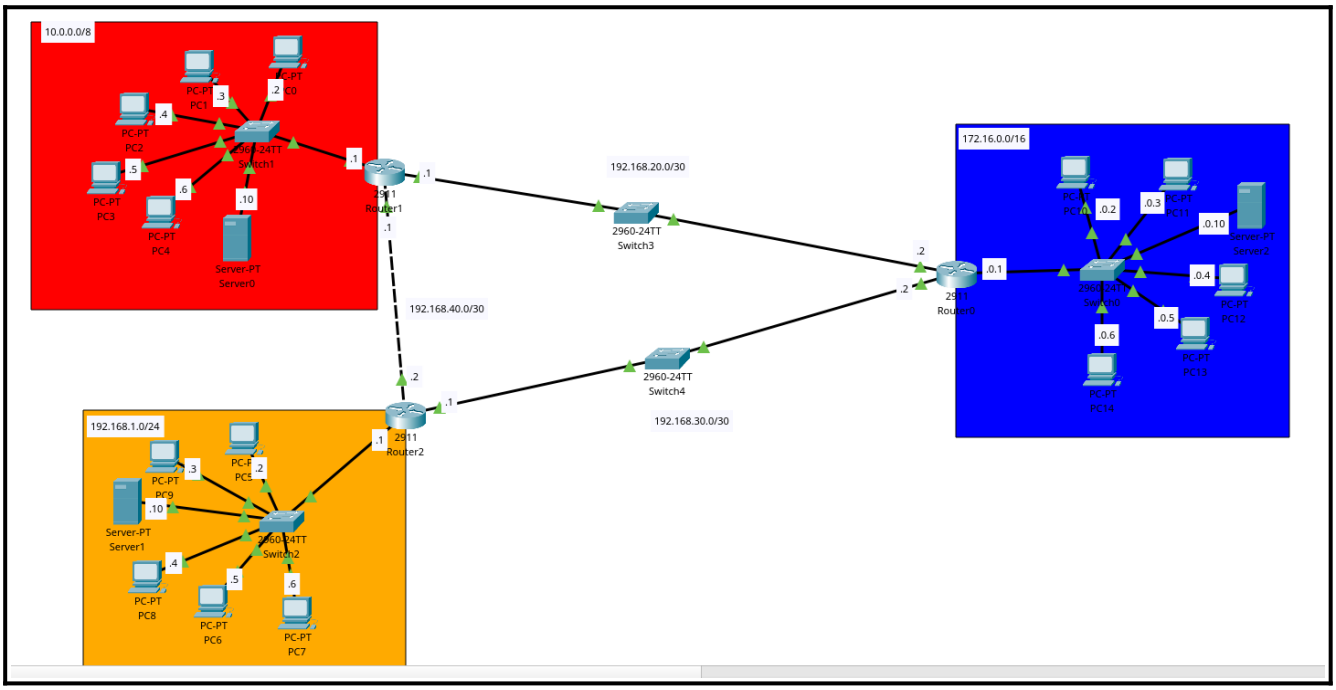
NETWORK TOPOLOGY AS CREATED IN PACKET TRACER



LAN CONFIGURATION

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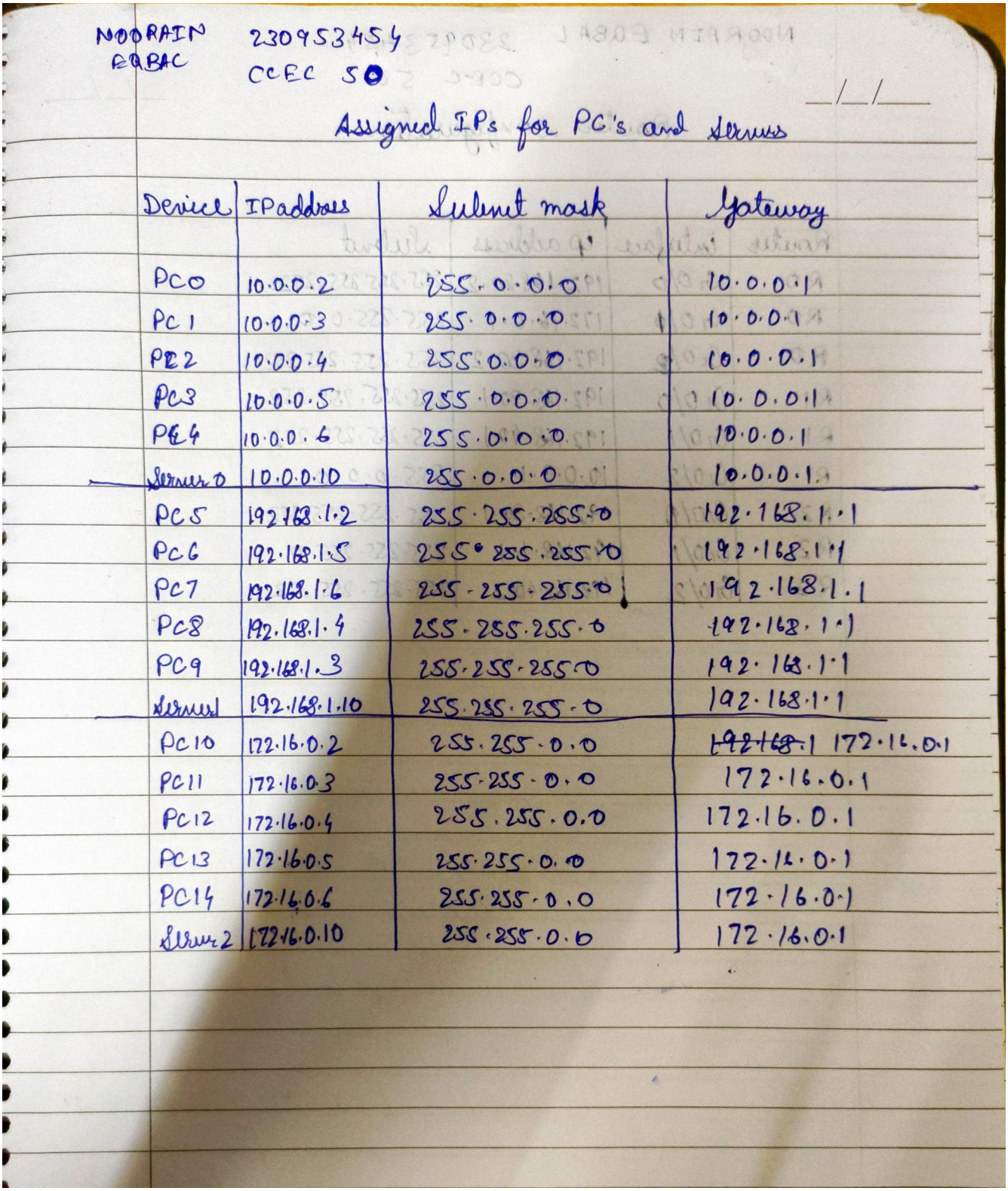
LAN networks (switch, PC's and servers)

Switch	connected devices	network address	subnet mask	class
Switch 0	PC10, PC11, PC12 PC13, PC14, S2	172.16.0.0/16	255.255.0.0	B
Switch 1	PC0 – PC4 S1	10.0.0.0/8	255.0.0.0	A
Switch 2	PC5 – PC9 S0	192.168.1.0/24	255.255.255.0	C
Switch 3	R1, R0	192.168.20.0/30	255.255.255.252	classless
Switch 4	R0, R2	192.168.30.0/30	255.255.255.252	classless

IP ADDRESS ASSIGNED FOR EACH PC AND SERVER



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Assigned IPs for PC's and Servers

Device	IP address	Subnet mask	Gateway
PC0	10.0.0.2	255.0.0.0	10.0.0.1
PC1	10.0.0.3	255.0.0.0	10.0.0.1
PC2	10.0.0.4	255.0.0.0	10.0.0.1
PC3	10.0.0.5	255.0.0.0	10.0.0.1
PC4	10.0.0.6	255.0.0.0	10.0.0.1
Server0	10.0.0.10	255.0.0.0	10.0.0.1
PC5	192.168.1.2	255.255.255.0	192.168.1.1
PC6	192.168.1.5	255.255.255.0	192.168.1.1
PC7	192.168.1.6	255.255.255.0	192.168.1.1
PC8	192.168.1.4	255.255.255.0	192.168.1.1
PC9	192.168.1.3	255.255.255.0	192.168.1.1
Server1	192.168.1.10	255.255.255.0	192.168.1.1
PC10	172.16.0.2	255.255.0.0	~~192.168.1~~ 172.16.0.1
PC11	172.16.0.3	255.255.0.0	172.16.0.1
PC12	172.16.0.4	255.255.0.0	172.16.0.1
PC13	172.16.0.5	255.255.0.0	172.16.0.1
PC14	172.16.0.6	255.255.0.0	172.16.0.1
Server2	172.16.0.10	255.255.0.0	172.16.0.1

ROUTER CONFIGURATION

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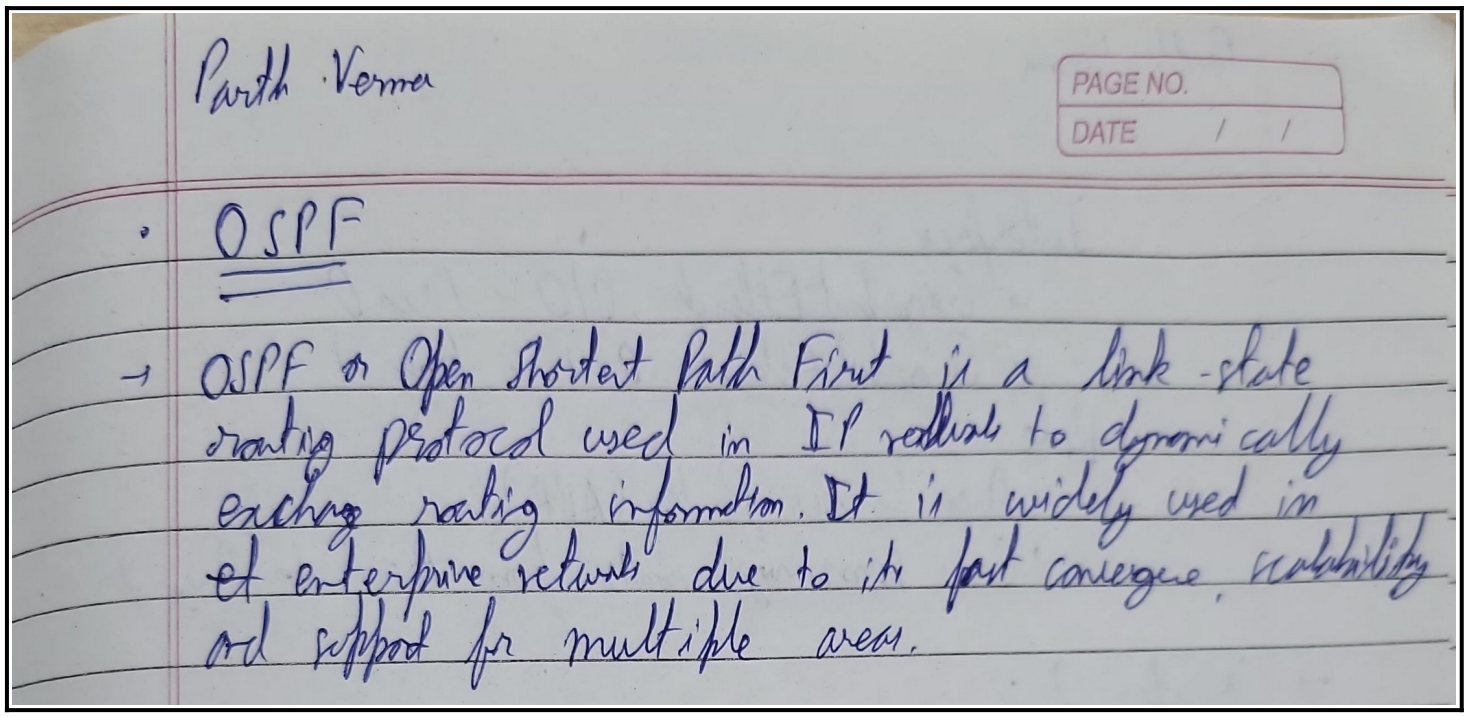
Router configuration

Router	interface	ip address	Subnet
R0	Gi0/0	192.168.20.2	255.255.255.252
R0	Gi0/1	172.16.0.1	255.255.0.0
R0	Gi0/2	192.168.30.2	255.255.255.252
R1	Gi0/0	192.168.20.1	255.255.255.252
R1	Gi0/1	192.168.40.1	255.255.255.252
R1	Gi0/2	10.0.0.1	255.0.0.0
R2	Gi0/0	192.168.30.1	255.255.255.252
R2	Gi0/1	192.168.1.1	255.255.255.0
R2	Gi0/2	192.168.40.2	255.255.255.252

OSPF Configuration for the network



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• OSPF

→ OSPF or Open Shortest Path First is a link-state routing protocol used in IP network to dynamically exchange routing information. It is widely used in enterprise networks due to its fast convergence, scalability and support for multiple areas.

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⇒ Router 0

- Router ID : Not explicitly set
- OSPF Area : Area 0 (Backbone)
- Connected Networks :
  - 172.16.0.0/16 → Cover a large subnet
  - 192.168.20.0/30 → PTP ~~link~~ link to Router 1
  - 192.168.30.0/30 → PTP link to Router 2
- Role :
  - Backbone Router
  - Facilitates communication between Router 1 and Router 2

⇒ Router 1

- Router ID : Not explicitly set, so highest IP address of an active interface will be used
- OSPF Area : Area 0 (Backbone)
- Connected Networks :
  - 10.0.0.0/8 → Large network covering 10.x.x.x range
  - 192.168.20.0/30 → PTP link
  - 192.168.40.0/30 → PTP link
- Role :
  - Backbone Router
  - Connects to Router 0 via 192.168.20.0/30
  - Connects to Router 2 via 192.168.40.0/30

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⇒ Router 2

→ Router ID: Not explicitly set
→ OSPF Area: Area 0
→ Connected Networks:
  • 192.168.1.0/24 → Local subnet
  • 192.168.30.0/30 → PTP link to Router 0
  • 192.168.40.0/30 → PTP link to Router 1

→ Role:
  • Backbone Router
  • Connects both Router 0 and Router 1

BGP configuration for the networ

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BGP (Border Gateway Protocol)

Router 0

```
en
conf t
router bgp 65000
bgp router-id 0.0.0.0
neighbour 192.168.20.1 remote-as 65001
neighbour 192.168.30.1 remote-as 65002
network 172.16.0.0 mask 255.255.0.0
```

Router 1

```
en
conf t
router bgp 65001
bgp router-id 1.1.1.1
neighbour 192.168.20.2 remote-as 65000
neighbour 192.168.40.2 remote-as 65002
network 10.0.0.0 mask 255.0.0.0
```

Router 2

```
en
conf t
router bgp 65002
bgp router-id 2.2.2.2
neighbour 192.168.30.2 remote-as 65000
neighbour 192.168.40.1 remote-as 65001
network 192.168.1.0 mask 255.255.255.0
```

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→ Introduction :-

BGP (Border Gateway Protocol) is an inter domain routing protocol used to exchange routing information between different autonomous systems (AS). It helps in determining the best path for data to travel across the internet.

Each Router is part of Autonomous System (AS) and is configured to establish BGP peering with its neighbours.

→ Breakdown :-

Router 0 (AS 65000) peers with Router 1 (AS 65001) and Router 2
It advertises the 172.16.0.0/16 network

Router 1 (AS 65001) peers with Router 0 (AS 65000) and Router 2 (AS 65002)
It advertises the 10.0.0.0/8 network

Router 2 (AS 65002) peers with Router 0 (AS 65000) and Router 1 (AS 65001)
It advertises the 192.168.1.0/24

OSPF ROUTING TABLE

ROUTER 0

```
Router>show ip ospf neighbor


Neighbor ID     Pri   State           Dead Time   Address         Interface
192.168.40.1      1   FULL/BDR        00:00:30    192.168.20.1    GigabitEthernet0/0
192.168.40.2      1   FULL/DR         00:00:30    192.168.30.1    GigabitEthernet0/2
Router>show ip route ospf
     192.168.40.0/30 is subnetted, 1 subnets
O       192.168.40.0 [110/2] via 192.168.20.1, 04:37:48, GigabitEthernet0/0
                     [110/2] via 192.168.30.1, 04:37:48, GigabitEthernet0/2
```

ROUTER 1

```
Router>show ip ospf neighbor


Neighbor ID     Pri   State           Dead Time   Address         Interface
192.168.40.2      1   FULL/DR         00:00:37    192.168.40.2    GigabitEthernet0/1
192.168.30.1      1   FULL/DR         00:00:31    192.168.20.2    GigabitEthernet0/0
Router>show ip route ospf
     192.168.30.0/30 is subnetted, 1 subnets
O       192.168.30.0 [110/2] via 192.168.20.2, 04:38:41, GigabitEthernet0/0
                     [110/2] via 192.168.40.2, 04:38:41, GigabitEthernet0/1
```

ROUTER 2

```
Router>show ip ospf neighbor


Neighbor ID     Pri   State           Dead Time   Address         Interface
192.168.30.1      1   FULL/BDR        00:00:38    192.168.30.2    GigabitEthernet0/0
192.168.40.1      1   FULL/BDR        00:00:31    192.168.40.1    GigabitEthernet0/2
Router>show ip route ospf
     192.168.20.0/30 is subnetted, 1 subnets
O       192.168.20.0 [110/2] via 192.168.30.2, 04:39:33, GigabitEthernet0/0
                     [110/2] via 192.168.40.1, 04:39:33, GigabitEthernet0/2
```

BGP ROUTING TABLE

ROUTER 0

```
Router>show ip bgp
BGP table version is 6, local router ID is 0.0.0.0
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*> 10.0.0.0/8        192.168.20.1             0     0     0 65001 i
*                    192.168.30.1             0     0     0 65002 65001 i
*> 172.16.0.0/16     0.0.0.0                  0     0 32768 i
*> 192.168.1.0/24    192.168.30.1             0     0     0 65002 i
*                    192.168.20.1             0     0     0 65001 65002 i

Router>show ip route bgp
B    10.0.0.0/8 [20/0] via 192.168.20.1, 00:00:00
B    192.168.1.0/24 [20/0] via 192.168.30.1, 00:00:00
```

ROUTER 1

```
Router>show ip bgp
BGP table version is 6, local router ID is 1.1.1.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*> 10.0.0.0/8        0.0.0.0                  0     0 32768 i
*> 172.16.0.0/16     192.168.20.2             0     0     0 65000 i
*                    192.168.40.2             0     0     0 65002 65000 i
*  192.168.1.0/24    192.168.20.2             0     0     0 65000 65002 i
*>                   192.168.40.2             0     0     0 65002 i

Router>show ip route bgp
B    172.16.0.0/16 [20/0] via 192.168.20.2, 00:00:00
B    192.168.1.0/24 [20/0] via 192.168.40.2, 00:00:00
```

ROUTER 2

```
Router>show ip bgp
BGP table version is 6, local router ID is 2.2.2.2
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*> 10.0.0.0/8        192.168.40.1             0     0     0 65001 i
*                    192.168.30.2             0     0     0 65000 65001 i
*  172.16.0.0/16     192.168.40.1             0     0     0 65001 65000 i
*>                   192.168.30.2             0     0     0 65000 i
*> 192.168.1.0/24    0.0.0.0                  0     0 32768 i

Router>show ip route bgp
B    10.0.0.0/8 [20/0] via 192.168.40.1, 00:00:00
B    172.16.0.0/16 [20/0] via 192.168.30.2, 00:00:00
```

ROUTING TABLES

Router 0

```
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

B    10.0.0.0/8 [20/0] via 192.168.20.1, 00:00:00
     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.0.0/16 is directly connected, GigabitEthernet0/1
L       172.16.0.1/32 is directly connected, GigabitEthernet0/1
B    192.168.1.0/24 [20/0] via 192.168.30.1, 00:00:00
     192.168.20.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.20.0/30 is directly connected, GigabitEthernet0/0
L       192.168.20.2/32 is directly connected, GigabitEthernet0/0
     192.168.30.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.30.0/30 is directly connected, GigabitEthernet0/2
L       192.168.30.2/32 is directly connected, GigabitEthernet0/2
     192.168.40.0/30 is subnetted, 1 subnets
```

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       10.0.0.0/8 is directly connected, GigabitEthernet0/2
L       10.0.0.1/32 is directly connected, GigabitEthernet0/2
B    172.16.0.0/16 [20/0] via 192.168.20.2, 00:00:00
B    192.168.1.0/24 [20/0] via 192.168.40.2, 00:00:00
     192.168.20.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.20.0/30 is directly connected, GigabitEthernet0/0
L       192.168.20.1/32 is directly connected, GigabitEthernet0/0
     192.168.30.0/30 is subnetted, 1 subnets
O       192.168.30.0/30 [110/2] via 192.168.20.2, 04:44:30, GigabitEthernet0/0
                        [110/2] via 192.168.40.2, 04:44:30, GigabitEthernet0/1
     192.168.40.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.40.0/30 is directly connected, GigabitEthernet0/1
L       192.168.40.1/32 is directly connected, GigabitEthernet0/1
```

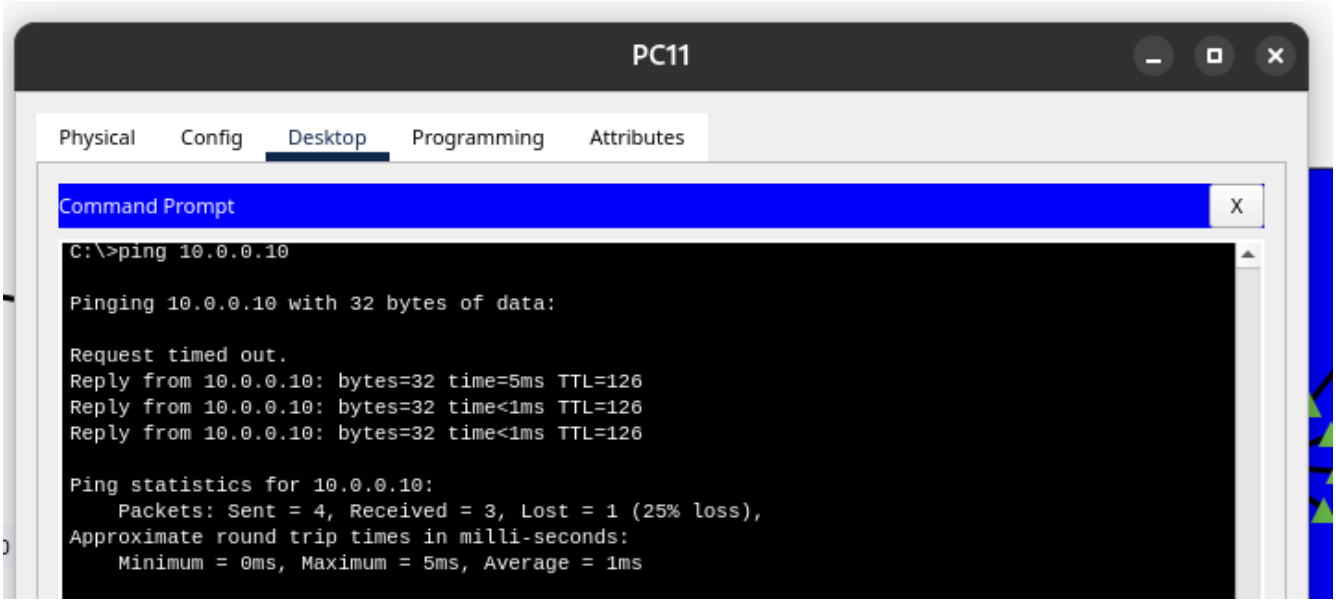
Router 2

```
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

B    10.0.0.0/8 [20/0] via 192.168.40.1, 00:00:00
B    172.16.0.0/16 [20/0] via 192.168.30.2, 00:00:00
     192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.1.0/24 is directly connected, GigabitEthernet0/1
L       192.168.1.1/32 is directly connected, GigabitEthernet0/1
     192.168.20.0/30 is subnetted, 1 subnets
O       192.168.20.0/30 [110/2] via 192.168.30.2, 04:45:14, GigabitEthernet0/0
                        [110/2] via 192.168.40.1, 04:45:14, GigabitEthernet0/2
     192.168.30.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.30.0/30 is directly connected, GigabitEthernet0/0
L       192.168.30.1/32 is directly connected, GigabitEthernet0/0
     192.168.40.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.40.0/30 is directly connected, GigabitEthernet0/2
L       192.168.40.2/32 is directly connected, GigabitEthernet0/2
```

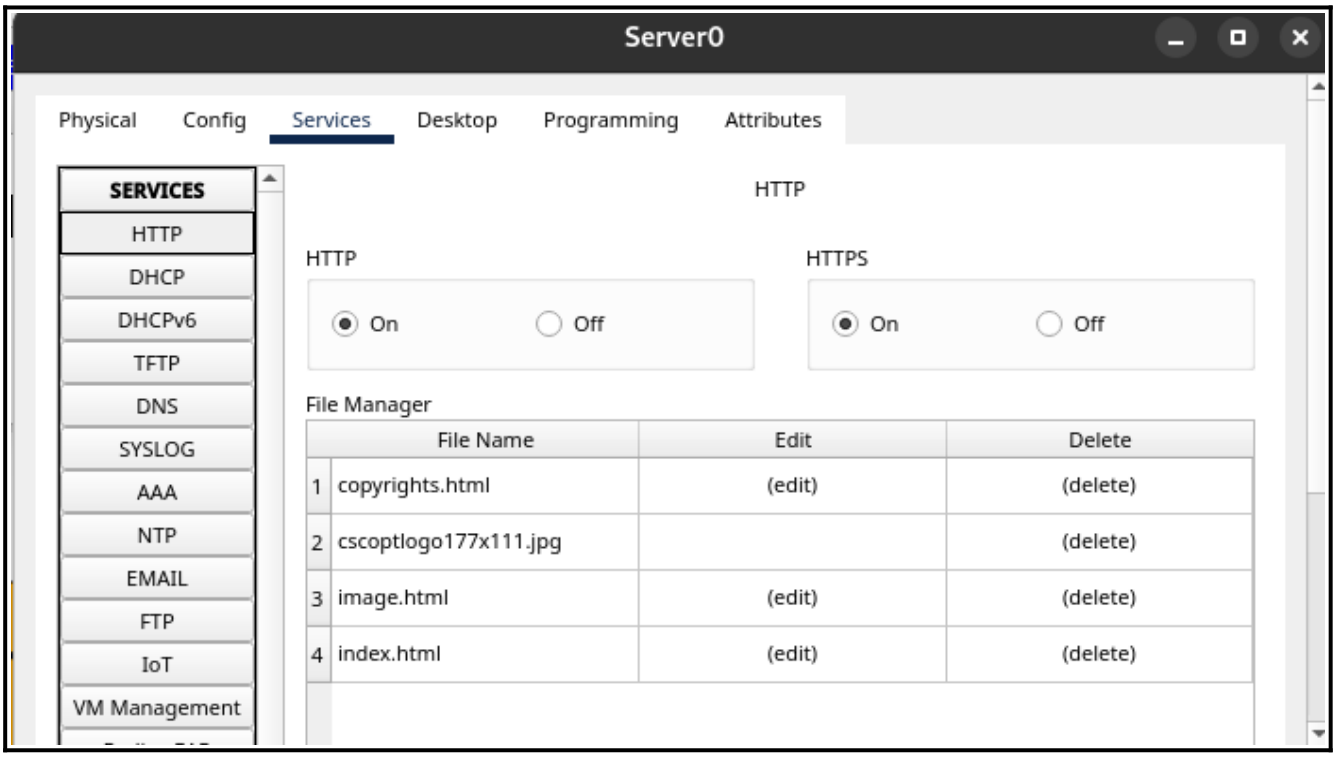
CHECKING CONNECTIVITY



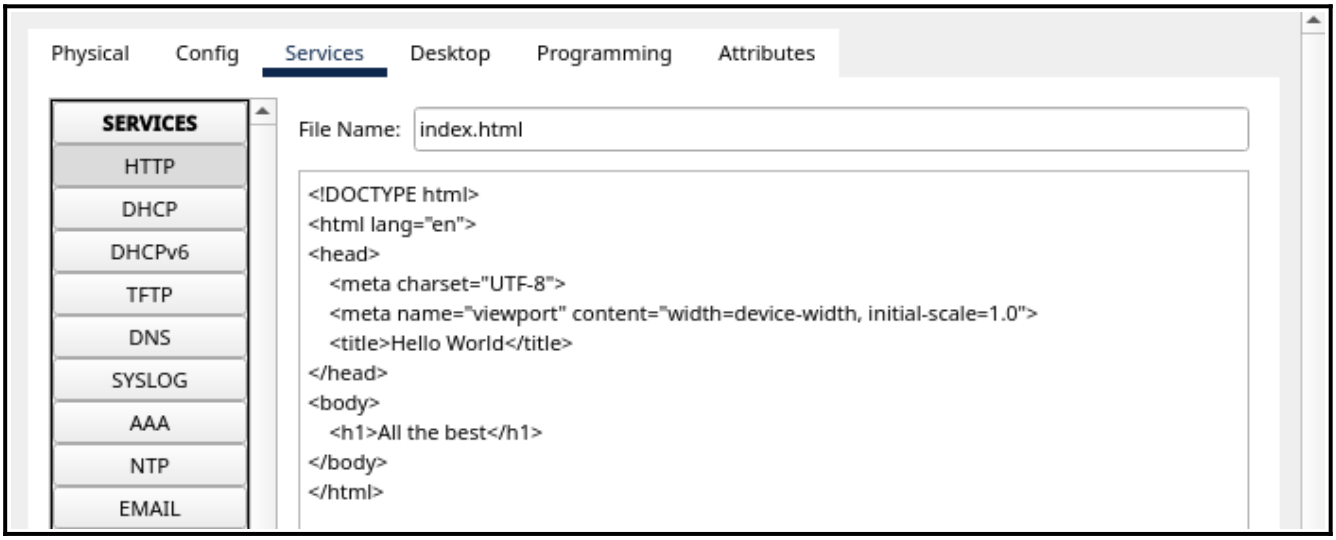
PC11 in subnet 172.16.0.0/16 pings Server 0 in subnet 10.0.0.0/8

Displaying “ALL THE BEST” message on PC0 from server 0

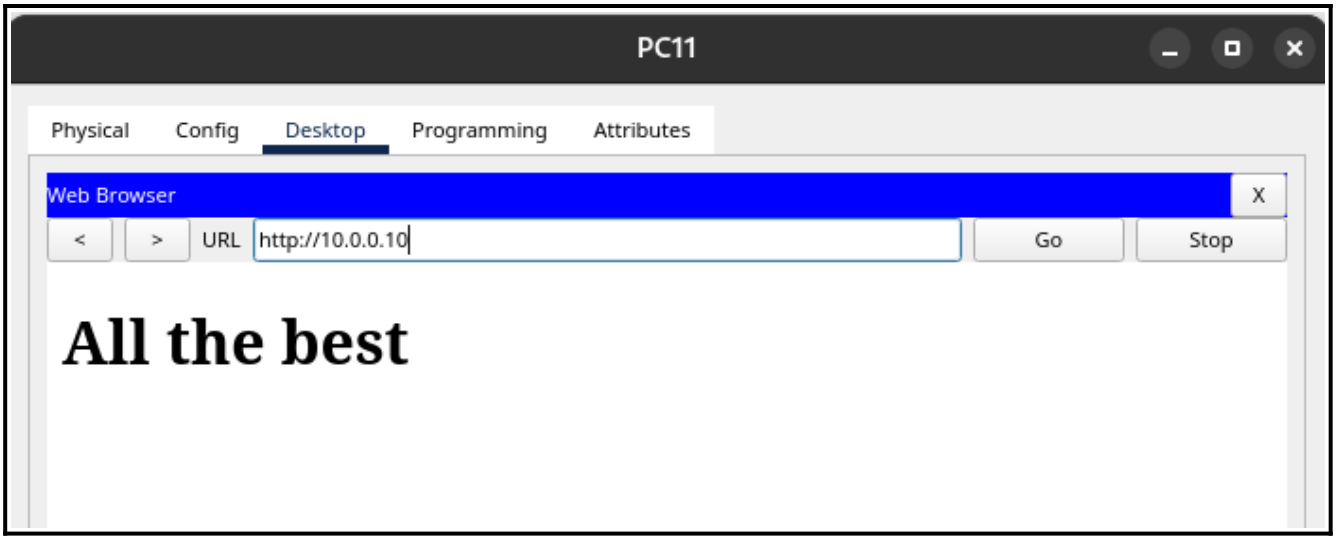
Server 0 configuration



index.html file on server 0



All the best message on PC11



ETHERNET FRAME

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Ethernet frame

Introduction to Ethernet frames

Ethernet is one of the most widely used networking technologies. It defines the structure of data packets known as Ethernet frames, which are used for communications over a network. Ethernet frames encapsulate data and provide essential information for addressing and error checking.

Structure of an Ethernet Frame

An Ethernet frame consists of several fields, each serving a specific function. The standard frame structure follows the IEEE 802.3 protocol and consists of the following components:

1) Preamble (7 bytes)

A sequence of alternating 1s and 0s.

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Helps synchronize the sender and receiver clock

2) Start Frame Delimiter (SFD) (1 Byte)

Marks the end of the preamble and the beginning of the actual frame.

Value : 10101011 (binary)

3) Destination MAC Address (6 Bytes)

Identifies the intended recipient of the frame.
If the destination MAC is FF:FF:FF:FF:FF:FF, the frame is a broadcast message sent to all devices in the network.

4) Source MAC Address (6 Bytes)

Specifies the sender's MAC address.
Enables the recipient to send a response back to the sender.

5) EtherType / Length (2 Bytes)

If the value is greater than 1536 (0x0600), it represents an EtherType, indicating the protocol (e.g. IPV4, IPv6, ARP).

If the value is less than or equal to 1500, it represents the length of the payload (used in IEEE 802.3 frames).

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6) Payload / Data (46-1500 Bytes)

Contains the actual data being transmitted.

Minimum payload size is 46 bytes; padding is added if necessary.

7) Frame Check Sequence (FCS) (4 Bytes)

Uses a Cyclic Redundancy Check (CRC) to detect errors in the frame.
If an error is detected, the frame is discarded.

Ethernet Frame Variants.

There are different types of Ethernet frames based on standards and use cases:

1) Ethernet II (DIX Ethernet)

Commonly used in modern networks.

2) IEEE 802.3 Frame

Supports IEEE 802.2 Logical Link Control (LLC) and SNAP headers.

3) VLAN Tagged Frame (IEEE 802.1Q)

Used for Virtual LAN (VLAN) segmentation.

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4) Jumbo Frames

Improve Efficiency by reducing overhead in high-speed networks.

ETHERNET FRAME AS VIEWED IN SIMULATION MODE OF PACKET TRACER