.1
	30.0.0.0/8	40.1.1.1
	50.0.0.0/8	connected

- The routing table made us clear by analyzing the nexthop address and destination address. By analyzing this we can know the flow of packet distribution in the routers.
- All the routers are configured according to their port connectivity lets have a look on each router configuration.
-
-

R1 connection establishment configuration. Once the connection is established the status are manually up

```
R1#sh ip int brief
Interface              IP-Address      OK? Method Status
Protocol
FastEthernet0/0        10.1.1.100      YES manual up
up
FastEthernet0/1        20.1.1.1        YES manual up
up
Vlan1                  unassigned      YES unset
administratively down down
R1#conf t
Enter configuration commands, one per line.  End with
CNTL/7
```

```
Router>
Router>en
Router#conf t
Enter configuration commands, one per line.  End with
CNTL/Z.
Router(config)#hostname R1
R1(config)#int f0/0
R1(config-if)#ip address 10.1.1.100 255.0.0.0
R1(config-if)#no shutdown

R1(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed
state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface
FastEthernet0/0, changed state to up

R1(config-if)#int f0/1
R1(config-if)#ip address 20.1.1.1 255.0.0.0
R1(config-if)#no shutdown

R1(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/1, changed
state to up

R1(config-if)#exit
```

R2 connection establishment configuration The port status is manually up

```
Router>
Router>en
Router#conf t
Enter configuration commands, one per line.  End with
CNTL/Z.
Router(config)#hostname R2
R2(config)#int g0/0
R2(config-if)#ip address 20.1.1.2 255.0.0.0
R2(config-if)#no shutdown

R2(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

R2(config-if)#exit
R2(config)#int g0/1
R2(config-if)#ip ad
R2(config-if)#ip address 30.1.1.100 255.0.0.0
R2(config-if)#no shutdown
```

```
R2#sh ip int brief
Interface              IP-Address      OK? Method Status
Protocol
GigabitEthernet0/0     20.1.1.2        YES manual up
up
GigabitEthernet0/1     30.1.1.100      YES manual up
up
GigabitEthernet0/2     40.1.1.1        YES manual up
up
Vlan1                  unassigned      YES unset
```

R3 connection establishment configuration.The port status is manually up

```
Router>en
Router#conf
Router#conf terminal
Enter configuration commands, one per line.  End with
CNTL/Z.
Router(config)#hostname R3
R3(config)#int fa0/1
R3(config-if)#ip ad
R3(config-if)#ip address 40.1.1.2 255.0.0.0
R3(config-if)#no shutdown

R3(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/1, changed
state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface
FastEthernet0/1, changed state to up

R3(config-if)#exit
R3(config)#int fa0/0
R3(config-if)#ip ad
R3(config-if)#ip address 50.1.1.100 255.0.0.0
R3(config-if)#no shut
R3(config-if)#no shutdown
[OK]
R3#sh ip int brief
Interface              IP-Address      OK? Method Status
Protocol
FastEthernet0/0        50.1.1.100      YES manual up
up
FastEthernet0/1        40.1.1.2        YES manual up
up
Vlan1                  unassigned      YES unset
administratively down down
```

R1 Routing configuration

- The process that routers use to determine the path that ip packets should take over a network to reach their destination is called static routing or routing.
- Routers store routes to all of their known destinations in a routing table.
- When routers receive packets, they look in the routing table to find the best route to forward that packet.
- A Connected route is a route to the network the interface is connected to
- Here the network 10.0.0.0/8 is connected go fa0/0
- Local route is a route to the exact ip address configured on the interface
- A /32 netmask is used to specify the exact ip address of the interface./32 means 32 bits are fixed , they cannot change.

Connetced routes:

- 10.0.0.0/8 –fa0/0
- 20.0.0.0/8-fa0/1

Static routes:

- 30.0.0.0/8 [1/0] via 20.1.1.2
- 50.0.0.0/8 [1/0] via 20.1.1.2
- These two network take their path via 20.1.1.2 to reach their destination network.

```
R1(config)# ip route 50.0.0.0 255.0.0.0 20.1.1.2
R1(config)#ip route 30.0.0.0 255.0.0.0 20.1.1.2
R1(config)#exit
R1#
%SYS-5-CONFIG_I: Configured from console by console
```

```
R1#sh ip route
Codes: C - connected, S - static, I - IGRP, 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

C    10.0.0.0/8 is directly connected, FastEthernet0/0
C    20.0.0.0/8 is directly connected, FastEthernet0/1
S    30.0.0.0/8 [1/0] via 20.1.1.2
S    50.0.0.0/8 [1/0] via 20.1.1.2
```

Static routes:

10.0.0.0/8 [1/0] via 20.1.1.1

50.0.0.0/8 [1/0] via 40.1.1.2

Connected routes:

20.0.0.0/8 is directly connected ,g0/0 30.0.0.0/8 is directly connected, g0/1 40.0.0.0/8 is directly connected,g0/2 **Local routes:**

20.1.1.2/32 is direcly connected, g0/0 30.1.1.100/32 is directly connected, g0/1 40.1.1.1/32 is directly connected, g0/2

```
R2#conf t
Enter configuration commands, one per line.   End
R2(config)#ip route?
route
R2(config)#ip route 10.0.0.0 255.0.0.0 20.1.1.1
R2(config)#ip route 50.0.0.0 255.0.0.0 40.1.1.2
```

```
R2#sh 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

S    10.0.0.0/8 [1/0] via 20.1.1.1
     20.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       20.0.0.0/8 is directly connected, GigabitEthernet0/0
L       20.1.1.2/32 is directly connected, GigabitEthernet0/0
     30.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       30.0.0.0/8 is directly connected, GigabitEthernet0/1
L       30.1.1.100/32 is directly connected,
GigabitEthernet0/1
     40.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       40.0.0.0/8 is directly connected, GigabitEthernet0/2
L       40.1.1.1/32 is directly connected, GigabitEthernet0/2
S    50.0.0.0/8 [1/0] via 40.1.1.2
```

R3 routing configuration

Connected routes:

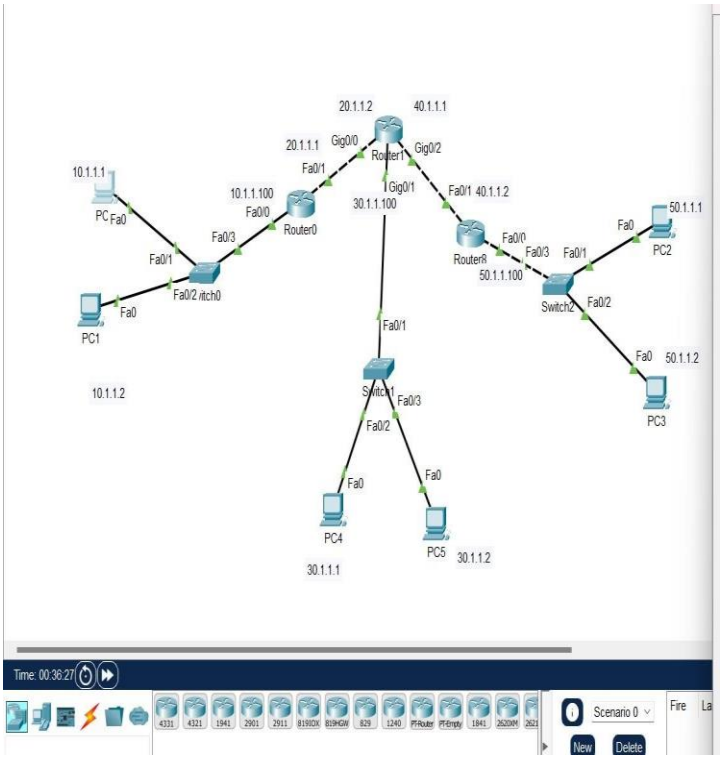
- 50.0.0.0/8 –fa0/0
- 40.0.0.0/8-fa0/1

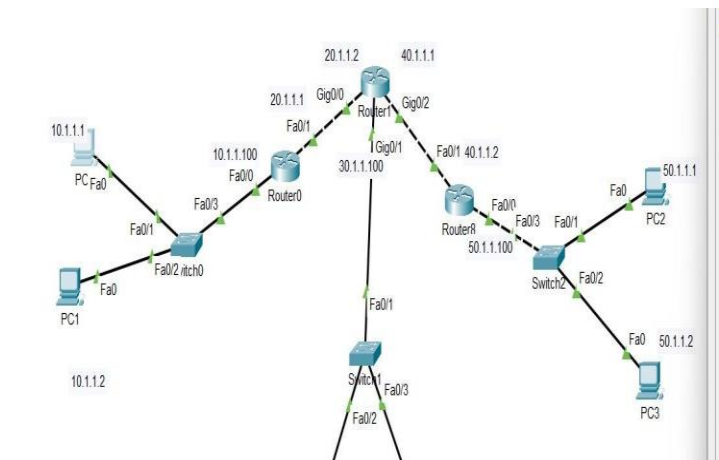
Static routes:

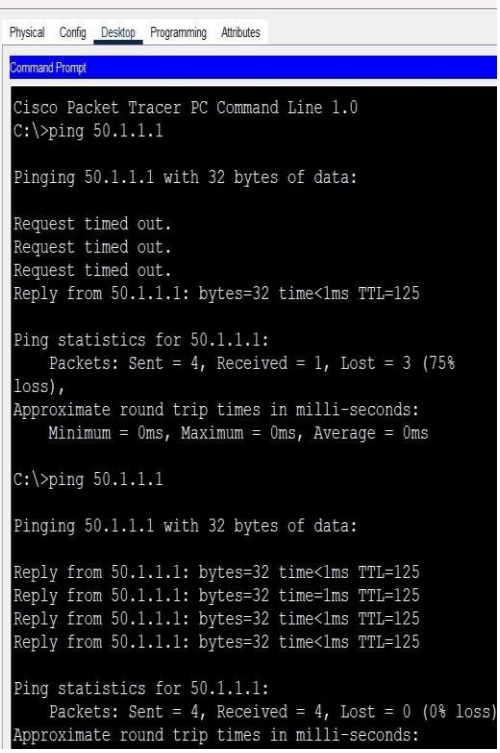
- 10.0.0.0/8 [1/0] via 40.1.1.1
- 30.0.0.0/8 [1/0] via 40.1.1.1
- These two network take their path via 40.1.1.1 to reach their destination network.
- Now ping the PC3(50.1.1.2) from PC0 (10.1.1.1)
- The connection is successful.
- Ping PC4(30.1.1.1) from PC0(10.1.1.1).The

connection is successful. That means all the different networks can communicate with each other through static routing.

- The next slide shows the ping process.


20.1.1.2
40.1.1.1
20.1.1.1
Gig0/0
Router1
Gig0/2
Fa0/1
Gig0/1
Fa0/1 40.1.1.2
10.1.1.1
10.1.1.100
Fa0/0
30.1.1.100
50.1.1.1
PC
Fa0
Router0
Router8
Fa0/0
Fa0/3
Fa0/1
Fa0
PC2
Fa0/3
Fa0/1
50.1.1.100
Fa0/1
Fa0/2 itch0
Switch2
Fa0/2
Fa0
PC1
Fa0/1
Fa0
50.1.1.2
10.1.1.2
Switch1
Fa0/3
PC3
Fa0/2
Fa0
Fa0
PC4
PC5
30.1.1.2
30.1.1.1


Time: 00:36:27
Scenario 0
New
Delete
Fire


Physical
Config
Desktop
Programming
Attributes
Command Prompt
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 50.1.1.1
Pinging 50.1.1.1 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Reply from 50.1.1.1: bytes=32 time<1ms TTL=125
Ping statistics for 50.1.1.1:
Packets: Sent = 4, Received = 1, Lost = 3 (75%
loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms
C:\>ping 50.1.1.1
Pinging 50.1.1.1 with 32 bytes of data:
Reply from 50.1.1.1: bytes=32 time<1ms TTL=125
Reply from 50.1.1.1: bytes=32 time=1ms TTL=125
Reply from 50.1.1.1: bytes=32 time<1ms TTL=125
Reply from 50.1.1.1: bytes=32 time<1ms TTL=125
Ping statistics for 50.1.1.1:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss)
Approximate round trip times in milli-seconds:

20.1.1.2
40.1.1.1
20.1.1.1
Gig0/0
Router1
Gig0/2
Fa0/1
Gig0/1
Fa0/1 40.1.1.2
10.1.1.1
10.1.1.100
Fa0/0
30.1.1.100
50.1.1.1
PC
Fa0
Router0
Router8
Fa0/0
Fa0/3
Fa0/1
Fa0
PC2
Fa0/3
Fa0/1
50.1.1.100
Fa0/2 itch0
Switch2
Fa0/2
Fa0
PC1
Fa0/1
Fa0
50.1.1.2
10.1.1.2
Switch1
Fa0/3
PC3
Fa0/2
Fa0
Fa0
PC4
PC5
30.1.1.2
30.1.1.1

Time: 00:36:35
Scenario 0
Fire


Command Prompt
Pinging 50.1.1.1 with 32 bytes of data:
Reply from 50.1.1.1: bytes=32 time<1ms TTL=125
Reply from 50.1.1.1: bytes=32 time=1ms TTL=125
Reply from 50.1.1.1: bytes=32 time<1ms TTL=125
Reply from 50.1.1.1: bytes=32 time<1ms TTL=125
Ping statistics for 50.1.1.1:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 1ms, Average = 0ms
C:\>ping 30.1.1.1
Pinging 30.1.1.1 with 32 bytes of data:
Request timed out.
Reply from 30.1.1.1: bytes=32 time<1ms TTL=126
Reply from 30.1.1.1: bytes=32 time<1ms TTL=126
Reply from 30.1.1.1: bytes=32 time<1ms TTL=126
Ping statistics for 30.1.1.1:
Packets: Sent = 4, Received = 3, Lost = 1 (25%
loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms

LEVEL 7:

What is OSPF?

- **OSPF** is a type of **routing protocol** used in networks.
- Its main job is to help routers decide the best path for data to travel across a network.

How Does OSPF Work?

1. **Router Communication**:
    1. Routers using OSPF talk to each other to share information about the network.
    2. They send out "hello" messages to find other OSPF routers and become neighbors.
2. **Building a Map**:
    1. Each router creates a map of the network, showing all the possible paths data can take.
    2. This map is called a **link-state database**.
    3. **Finding the Best Path**:
        1. OSPF uses an algorithm called **Dijkstra's algorithm** to find the shortest path from one router to another.
        2. The shortest path is the one with the least "cost," which usually means the fastest or most reliable route.

Why Use OSPF?

- **Efficiency**: OSPF finds the best paths quickly and adjusts when the network changes.
- **Flexibility**: It supports a variety of network sizes and types.
- **Reliability**: It helps ensure data takes the fastest, most reliable routes.

By using OSPF, networks can efficiently manage and route data, ensuring smooth communication across multiple routers and networks

OSPF Neighbors and Interface States:

- **Neighbors**: Routers that can talk directly to each other.
- **Neighbor States**: Steps in forming a full OSPF relationship, including Down, Init, 2-Way, ExStart, Exchange, Loading, and Full.
- **Interface States**: Shows if an interface is the Designated Router (DR), Backup Designated Router (BDR), or another router (DROTHER).

How Areas Work in OSPF:

- **Internal Routers**: Routers within the same area share detailed link-state information with each other.
- **Area Border Routers (ABRs)**: These routers connect different areas. They summarize and send routing information between areas and the backbone area.

- **Backbone Routers**: These are routers within the backbone area (Area 0) and are responsible for routing between different areas.

Benefits of OSPF areas:

- Scalability
- Stability
- Performance

States of OSPF

1.Down State:

- No Hello packets received from the neighbor.
- The router does not have any information about the neighbor.

2.Init State:

- Hello packets are received from the neighbor, but the router's own Router ID is not included in the received Hello packet.
- The router knows about the neighbor but does not establish two-way communication.

3.Two-Way State:

- Hello packets are received, and the router's own Router ID is included in the Hello packet.
- Two-way communication is established.
- This is the state where DR (Designated Router) and BDR (Backup Designated Router) election takes place in broadcast and NBMA networks.

4.ExStart State:

- The router and its neighbor establish the initial sequence number for DBD (Database Description) packets.
- Master/slave relationship is determined (master sends first DBD packet).

5. Exchange State:

- Routers exchange DBD packets, which contain descriptions of the topological database.
- Routers compare DBD packets and request more information about unknown or outdated LSAs (Link-State Advertisements).

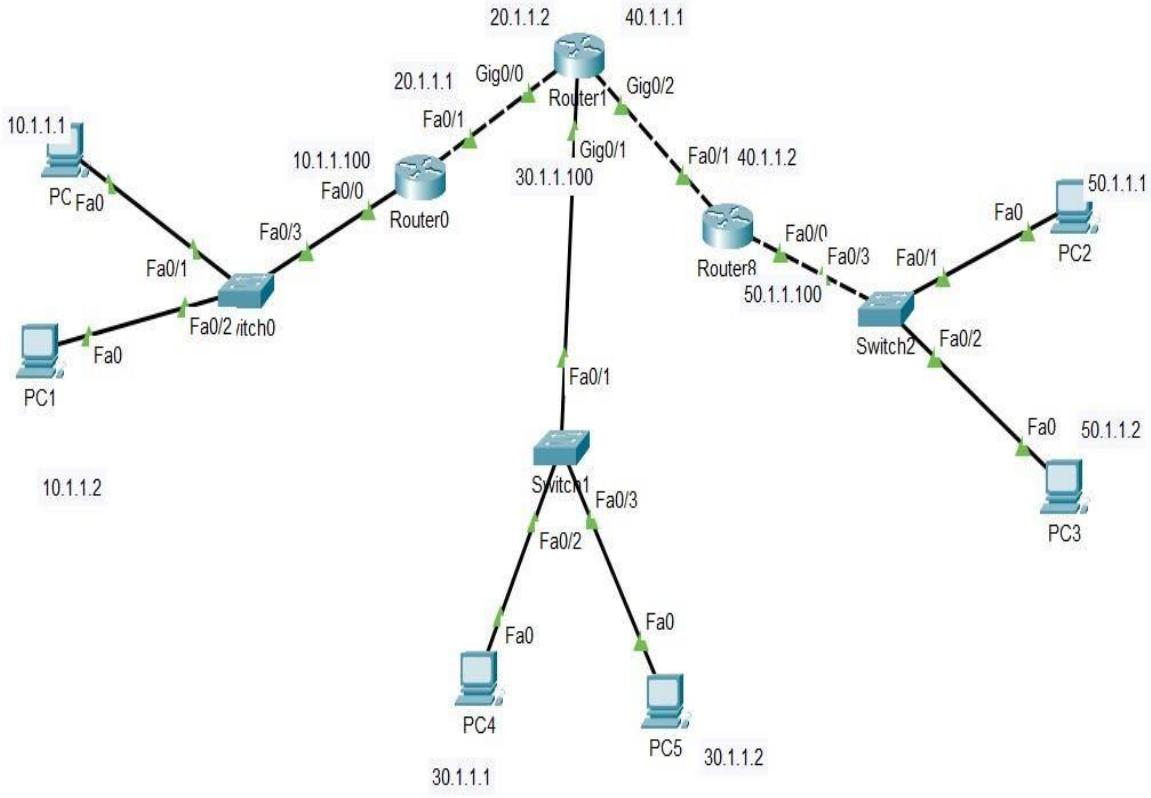
6.Loading State:

- Routers send LSRs (Link-State Requests) for more recent LSAs that were discovered during the Exchange state.
- The requested LSAs are sent in LSU (Link-State Update) packets.

7.Full State:

- The routers are fully synchronized and have identical OSPF databases.

OSPF(Open shortest Path First)



R1 configuration: Establishment and ospf

```
R1>
R1>en
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#int f0/0
R1(config-if)#ip ad
R1(config-if)#ip address 10.1.1.100 255.0.0.0
R1(config-if)#no shutdown
R1(config-if)#exit
R1(config)#int f0/1
R1(config-if)#ip ad
R1(config-if)#ip address 20.1.1.1 255.0.0.0
R1(config-if)#no shut
R1(config-if)#exit
R1(config)#do write
Building configuration...
[OK]
R1(config)#router ospf 1
R1(config-router)#network 10.0.0.0 0.255.255.255 area 0
R1(config-router)#network 20.0.0.0 0.255.255.255 area 0
R1(config-router)#exit
R1(config)#do wr
```

```
%SYS-5-CONFIG_I: Configured from console by console

R1#show ip ospf neighbor


Neighbor ID     Pri   State           Dead Time   Address         Interface
40.1.1.1          1   FULL/BDR        00:00:37    20.1.1.2        FastEthernet0/1
R1#
R1#show ip ospf database
            OSPF Router with ID (20.1.1.1) (Process ID 1)

                Router Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum Link count
20.1.1.1        20.1.1.1        471         0x80000003 0x009546 2
40.1.1.1        40.1.1.1        383         0x80000005 0x0081b4 3
50.1.1.100      50.1.1.100      375         0x80000003 0x0095f1 2

                Net Link States (Area 0)
Link ID         ADV Router      Age         Seq#       Checksum
20.1.1.1        20.1.1.1        471         0x80000001 0x009aeb
40.1.1.1        40.1.1.1        383         0x80000001 0x00dbed
R1#show ip route
Codes: C - connected, S - static, I - IGRP, 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

C    10.0.0.0/8 is directly connected, FastEthernet0/0
C    20.0.0.0/8 is directly connected, FastEthernet0/1
S    30.0.0.0/8 [1/0] via 20.1.1.2
O    40.0.0.0/8 [110/2] via 20.1.1.2, 00:07:23, FastEthernet0/1
S    50.0.0.0/8 [1/0] via 20.1.1.2
```

R2 Configuration:Establishment and ospf

```
R2>
R2>en
R2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#int g0/0
R2(config-if)#ip add 20.1.1.2 255.0.0.0
R2(config-if)#no shut
R2(config-if)#exit
R2(config)#
R2(config)#int g0/1
R2(config-if)#ip add 30.1.1.100 255.0.0.0
R2(config-if)#no shut
R2(config-if)#exit
R2(config)#
R2(config)#int g0/2
R2(config-if)#ip add 40.1.1.1 255.0.0.0
R2(config-if)#no shut
R2(config-if)#exit
```

```
R2(config)#router ospf 2
R2(config-router)#network 20.0.0.0 0.255.255.255 area 0
R2(config-router)#network 30.0.0.0
00:41:54: %OSPF-5-ADJCHG: Process 2, Nbr 20.1.1.1 on GigabitEthernet0/0 from LOADING to FULL, Loading Done
0.255.255.255 area 0
R2(config-router)#network 40.0.0.0 0.255.255.255 area 0
R2(config-router)#
R2(config-router)#exit
```

```
R2#sh ip ospf neighbor


Neighbor ID     Pri   State           Dead Time   Address         Interface
50.1.1.100        1   FULL/BDR        00:00:36    40.1.1.2        GigabitEthernet0/2
20.1.1.1          1   FULL/DR         00:00:32    20.1.1.1        GigabitEthernet0/0
R2#show ip ospf database
            OSPF Router with ID (40.1.1.1) (Process ID 2)

                Router Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum Link count
20.1.1.1        20.1.1.1        572         0x80000003 0x009546 2
40.1.1.1        40.1.1.1        484         0x80000005 0x0081b4 3
50.1.1.100      50.1.1.100      477         0x80000003 0x0095f1 2

                Net Link States (Area 0)
Link ID         ADV Router      Age         Seq#       Checksum
20.1.1.1        20.1.1.1        572         0x80000001 0x009aeb
40.1.1.1        40.1.1.1        484         0x80000001 0x00dbed
R2#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

S    10.0.0.0/8 [1/0] via 20.1.1.1
     20.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       20.0.0.0/8 is directly connected, GigabitEthernet0/0
L       20.1.1.2/32 is directly connected, GigabitEthernet0/0
     30.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       30.0.0.0/8 is directly connected, GigabitEthernet0/1
L       30.1.1.100/32 is directly connected, GigabitEthernet0/1
     40.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       40.0.0.0/8 is directly connected, GigabitEthernet0/2
L       40.1.1.1/32 is directly connected, GigabitEthernet0/2
```

Prefix: 10.0.0.0/8

This indicates the network 10.0.0.0 with a subnet mask of 255.0.0.0.

- **S**: This is a static route.

The router can reach this network via the next-hop IP address **20.1.1.1** with an administrative distance of [1/0].

Prefix: 20.0.0.0/8

This indicates the network 20.0.0.0 with a subnet mask of 255.0.0.0, which is variably subnetted into two subnets.

- **20.0.0.0/8**

C: This subnet is directly connected to the router via the GigabitEthernet0/0 interface.

- **20.1.1.2/32**

L: This is a local route, indicating the IP address of the router's own interface (GigabitEthernet0/0).

Prefix: 30.0.0.0/8

This indicates the network 30.0.0.0 with a subnet mask of 255.0.0.0, which is variably subnetted into two subnets.

- **30.0.0.0/8**

C: This subnet is directly connected to the router via the GigabitEthernet0/1 interface.

- **30.1.1.100/32**

L: This is a local route, indicating the IP address of the router's own interface (GigabitEthernet0/1).

Same goes for other C and L routes

R3 configuration: Establishment and ospf

```
R3>en
R3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R3(config)#int f0/1
R3(config-if)#ip add 40.1.1.2 255.0.0.0
R3(config-if)#no shut
R3(config-if)#exit
R3(config)#
R3(config)#int f0/0
R3(config-if)#ip add 50.1.1.100 255.0.0.0
R3(config-if)#no shut
R3(config-if)#exit
```

```
R3(config)#router ospf 3
R3(config-router)#network 40.0.0.0 0.255.255.255 area 0
R3(config-router)#network 50.0.0.0 0.255.2
00:43:23: %OSPF-5-ADJCHG: Process 3, Nbr 40.1.1.1 on FastEthernet0/1 from LOADING to FULL, Loading Done
55.255 area 0
R3(config-router)#exit
R3(config)#do wr
Building configuration...
[OK]
R3(config)#
R3(config)#exit
```

```
R3#show ip ospf neighbor


Neighbor ID     Pri   State           Dead Time   Address         Interface
40.1.1.1          1   FULL/DR         00:00:31    40.1.1.1        FastEthernet0/1
R3#show ip ospf database
            OSPF Router with ID (50.1.1.100) (Process ID 3)

                Router Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum Link count
20.1.1.1        20.1.1.1        732         0x80000003 0x009546 2
40.1.1.1        40.1.1.1        644         0x80000005 0x0081b4 3
50.1.1.100      50.1.1.100      636         0x80000003 0x0095f1 2

                Net Link States (Area 0)
Link ID         ADV Router      Age         Seq#       Checksum
20.1.1.1        20.1.1.1        732         0x80000001 0x009aeb
40.1.1.1        40.1.1.1        644         0x80000001 0x00dbed
R3#show ip route
Codes: C - connected, S - static, I - IGRP, 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

S    10.0.0.0/8 [1/0] via 40.1.1.1
O    20.0.0.0/8 [110/2] via 40.1.1.1, 00:10:54, FastEthernet0/1
S    30.0.0.0/8 [1/0] via 40.1.1.1
C    40.0.0.0/8 is directly connected, FastEthernet0/1
C    50.0.0.0/8 is directly connected, FastEthernet0/0
```

1.10.0.0.0/8

1. **S (Static)**: This is a manually configured route.
2. The router can reach the 10.0.0.0/8 network via the next- hop IP address **40.1.1.1** with an administrative distance of [1/0].

2.20.0.0.0/8

1. **O (OSPF)**: This route is learned via the OSPF protocol.
2. The router can reach the 20.0.0.0/8 network via the next- hop IP address **40.1.1.1** using the FastEthernet0/1 interface. The route has a metric of [110/2], meaning it's an OSPF route with a cost of 2, and has been up for 10 minutes and 54 seconds.

3.30.0.0.0/8

1. **S (Static)**: This is a manually configured route.
2. The router can reach the 30.0.0.0/8 network via the next- hop IP address **40.1.1.1** with an administrative distance of [1/0].

4.40.0.0.0/8

1. **C (Connected)**: This network is directly connected to the router.
2. It is connected via the FastEthernet0/1 interface.

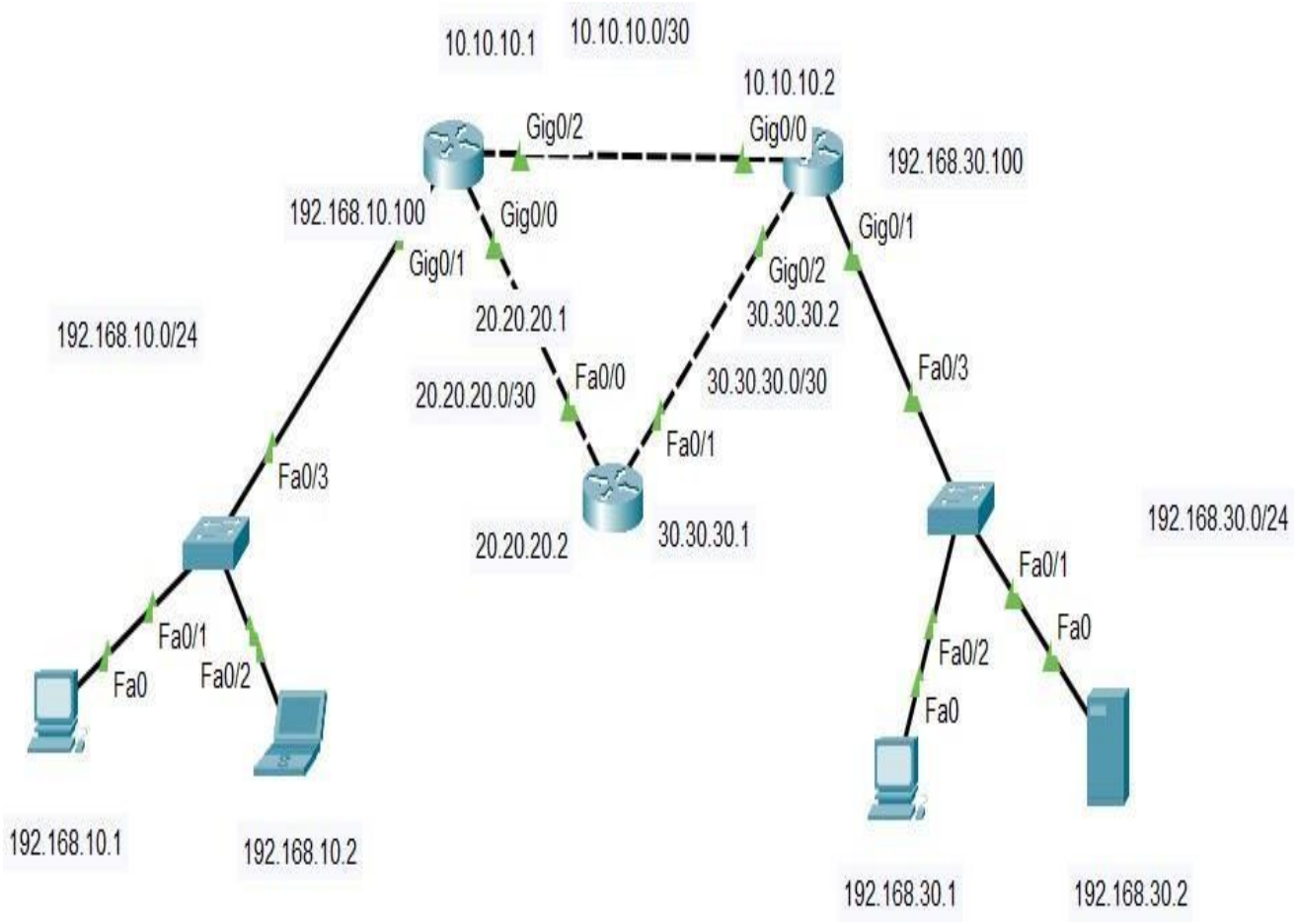
5.50.0.0.0/8

1. **C (Connected)**: This network is directly connected to the router.

It is connected via the FastEthernet0/0 interface

LEVEL 8:

To establish network connectivity between multiple networks using routers by configuring OSPF (Open Shortest Path First) on each router.



OSPF Configuration for R1

- On R1 we configure Ip addresses of interface g0/1, g0/0, g0/3 to establish connection and we turn on the router by giving no shut command on each interface.

- OSPF process id can range from (1-65535) There are 3 steps to configure using OSPF :

1. Define OSPF process

2. Configure Router ID

3. Advertise connected network and area they belong to

- First we define ospf process using command “router ospf 1”

- Configure Router Id as the database table take router id

- Advertise network and area they belong to.

- Here we use **wildcard mask** instead subnetmask to find shortest path.

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#
Router(config)#hostname R1
R1(config)#int g0/1
R1(config-if)#ip ad
R1(config-if)#ip address 192.168.10.100 255.255.255.0
R1(config-if)#no shutdown
R1(config-if)#exit
R1(config)#
R1(config)#int g0/0
R1(config-if)#ip ad
R1(config-if)#ip address 20.20.20.1 255.255.255.252
R1(config-if)#no shut
R1(config-if)#exit
R1(config)#int g0/2
R1(config-if)#ip ad
R1(config-if)#ip address
% Incomplete command.
R1(config-if)#ip address 10.10.10.1 255.255.255.252
R1(config-if)#no shut
```

```
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#router ospf 1
R1(config-router)#router-id 100.100.100.1
R1(config-router)#network 192.168.10.0 0.0.0.255 area 0
R1(config-router)#network 10.10.10.0 0.0.0.3 area 0
R1(config-router)#network 20.20.20.0 0.0.0.3 area 0
R1(config-router)#exit
R1(config)#do write
Building configuration...
[OK]
```

OSPF configuration on R2

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R2
R2(config)#int fa0/0
R2(config-if)#ip ad
R2(config-if)#ip address 20.20.20.2 255.255.255.252
R2(config-if)#no shut
R2(config-if)#exit
R2(config)#
R2(config)#int fa0/1
R2(config-if)#ip ad
R2(config-if)#ip address 30.30.30.1 255.255.255.252
R2(config-if)#no shut
```

```
R2(config)#router ospf 2
R2(config-router)#router-id 150.150.150.1
R2(config-router)#network 20.20.20.0 0.0.0.3 area 0
R2(config-router)#network 30.30.30.0 0.
00:34:14: %OSPF-5-ADJCHG: Process 2, Nbr 100.100.100.1 on FastEthernet0/0 from LOADING to FULL, Loading Done
0.0.3 area 0
R2(config-router)#exit
R2(config)#do write
```

OSPF Configuration on R3

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R3
R3(config)#int g0/0
R3(config-if)#ip ad
R3(config-if)#ip address 10.10.10.2 255.255.255.252
R3(config-if)#no shut
R3(config-if)#exit
R3(config)#
R3(config)#int g0/2
R3(config-if)#ip ad
R3(config-if)#ip address 30.30.30.2 255.255.255.252
R3(config-if)#no shut
R3(config-if)#exit
R3(config)#int g0/1
R3(config-if)#ip ad
R3(config-if)#ip address 192.168.30.100 255.255.255.0
R3(config-if)#no shut
```

```
R3(config)#router ospf 3
R3(config-router)#router-id 200.200.200.1
R3(config-router)#network 192.168.30.0 0.0.0.255 area 0
R3(config-router)#network 30.30.30.0 0.0.0.3 area 0
R3(config-router)#network 10.10.10.0 0.0.0.
00:36:46: %OSPF-5-ADJCHG: Process 3, Nbr 150.150.150.1 on GigabitEthernet0/2 from LOADING to FULL, Loading Done
3 area 0
R3(config-router)#exit
R3(config)#exit
```

Prefix: 20.0.0.0/30

This indicates the network 20.0.0.0 with a subnet mask of 255.255.255.252, which has one subnet.

- **20.20.20.0/30**
    - **O**: This route is learned via OSPF.
    - The router can reach this network through two paths:
        - **via 30.30.30.1**: using GigabitEthernet0/2 with a metric of [110/2].
        - **via 10.10.10.1**: using GigabitEthernet0/0 with a metric of [110/2].

Prefix: 192.168.10.0/24

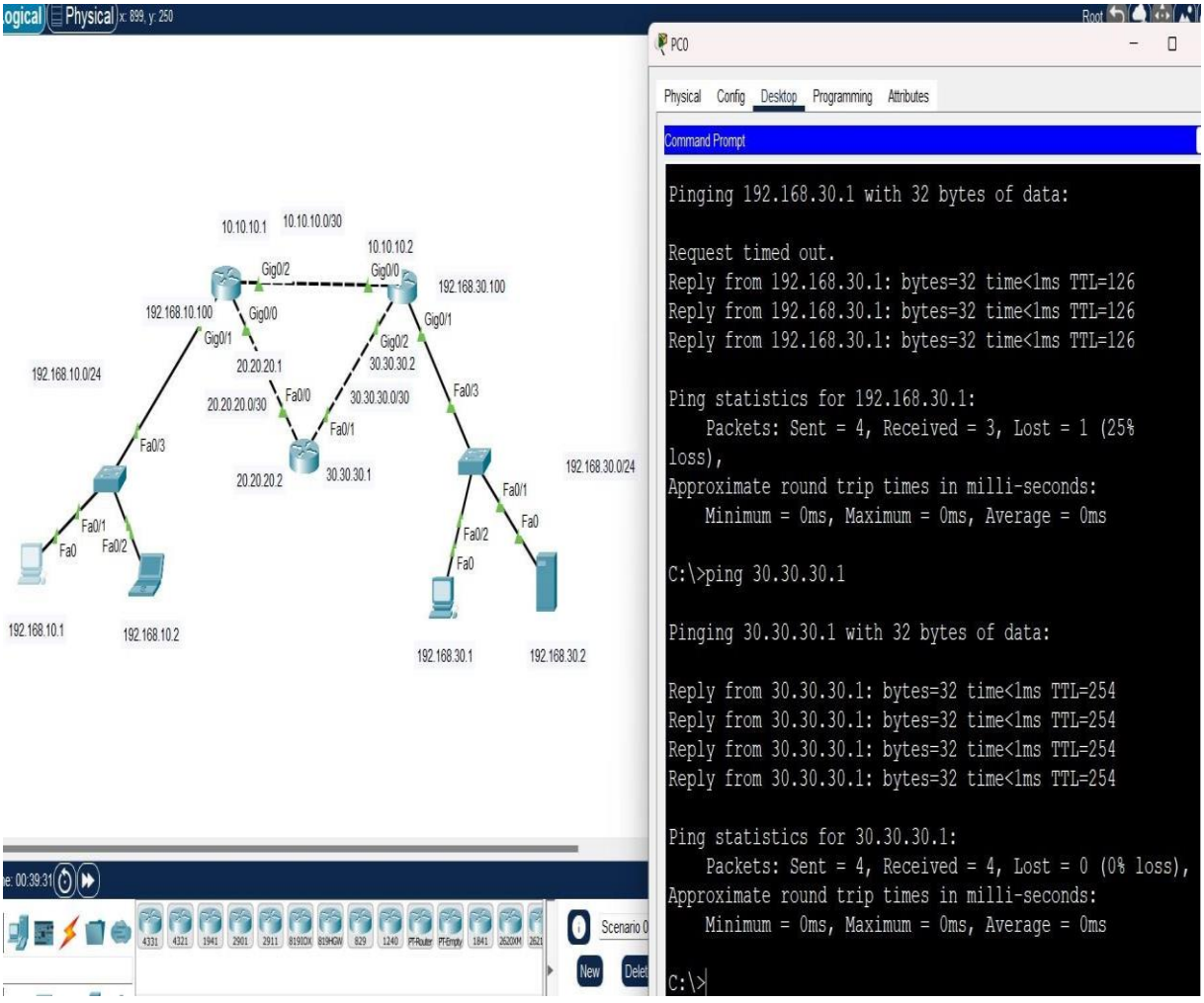
This indicates the network 192.168.10.0 with a subnet mask of 255.255.255.0.

- **192.168.10.0/24**
    - **O**: This route is learned via OSPF.
    - The router can reach this network via

10.10.10.1 using the GigabitEthernet0/0 interface with a metric of [110/2].

```
R3#sh ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
100.100.100.1     1   FULL/DR         00:00:35    10.10.10.1      GigabitEthernet0/0
150.150.150.1     1   FULL/DR         00:00:38    30.30.30.1      GigabitEthernet0/2
R3#sh ip ospf database
            OSPF Router with ID (200.200.200.1) (Process ID 3)

                Router Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum Link count
150.150.150.1   150.150.150.1   74          0x80000004 0x008ff6 2
200.200.200.1   200.200.200.1   57          0x80000005 0x00b644 3
100.100.100.1   100.100.100.1   57          0x80000005 0x00eeb8 3

                Net Link States (Area 0)
Link ID         ADV Router      Age         Seq#       Checksum
20.20.20.1      100.100.100.1   225         0x80000001 0x00d8ba
30.30.30.1      150.150.150.1   74          0x80000001 0x000138
10.10.10.1      100.100.100.1   57          0x80000002 0x0039d2
R3#sh 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       10.10.10.0/30 is directly connected, GigabitEthernet0/0
L       10.10.10.2/32 is directly connected, GigabitEthernet0/0
     20.0.0.0/30 is subnetted, 1 subnets
O       20.20.20.0/30 [110/2] via 30.30.30.1, 00:00:58, GigabitEthernet0/2
                      [110/2] via 10.10.10.1, 00:00:58, GigabitEthernet0/0
     30.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       30.30.30.0/30 is directly connected, GigabitEthernet0/2
L       30.30.30.2/32 is directly connected, GigabitEthernet0/2
O    192.168.10.0/24 [110/2] via 10.10.10.1, 00:00:58, GigabitEthernet0/0
     192.168.30.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.30.0/24 is directly connected, GigabitEthernet0/1
L       192.168.30.100/32 is directly connected, GigabitEthernet0/1
```

- Assign Ip address and default gateway for all the PCs .Here we used different networks with different variable length /24 and /30.
- Now ping PC 192.168.30.1 from PC 192.168.10.1
- The ping is successful . 1st ping fails due to ARP.
- Now ping other networks the ping is successful that means every network can communicate with each other.



Demonstration with packet sniffer

Whole project link: https://github.com/Nithika-KS/Aicte-Cisco-Virtual-Intern-