

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

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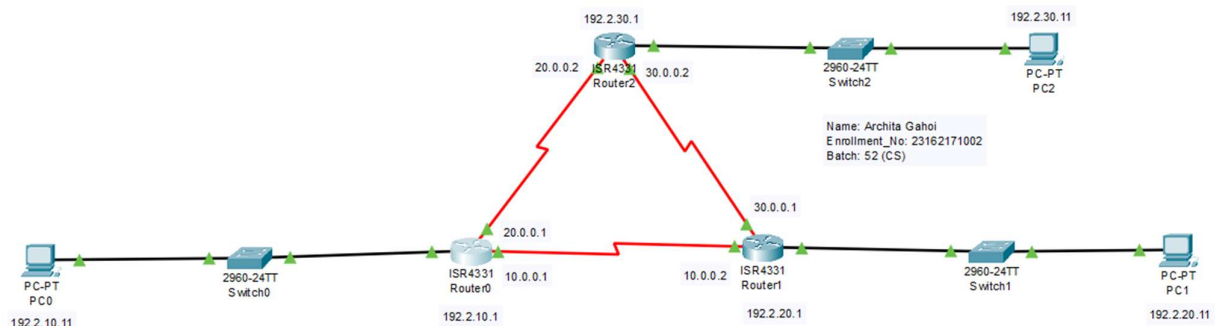
## Practical 9

**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

**GigabitEthernet0/0/0**

Port Status ☐ 1000 Mbps ☒ 100 Mbps ☐ 10 Mbps ☒ On

Bandwidth ☐ Half Duplex ☒ Full Duplex ☒ Auto

Duplex

MAC Address 0090.0C63.4001

IP Configuration

IPv4 Address 192.2.10.1

Subnet Mask 255.255.255.0

Tx Ring Limit 10

Equivalent IOS Commands

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

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

☐ Top

Router0

Physical Config CLI Attributes

**GLOBAL**

Settings

Algorithm Settings

**ROUTING**

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**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 10.0.0.1

Subnet Mask 255.0.0.0

Tx Ring Limit 10

Equivalent IOS Commands

```
Router(config-router)#
Router(config-router)#
Router(config-router)#
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

Router0

Physical

Config

CLI

Attributes

GLOBAL

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VLAN Database

INTERFACE

GigabitEthernet0/0/0

GigabitEthernet0/0/1

GigabitEthernet0/0/2

Serial0/1/0

Serial0/1/1

Serial0/1/1

Port Status

Duplex

Clock Rate

IP Configuration

IPv4 Address

Subnet Mask

Tx Ring Limit

☒ On

☐ Full Duplex

2000000

20.0.0.1

255.0.0.0

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

Bandwidth

Duplex

MAC Address

IP Configuration

IPv4 Address

Subnet Mask

Tx Ring Limit

On

1000 Mbps

100 Mbps

10 Mbps

Auto

Half Duplex

Full Duplex

Auto

0002.4AC5.1D01

192.2.20.1

255.255.255.0

10

Equivalent IOS Commands

Router(config-if)#  
Router(config-if)#  
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)#  
Router(config-if)#  
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

Duplex

Clock Rate

IP Configuration

IPv4 Address

Subnet Mask

Tx Ring Limit

On

Full Duplex

2000000

10.0.0.2

255.0.0.0

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 ☒ On

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

Bandwidth

Duplex

MAC Address

IP Configuration

IPv4 Address

Subnet Mask

Tx Ring Limit

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

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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

Duplex

Clock Rate

IP Configuration

IPv4 Address

Subnet Mask

Tx Ring Limit

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

PhysicalConfigCLIAttributes

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

☒ On

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

PC0

Physical Config **Desktop** Programming Attributes

IP Configuration [X]

Interface FastEthernet0

IP Configuration

☐ DHCP ☒ Static

IPv4 Address 192.2.10.11

Subnet Mask 255.255.255.0

Default Gateway 192.2.10.1

DNS Server 0.0.0.0

IPv6 Configuration

☐ Automatic ☒ Static

IPv6 Address /

Link Local Address FE80::260:2FFF:FE68:1709

Default Gateway

DNS Server

PC1

Physical Config **Desktop** Programming Attributes

IP Configuration [X]

Interface FastEthernet0

IP Configuration

☐ DHCP ☒ Static

IPv4 Address 192.2.20.11

Subnet Mask 255.255.255.0

Default Gateway 192.2.20.1

DNS Server 0.0.0.0

IPv6 Configuration

☐ Automatic ☒ Static

IPv6 Address /

Link Local Address FE80::260:47FF:FE16:7DAE

Default Gateway

DNS Server

PC2

Physical Config **Desktop** Programming Attributes

IP Configuration [X]

Interface FastEthernet0

IP Configuration

☐ DHCP ☒ Static

IPv4 Address 192.2.30.11

Subnet Mask 255.255.255.0

Default Gateway 192.2.30.1

DNS Server 0.0.0.0

IPv6 Configuration

☐ Automatic ☒ Static

IPv6 Address /

Link Local Address FE80::290:21FF:FE36:3689

Default Gateway

DNS Server



## ⇒ 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 192.02.10.0 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
C    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

%LINK-5-CHANGED: Interface Serial0/1/0, changed state to up
%LINK-5-CHANGED: Interface Serial0/1/1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1/1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1/0, changed state to up

Router(config-if)#
Router(config-if)#
Router(config-if)#
Router(config-if)#
Router(config-if)#
Router(config-if)#
Router(config-if)#exit
Router(config)#
Router(config)#
Router(config)#router bgp 20002
Router(config-router)#neighbor 10.0.0.1 remote-as 10002
Router(config-router)#%BGP-5-ADJCHANGE: neighbor 10.0.0.1 Up

Router(config-router)#neighbor 30.0.0.2 remote-as 30002
Router(config-router)#network 192.2.20.0 mask 255.255.255.0
Router(config-router)#do show ip bgp summary
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)#
```

```
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
      C    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
      C    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)#
```

Copy Paste

☐ Top

## ⇒ Configuring Border Gateway Protocol (BGP) in Router2.

```
Router2
Physical Config CLI Attributes
IOS Command Line Interface

Router>
Router>
Router>
Router>
Router>
Router>en
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)#
```

```
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

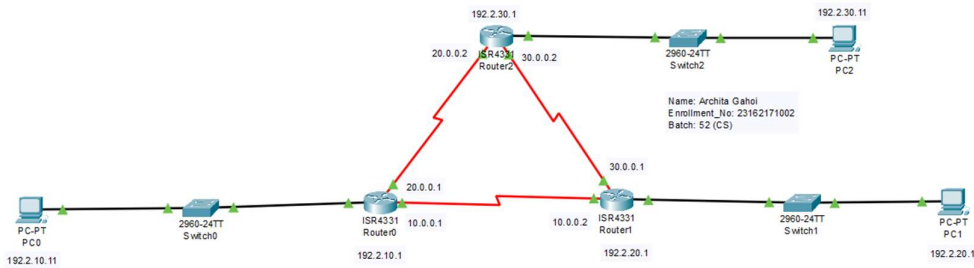
Router(config-router)#do show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external 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
C    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)#
```

## Output:



Realtime										
Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
Successful	PC0	PC1	ICMP	0.000	N	0	(edit)	(delete)		
Successful	PC1	PC2	ICMP	0.000	N	1	(edit)	(delete)		
Successful	PC2	PC0	ICMP	0.000	N	2	(edit)	(delete)		
Successful	PC0	PC2	ICMP	0.000	N	3	(edit)	(delete)		

## 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.