

INSTITUTE OF COMPUTER TECHNOLOGY
B. TECH COMPUTER SCIENCE AND ENGINEERING
Subject: Computer Networks[CN]

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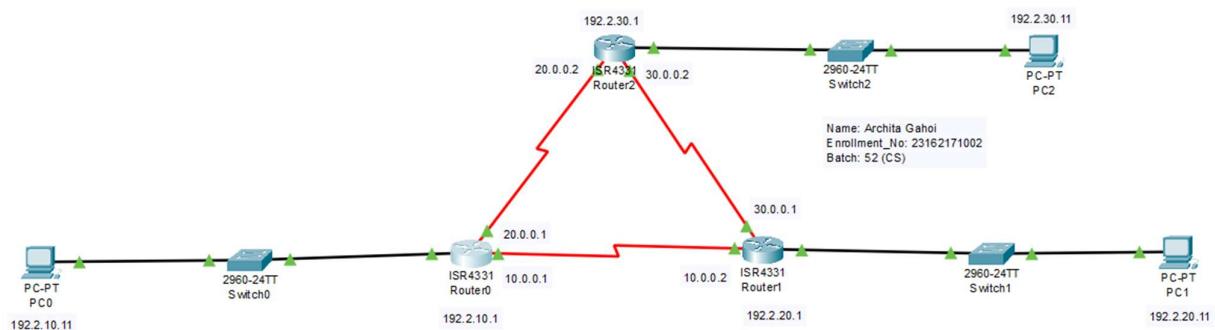
Practical 9

Aim: To design a network using Border Gateway Protocol (BGP).

Scenario:

Consider that organization has three departments and as routing protocol Border Gateway Protocol (BGP) is to be implemented. Configure network as shown in figure below and implement Border Gateway Protocol (BGP).

⇒ Main Circuit

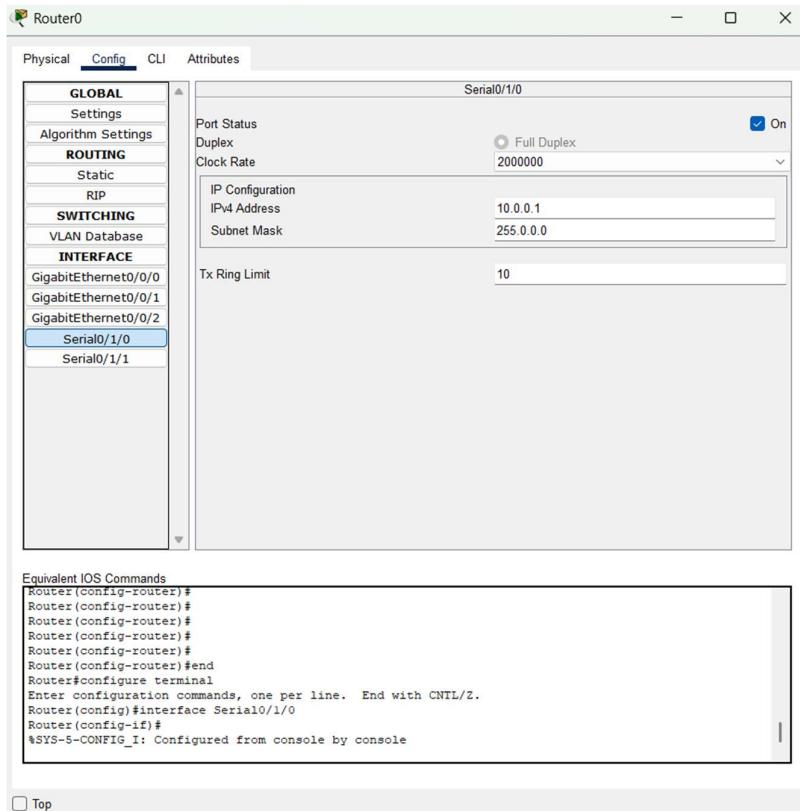
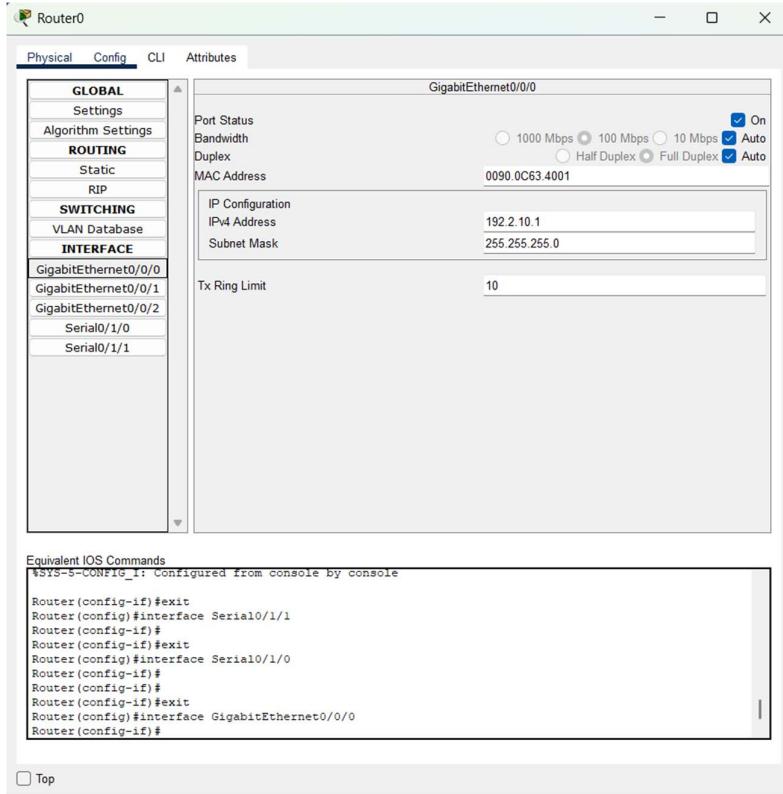


Configuration:

IP Address:

⇒ Routers

Router 0



Router0

Physical Config CLI Attributes

GLOBAL

- Settings
- Algorithm Settings

ROUTING

- Static
- RIP

SWITCHING

VLAN Database

INTERFACE

- GigabitEthernet0/0/0
- GigabitEthernet0/0/1
- GigabitEthernet0/0/2
- Serial0/1/0
- Serial0/1/1**

Serial0/1/1

Port Status

Duplex On Full Duplex

Clock Rate 2000000

IP Configuration

IPv4 Address 20.0.0.1

Subnet Mask 255.0.0.0

Tx Ring Limit 10

Equivalent IOS Commands

```
Router(config-router)#
Router(config-router)#
Router(config-router)#end
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface Serial0/1/0
Router(config-if)#
%SYS-5-CONFIG_I: Configured from console by console

Router(config-if)#exit
Router(config)#interface Serial0/1/1
Router(config-if)#

```

Top

Router 1

Router1

Physical Config CLI Attributes

GLOBAL

Settings

Algorithm Settings

ROUTING

Static

RIP

SWITCHING

VLAN Database

INTERFACE

GigabitEthernet0/0/0

GigabitEthernet0/0/1

GigabitEthernet0/0/2

Serial0/1/0

Serial0/1/1

GigabitEthernet0/0/0

Port Status: On

Bandwidth: 1000 Mbps

Duplex: Full Duplex

MAC Address: 0002.4AC5.1D01

IP Configuration:

IPv4 Address: 192.2.20.1

Subnet Mask: 255.255.255.0

Tx Ring Limit: 10

Equivalent IOS Commands

```
Router(config-if)#  
Router(config-if)#exit  
Router(config)#interface Serial0/1/0  
Router(config-if)#exit  
Router(config-if)#exit  
Router(config)#interface Serial0/1/1  
Router(config-if)#exit  
Router(config-if)#exit  
Router(config)#interface GigabitEthernet0/0/0  
Router(config-if)#
```

Top

Router1

Physical Config CLI Attributes

GLOBAL

Settings

Algorithm Settings

ROUTING

Static

RIP

SWITCHING

VLAN Database

INTERFACE

GigabitEthernet0/0/0

GigabitEthernet0/0/1

GigabitEthernet0/0/2

Serial0/1/0

Serial0/1/1

Serial0/1/0

Port Status: On

Duplex: Full Duplex

Clock Rate: 2000000

IP Configuration:

IPv4 Address: 10.0.0.2

Subnet Mask: 255.0.0.0

Tx Ring Limit: 10

Equivalent IOS Commands

```
L 192.2.20.1/32 is directly connected, GigabitEthernet0/0/0  
B 192.2.30.0/24 [20/0] via 30.0.0.2, 00:00:00  
  
Router(config-router)#  
Router(config-router)#  
Router(config-router)#end  
Router#configure terminal  
Enter configuration commands, one per line. End with CNTL/Z.  
Router(config)#interface Serial0/1/0  
Router(config-if)#  
%SYS-5-CONFIG_I: Configured from console by console
```

Top

Router1

Physical Config CLI Attributes

GLOBAL

Settings

Algorithm Settings

ROUTING

Static

RIP

SWITCHING

VLAN Database

INTERFACE

GigabitEthernet0/0/0

GigabitEthernet0/0/1

GigabitEthernet0/0/2

Serial0/1/0

Serial0/1/1

Serial0/1/1

Port Status

Duplex Full Duplex

Clock Rate 2000000

IP Configuration

IPv4 Address 30.0.0.1

Subnet Mask 255.0.0.0

Tx Ring Limit 10

Equivalent IOS Commands

```
Router(config-router)#
Router(config-router)#
Router(config-router)#end
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface Serial0/1/0
Router(config-if)#
%SYS-5-CONFIG_I: Configured from console by console

Router(config-if)#exit
Router(config)#interface Serial0/1/1
Router(config-if)#

```

Top

Router 2

Router2

Physical Config CLI Attributes

GLOBAL
Settings
Algorithm Settings
ROUTING
Static
RIP
SWITCHING
VLAN Database
INTERFACE
GigabitEthernet0/0/0
GigabitEthernet0/0/1
GigabitEthernet0/0/2
Serial0/1/0
Serial0/1/1

GigabitEthernet0/0/0

Port Status: On
Bandwidth: 100 Mbps
Duplex: Full Duplex
MAC Address: 0009.7C65.B301

IP Configuration
IPv4 Address: 192.2.30.1
Subnet Mask: 255.255.255.0

Tx Ring Limit: 10

Equivalent IOS Commands

```
Press RETURN to get started!

Router>enable
Router#
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface GigabitEthernet0/0/0
Router(config-if)#

```

Top

Router2

Physical Config CLI Attributes

GLOBAL
Settings
Algorithm Settings
ROUTING
Static
RIP
SWITCHING
VLAN Database
INTERFACE
GigabitEthernet0/0/0
GigabitEthernet0/0/1
GigabitEthernet0/0/2
Serial0/1/0
Serial0/1/1

Serial0/1/0

Port Status: On
Duplex: Full Duplex
Clock Rate: 2000000

IP Configuration
IPv4 Address: 20.0.0.2
Subnet Mask: 255.0.0.0

Tx Ring Limit: 10

Equivalent IOS Commands

```
%SYS-5-CONFIG_I: Configured from console by console
Router(config-router)#end
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface GigabitEthernet0/0/2
Router(config-if)#
%SYS-5-CONFIG_I: Configured from console by console
Router(config-if)#exit
Router(config)#interface Serial0/1/0
Router(config-if)#

```

Top

Router2

Physical Config CLI Attributes

GLOBAL

Settings

Algorithm Settings

ROUTING

Static

RIP

SWITCHING

VLAN Database

INTERFACE

GigabitEthernet0/0/0

GigabitEthernet0/0/1

GigabitEthernet0/0/2

Serial0/1/0

Serial0/1/1

Port Status

Duplex Full Duplex

Clock Rate 2000000

IP Configuration

IPv4 Address 30.0.0.2

Subnet Mask 255.0.0.0

Tx Ring Limit 10

Equivalent IOS Commands

```
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface GigabitEthernet0/0/2
Router(config-if)#
%SYS-5-CONFIG_I: Configured from console by console

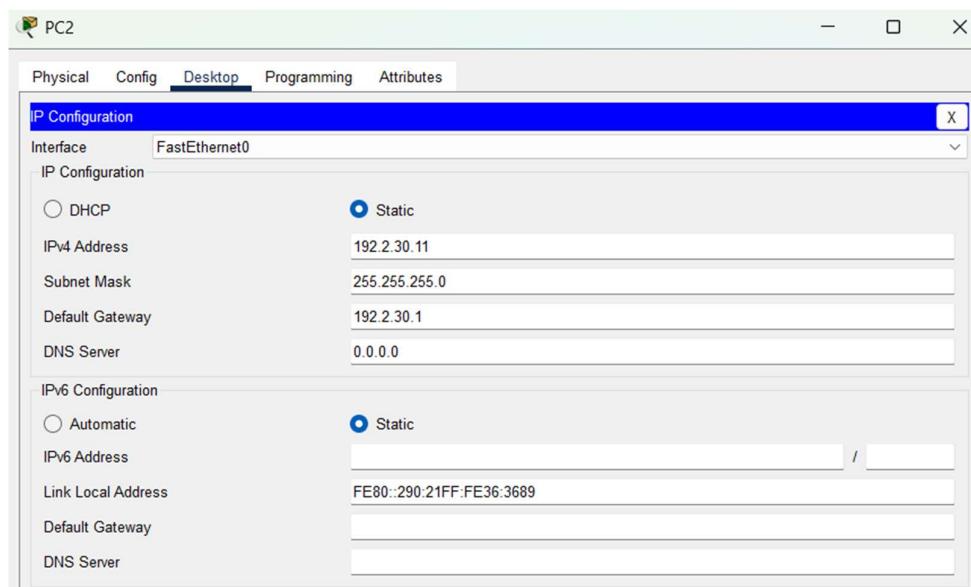
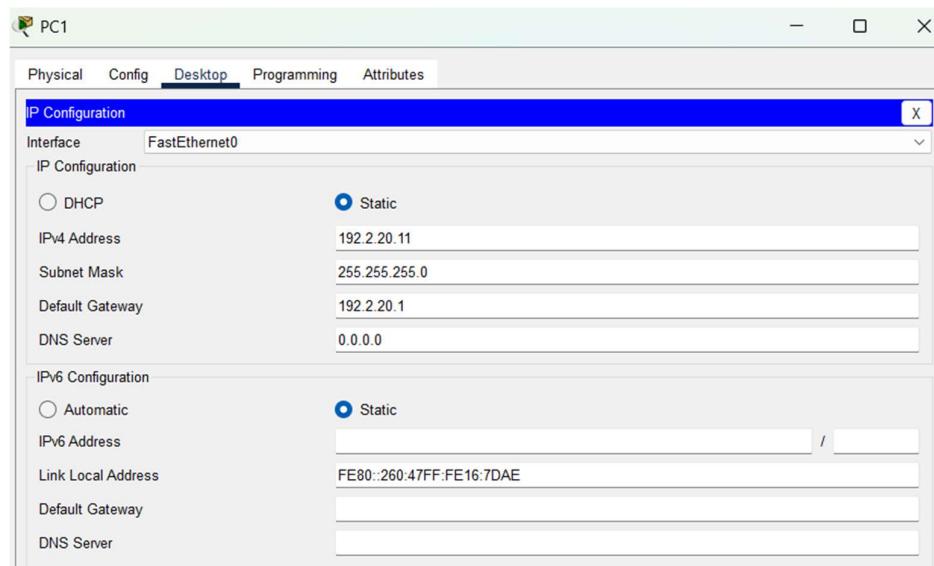
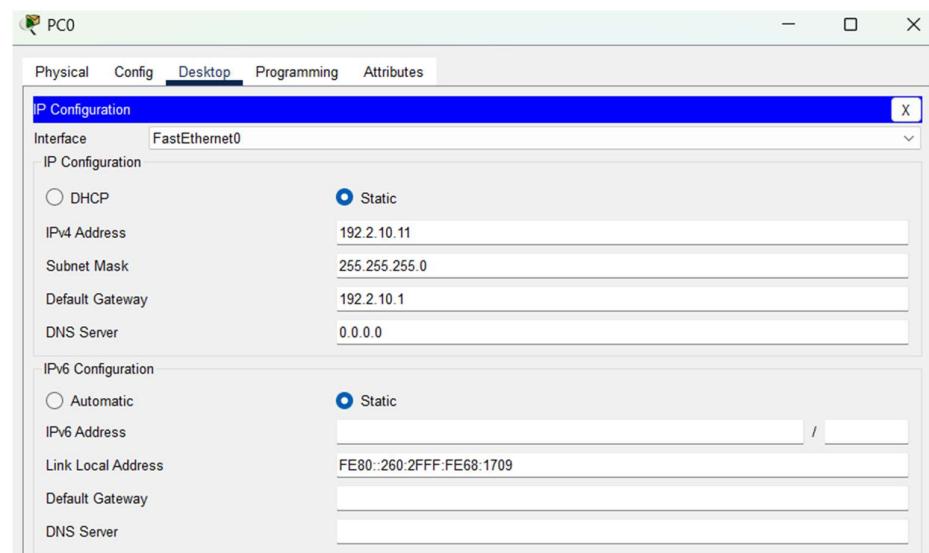
Router(config-if)#exit
Router(config)#interface Serial0/1/0
Router(config-if)#
Router(config-if)#exit
Router(config)#interface Serial0/1/1
Router(config-if)#

```

Top

⇒ PCS

PC0, PC1, PC2



⇒ Configuring Border Gateway Protocol (BGP) in Router0.

Router0

Physical Config **CLI** Attributes

IOS Command Line Interface

```
Router(config)#router bgp 10002
Router(config-router)#neighbor 20.0.0.2 remote-as 30002
Router(config-router)#neighbor 10.0.0.2 remote-as 10002
Router(config-router)#
%Cisco Packet Tracer does not support internal BGP in this version. Only external neighbors are supported.

neighbor 10.0.0.2 remote-as 20002
Router(config-router)#network 192.0.2.10.0 mask 255.255.255.0
Router(config-router)#do show ip bgp summary
BGP router identifier 192.2.10.1, local AS number 10002
BGP table version is 1, main routing table version 6
0 network entries using 0 bytes of memory
0 path entries using 0 bytes of memory
0/0 BGP path/bestpath attribute entries using 0 bytes of memory
0 BGP AS-PATH entries using 0 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
Bitfield cache entries: current 1 (at peak 1) using 32 bytes of memory
BGP using 32 total bytes of memory
BGP activity 0/0 prefixes, 0/0 paths, scan interval 60 secs

Neighbor      V      AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
20.0.0.2        4  30002       0       0       1       0    0 00:10:23      4
10.0.0.2        4  20002       0       0       1       0    0 00:10:23      4
```

Router0

Physical Config **CLI** Attributes

IOS Command Line Interface

```
Router(config-router)#do 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, Serial0/1/0
L    10.0.0.1/32 is directly connected, Serial0/1/0
  20.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C    20.0.0.0/8 is directly connected, Serial0/1/1
L    20.0.0.1/32 is directly connected, Serial0/1/1
  192.2.10.0/24 is variably subnetted, 2 subnets, 2 masks
C    192.2.10.0/24 is directly connected, GigabitEthernet0/0/0
L    192.2.10.1/32 is directly connected, GigabitEthernet0/0/0
B    192.2.20.0/24 [20/0] via 10.0.0.2, 00:00:00
B    192.2.30.0/24 [20/0] via 20.0.0.2, 00:00:00

Router(config-router)#

```

⇒ Configuring Border Gateway Protocol (BGP) in Router1.

Router1

Physical Config CLI Attributes

IOS Command Line Interface

```
BGP router identifier 192.2.20.1, local AS number 20002
BGP table version is 3, main routing table version 6
2 network entries using 264 bytes of memory
2 path entries using 104 bytes of memory
1/1 BGP path/bestpath attribute entries using 184 bytes of memory
2 BGP AS-PATH entries using 48 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
Bitfield cache entries: current 1 (at peak 1) using 32 bytes of memory
BGP using 632 total bytes of memory
BGP activity 2/0 prefixes, 2/0 paths, scan interval 60 secs

Neighbor      V   AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down State/PfxRcd
10.0.0.1      4   10002      4       3       3   0     0 00:01:10          4
30.0.0.2      4   30002      0       0       3   0     0 00:14:12          4

Router(config-router)#%BGP-5-ADJCHANGE: neighbor 30.0.0.2 Up

Router(config-router)#do 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, Serial0/1/0
L        10.0.0.2/32 is directly connected, Serial0/1/0
      30.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C        30.0.0.0/8 is directly connected, Serial0/1/1
L        30.0.0.1/32 is directly connected, Serial0/1/1
B        192.2.10.0/24 [20/0] via 10.0.0.1, 00:00:00
      192.2.20.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.2.20.0/24 is directly connected, GigabitEthernet0/0/0
L        192.2.20.1/32 is directly connected, GigabitEthernet0/0/0
B        192.2.30.0/24 [20/0] via 30.0.0.2, 00:00:00

Router(config-router)#

```

Top

⇒ Configuring Border Gateway Protocol (BGP) in Router2.

Router2

Physical Config **CLI** Attributes

IOS Command Line Interface

```

Router>
Router>
Router>
Router>
Router>
Router#config terminal
^
% Invalid input detected at '^' marker.

Router#config terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router bgp 30002
Router(config-router)#neighbor 20.0.0.1 remote as 10002
^
% Invalid input detected at '^' marker.

Router(config-router)#neighbor 20.0.0.1 remote-as 10002
Router(config-router)##BGP-5-ADJCHANGE: neighbor 20.0.0.1 Up

Router(config-router)#neighbor 30.0.0.1 remote-as 20002
Router(config-router)##BGP-5-ADJCHANGE: neighbor 30.0.0.1 Up

Router(config-router)#network 192.02.30.0 mask 255.255.255.0
Router(config-router)#do show ip bgp summary
BGP router identifier 192.2.30.1, local AS number 30002
BGP table version is 6, main routing table version 6
5 network entries using 660 bytes of memory
5 path entries using 260 bytes of memory
4/4 BGP path/bestpath attribute entries using 736 bytes of memory
3 BGP AS-PATH entries using 72 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
Bitfield cache entries: current 1 (at peak 1) using 32 bytes of memory
BGP using 1760 total bytes of memory
BGP activity 3/0 prefixes, 5/0 paths, scan interval 60 secs

Neighbor      V   AS MsgRcvd MsgSent   TblVer InQ OutQ Up/Down State/PfxRcd
20.0.0.1      4 10002      6     3       6   0    0 00:01:01      4
30.0.0.1      4 20002      5     2       6   0    0 00:00:43      4

Router(config-router)#

```

Top

Router2

Physical Config **CLI** Attributes

IOS Command Line Interface

```

Router(config-router)#network 192.02.30.0 mask 255.255.255.0
Router(config-router)#do show ip bgp summary
BGP router identifier 192.2.30.1, local AS number 30002
BGP table version is 6, main routing table version 6
5 network entries using 660 bytes of memory
5 path entries using 260 bytes of memory
4/4 BGP path/bestpath attribute entries using 736 bytes of memory
3 BGP AS-PATH entries using 72 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
Bitfield cache entries: current 1 (at peak 1) using 32 bytes of memory
BGP using 1760 total bytes of memory
BGP activity 3/0 prefixes, 5/0 paths, scan interval 60 secs

Neighbor      V   AS MsgRcvd MsgSent   TblVer InQ OutQ Up/Down State/PfxRcd
20.0.0.1      4 10002      6     3       6   0    0 00:01:01      4
30.0.0.1      4 20002      5     2       6   0    0 00:00:43      4

Router(config-router)#do 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

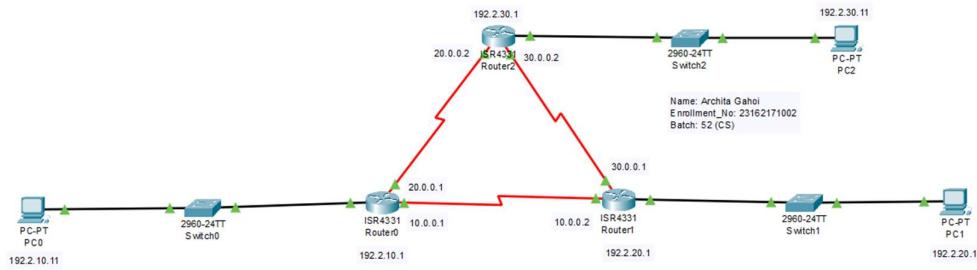
  20.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C        20.0.0.0/8 is directly connected, Serial0/1/0
L        20.0.0.2/32 is directly connected, Serial0/1/0
  30.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C        30.0.0.0/8 is directly connected, Serial0/1/1
L        30.0.0.2/32 is directly connected, Serial0/1/1
B        192.2.10.0/24 [20/0] via 20.0.0.1, 00:00:00
B        192.2.20.0/24 [20/0] via 30.0.0.1, 00:00:00
  192.2.30.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.2.30.0/24 is directly connected, GigabitEthernet0/0/0
L        192.2.30.1/32 is directly connected, GigabitEthernet0/0/0

Router(config-router)#

```

Top

Output:



Conclusion:

In conclusion, the practical successfully demonstrated how BGP can be used to establish routing between multiple autonomous networks, such as the three departments in the organization. By configuring BGP peers and propagating network prefixes, efficient and scalable inter-department communication was achieved. The exercise highlighted BGP's strength in path selection and policy-based routing, making it suitable for large, distributed networks. Overall, the implementation reinforced the importance of BGP in real-world enterprise and ISP environments.