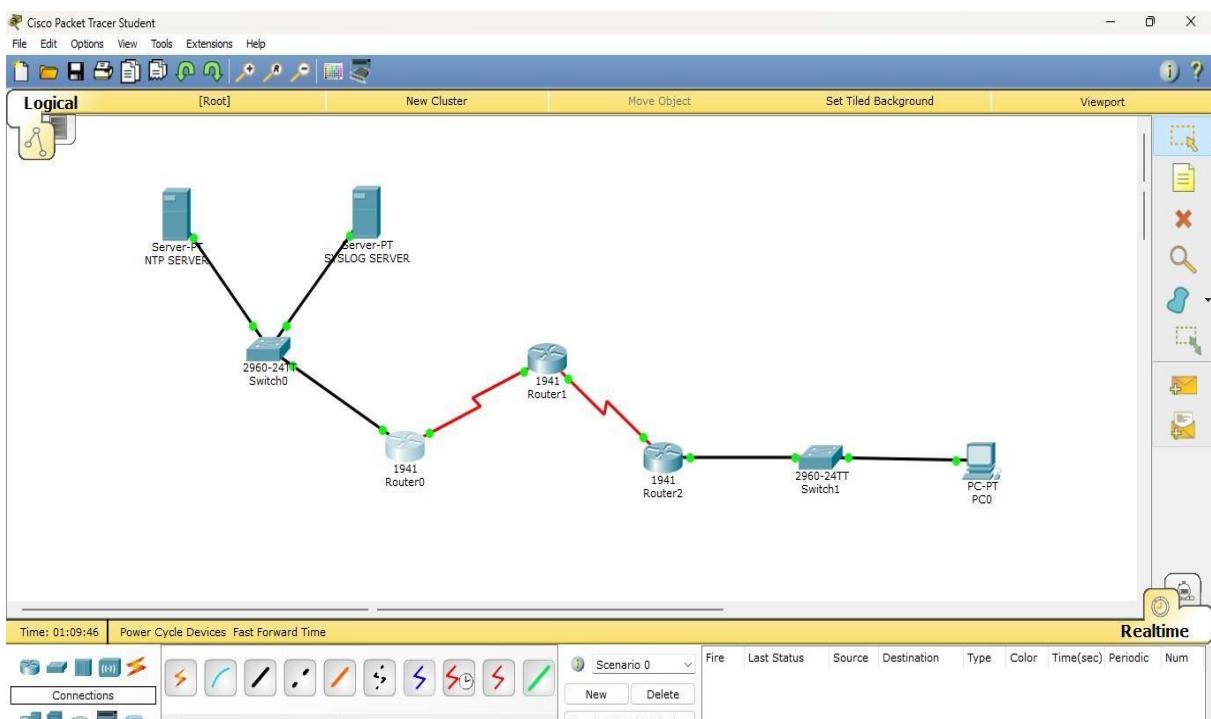


### **PRACTICAL NO 1**

#### **AIM: CONFIGURE ROUTERS**

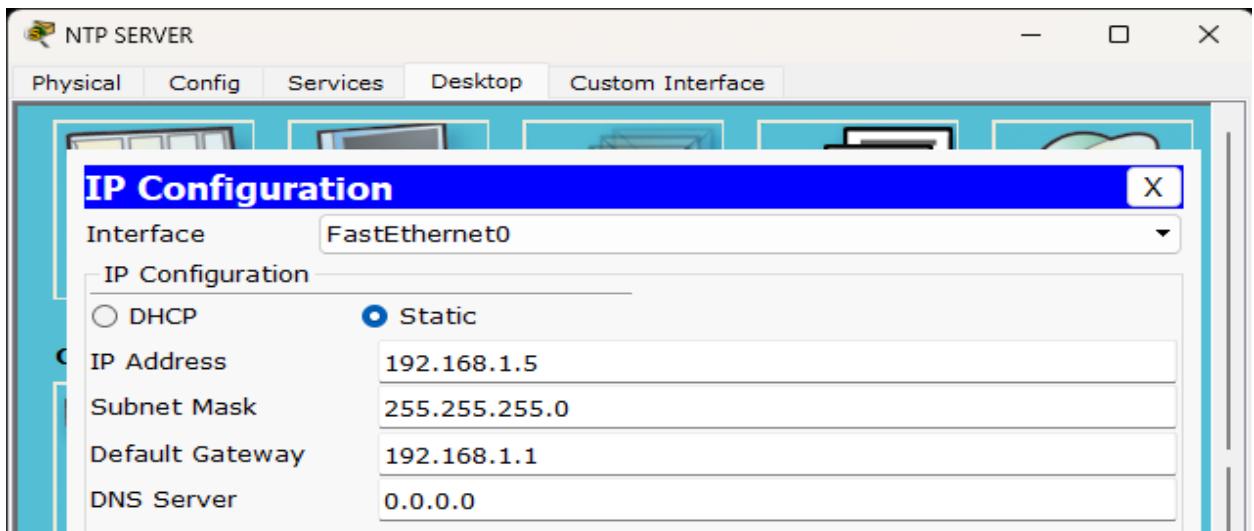
- a. OSPF MD5 authentication
- b. NTP
- c. to log messages to the SYSLOG server
- d. to support SSH connections.

#### ➤ **Topology Diagram**

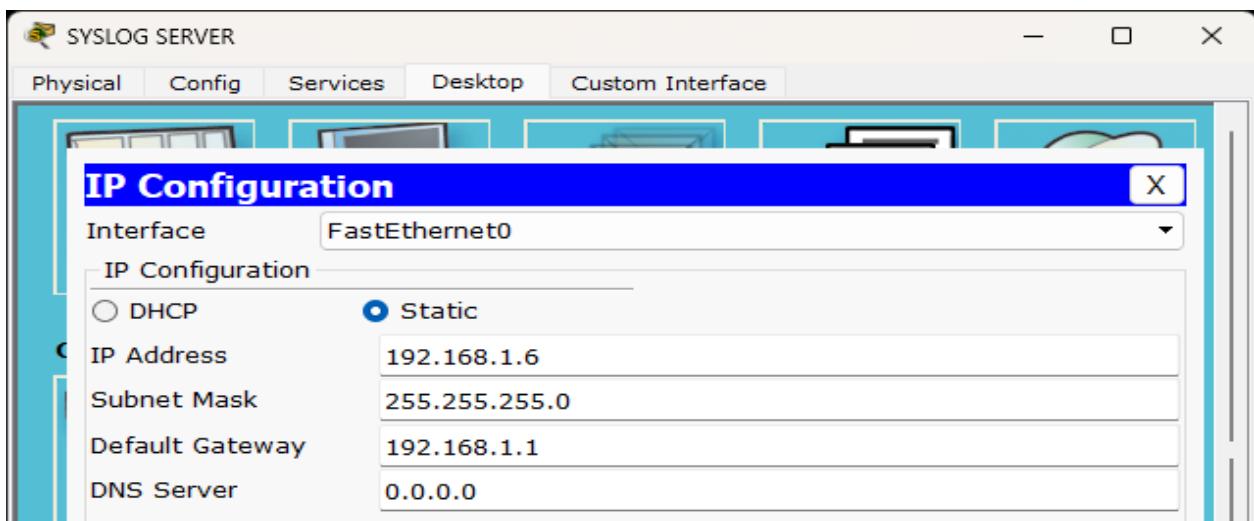


➤ **Assigning IP Addresses**

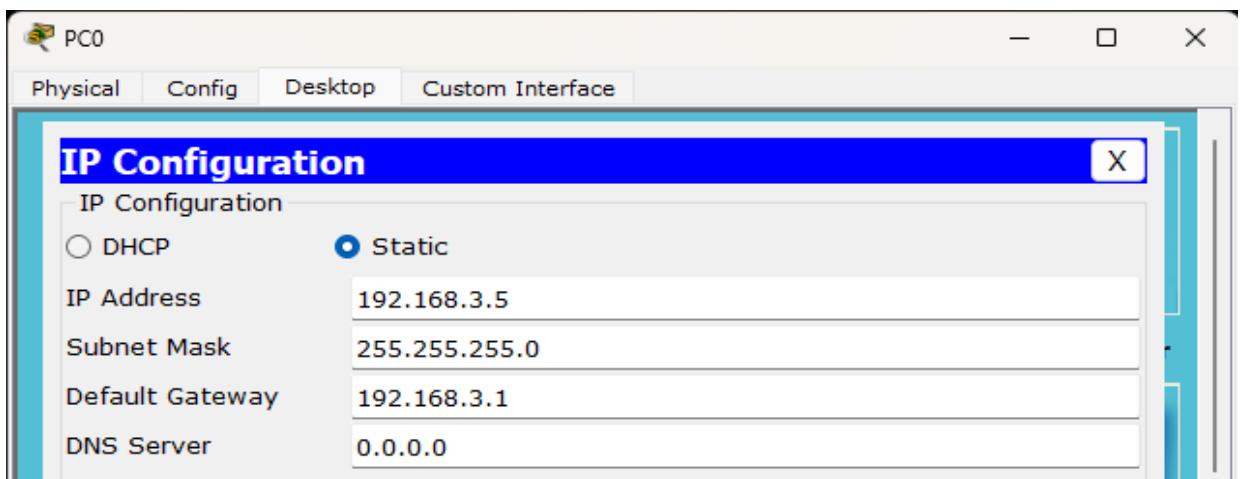
1. NTPServer



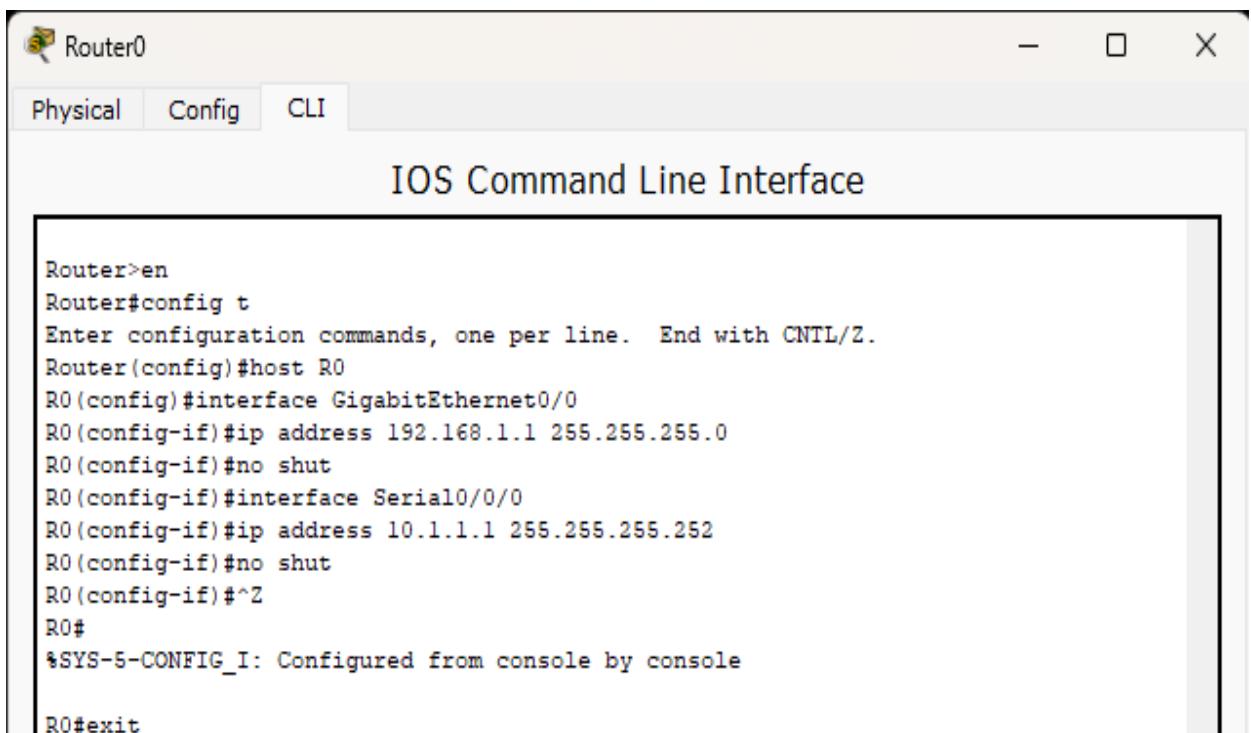
2. SYSLOG Server



3. PC-0



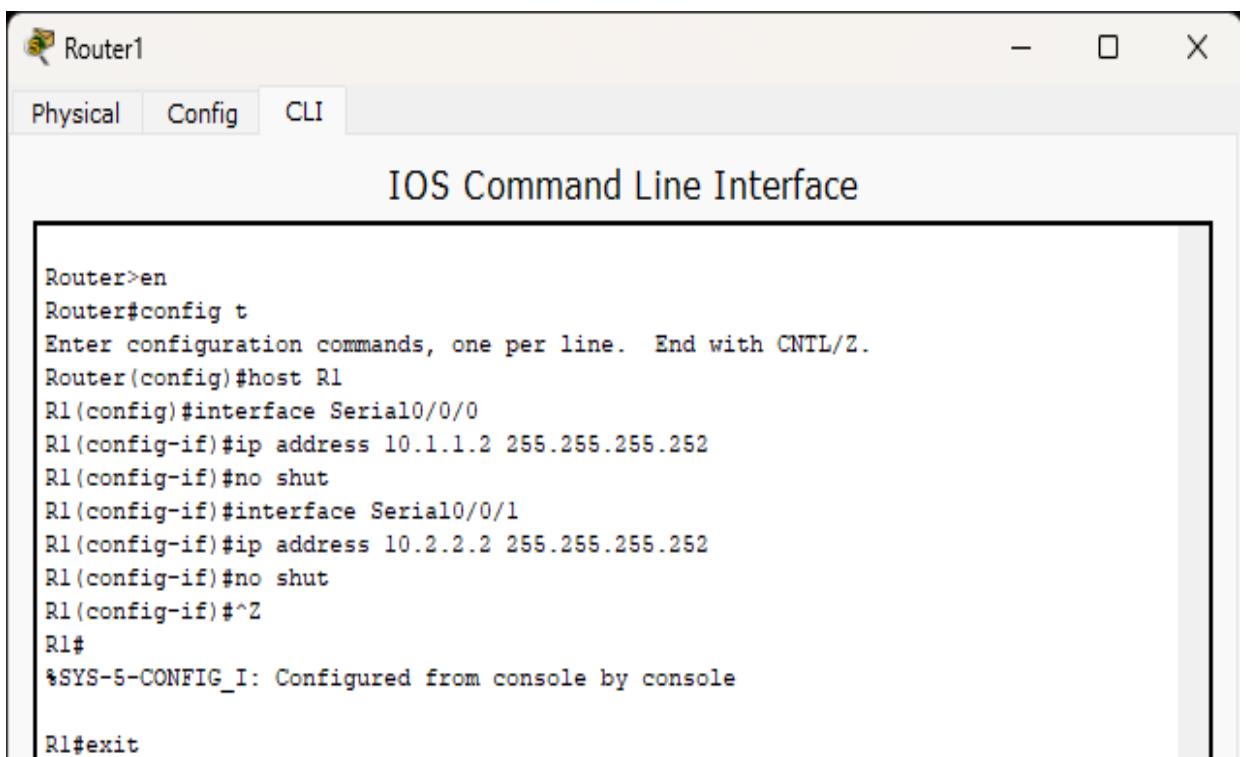
4. Router 0



The image shows a software interface for managing network devices. The title bar says "Router0". Below it is a tab bar with "Physical", "Config" (which is selected), and "CLI". The main area is titled "IOS Command Line Interface". It contains the following configuration commands:

```
Router>en
Router#config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#host R0
R0(config)#interface GigabitEthernet0/0
R0(config-if)#ip address 192.168.1.1 255.255.255.0
R0(config-if)#no shut
R0(config-if)#interface Serial0/0/0
R0(config-if)#ip address 10.1.1.1 255.255.255.252
R0(config-if)#no shut
R0(config-if)#^Z
R0#
%SYS-5-CONFIG_I: Configured from console by console
R0#exit
```

5. Router 1



The image shows a software interface for managing network devices. The title bar says "Router1". Below it is a tab bar with "Physical", "Config" (which is selected), and "CLI". The main area is titled "IOS Command Line Interface". It contains the following configuration commands:

```
Router>en
Router#config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#host R1
R1(config)#interface Serial0/0/0
R1(config-if)#ip address 10.1.1.2 255.255.255.252
R1(config-if)#no shut
R1(config-if)#interface Serial0/0/1
R1(config-if)#ip address 10.2.2.2 255.255.255.252
R1(config-if)#no shut
R1(config-if)#^Z
R1#
%SYS-5-CONFIG_I: Configured from console by console
R1#exit
```

## 6. Router 2

The screenshot shows a window titled "Router2" with three tabs: "Physical", "Config" (which is selected), and "CLI". Below the tabs, it says "IOS Command Line Interface". The CLI window contains the following configuration commands:

```
Router>en
Router#config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#host R2
R2(config)#interface Serial0/0/0
R2(config-if)#ip address 10.2.2.1 255.255.255.252
R2(config-if)#no shut
R2(config-if)#interface GigabitEthernet0/0
R2(config-if)#ip address 192.168.3.1 255.255.255.0
R2(config-if)#^Z
R2#
%SYS-5-CONFIG_I: Configured from console by console

R2#exit
```

### ➤ Displaying IPAddress Details of Routers

#### 1. Router 0

```
R0>show ip interface brief
Interface          IP-Address      OK? Method Status      Protocol
GigabitEthernet0/0  192.168.1.1    YES manual up        up
GigabitEthernet0/1  unassigned     YES unset  administratively down down
Serial0/0/0         10.1.1.1      YES manual up        up
Serial0/0/1         unassigned     YES unset  administratively down down
Vlan1              unassigned     YES unset  administratively down down
--
```

```
R1>show ip interface brief
Interface          IP-Address      OK? Method Status      Protocol
GigabitEthernet0/0  unassigned      YES unset  administratively down down
GigabitEthernet0/1  unassigned      YES unset  administratively down down
Serial0/0/0         10.1.1.2       YES manual up           up
Serial0/0/1         10.2.2.2       YES manual up           up
Vlan1              unassigned      YES unset  administratively down down
```

### 3. Router 2

```
R2>show ip interface brief
Interface          IP-Address      OK? Method Status      Protocol
GigabitEthernet0/0  192.168.3.1    YES manual up           up
GigabitEthernet0/1  unassigned      YES unset  administratively down down
Serial0/0/0         10.2.2.1       YES manual up           up
Serial0/0/1         unassigned      YES unset  administratively down down
Vlan1              unassigned      YES unset  administratively down down
```

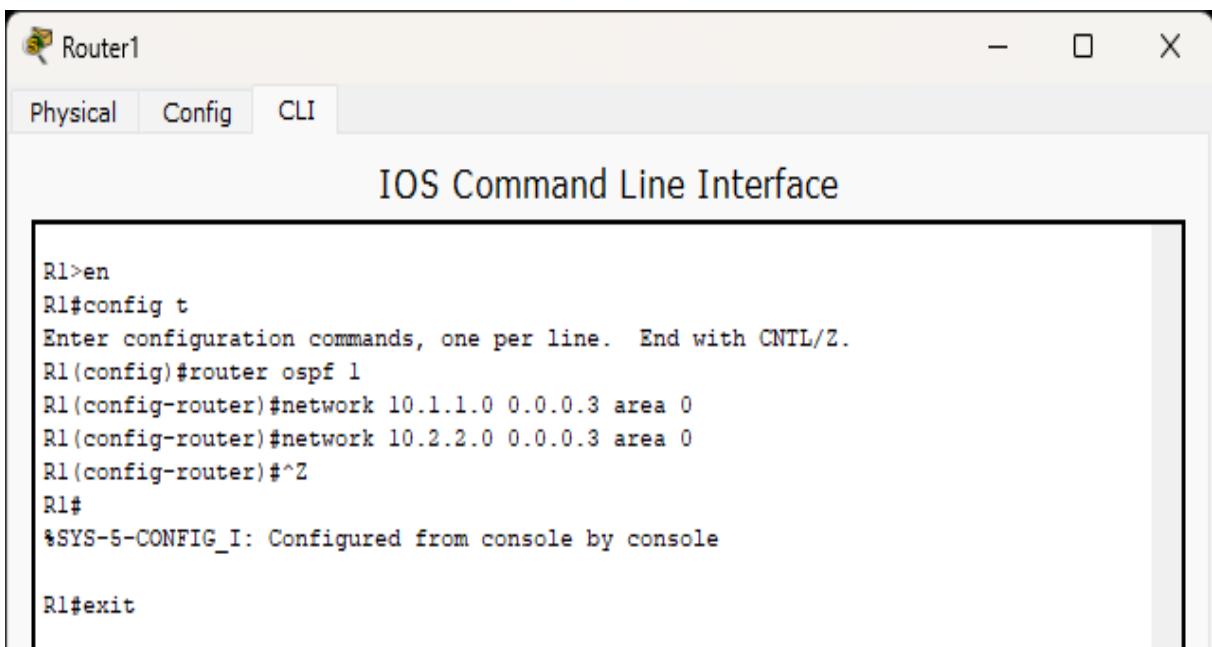
## ➤ Configure OSPF on routes

### 1. Router 0

The screenshot shows the Cisco IOS CLI interface for Router0. The window title is "Router0". Below the title bar are three tabs: "Physical", "Config" (which is selected), and "CLI". The main area is titled "IOS Command Line Interface". The command history and output are as follows:

```
R0>en
R0#config t
Enter configuration commands, one per line. End with CNTL/Z.
R0(config)#router ospf 1
R0(config-router)#network 192.168.1.0 0.0.0.255 area 0
R0(config-router)#network 10.1.1.0 0.0.0.3 area 0
R0(config-router)#
04:23:31: %OSPF-5-ADJCHG: Process 1, Nbr 10.2.2.2 on Serial0/0/0 from LOADING to
FULL, Loading Done
^Z
R0#
*SYS-5-CONFIG_I: Configured from console by console

R0#exit
```



Router1

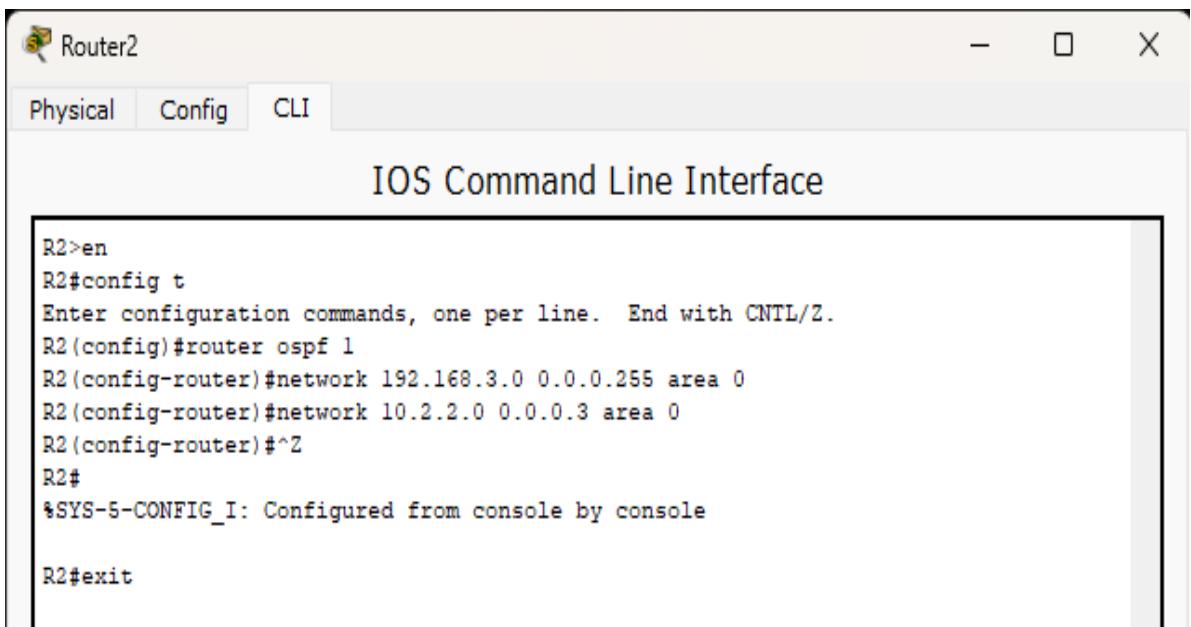
Physical Config CLI

IOS Command Line Interface

```
R1>en
R1#config t
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#router ospf 1
R1(config-router)#network 10.1.1.0 0.0.0.3 area 0
R1(config-router)#network 10.2.2.0 0.0.0.3 area 0
R1(config-router)#^Z
R1#
%SYS-5-CONFIG_I: Configured from console by console

R1#exit
```

### 3. Router 2



Router2

Physical Config CLI

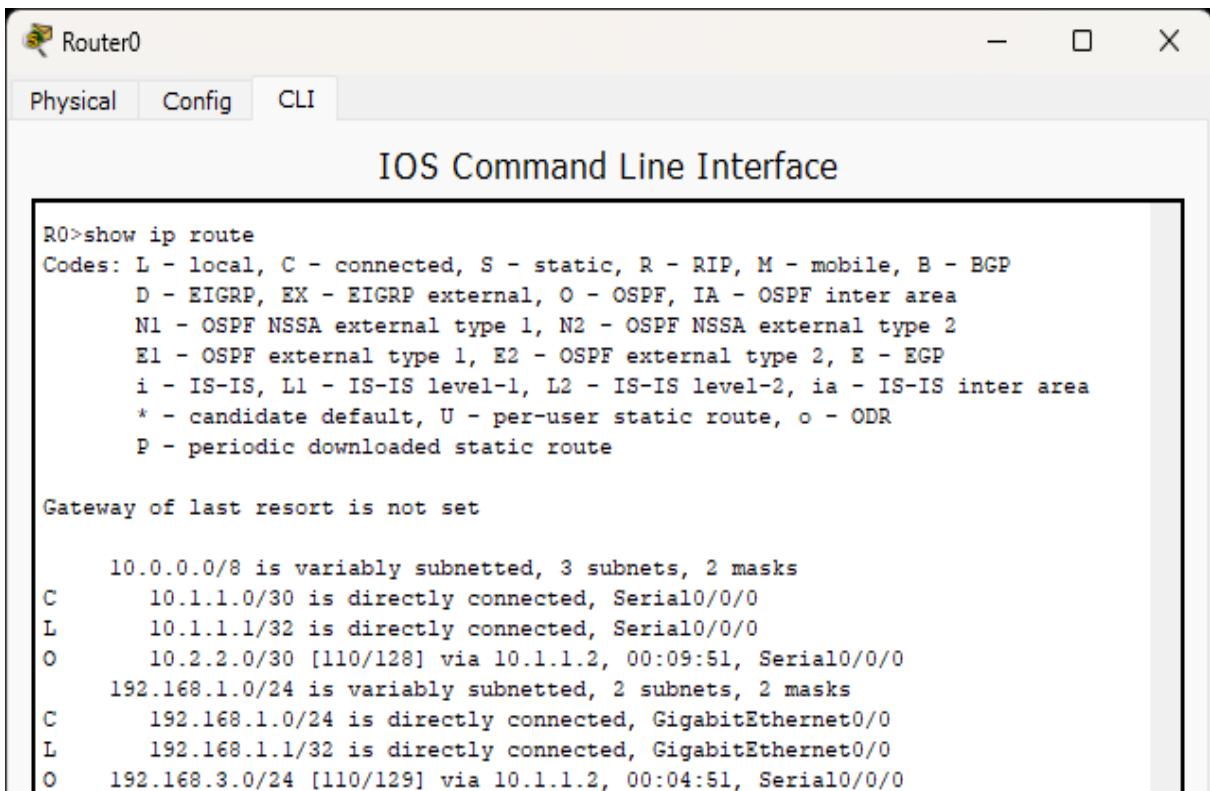
IOS Command Line Interface

```
R2>en
R2#config t
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#router ospf 1
R2(config-router)#network 192.168.3.0 0.0.0.255 area 0
R2(config-router)#network 10.2.2.0 0.0.0.3 area 0
R2(config-router)#^Z
R2#
%SYS-5-CONFIG_I: Configured from console by console

R2#exit
```

➤ **Displaying routing table of routers**

1. Router 0



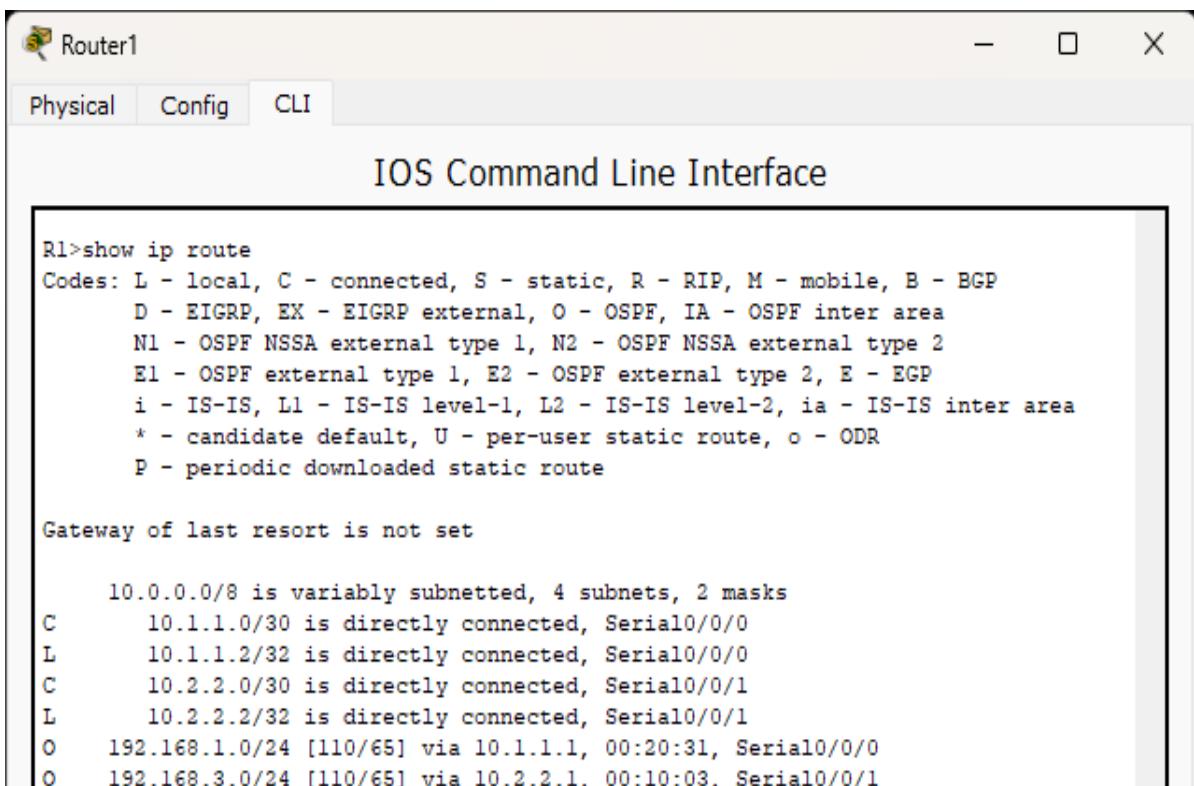
The image shows a software interface for a router named "Router0". The title bar says "Router0". Below it is a menu bar with "Physical", "Config", and "CLI" tabs, where "CLI" is selected. The main area is titled "IOS Command Line Interface". It displays the output of the command "R0>show ip route". The output includes route codes and descriptions for various network routes.

```
R0>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, 3 subnets, 2 masks
C        10.1.1.0/30 is directly connected, Serial0/0/0
L        10.1.1.1/32 is directly connected, Serial0/0/0
O        10.2.2.0/30 [110/128] via 10.1.1.2, 00:09:51, Serial0/0/0
          192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.1.0/24 is directly connected, GigabitEthernet0/0
L        192.168.1.1/32 is directly connected, GigabitEthernet0/0
O        192.168.3.0/24 [110/129] via 10.1.1.2, 00:04:51, Serial0/0/0
```

2. Router 1



The image shows a software interface for a router named "Router1". The title bar says "Router1". Below it is a menu bar with "Physical", "Config", and "CLI" tabs, where "CLI" is selected. The main area is titled "IOS Command Line Interface". It displays the output of the command "R1>show ip route". The output includes route codes and descriptions for various network routes.

```
R1>show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
      i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
      * - candidate default, U - per-user static route, o - ODR
      P - periodic downloaded static route

Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks
C        10.1.1.0/30 is directly connected, Serial0/0/0
L        10.1.1.2/32 is directly connected, Serial0/0/0
C        10.2.2.0/30 is directly connected, Serial0/0/1
L        10.2.2.2/32 is directly connected, Serial0/0/1
O        192.168.1.0/24 [110/65] via 10.1.1.1, 00:20:31, Serial0/0/0
O        192.168.3.0/24 [110/65] via 10.2.2.1, 00:10:03, Serial0/0/1
```

### 3. Router 2

The screenshot shows a window titled "Router2" with three tabs: "Physical", "Config", and "CLI". The "CLI" tab is selected, displaying the "IOS Command Line Interface". The output of the "show ip route" command is shown, listing various network routes with their types (O, C, L), subnet masks, and interfaces.

```
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

      10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
O        10.1.1.0/30 [110/128] via 10.2.2.2, 00:11:51, Serial0/0/0
C        10.2.2.0/30 is directly connected, Serial0/0/0
L        10.2.2.1/32 is directly connected, Serial0/0/0
O        192.168.1.0/24 [110/129] via 10.2.2.2, 00:11:51, Serial0/0/0
          192.168.3.0/24 is variably subnetted, 2 subnets, 2 masks
C          192.168.3.0/24 is directly connected, GigabitEthernet0/0
L          192.168.3.1/32 is directly connected, GigabitEthernet0/0
```

### A. OSPF MD5 authentication

#### ➤ Configure OSPF MD5 authentication on Routers

1. Router 0

The screenshot shows the Cisco IOS Command Line Interface for Router0. The window title is "Router0". The tabs at the top are "Physical", "Config" (which is selected), and "CLI". The main area is titled "IOS Command Line Interface". The command history shows:

```
R0>en
R0#config t
Enter configuration commands, one per line. End with CNTL/Z.
R0(config)#router ospf 1
R0(config-router)#area 0 authentication message-digest
R0(config-router)#^Z
R0#
%SYS-5-CONFIG_I: Configured from console by console

R0#exit
```

2. Router 1

The screenshot shows the Cisco IOS Command Line Interface for Router1. The window title is "Router1". The tabs at the top are "Physical", "Config" (which is selected), and "CLI". The main area is titled "IOS Command Line Interface". The command history shows:

```
R1>en
R1#config t
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#router ospf 1
R1(config-router)#area 0 authentication message-digest
R1(config-router)#^Z
R1#
%SYS-5-CONFIG_I: Configured from console by console

R1#exit
```

3. Router 2

The screenshot shows the Cisco IOS Command Line Interface for Router2. The window title is "Router2". The tabs at the top are "Physical", "Config" (which is selected), and "CLI". The main area is titled "IOS Command Line Interface". The command history shows:

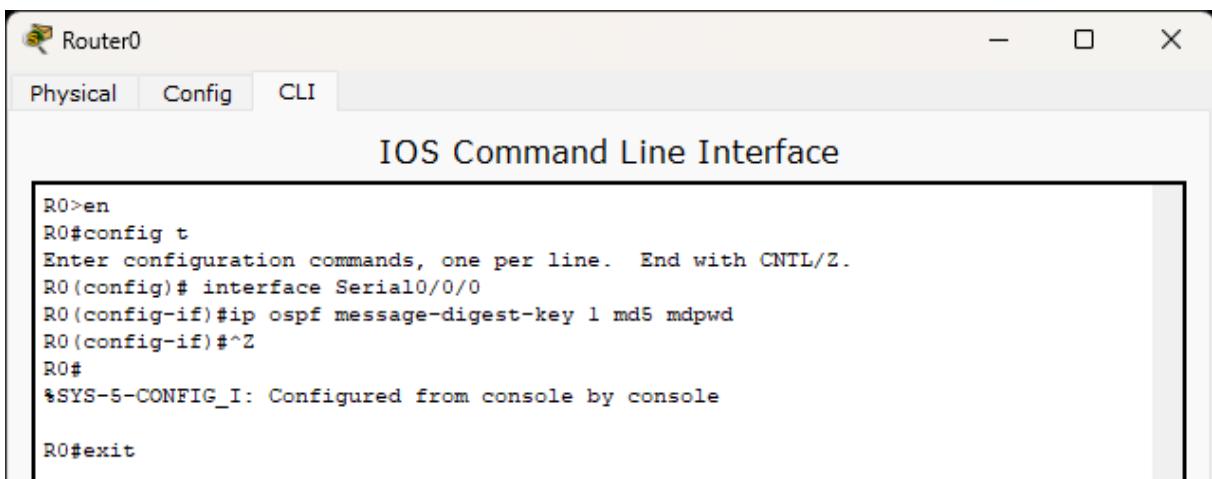
```
R2>en
R2#config t
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#router ospf 1
R2(config-router)#area 0 authentication message-digest
R2(config-router)#^Z
R2#
%SYS-5-CONFIG_I: Configured from console by console

00:06:20: %OSPF-5-ADJCHG: Process 1, Nbr 10.2.2.2 on Serial0/0/0 from LOADING to
FULL, Loading Done

R2#exit
```

➤ Configure the MD5 key for all the routers

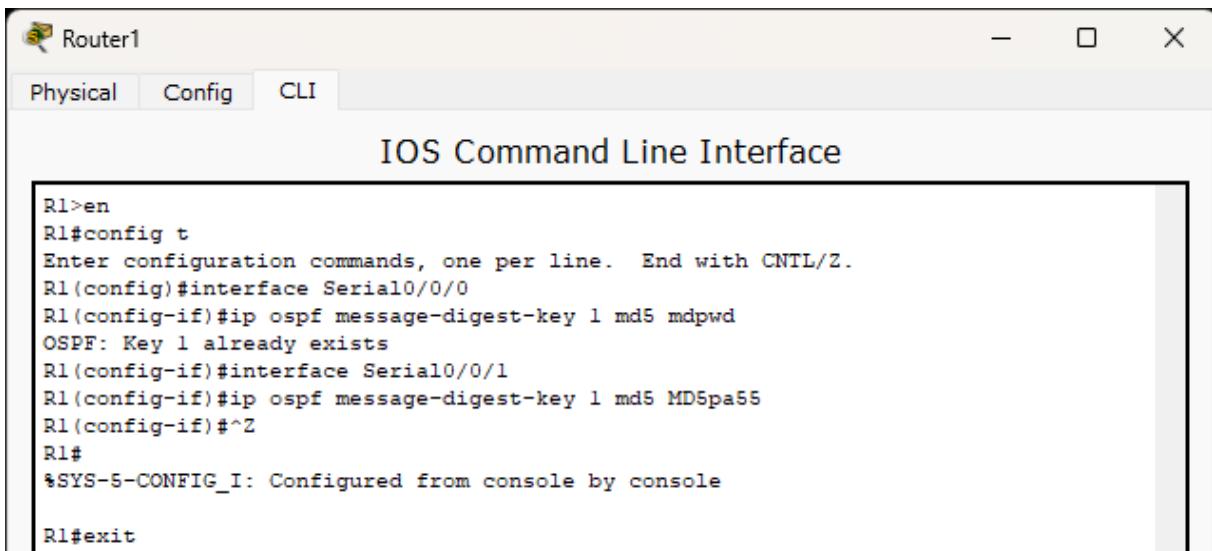
1. Router 0



The window title is "Router0". The tabs at the top are "Physical", "Config" (which is selected), and "CLI". The main area is titled "IOS Command Line Interface". The command history shows:

```
R0>en
R0#config t
Enter configuration commands, one per line. End with CNTL/Z.
R0(config)# interface Serial0/0/0
R0(config-if)#ip ospf message-digest-key 1 md5 mdpwd
R0(config-if)#^Z
R0#
%SYS-5-CONFIG_I: Configured from console by console
R0#exit
```

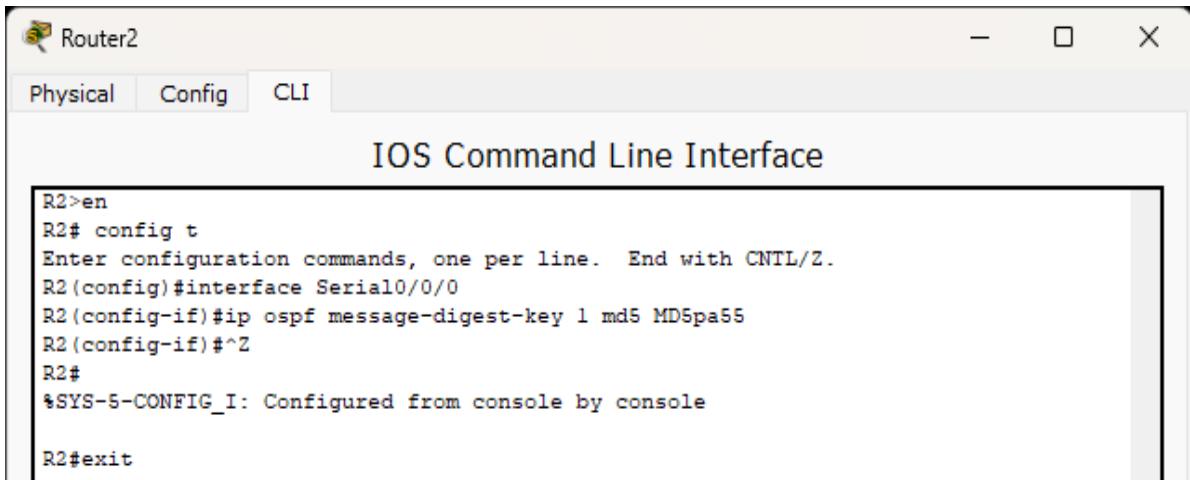
2. Router 1



The window title is "Router1". The tabs at the top are "Physical", "Config" (which is selected), and "CLI". The main area is titled "IOS Command Line Interface". The command history shows:

```
R1>en
R1#config t
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#interface Serial0/0/0
R1(config-if)#ip ospf message-digest-key 1 md5 mdpwd
OSPF: Key 1 already exists
R1(config-if)#interface Serial0/0/1
R1(config-if)#ip ospf message-digest-key 1 md5 MD5pass
R1(config-if)#^Z
R1#
%SYS-5-CONFIG_I: Configured from console by console
R1#exit
```

3. Router 2

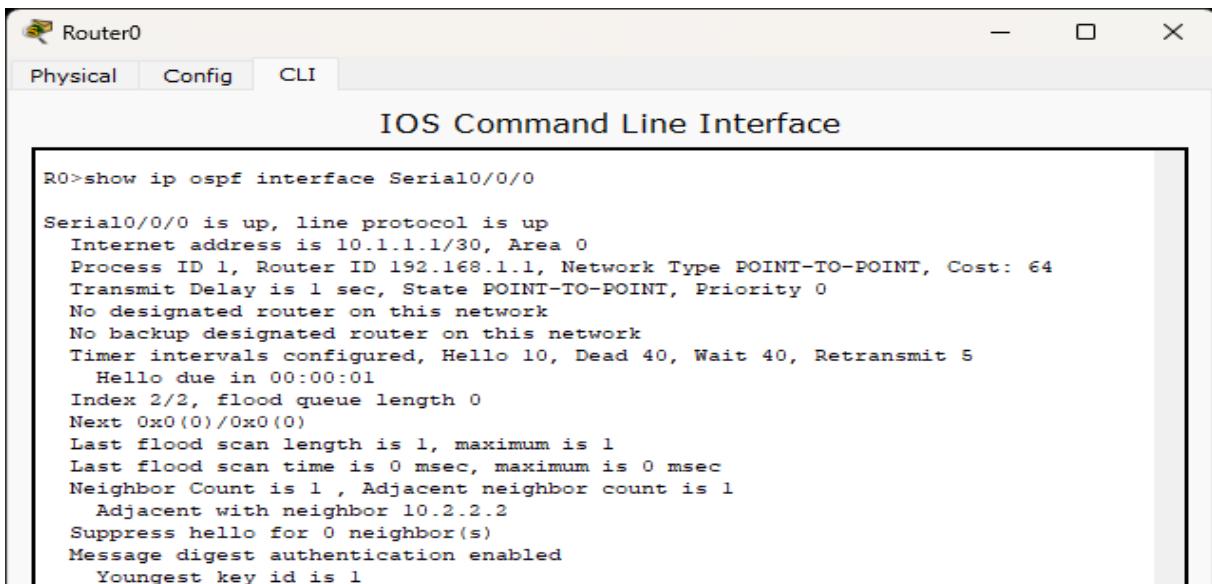


The window title is "Router2". The tabs at the top are "Physical", "Config" (which is selected), and "CLI". The main area is titled "IOS Command Line Interface". The command history shows:

```
R2>en
R2# config t
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#interface Serial0/0/0
R2(config-if)#ip ospf message-digest-key 1 md5 MD5pass
R2(config-if)#^Z
R2#
%SYS-5-CONFIG_I: Configured from console by console
R2#exit
```

➤ Displaying OSPF details of all the routers

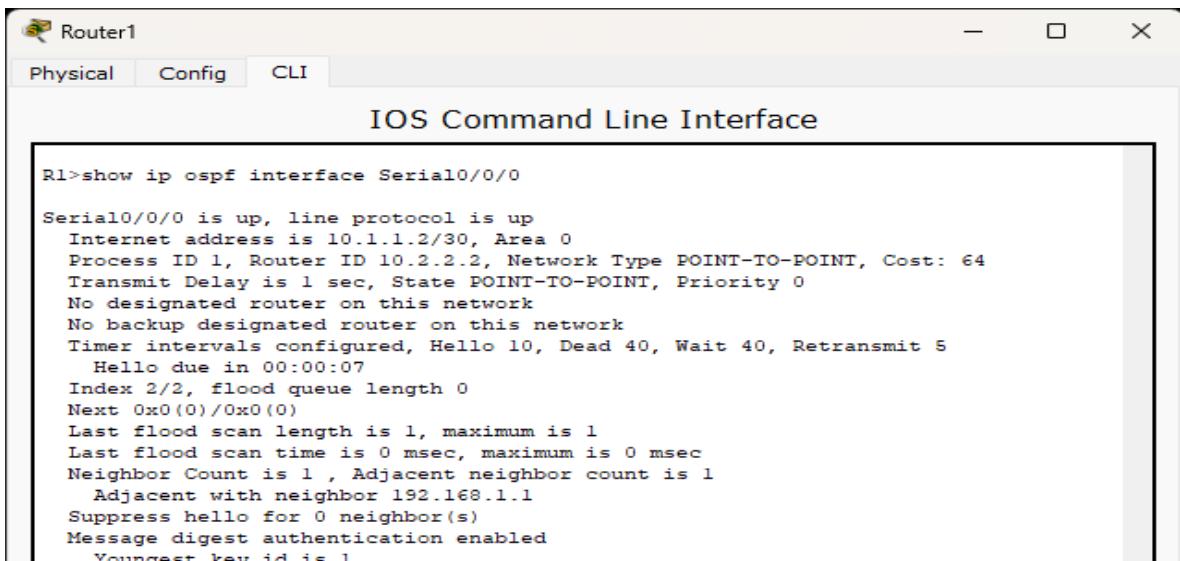
1. Router 0



```
R0>show ip ospf interface Serial0/0/0

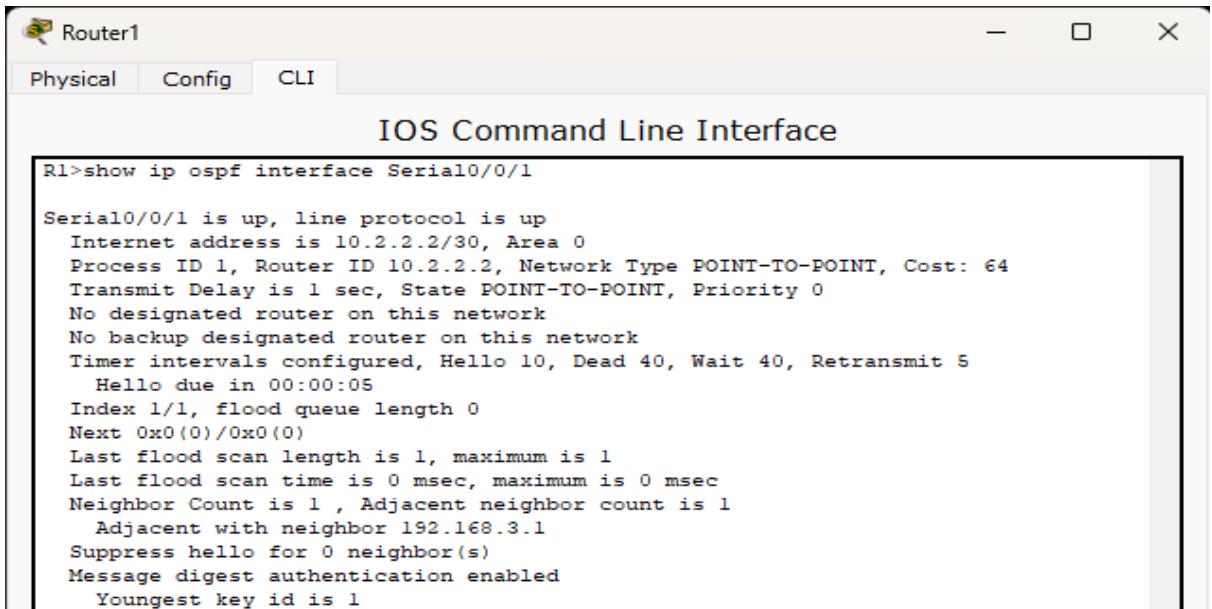
Serial0/0/0 is up, line protocol is up
  Internet address is 10.1.1.1/30, Area 0
  Process ID 1, Router ID 192.168.1.1, Network Type POINT-TO-POINT, Cost: 64
  Transmit Delay is 1 sec, State POINT-TO-POINT, Priority 0
  No designated router on this network
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:01
  Index 2/2, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1 , Adjacent neighbor count is 1
    Adjacent with neighbor 10.2.2.2
  Suppress hello for 0 neighbor(s)
  Message digest authentication enabled
    Youngest key id is 1
```

2. Router 1



```
R1>show ip ospf interface Serial0/0/0

Serial0/0/0 is up, line protocol is up
  Internet address is 10.1.1.2/30, Area 0
  Process ID 1, Router ID 10.2.2.2, Network Type POINT-TO-POINT, Cost: 64
  Transmit Delay is 1 sec, State POINT-TO-POINT, Priority 0
  No designated router on this network
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:07
  Index 2/2, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1 , Adjacent neighbor count is 1
    Adjacent with neighbor 192.168.1.1
  Suppress hello for 0 neighbor(s)
  Message digest authentication enabled
    Youngest key id is 1
```



Router1

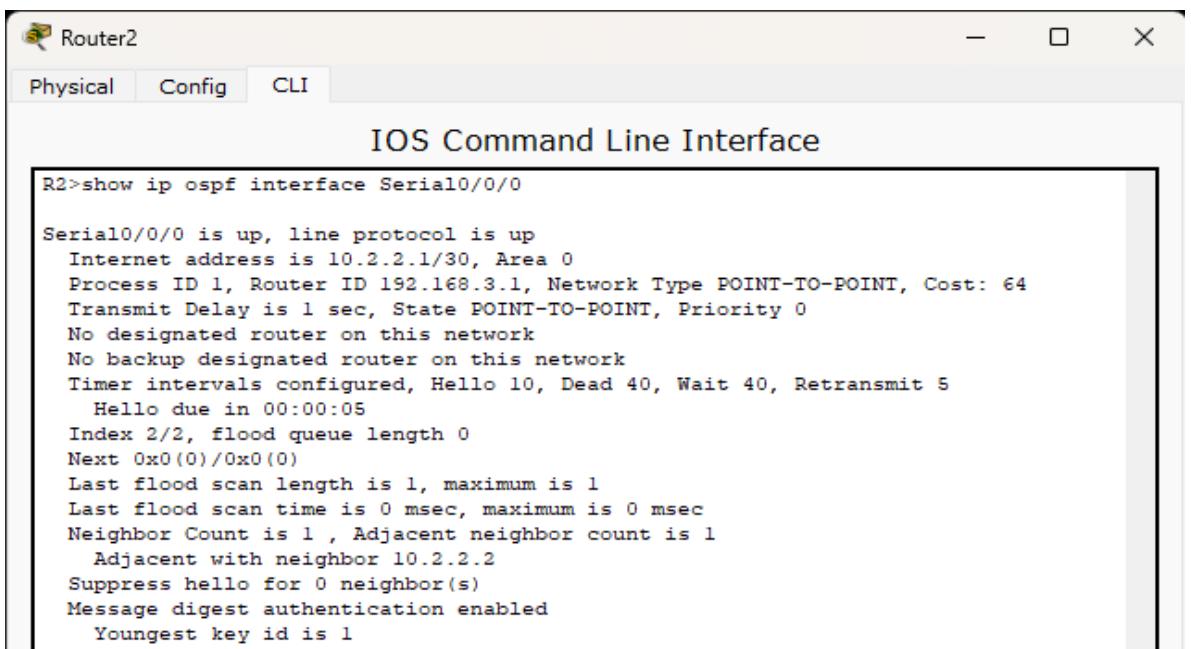
Physical Config CLI

IOS Command Line Interface

```
R1>show ip ospf interface Serial0/0/1

Serial0/0/1 is up, line protocol is up
  Internet address is 10.2.2.2/30, Area 0
  Process ID 1, Router ID 10.2.2.2, Network Type POINT-TO-POINT, Cost: 64
  Transmit Delay is 1 sec, State POINT-TO-POINT, Priority 0
  No designated router on this network
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:05
  Index 1/1, flood queue length 0
  Next Ox0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1 , Adjacent neighbor count is 1
    Adjacent with neighbor 192.168.3.1
  Suppress hello for 0 neighbor(s)
  Message digest authentication enabled
    Youngest key id is 1
```

### 3. Router 2



Router2

Physical Config CLI

IOS Command Line Interface

```
R2>show ip ospf interface Serial0/0/0

Serial0/0/0 is up, line protocol is up
  Internet address is 10.2.2.1/30, Area 0
  Process ID 1, Router ID 192.168.3.1, Network Type POINT-TO-POINT, Cost: 64
  Transmit Delay is 1 sec, State POINT-TO-POINT, Priority 0
  No designated router on this network
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:05
  Index 2/2, flood queue length 0
  Next Ox0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1 , Adjacent neighbor count is 1
    Adjacent with neighbor 10.2.2.2
  Suppress hello for 0 neighbor(s)
  Message digest authentication enabled
    Youngest key id is 1
```

## B. NTP

### ➤ Check Clock Time in the routers

1. Router 0

```
R0>show clock
*0:49:14.954 UTC Mon Mar 1 1993
R0>
```

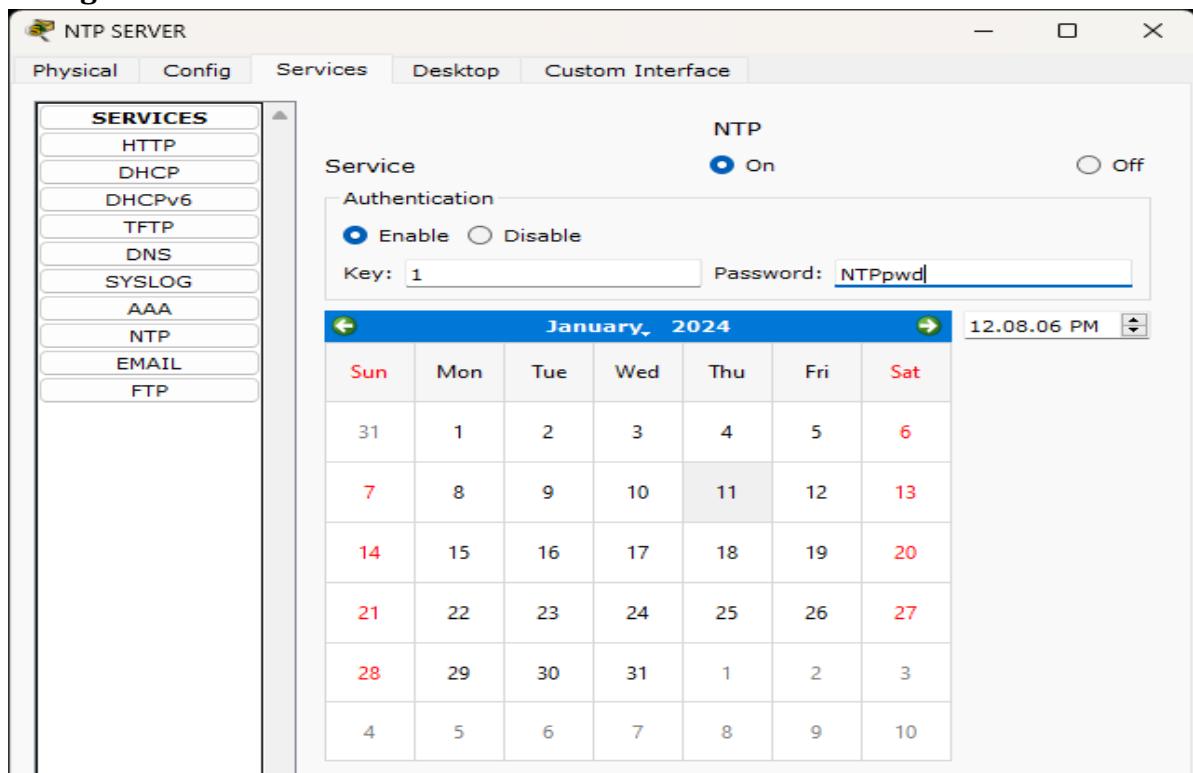
2. Router 1

```
R1>show clock
*0:51:40.343 UTC Mon Mar 1 1993
R1>
```

3. Router 2

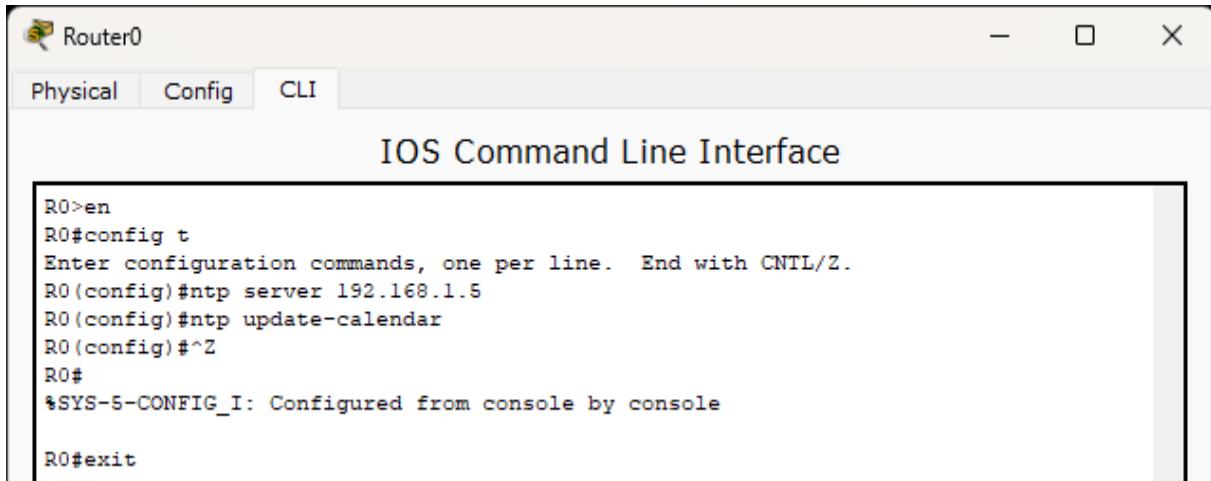
```
R2>show clock
*0:53:5.140 UTC Mon Mar 1 1993
R2>
```

### ➤ Configure NTP Server



➤ Configure NTP Client

1. Router 0



Router0

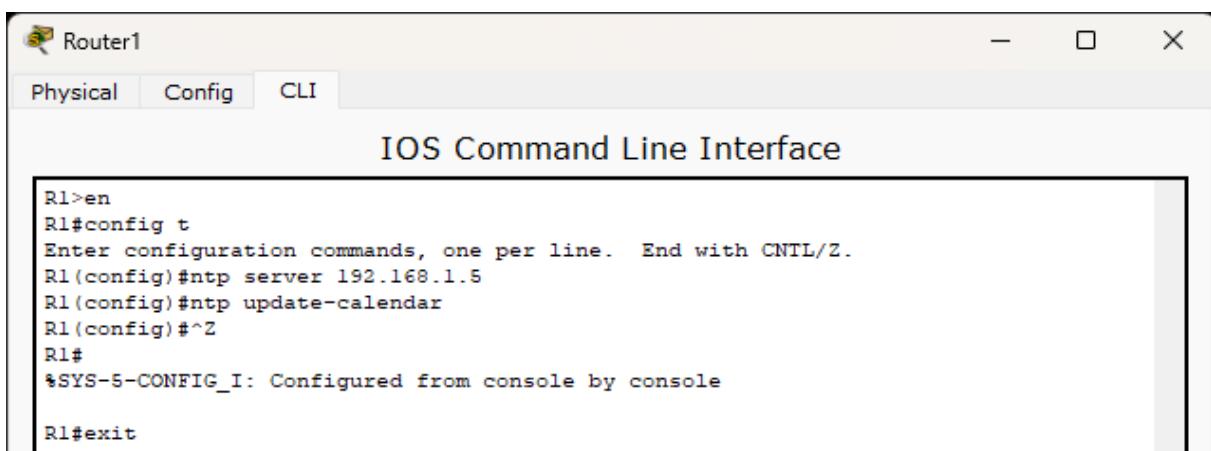
Physical Config CLI

IOS Command Line Interface

```
R0>en
R0#config t
Enter configuration commands, one per line. End with CNTL/Z.
R0(config)#ntp server 192.168.1.5
R0(config)#ntp update-calendar
R0(config)#^Z
R0#
%SYS-5-CONFIG_I: Configured from console by console

R0#exit
```

2. Router 1



Router1

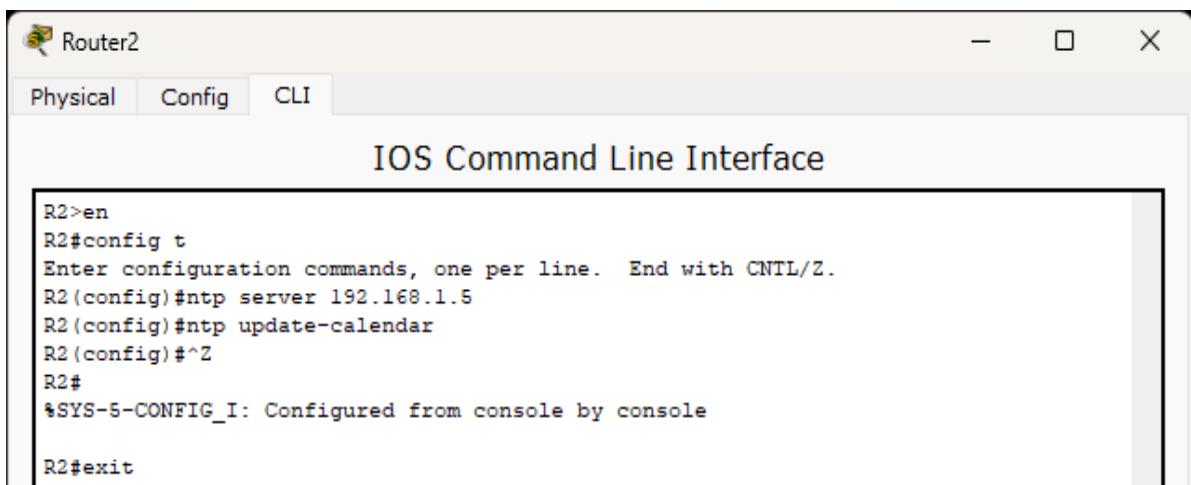
Physical Config CLI

IOS Command Line Interface

```
R1>en
R1#config t
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#ntp server 192.168.1.5
R1(config)#ntp update-calendar
R1(config)#^Z
R1#
%SYS-5-CONFIG_I: Configured from console by console

R1#exit
```

3. Router 2



Router2

Physical Config CLI

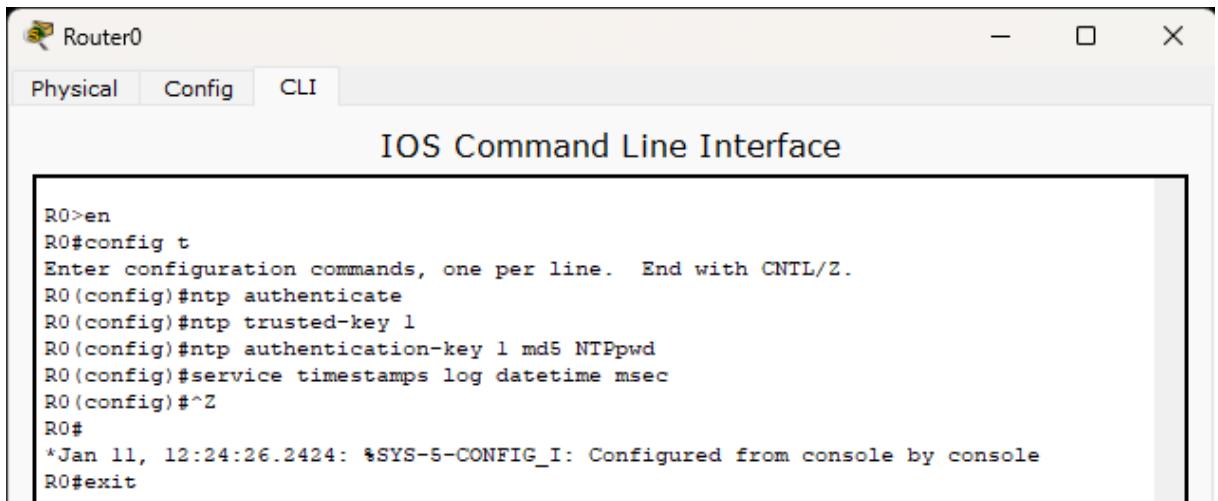
IOS Command Line Interface

```
R2>en
R2#config t
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#ntp server 192.168.1.5
R2(config)#ntp update-calendar
R2(config)#^Z
R2#
%SYS-5-CONFIG_I: Configured from console by console

R2#exit
```

- Configure NTP authentication and to timestamp log messages on the routers

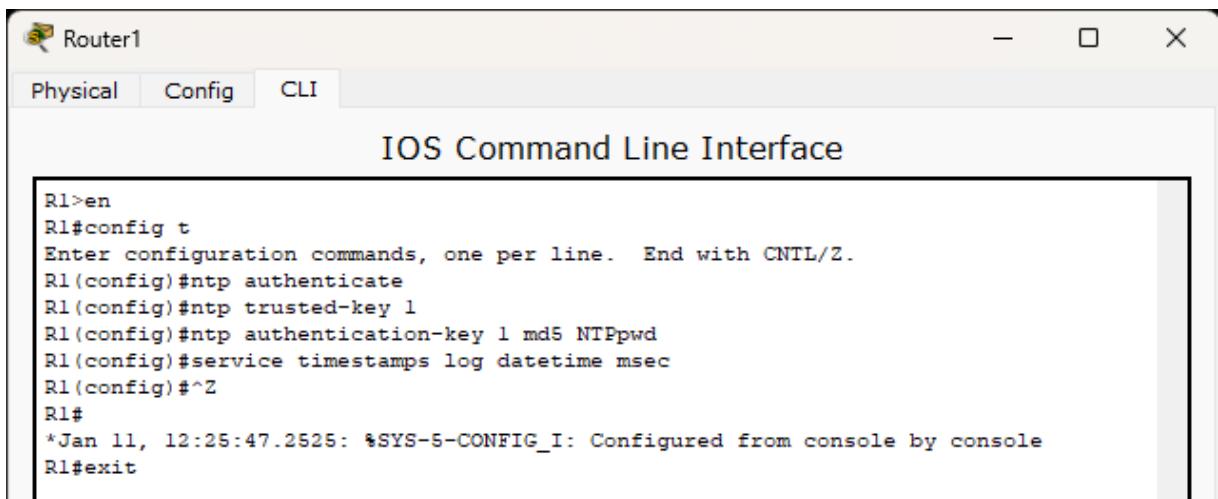
1. Router 0



The window title is "Router0". The tabs at the top are "Physical", "Config" (which is selected), and "CLI". The main area is titled "IOS Command Line Interface". The command history is as follows:

```
R0>en
R0#config t
Enter configuration commands, one per line. End with CNTL/Z.
R0(config)#ntp authenticate
R0(config)#ntp trusted-key 1
R0(config)#ntp authentication-key 1 md5 NTPpwd
R0(config)#service timestamps log datetime msec
R0(config)#^Z
R0#
*Jan 11, 12:24:26.2424: %SYS-5-CONFIG_I: Configured from console by console
R0#exit
```

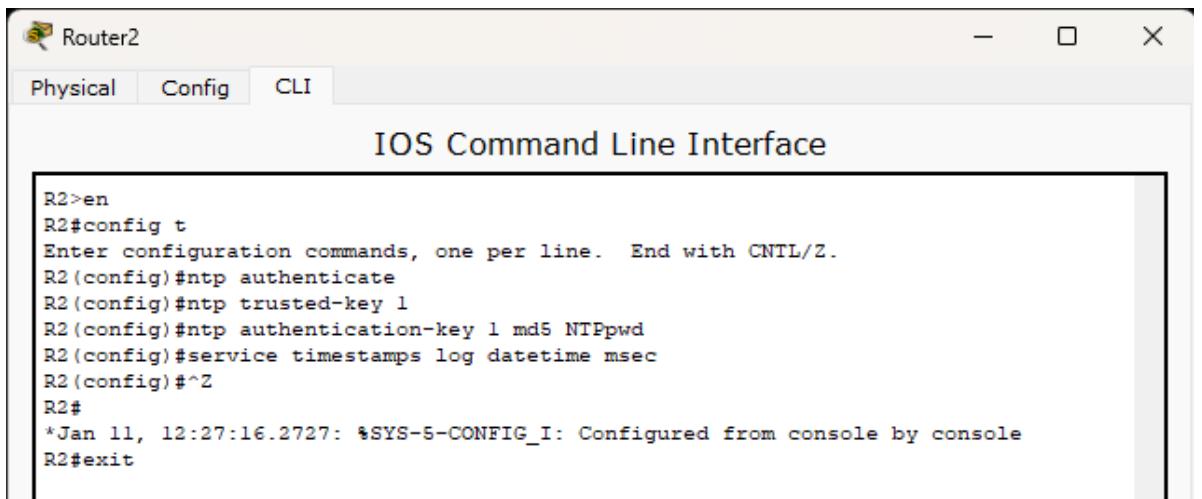
2. Router 1



The window title is "Router1". The tabs at the top are "Physical", "Config" (which is selected), and "CLI". The main area is titled "IOS Command Line Interface". The command history is as follows:

```
R1>en
R1#config t
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#ntp authenticate
R1(config)#ntp trusted-key 1
R1(config)#ntp authentication-key 1 md5 NTPpwd
R1(config)#service timestamps log datetime msec
R1(config)#^Z
R1#
*Jan 11, 12:25:47.2525: %SYS-5-CONFIG_I: Configured from console by console
R1#exit
```

3. Router 2



The window title is "Router2". The tabs at the top are "Physical", "Config" (which is selected), and "CLI". The main area is titled "IOS Command Line Interface". The command history is as follows:

```
R2>en
R2#config t
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#ntp authenticate
R2(config)#ntp trusted-key 1
R2(config)#ntp authentication-key 1 md5 NTPpwd
R2(config)#service timestamps log datetime msec
R2(config)#^Z
R2#
*Jan 11, 12:27:16.2727: %SYS-5-CONFIG_I: Configured from console by console
R2#exit
```

➤ Check updated UTC Clock Time in the routers

1. Router 0

```
R0>show clock
*12:30:36.142 UTC Thu Jan 11 2024
R0>
```

2. Router 1

```
R1>show clock
*12:30:54.211 UTC Thu Jan 11 2024
R1>
```

3. Router 2

```
R2>show clock
*12:31:2.851 UTC Thu Jan 11 2024
R2>
```

### C. SYSLOG

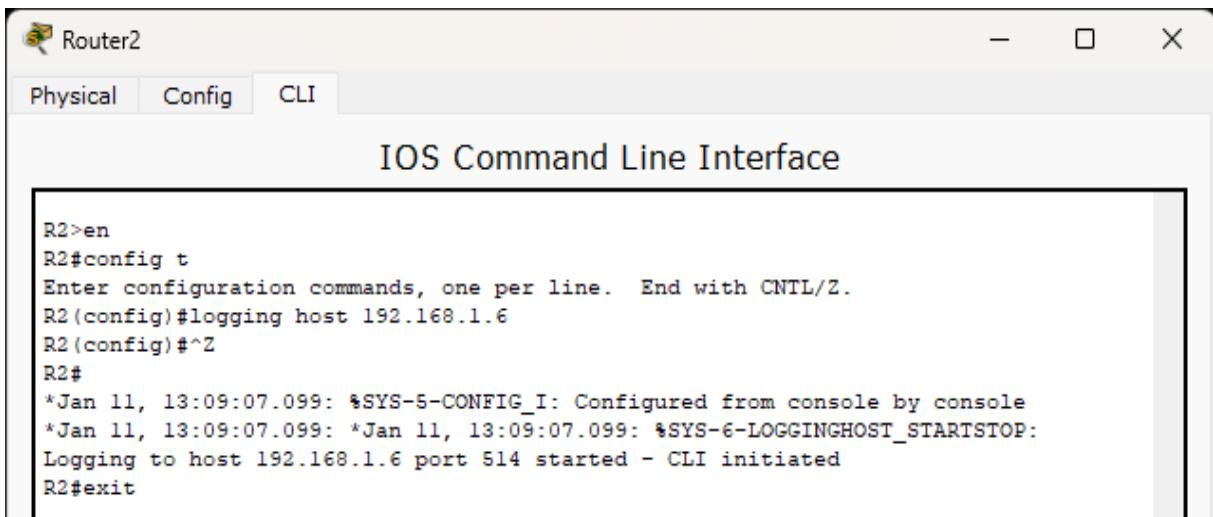
➤ Configure Routers to Log Messages to the SYSLOG Server

1. Router 0

```
R0>en
R0#config t
Enter configuration commands, one per line. End with CNTL/Z.
R0(config)#logging host 192.168.1.6
R0(config)#^Z
R0#
*Jan 11, 13:08:06.088: %SYS-5-CONFIG_I: Configured from console by console
*Jan 11, 13:08:06.088: *Jan 11, 13:08:06.088: %SYS-6-LOGGINGHOST_STARTSTOP:
Logging to host 192.168.1.6 port 514 started - CLI initiated
R0#exit
```

2. Router 1

```
R1>en
R1#config t
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#logging host 192.168.1.6
R1(config)#^Z
R1#
*Jan 11, 13:08:38.088: %SYS-5-CONFIG_I: Configured from console by console
*Jan 11, 13:08:38.088: *Jan 11, 13:08:38.088: %SYS-6-LOGGINGHOST_STARTSTOP:
Logging to host 192.168.1.6 port 514 started - CLI initiated
R1#exit
```



Router2

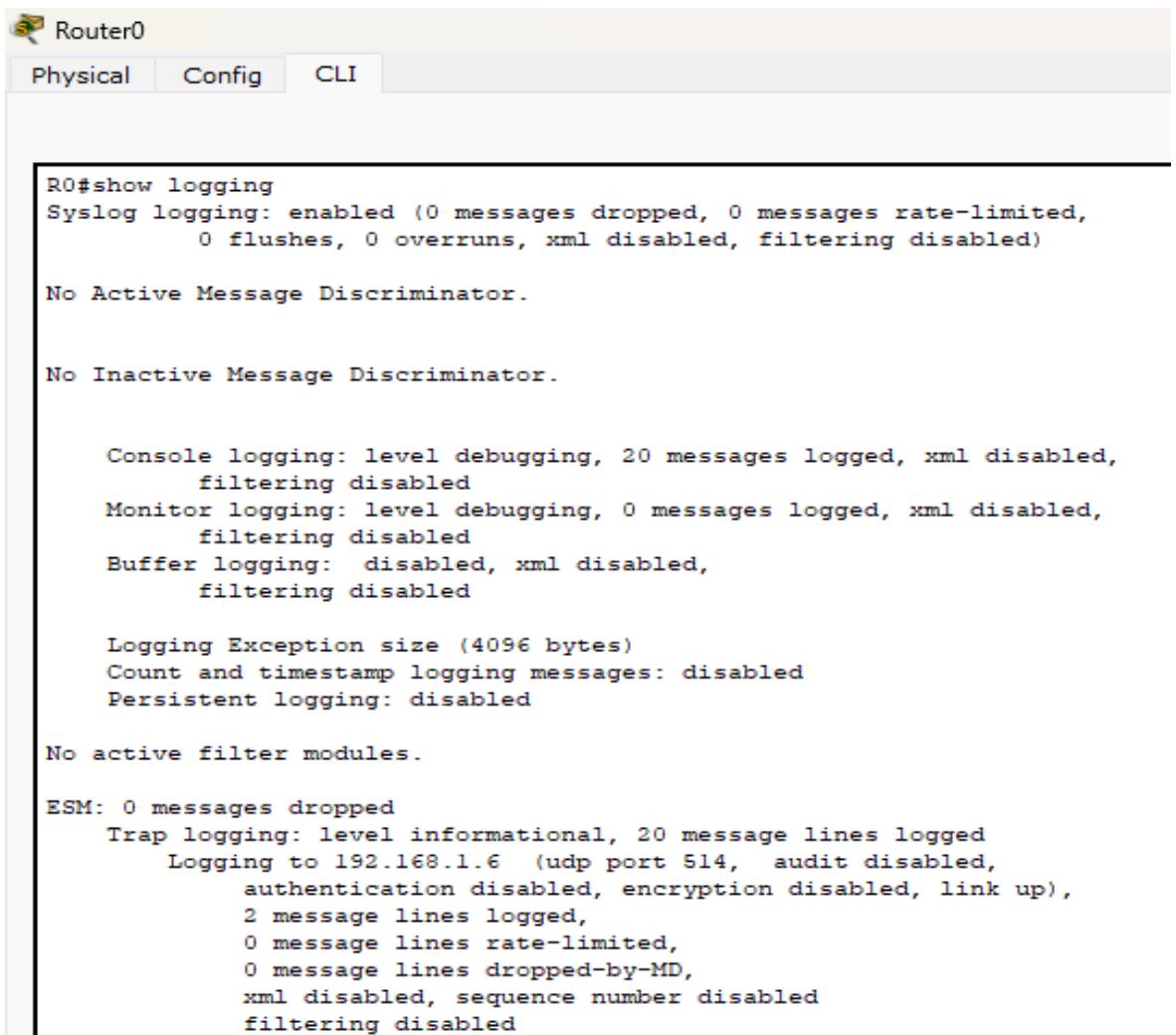
Physical Config CLI

IOS Command Line Interface

```
R2>en
R2#config t
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#logging host 192.168.1.6
R2(config)#+Z
R2#
*Jan 11, 13:09:07.099: *SYS-5-CONFIG_I: Configured from console by console
*Jan 11, 13:09:07.099: *Jan 11, 13:09:07.099: *SYS-6-LOGGINGHOST_STARTSTOP:
Logging to host 192.168.1.6 port 514 started - CLI initiated
R2#exit
```

➤ Verify logging configuration on Routers

1. Router 0



Router0

Physical Config CLI

```
R0#show logging
Syslog logging: enabled (0 messages dropped, 0 messages rate-limited,
                0 flushes, 0 overruns, xml disabled, filtering disabled)

No Active Message Discriminator.

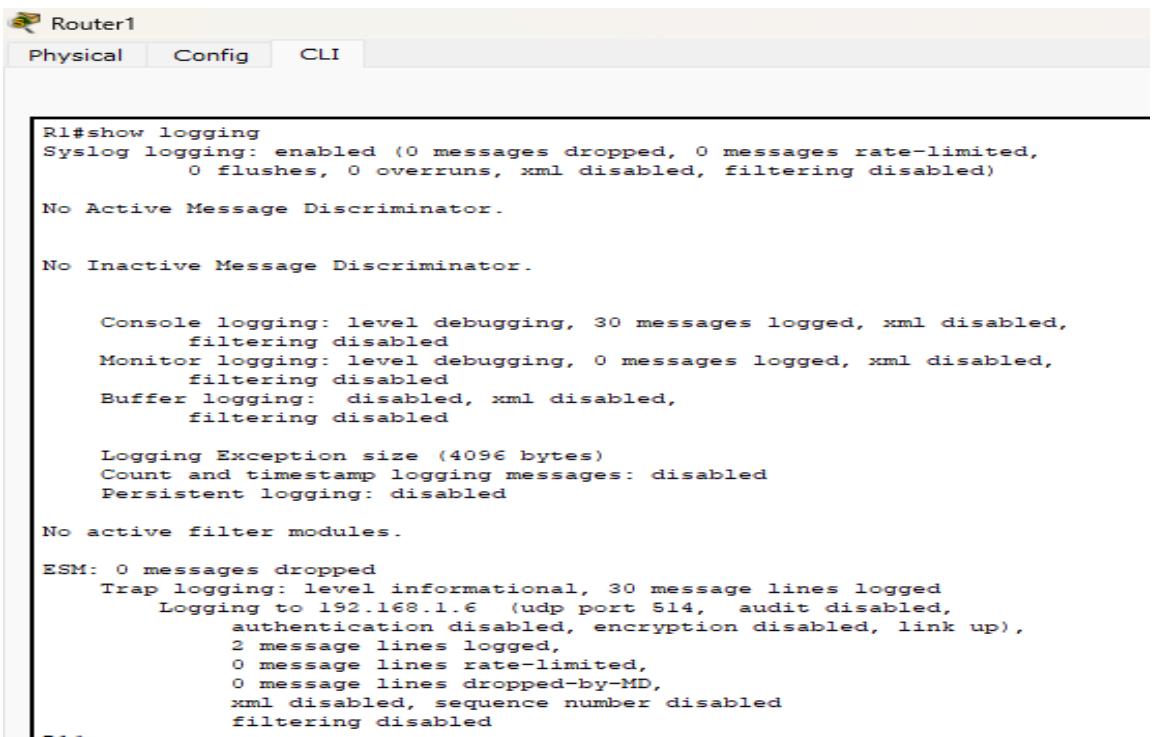
No Inactive Message Discriminator.

Console logging: level debugging, 20 messages logged, xml disabled,
                  filtering disabled
Monitor logging: level debugging, 0 messages logged, xml disabled,
                  filtering disabled
Buffer logging:  disabled, xml disabled,
                  filtering disabled

Logging Exception size (4096 bytes)
Count and timestamp logging messages: disabled
Persistent logging: disabled

No active filter modules.

ESM: 0 messages dropped
Trap logging: level informational, 20 message lines logged
              Logging to 192.168.1.6 (udp port 514, audit disabled,
              authentication disabled, encryption disabled, link up),
              2 message lines logged,
              0 message lines rate-limited,
              0 message lines dropped-by-MD,
              xml disabled, sequence number disabled
              filtering disabled
```



```
R1#show logging
Syslog logging: enabled (0 messages dropped, 0 messages rate-limited,
                 0 flushes, 0 overruns, xml disabled, filtering disabled)

No Active Message Discriminator.

No Inactive Message Discriminator.

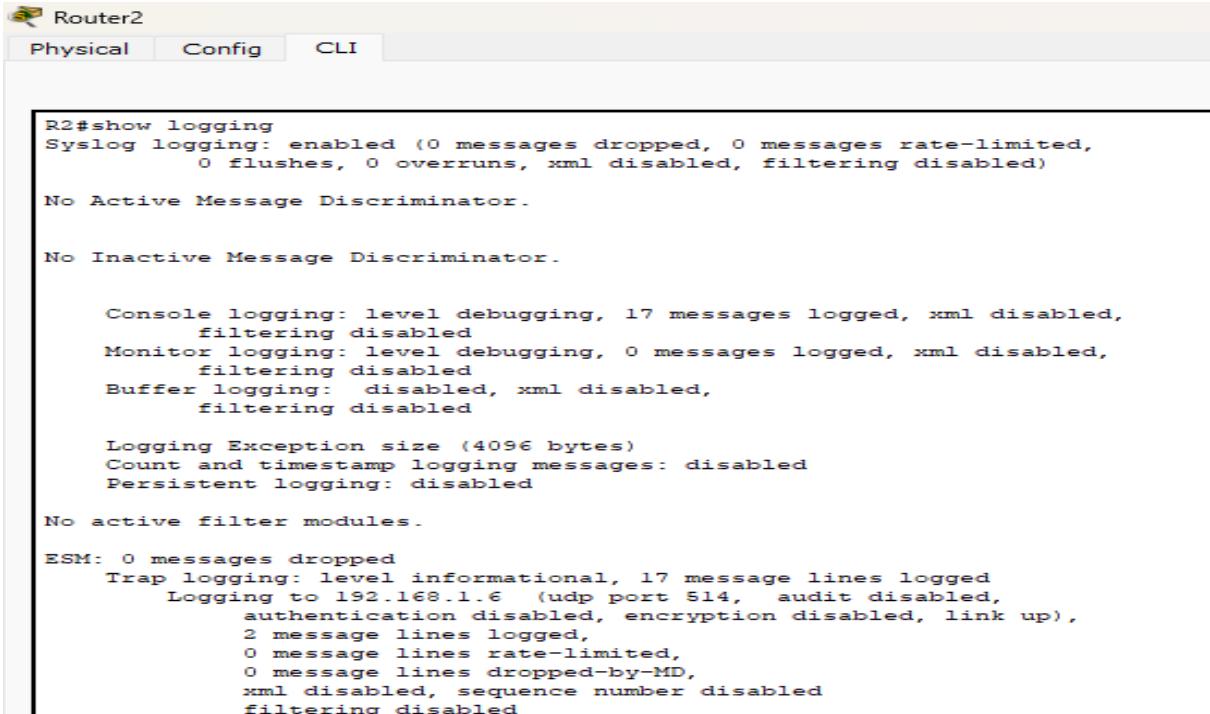
Console logging: level debugging, 30 messages logged, xml disabled,
                  filtering disabled
Monitor logging: level debugging, 0 messages logged, xml disabled,
                  filtering disabled
Buffer logging:  disabled, xml disabled,
                  filtering disabled

Logging Exception size (4096 bytes)
Count and timestamp logging messages: disabled
Persistent logging: disabled

No active filter modules.

ESM: 0 messages dropped
Trap logging: level informational, 30 message lines logged
              Logging to 192.168.1.6 (udp port 514, audit disabled,
              authentication disabled, encryption disabled, link up),
              2 message lines logged,
              0 message lines rate-limited,
              0 message lines dropped-by-MD,
              xml disabled, sequence number disabled
filtering disabled
...
...
```

### 3. Router 2



```
R2#show logging
Syslog logging: enabled (0 messages dropped, 0 messages rate-limited,
                 0 flushes, 0 overruns, xml disabled, filtering disabled)

No Active Message Discriminator.

No Inactive Message Discriminator.

Console logging: level debugging, 17 messages logged, xml disabled,
                  filtering disabled
Monitor logging: level debugging, 0 messages logged, xml disabled,
                  filtering disabled
Buffer logging:  disabled, xml disabled,
                  filtering disabled

Logging Exception size (4096 bytes)
Count and timestamp logging messages: disabled
Persistent logging: disabled

No active filter modules.

ESM: 0 messages dropped
Trap logging: level informational, 17 message lines logged
              Logging to 192.168.1.6 (udp port 514, audit disabled,
              authentication disabled, encryption disabled, link up),
              2 message lines logged,
              0 message lines rate-limited,
              0 message lines dropped-by-MD,
              xml disabled, sequence number disabled
filtering disabled
...
...
```

➤ Examine logs of the SYSLOG Server

The screenshot shows a software interface titled "SYSLOG SERVER". On the left, there's a sidebar with a tree view under "SERVICES" containing items like HTTP, DHCP, DNS, SYSLOG, AAA, NTP, EMAIL, and FTP. The main area is titled "Syslog" and has a sub-section "Service". It displays a table of log entries:

Time	HostName	Message
1 Mar 01 00:04:51.740	10.2.2.1	%LINEPROTO-5-UPDOWN: Line protocol on Interface
2 Mar 01 00:04:48.810	10.2.2.1	%LINEPROTO-5-UPDOWN: Line protocol on Interface
3 Mar 01 00:03:01.404	10.1.1.2	%SYS-5-CONFIG_I: Configured from console by console
4 Mar 01 00:03:31.695	10.2.2.1	%SYS-5-CONFIG_I: Configured from console by console

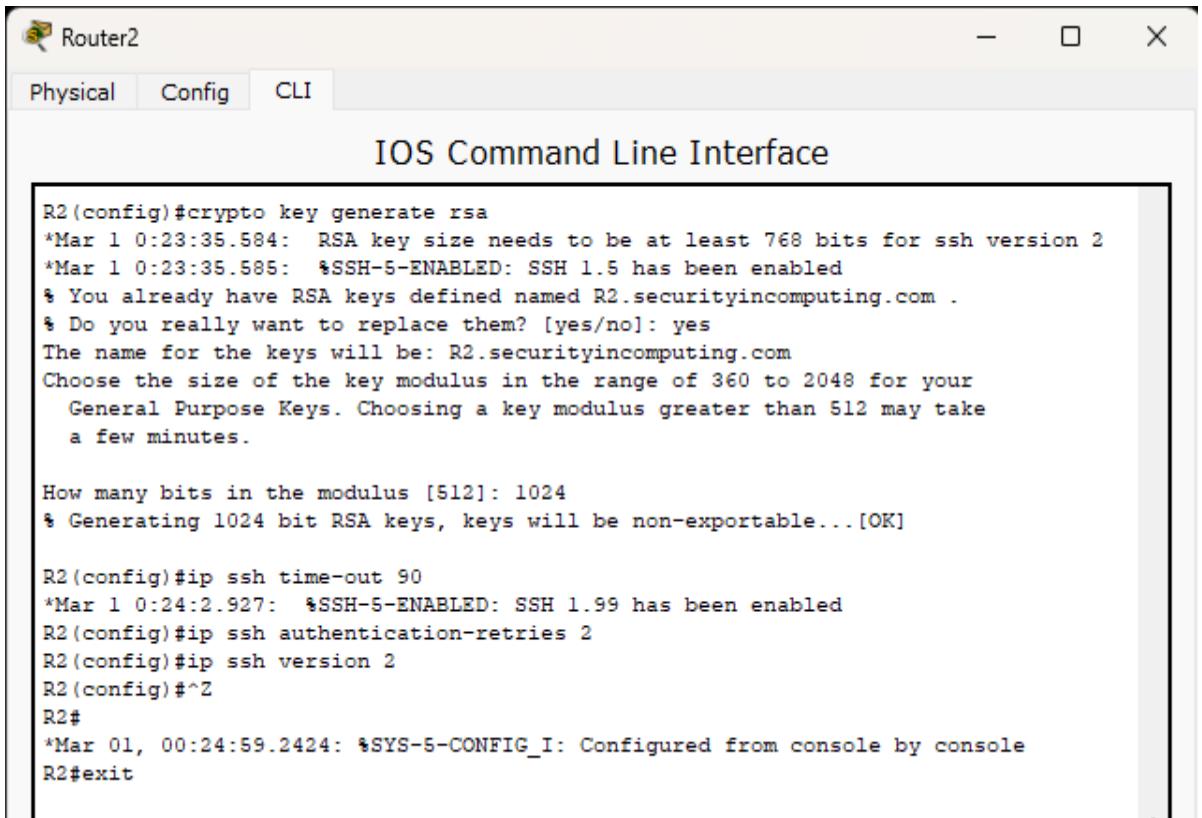
## D. SSH

➤ Configure SSH on R2

Router 2

The screenshot shows the "IOS Command Line Interface" for Router 2. The user is in configuration mode, specifically in transport input ssh configuration. The commands entered are:

```
R2>en
R2#config t
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#ip domain-name securityincomputing.com
R2(config)#username SSHadmin privilege 15 secret sshpwd
R2(config)#line vty 0 4
R2(config-line)#login local
R2(config-line)#transport input ssh
R2(config-line)#crypto key zeroize rsa
  * All RSA keys will be removed.
  * All router certs issued using these keys will also be removed.
  Do you really want to remove these keys? [yes/no]: yes
R2(config)#crypto key zeroize rsa
*Mar 1 0:23:24.500: %SSH-5-DISABLED: SSH 1.5 has been disabled
  * No Signature RSA Keys found in configuration.
```



Router2

Physical Config CLI

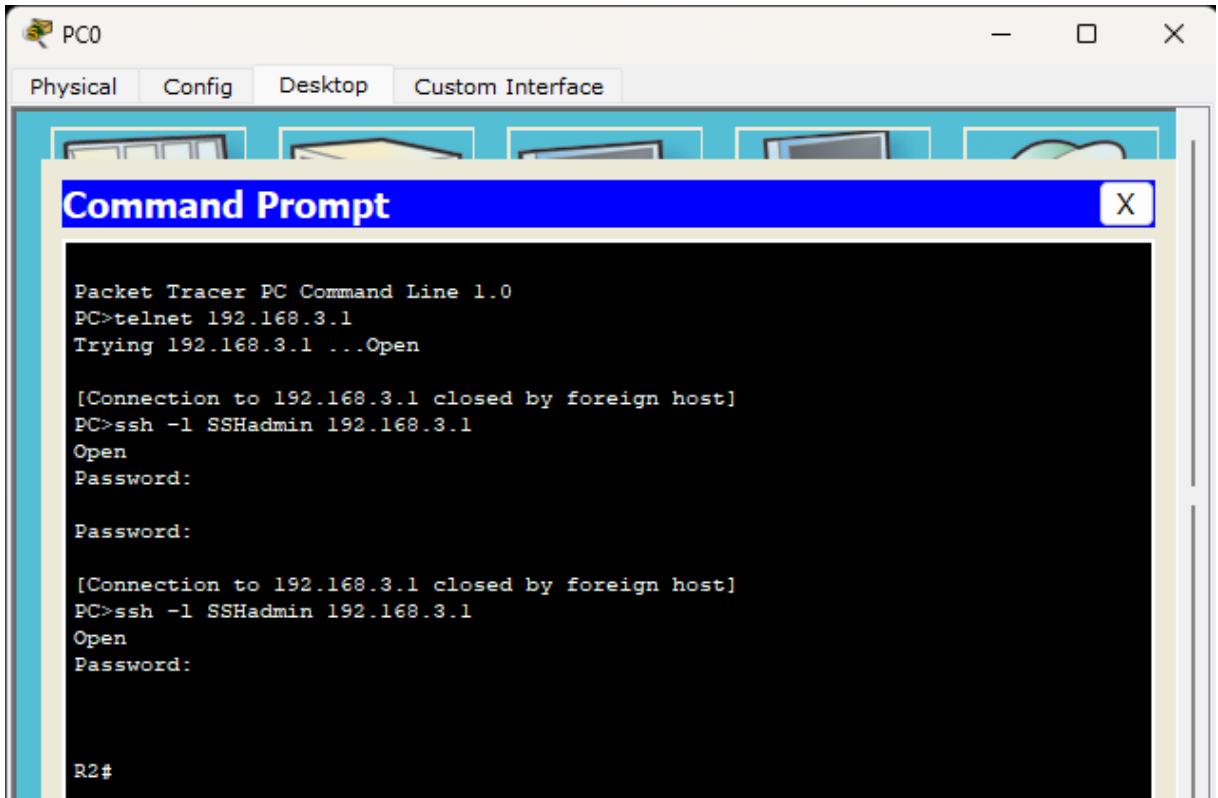
### IOS Command Line Interface

```
R2(config)#crypto key generate rsa
*Mar 1 0:23:35.584: RSA key size needs to be at least 768 bits for ssh version 2
*Mar 1 0:23:35.585: %SSH-5-ENABLED: SSH 1.5 has been enabled
& You already have RSA keys defined named R2.securityincomputing.com .
& Do you really want to replace them? [yes/no]: yes
The name for the keys will be: R2.securityincomputing.com
Choose the size of the key modulus in the range of 360 to 2048 for your
General Purpose Keys. Choosing a key modulus greater than 512 may take
a few minutes.

How many bits in the modulus [512]: 1024
& Generating 1024 bit RSA keys, keys will be non-exportable...[OK]

R2(config)#ip ssh time-out 90
*Mar 1 0:24:2.927: %SSH-5-ENABLED: SSH 1.99 has been enabled
R2(config)#ip ssh authentication-retries 2
R2(config)#ip ssh version 2
R2(config)#+Z
R2#
*Mar 01, 00:24:59.2424: %SYS-5-CONFIG_I: Configured from console by console
R2#exit
```

➤ Connect to R2 using telnet and SSH on PC



PC0

Physical Config Desktop Custom Interface

### Command Prompt

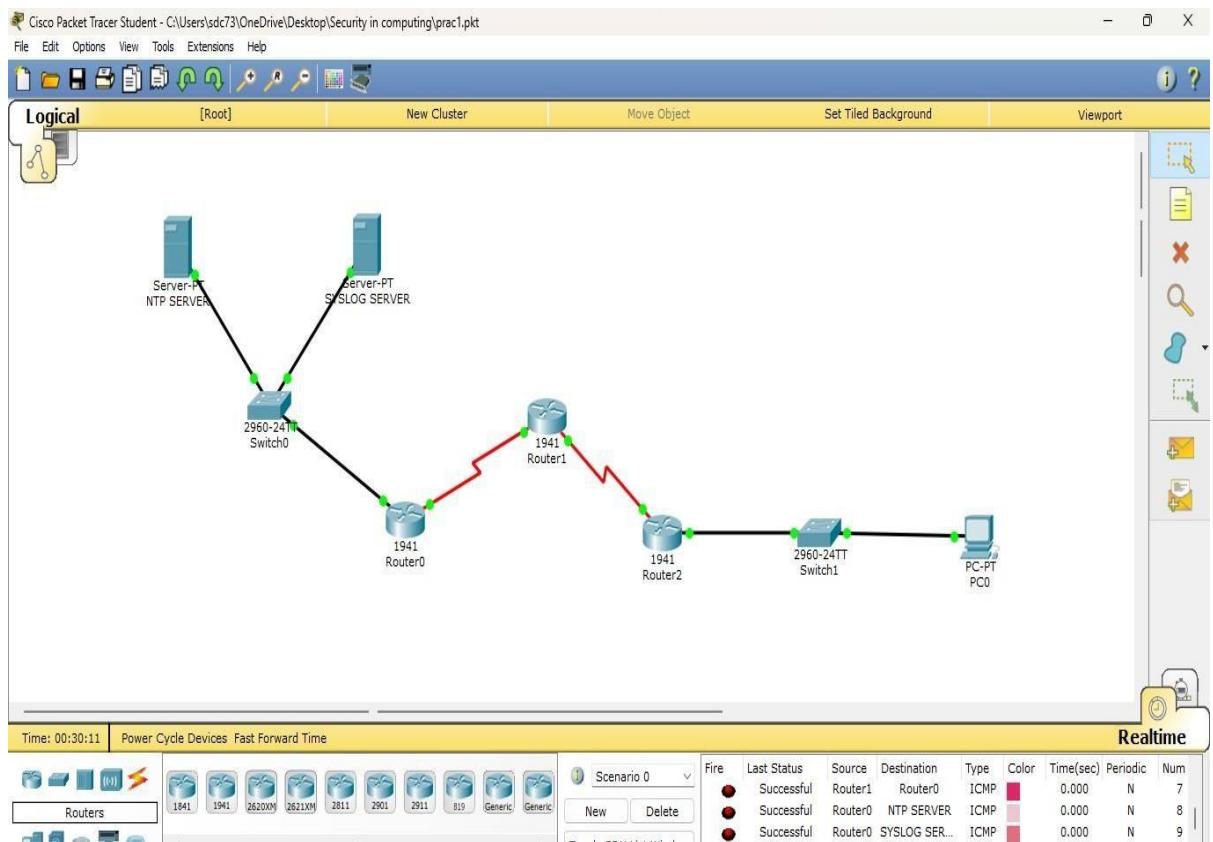
```
Packet Tracer PC Command Line 1.0
PC>telnet 192.168.3.1
Trying 192.168.3.1 ...Open

[Connection to 192.168.3.1 closed by foreign host]
PC>ssh -l SSHadmin 192.168.3.1
Open
Password:

Password:

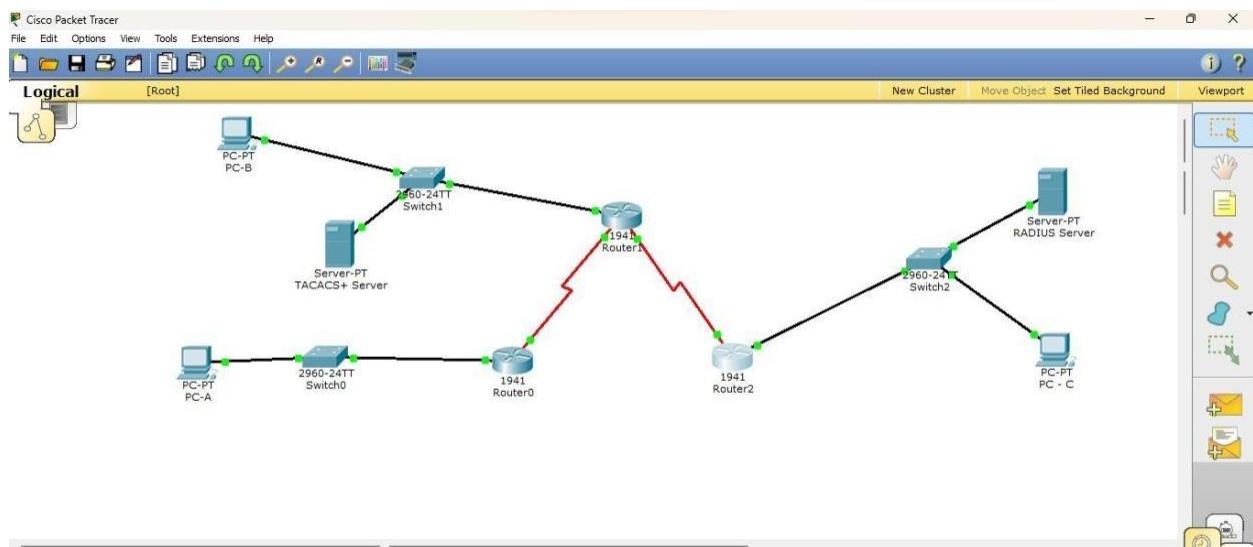
[Connection to 192.168.3.1 closed by foreign host]
PC>ssh -l SSHadmin 192.168.3.1
Open
Password:

R2#
```

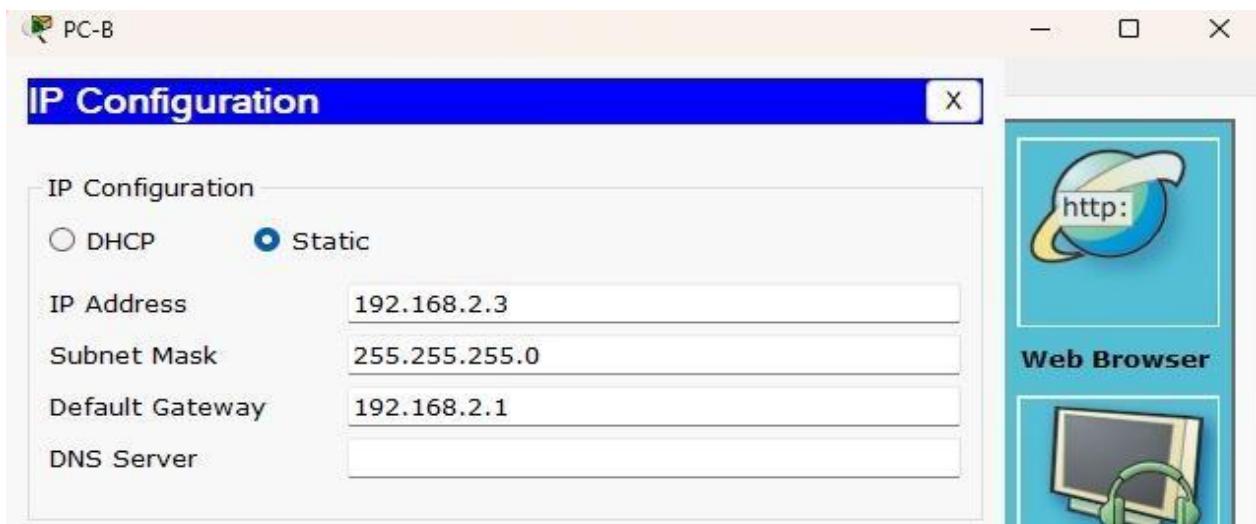
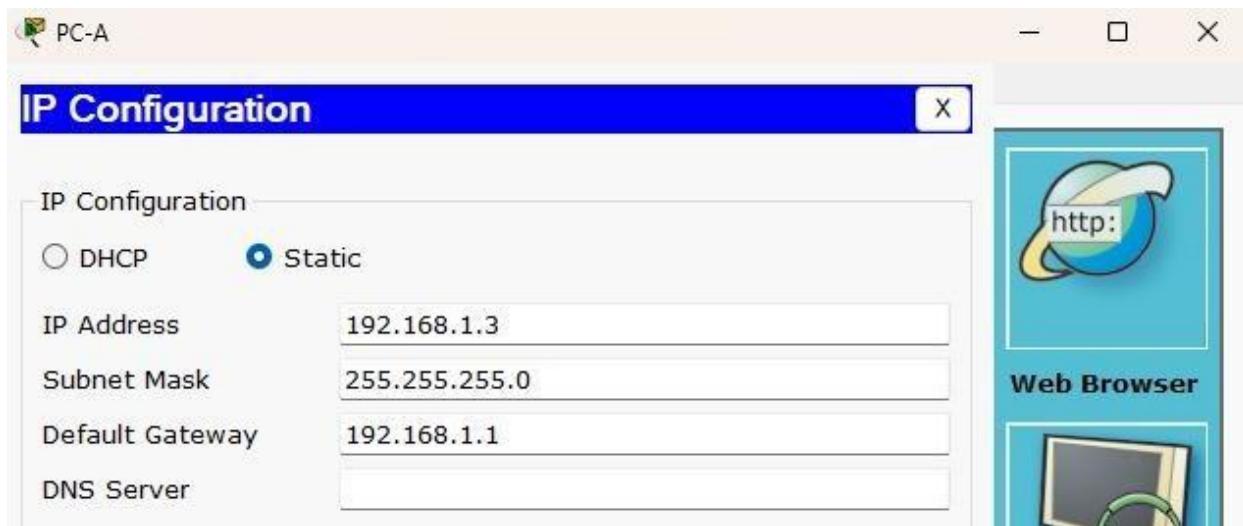


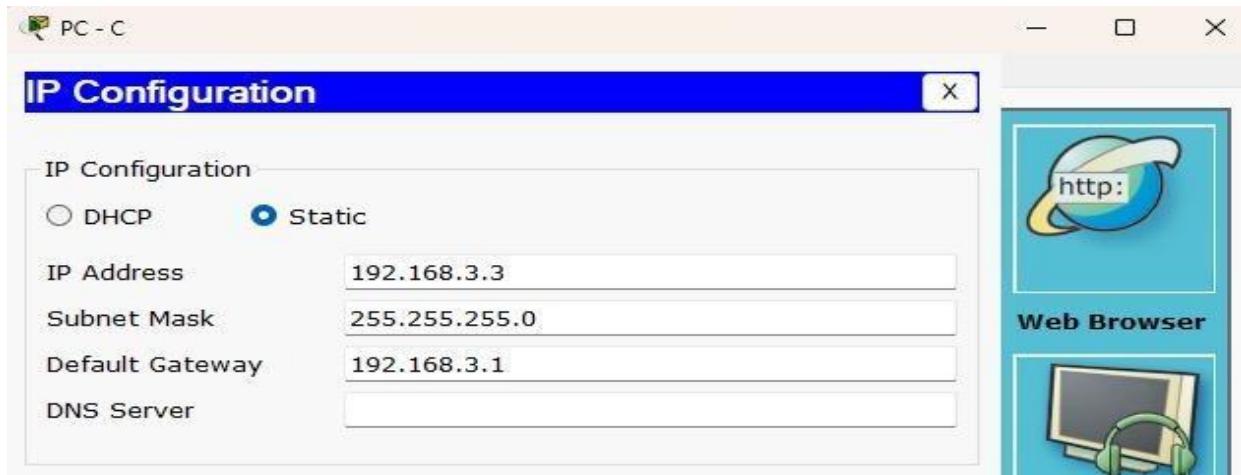
**PRACTICAL NO :2****AIM: CONFIGURE AAA AUTHENTICATION**

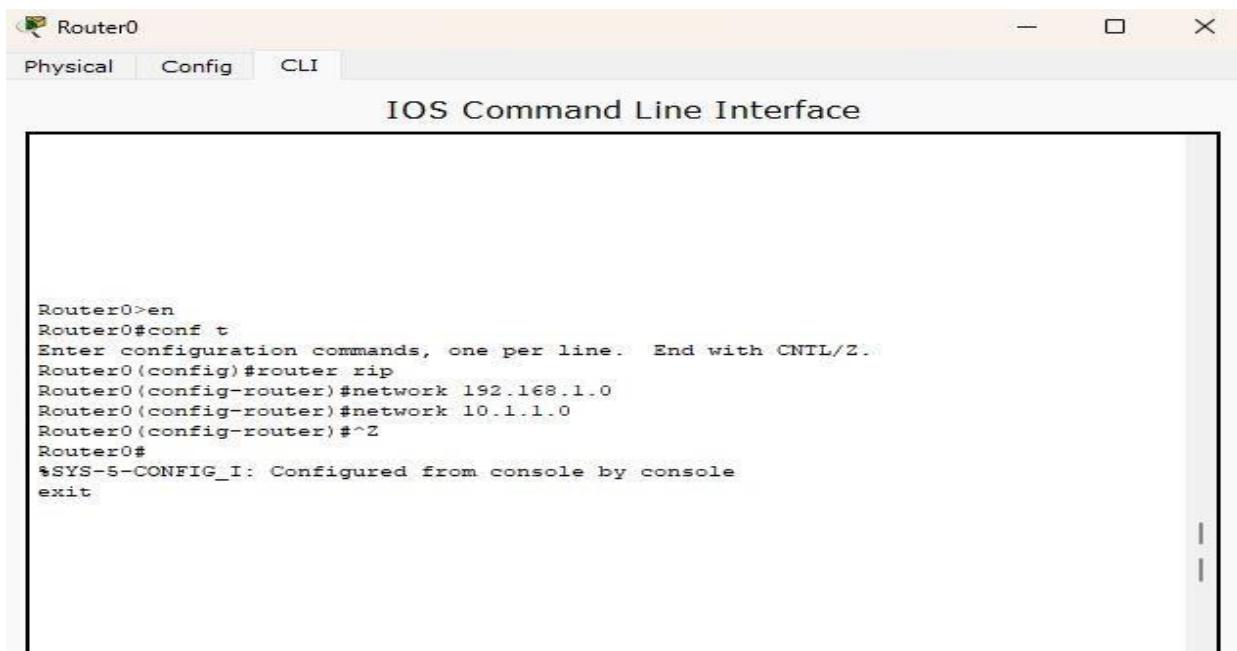
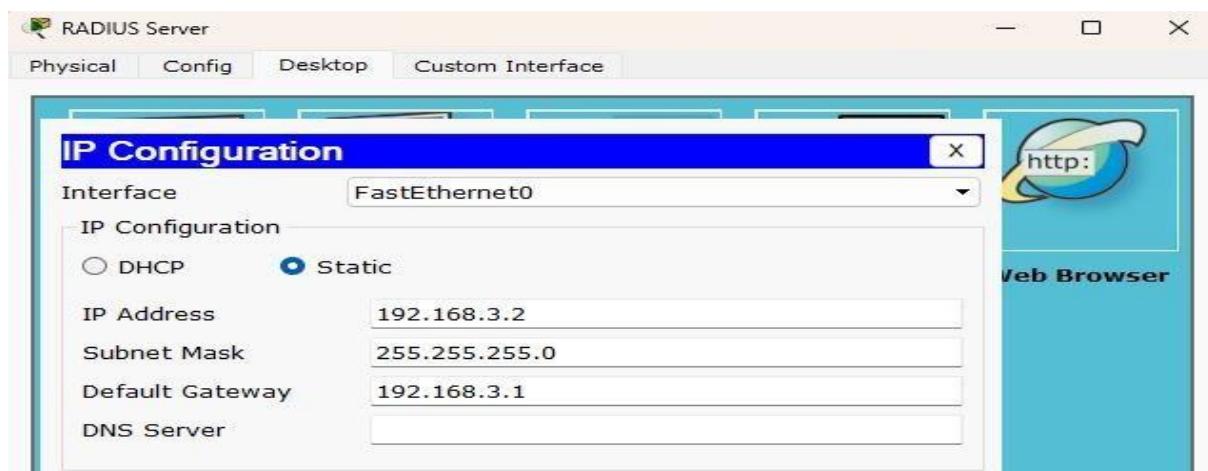
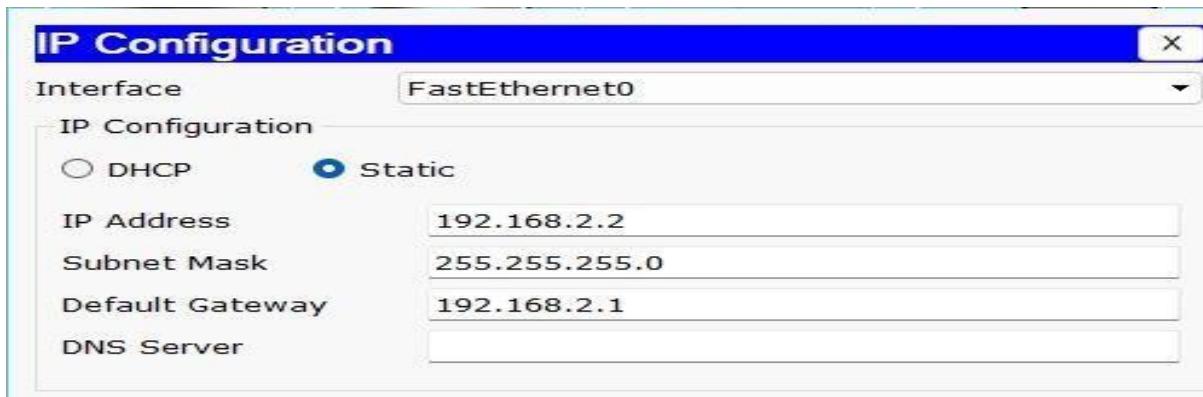
- A) CONFIGURE A LOCAL USER ACCOUNT ON ROUTER AND CONFIGURE AUTHENTICATE ON THE CONSOLE AND VTY LINE USING LOCAL AAA4
- B) VERIFY B. LOCAL AAA AUTHENTICATION FROM THE ROUTER CONSOLE AND THE PC-A CLIENT

**TOPOLOGY DAIGRAM**

## ASSIGN IP ADDRESS







Router1

Physical Config CLI

IOS Command Line Interface

```
*LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to up
*LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to up

Router(config-if)#exit
Router(config)#interface Serial0/0/0
Router(config-if)#ip address 10.1.1.1 255.0.0.0
Router(config-if)#ip address 10.1.1.1 255.255.255.252
Router(config-if)#no shutdown
Router(config-if)#
*LINK-5-CHANGED: Interface Serial0/0/0, changed state to up

Router(config-if)#exit
Router(config)#interface Serial0/0/1
Router(config-if)#
*LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0, changed state to up

ip address 10.2.2.1 255.255.255.252
Router(config-if)#no shutdown
Router(config-if)#
*LINK-5-CHANGED: Interface Serial0/0/1, changed state to up
```

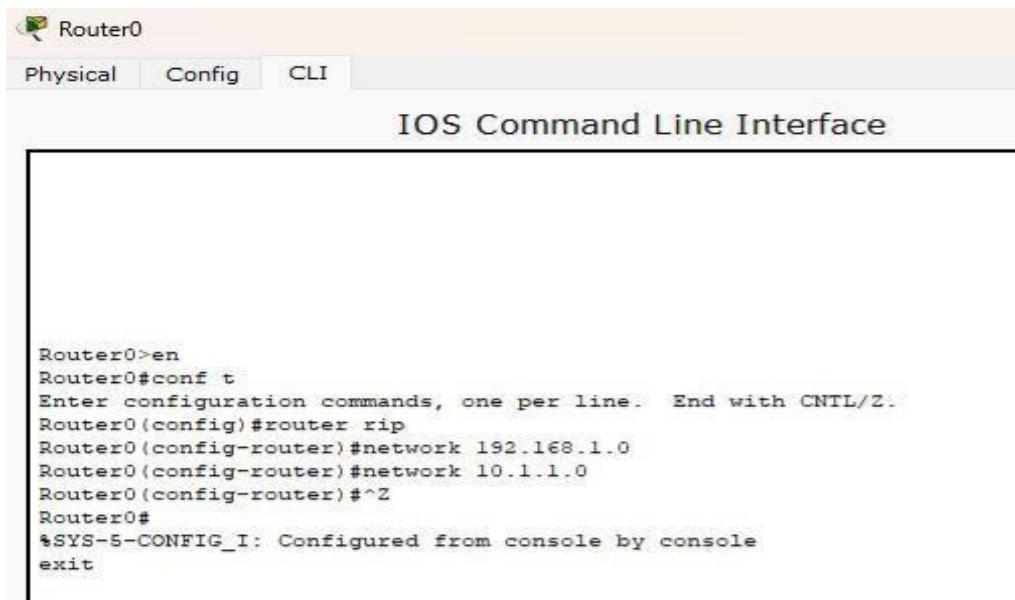
Router2

Physical Config CLI

IOS Command Line Interface

```
Router>en
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#username admin3 secret pwd3
Router(config)#radius-server host 192.168.3.2
Router(config)#radius-server key radiuspwd
Router(config)#aaa new-model
Router(config)#aaa authentication login default group radius local
Router(config)#line console 0
Router(config-line)#login authentication default
Router(config-line)#{^Z
Router#
*SYS-5-CONFIG_I: Configured from console by console
exit
```

## CONFIGURE RIP ON ROUTERS

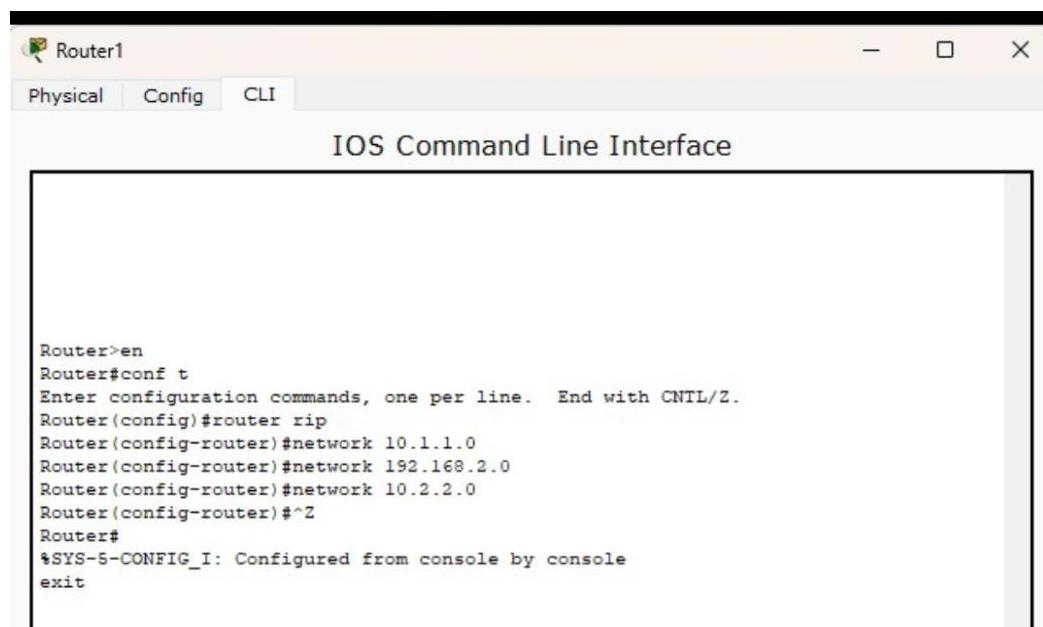


Router0

Physical Config CLI

IOS Command Line Interface

```
Router0>en
Router0#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router0(config)#router rip
Router0(config-router)#network 192.168.1.0
Router0(config-router)#network 10.1.1.0
Router0(config-router)#+Z
Router0#
%SYS-5-CONFIG_I: Configured from console by console
exit
```

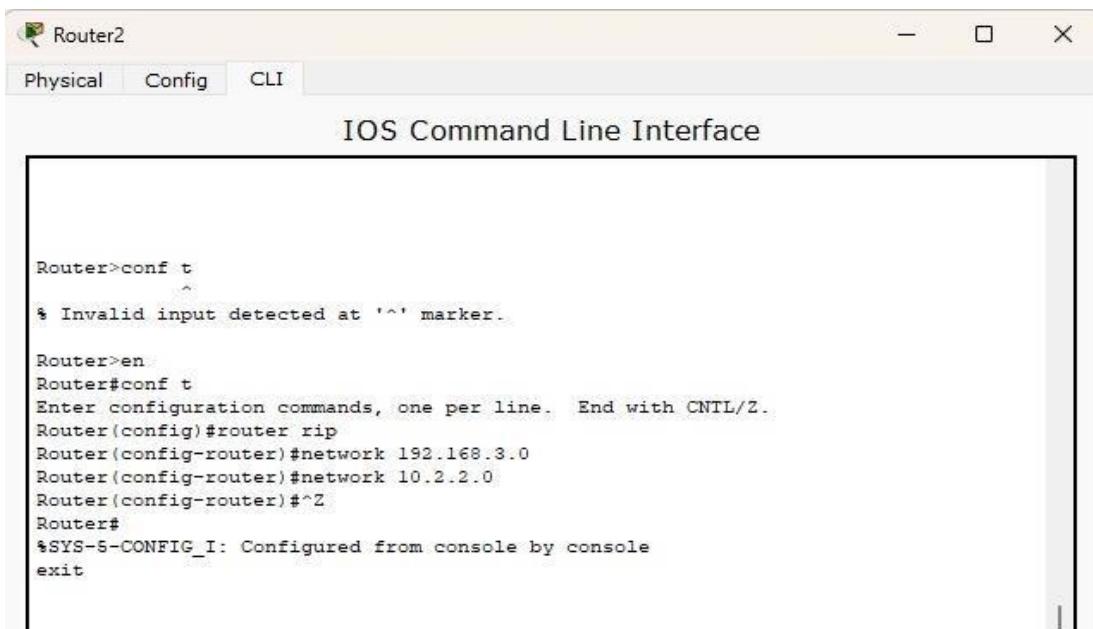


Router1

Physical Config CLI

IOS Command Line Interface

```
Router>en
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router rip
Router(config-router)#network 10.1.1.0
Router(config-router)#network 192.168.2.0
Router(config-router)#network 10.2.2.0
Router(config-router)#+Z
Router#
%SYS-5-CONFIG_I: Configured from console by console
exit
```



Router2

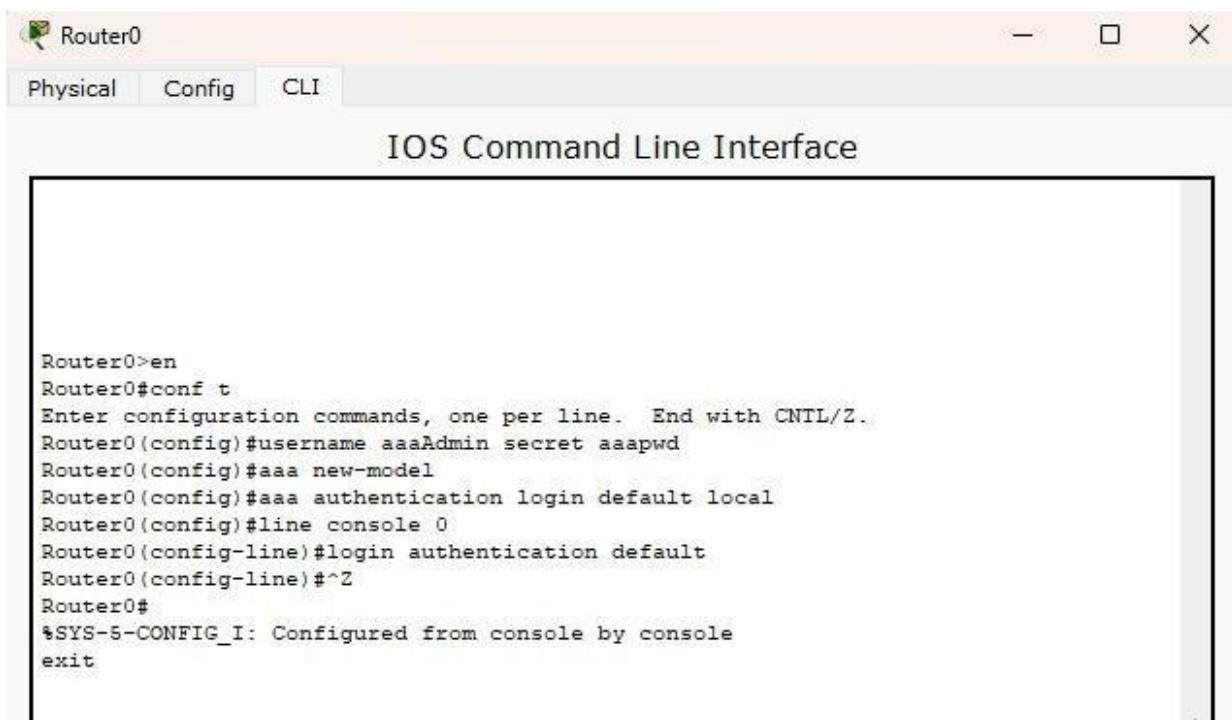
Physical Config CLI

IOS Command Line Interface

```
Router>conf t
^
% Invalid input detected at '^' marker.

Router>en
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router rip
Router(config-router)#network 192.168.3.0
Router(config-router)#network 10.2.2.0
Router(config-router)#+Z
Router#
%SYS-5-CONFIG_I: Configured from console by console
exit
```

: CONFIGURE LOCAL AAA AUTHENTICATION FOR CONSOLELINES ON R1



Router0

Physical Config CLI

IOS Command Line Interface

```
Router0>en
Router0#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router0(config)#username aaaAdmin secret aaapwd
Router0(config)#aaa new-model
Router0(config)#aaa authentication login default local
Router0(config)#line console 0
Router0(config-line)#login authentication default
Router0(config-line)#+Z
Router0#
%SYS-5-CONFIG_I: Configured from console by console
exit
```

```
User Access Verification
```

```
Username: aaaAdmin
Password:
Router0>|
```

: FCONFIGURE LOCAL AAA AUTHENTICATION FOR VTY LINESON R1

The screenshot shows the Cisco IOS CLI interface. The title bar says "IOS Command Line Interface". The window contains the following configuration commands:

```

password:
Router0>en
Router0#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router0(config)#ip domain-name sic.com
Router0(config)#crypto key generate rsa
The name for the keys will be: Router0.sic.com
Choose the size of the key modulus in the range of 360 to 2048 for your
General Purpose Keys. Choosing a key modulus greater than 512 may take
a few minutes.

How many bits in the modulus [512]: 1024
* Generating 1024 bit RSA keys, keys will be non-exportable...[OK]

Router0(config)#aaa authentication login SSH-LOGIN local
*Mar 1 0:33:3.65: %SSH-5-ENABLED: SSH 1.99 has been enabled
Router0(config)#line vty 0 4
Router0(config-line)#login authentication SSH-LOGIN
Router0(config-line)#transport input ssh
Router0(config-line)#^Z
Router0#
*SYS-5-CONFIG_I: Configured from console by console
exit

```

The screenshot shows the "Command Prompt" window of the Packet Tracer PC Command Line interface. The title bar says "Command Prompt". The window displays the following session log:

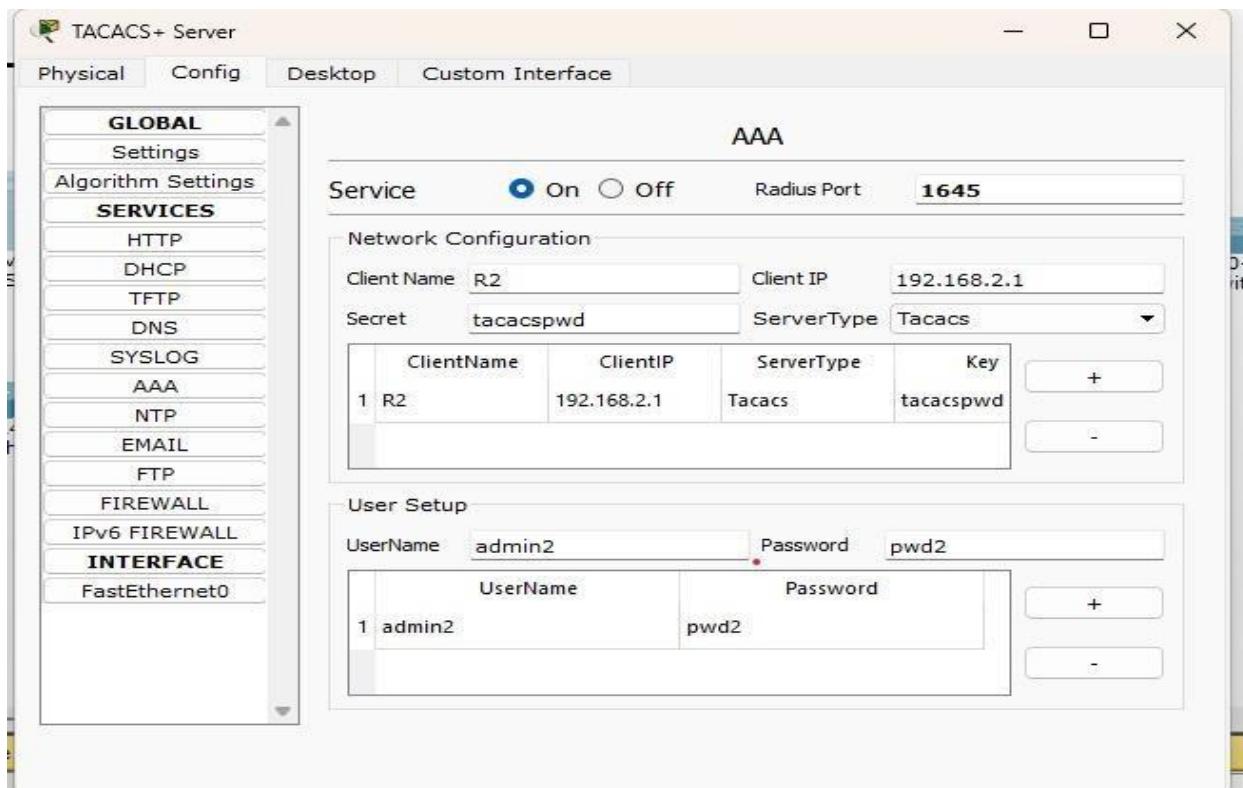
```

Packet Tracer PC Command Line 1.0
PC>ssh -l aaaAdmin 192.168.1.1
Open
Password:
* Login invalid

Password:
Password:
Router0>|

```

: CONFIGURE SERVER-BASED AAA AUTHENTICATION USING TACACS+ ON R2



The screenshot shows the Router1 CLI interface. The command history is as follows:

```

Router>en
Router#conf
Configuring from terminal, memory, or network [terminal]?
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#username admin2 secret pwd2
Router(config)#tacacs-server host 192.168.2.2
Router(config)#tacacs-server key tacacspwd
Router(config)#aaa new-model
Router(config)#aaa authentication login default group tacacs+ local
Router(config)#line console0
^
% Invalid input detected at '^' marker.

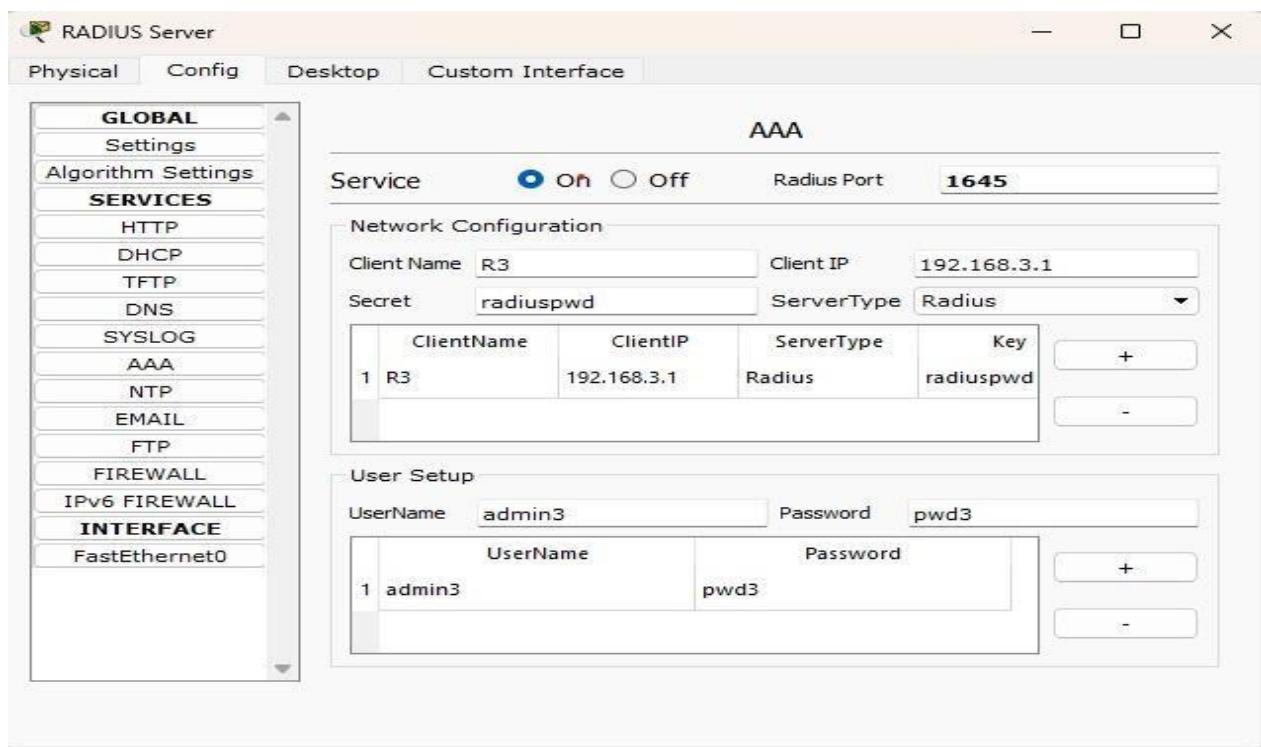
Router(config)#line console 0
Router(config-line)#login authentication default
Router(config-line)#^Z
Router#
%SYS-5-CONFIG_I: Configured from console by console
exit

```

```
User Access Verification

Username: admin2
Password:
Router>|
```

: CONFIGURE SERVER-BASED AAA AUTHENTICATION USING RADIUS ON R3



```
User Access Verification

Username: admin3
Password:
Router>|
```

**DATE : 16/01/24.**

**SECURITY IN COMPUTING**

**IT21036**

**DATE : 16/01/24.**

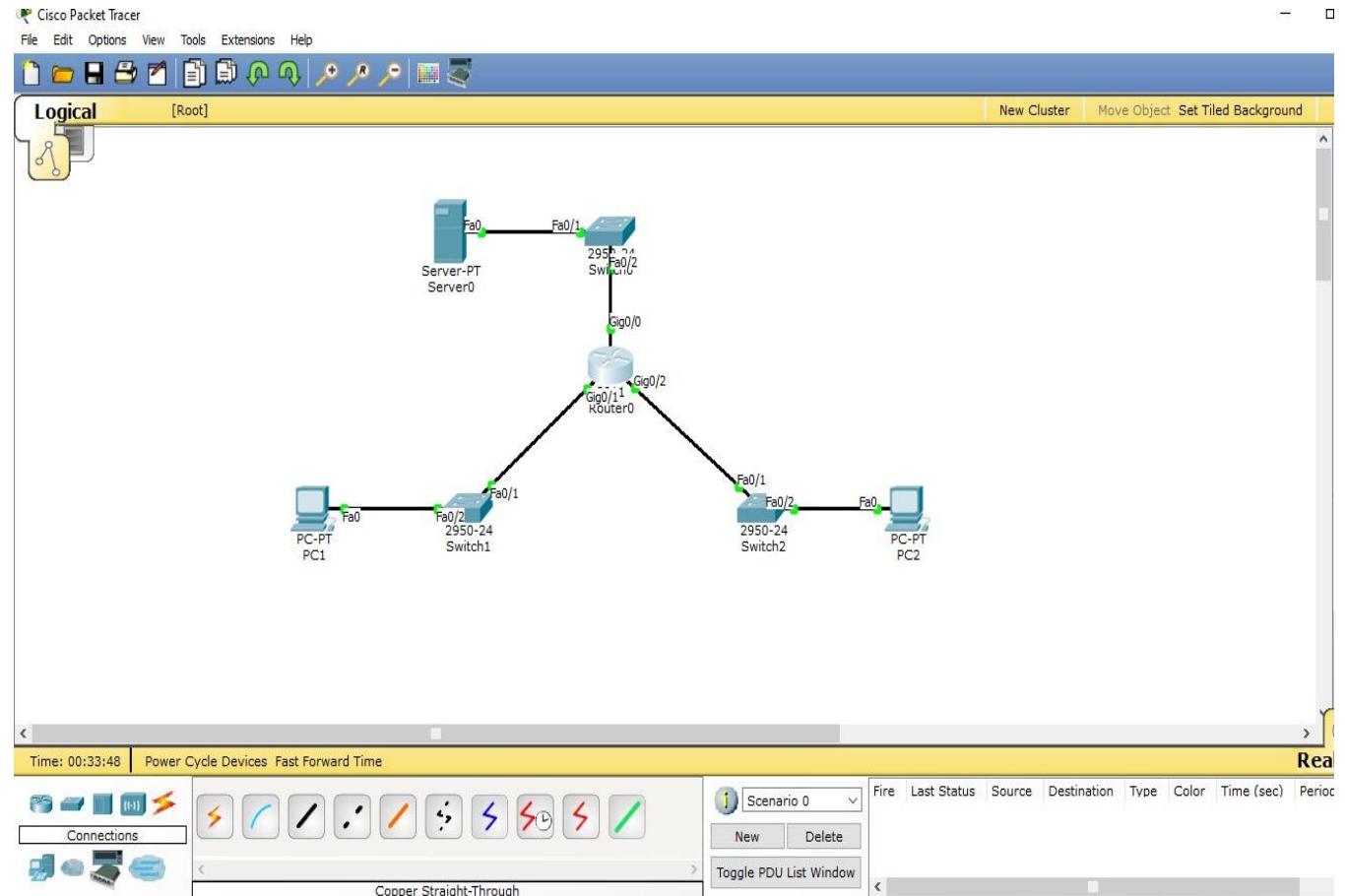
**SECURITY IN COMPUTING**

**IT21036**

**Date : 24/01/2024**  
**Practical No : 3A**

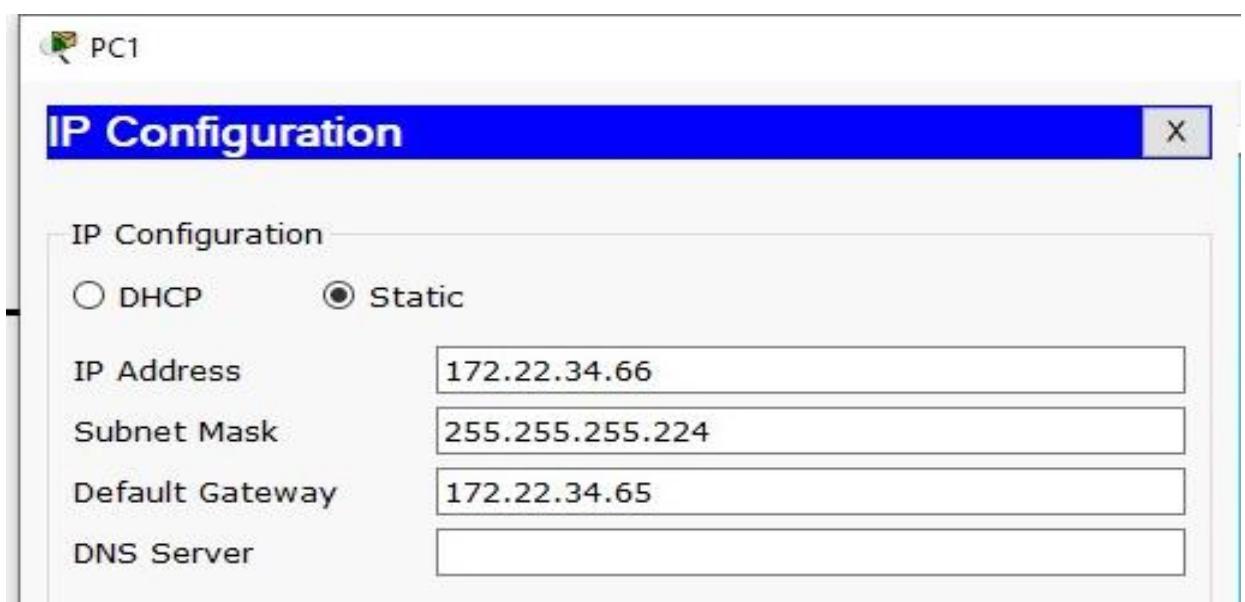
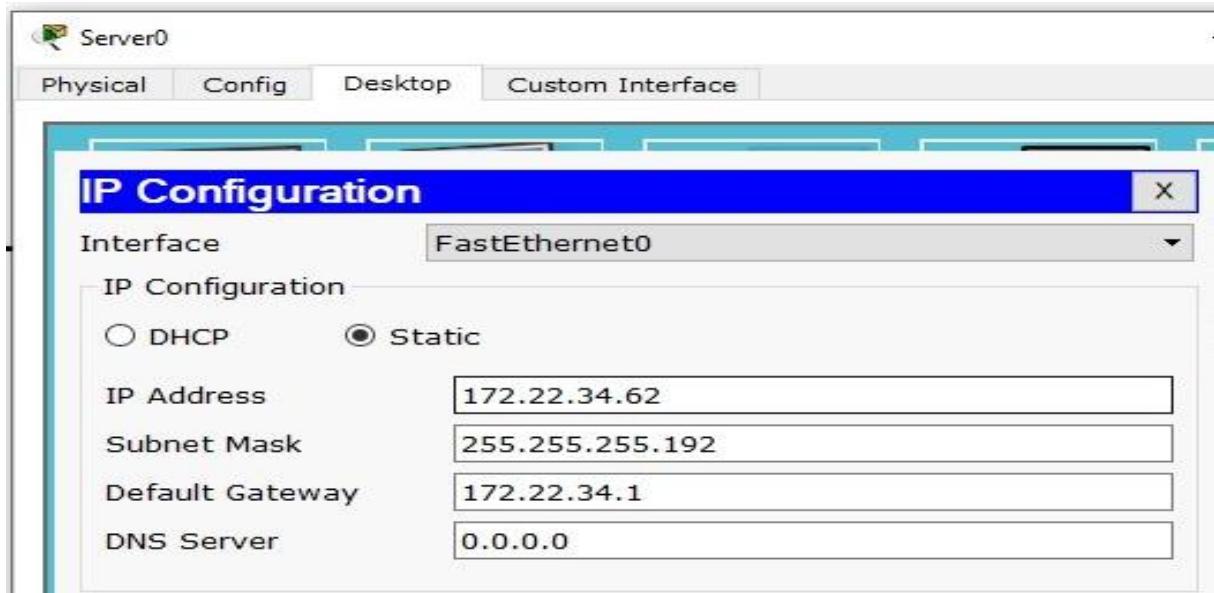
**• Aim : Configuring Extended ACLs**

**➤ Topology Diagram**

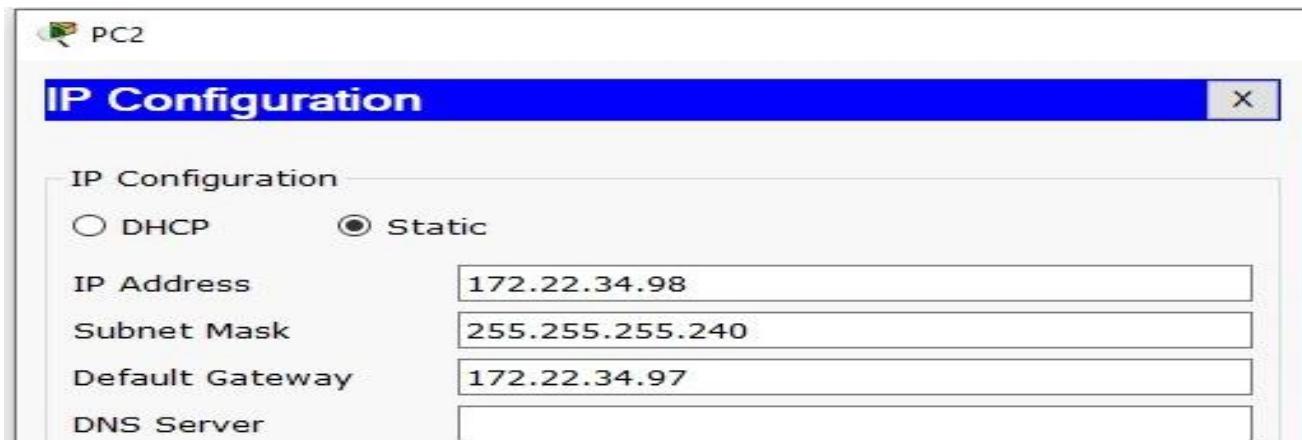


Date : 24/01/2024  
Practical No : 3A

➤ Assign IP Addresses



Date : 24/01/2024  
Practical No : 3A



➤ Performing Ping from PC1 to Server and PC2

The screenshot shows the 'Command Prompt' window for PC1. The window title is 'Command Prompt'. At the top, there are tabs: Physical, Config (which is selected), Desktop, and Custom Interface. The main area displays the output of ping commands:

```
PC>ping 172.22.34.98
Pinging 172.22.34.98 with 32 bytes of data:
Request timed out.
Reply from 172.22.34.98: bytes=32 time=0ms TTL=127
Reply from 172.22.34.98: bytes=32 time=1ms TTL=127
Reply from 172.22.34.98: bytes=32 time=2ms TTL=127

Ping statistics for 172.22.34.98:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 1ms

PC>ping 172.22.34.62
Pinging 172.22.34.62 with 32 bytes of data:
Request timed out.
Reply from 172.22.34.62: bytes=32 time=0ms TTL=127
Reply from 172.22.34.62: bytes=32 time=0ms TTL=127
Reply from 172.22.34.62: bytes=32 time=0ms TTL=127

Ping statistics for 172.22.34.62:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Date : 24/01/2024

Practical No : 3A

➤ Performing Ping from PC2 to Server and PC1

```
Command Prompt

Packet Tracer PC Command Line 1.0
PC>ping 172.22.34.66

Pinging 172.22.34.66 with 32 bytes of data:

Reply from 172.22.34.66: bytes=32 time=0ms TTL=127

Ping statistics for 172.22.34.66:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

PC>ping 172.22.34.66

Pinging 172.22.34.66 with 32 bytes of data:

Reply from 172.22.34.66: bytes=32 time=0ms TTL=127
Reply from 172.22.34.66: bytes=32 time=0ms TTL=127
Reply from 172.22.34.66: bytes=32 time=1ms TTL=127
Reply from 172.22.34.66: bytes=32 time=0ms TTL=127

Ping statistics for 172.22.34.66:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

PC>|
```

**Date : 24/01/2024**  
**Practical No : 3A**

➤ **Configure, Apply and Verify an Extended Numbered ACL**

**(PC1 needs only FTP access and should be able to ping the server, but not PC2)**

```
Router>en
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#ip access-list ?
  extended  Extended Access List
  standard  Standard Access List
Router(config)#ip access-list extended ?
<100-199>  Extended IP access-list number
  WORD      name
Router(config)#ip access-list extended HTTP-ACL
Router(config-ext-nacl)#permit tcp 172.22.34.96 ?
  A.B.C.D  Source wildcard bits
Router(config-ext-nacl)#permit tcp 172.22.34.96 0.0.0.15 ?
  A.B.C.D  Destination address
  any      Any destination host
  eq       Match only packets on a given port number
  gt       Match only packets with a greater port number
  host    A single destination host
  lt       Match only packets with a lower port number
  neq    Match only packets not on a given port number
  range   Match only packets in the range of port numbers
Router(config-ext-nacl)#permit tcp 172.22.34.96 0.0.0.15 host ?
  A.B.C.D  Destination address
Router(config-ext-nacl)#permit tcp 172.22.34.96 0.0.0.15 host 172.22.34.62 ?
  eq       Match only packets on a given port number
  established  established
  gt       Match only packets with a greater port number
  lt       Match only packets with a lower port number
  neq    Match only packets not on a given port number
  range   Match only packets in the range of port numbers
<cr>
Router(config-ext-nacl)#permit tcp 172.22.34.96 0.0.0.15 host 172.22.34.62 eq ?
<0-65535>  Port number
  domain   Domain Name Service (DNS, 53)
  ftp      File Transfer Protocol (21)
  pop3    Post Office Protocol v3 (110)
  smtp    Simple Mail Transport Protocol (25)
  telnet   Telnet (23)
  www     World Wide Web (HTTP, 80)
Router(config-ext-nacl)#permit tcp 172.22.34.96 0.0.0.15 host 172.22.34.62 eq www
w
```

Date : 24/01/2024  
Practical No : 3A

```
Router(config-ext-nacl)#permit icmp 172.22.34.96 0.0.0.15 host 172.22.34.62
Router(config-ext-nacl)#interface GigabitEthernet0/1
Router(config-if)#ip access-group HTTP_ACL in
Router(config-if)#^Z
Router#
%SYS-5-CONFIG_I: Configured from console by console
exit
```

- Performing Ping from PC1 to Server and PC2 to check the working of ACL

The screenshot shows a software interface for 'Packet Tracer' with a title bar 'PC1'. Below the title bar is a menu bar with tabs: 'Physical', 'Config', 'Desktop', and 'Custom Interface'. The 'Command Prompt' tab is currently selected, indicated by a blue border.

The terminal window displays the following log entries:

```
Packet Tracer PC Command Line 1.0
PC>ftp 172.22.34.62
Trying to connect...172.22.34.62
Connected to 172.22.34.62
220- Welcome to PT Ftp server
Username:cisco
331- Username ok, need password
Password:
%Error ftp://172.22.34.62/ (No such Account)
332- Need account for login

Packet Tracer PC Command Line 1.0
PC>ftp 172.22.34.62
Trying to connect...172.22.34.62
Connected to 172.22.34.62
220- Welcome to PT Ftp server
Username:cisco
331- Username ok, need password
Password:
230- Logged in
(passive mode On)
ftp>quit

Packet Tracer PC Command Line 1.0
PC>221- Service closing control connection.
PC>ping 172.22.34.98

Pinging 172.22.34.98 with 32 bytes of data:

Reply from 172.22.34.65: Destination host unreachable.

Ping statistics for 172.22.34.98:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

**Date : 24/01/2024**  
**Practical No : 3A**

➤ **Configure, Apply and Verify an Extended Numbered ACL**

**(PC2 needs only web access and should be able to ping the server, but not PC1)**

**Date : 24/01/2024**  
**Practical No : 3A**

```
Router>en
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#ip access-list ?
  extended  Extended Access List
  standard  Standard Access List
Router(config)#ip access-list extended ?
  <100-199>  Extended IP access-list number
    WORD      name
Router(config)#ip access-list extended HTTP-ACL
Router(config-ext-nacl)#permit tcp 172.22.34.96 ?
  A.B.C.D  Source wildcard bits
Router(config-ext-nacl)#permit tcp 172.22.34.96 0.0.0.15 ?
  A.B.C.D  Destination address
  any      Any destination host
  eq       Match only packets on a given port number
  gt       Match only packets with a greater port number
  host     A single destination host
  lt       Match only packets with a lower port number
  neq     Match only packets not on a given port number
  range   Match only packets in the range of port numbers
Router(config-ext-nacl)#permit tcp 172.22.34.96 0.0.0.15 host ?
  A.B.C.D  Destination address
Router(config-ext-nacl)#permit tcp 172.22.34.96 0.0.0.15 host 172.22.34.62 ?
  eq       Match only packets on a given port number
  established  established
  gt       Match only packets with a greater port number
  lt       Match only packets with a lower port number
  neq     Match only packets not on a given port number
  range   Match only packets in the range of port numbers
<cr>
Router(config-ext-nacl)#permit tcp 172.22.34.96 0.0.0.15 host 172.22.34.62 eq ?
  <0-65535>  Port number
  domain    Domain Name Service (DNS, 53)
  ftp       File Transfer Protocol (21)
  pop3     Post Office Protocol v3 (110)
  smtp     Simple Mail Transport Protocol (25)
  telnet   Telnet (23)
  www      World Wide Web (HTTP, 80)
Router(config-ext-nacl)#permit tcp 172.22.34.96 0.0.0.15 host 172.22.34.62 eq ww
w
```

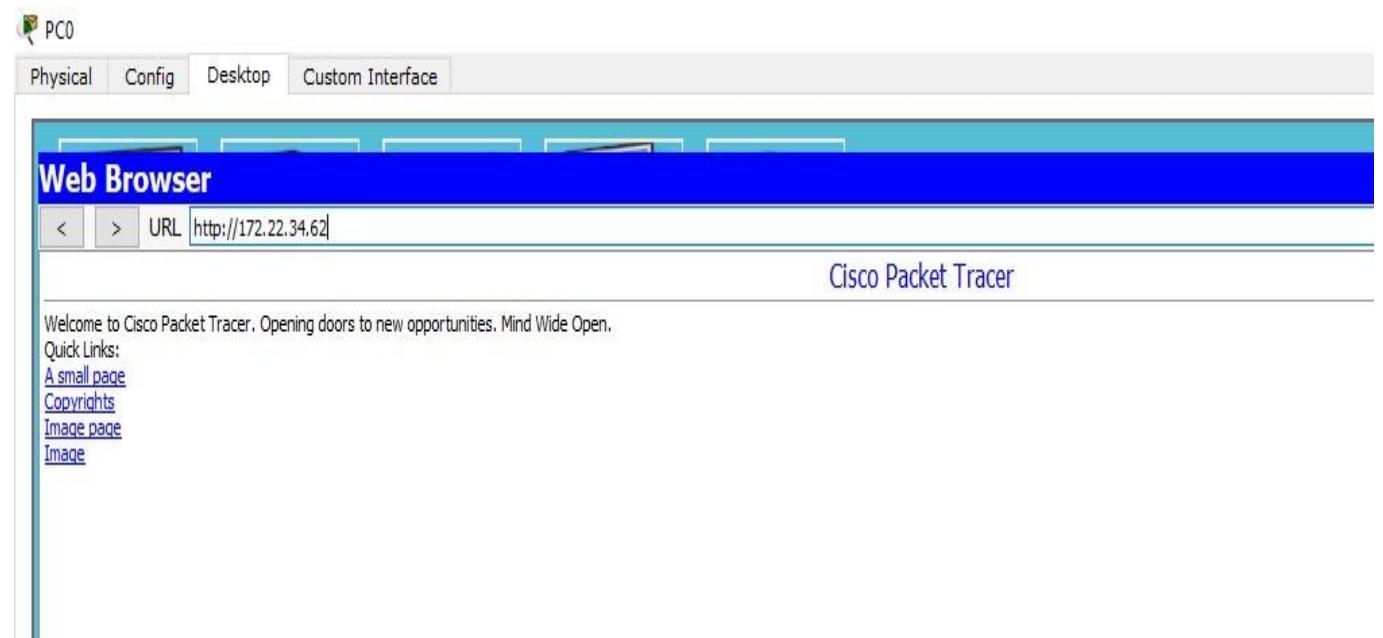
```
Router(config-ext-nacl)#permit icmp 172.22.34.96 0.0.0.15 host 172.22.34.62
Router(config-ext-nacl)#interface GigabitEthernet0/1
Router(config-if)#ip access-group HTTP_ACL in
Router(config-if)#^Z
Router#
%SYS-5-CONFIG_I: Configured from console by console
exit
```

➤ Performing Ping from PC2 to Server and PC1 to check the working of ACL

Date : 24/01/2024  
Practical No : 3A

◆ Checking http connection from PC2

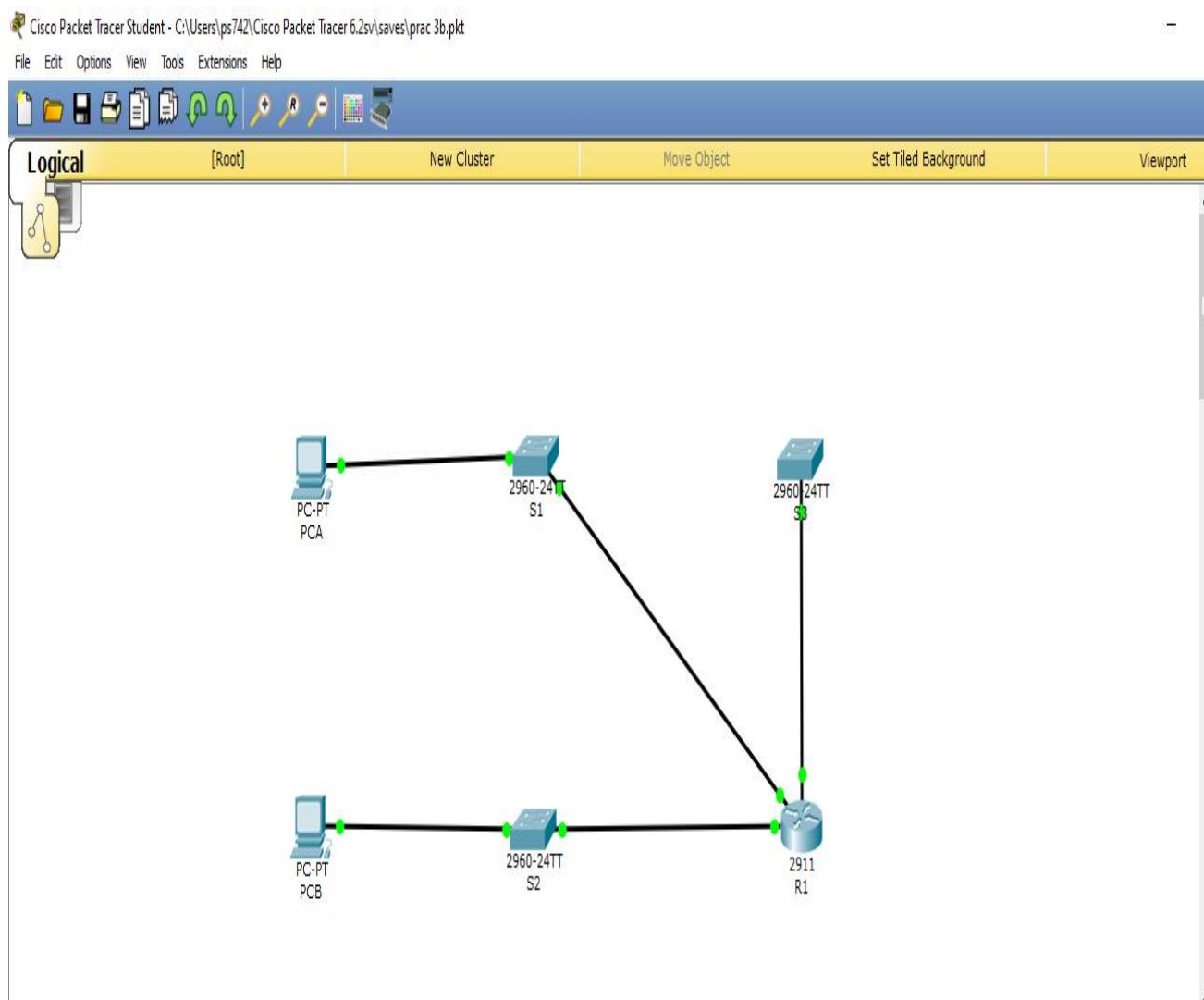
```
PC>
PC>
PC>
PC>
PC>
PC>
PC>
PC>
PC>
PC>ping 172.22.34.66
Pinging 172.22.34.66 with 32 bytes of data:
Reply from 172.22.34.66: bytes=32 time=0ms TTL=127
Reply from 172.22.34.66: bytes=32 time=0ms TTL=127
Reply from 172.22.34.66: bytes=32 time=0ms TTL=127
Reply from 172.22.34.66: bytes=32 time=1ms TTL=127
Ping statistics for 172.22.34.66:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms
```



**Date : 24/01/2024**  
**Practical No : 3B**

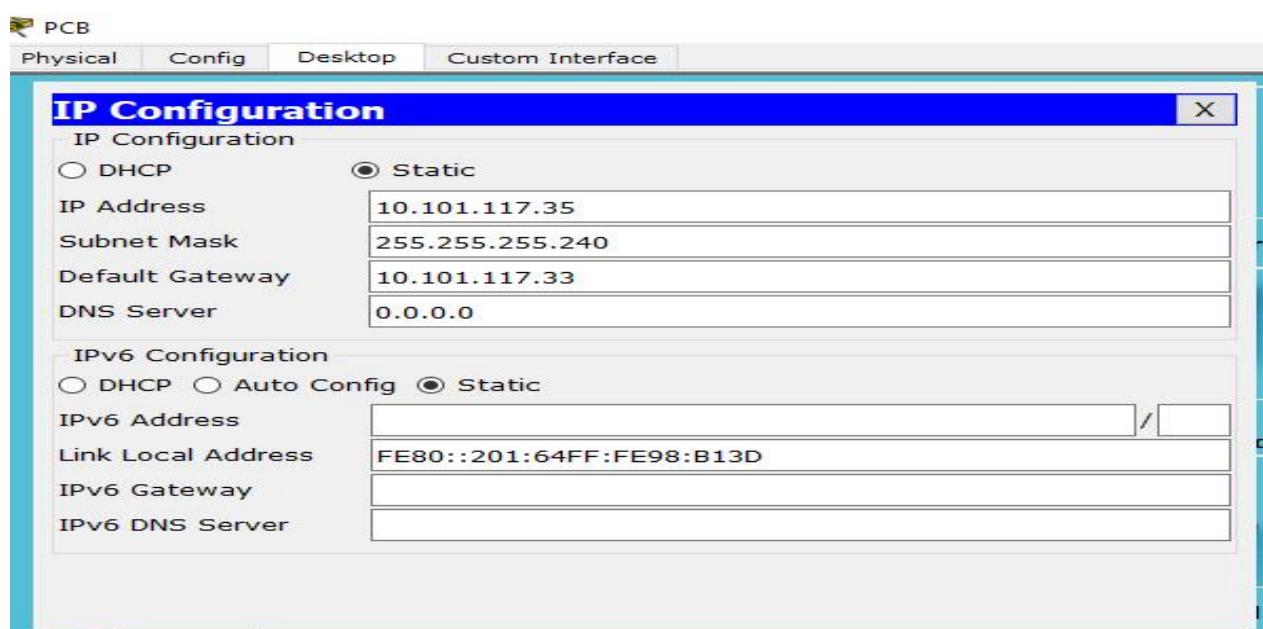
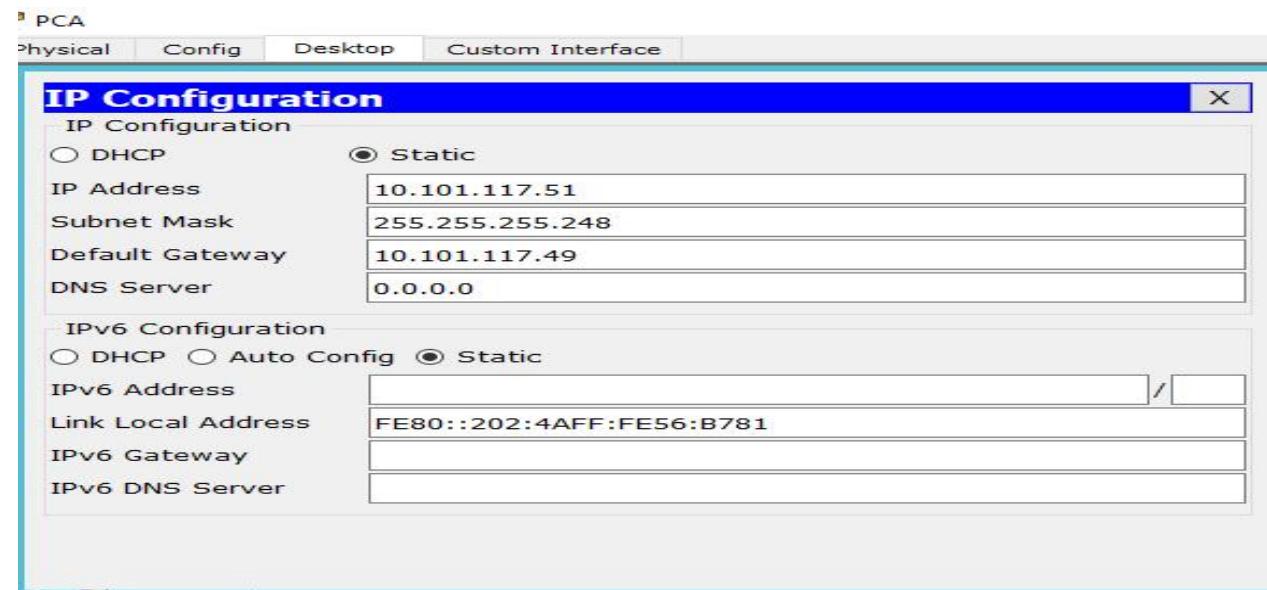
- **Aim :- Configure, Apply and Verify an Extended Numbered ACL**

➤ **Topology Diagram**

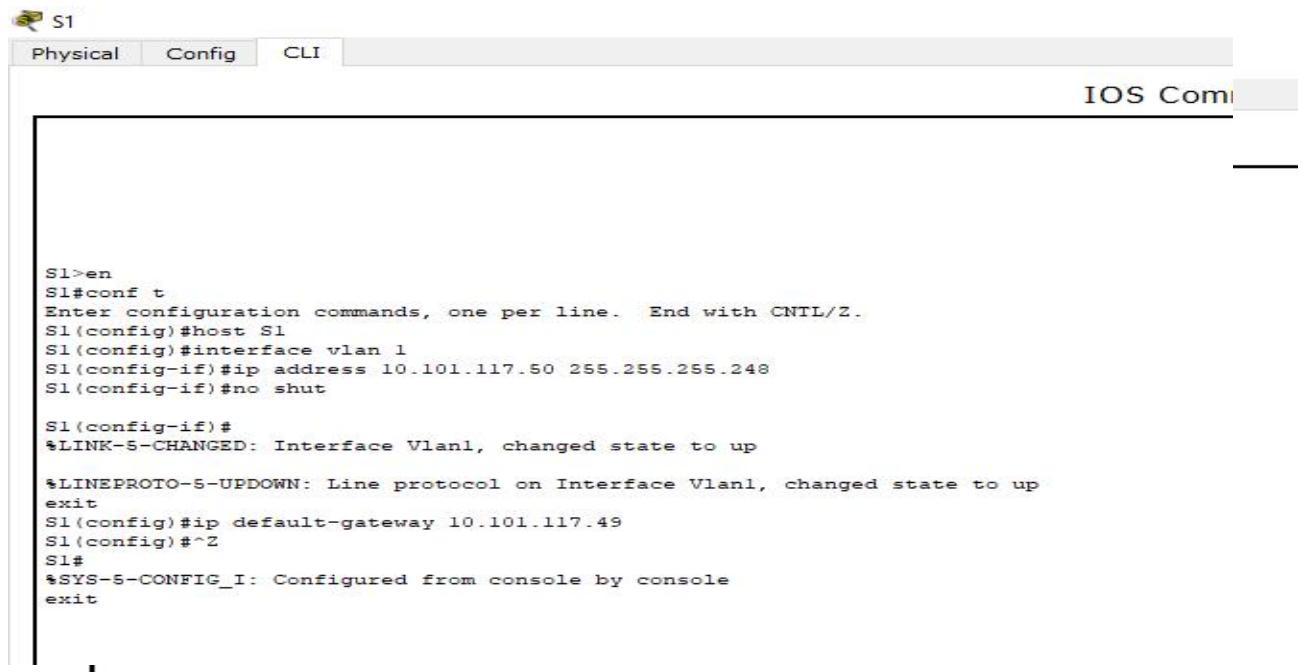


Date : 24/01/2024  
Practical No : 3B

➤ Assign IP Addresses



**Date : 24/01/2024**  
**Practical No : 3B**



The screenshot shows the Cisco IOS Command Line Interface (CLI) running on a device named 'S1'. The interface tabs at the top are 'Physical', 'Config' (which is selected), and 'CLI'. Below the tabs, the text 'IOS Com' is visible. The command-line session is as follows:

```
S1>en
S1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
S1(config)#host S1
S1(config)#interface vlan 1
S1(config-if)#ip address 10.101.117.50 255.255.255.248
S1(config-if)#no shut

S1(config-if)#
%LINK-5-CHANGED: Interface Vlan1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan1, changed state to up
exit
S1(config)#ip default-gateway 10.101.117.49
S1(config)#^Z
S1#
%SYS-5-CONFIG_I: Configured from console by console
exit
```

Date : 24/01/2024  
Practical No : 3B

The image shows two screenshots of the Cisco IOS Command Line Interface (CLI) for switches S2 and S3. Both screenshots are titled "IOS Comm" and show the "Config" tab selected.

**Screenshot for Switch S2:**

```
S2>en
S2#conf t
Enter configuration commands, one per line. End with CNTL/Z.
S2(config)#host S2
S2(config)#interface vlan 1
S2(config-if)#ip address 10.101.117.34 255.255.255.240
S2(config-if)#no shut

S2(config-if)#
%LINK-5-CHANGED: Interface Vlan1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan1, changed state to up
exit
S2(config)#ip default-gateway 10.101.117.33
S2(config)#^Z
S2#
%SYS-5-CONFIG_I: Configured from console by console

S2#exit
```

**Screenshot for Switch S3:**

```
S3>en
S3#conf t
Enter configuration commands, one per line. End with CNTL/Z.
S3(config)#host S3
S3(config)#interface vlan 1
S3(config-if)#ip address 10.101.117.2 255.255.255.224
S3(config-if)#no shut

S3(config-if)#
%LINK-5-CHANGED: Interface Vlan1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan1, changed state to up
exit
S3(config)#ip default-gateway 10.101.117.1
S3(config)#^Z
S3#
%SYS-5-CONFIG_I: Configured from console by console

S3#exit
```

**Date : 24/01/2024  
Practical No : 3B**

➤ **Displaying IP Addresses Details**

```
R1>show ip interface brief
Interface          IP-Address      OK? Method Status      Protocol
GigabitEthernet0/0  10.101.117.49  YES manual up       up
GigabitEthernet0/1  10.101.117.33  YES manual up       up
GigabitEthernet0/2  10.101.117.1   YES manual up       up
```

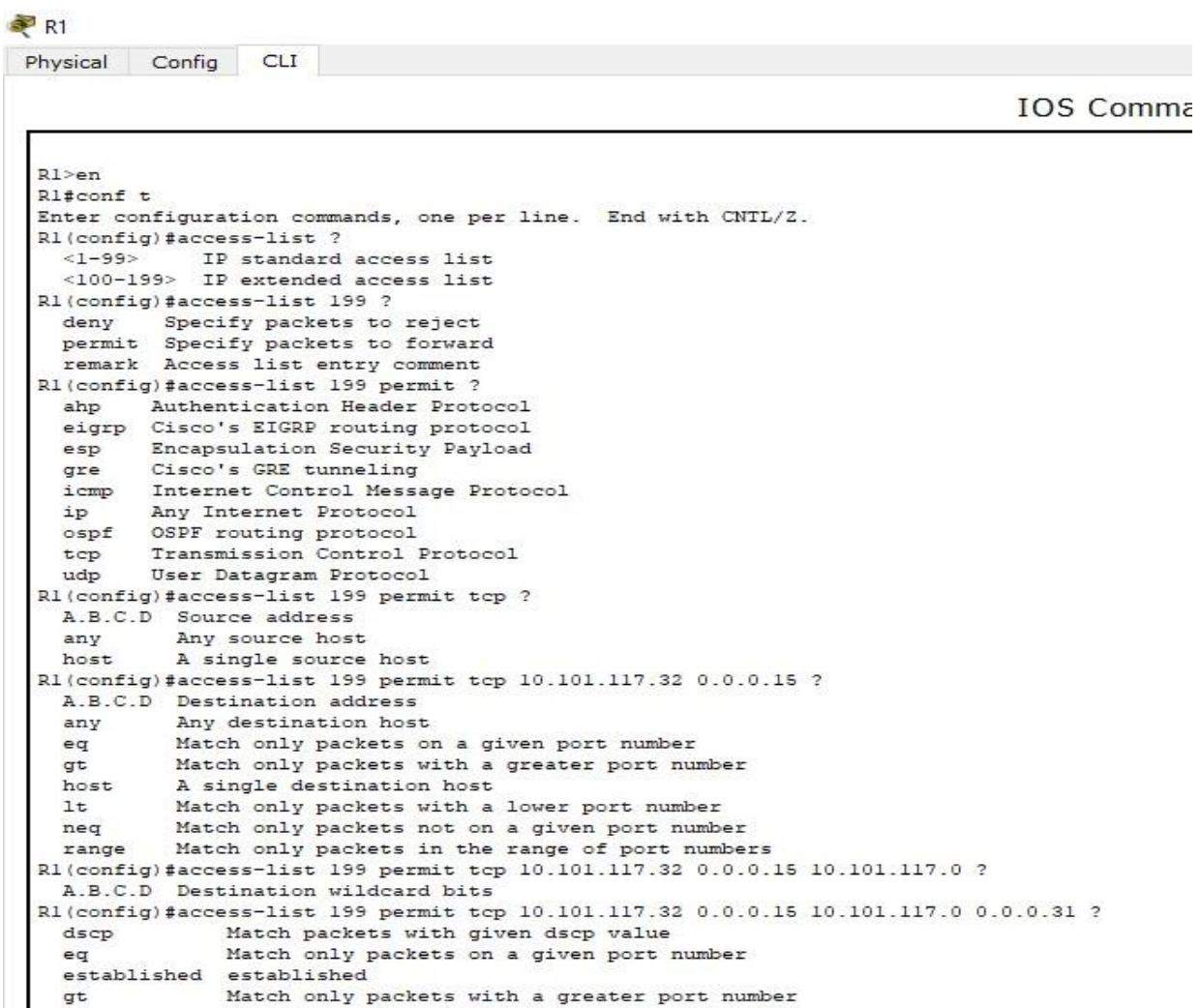
➤ **Configuring Telnet on S3**

```
S3>en
S3#conf t
Enter configuration commands, one per line. End with CNTL/Z.
S3(config)#username admin password teacher
S3(config)#line vty 0 4
S3(config-line)#login local
S3(config-line)#^Z
S3#
%SYS-5-CONFIG_I: Configured from console by console
exit
```

Date : 24/01/2024  
Practical No : 3B

◆ Configure, Apply and Verify an Extended Numbered ACL

(Devices on LAN 10.101.117.32 are allowed to remotely access devices in LAN 10.101.117.0 using the TELNET protocol. Besides ICMP, all traffic from other networks is denied.)



The screenshot shows the Cisco IOS CLI interface for router R1. The top navigation bar includes icons for Physical, Config, and CLI, with CLI being the active tab. Below the bar, the text "IOS Comm" is visible. The main area displays the configuration commands for creating and applying an extended access list (ACL 199) to permit TCP traffic from 10.101.117.32 to 10.101.117.0 on port 15, while denying all other traffic.

```
R1>en
R1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#access-list ?
<1-99>    IP standard access list
<100-199>  IP extended access list
R1(config)#access-list 199 ?
deny      Specify packets to reject
permit    Specify packets to forward
remark   Access list entry comment
R1(config)#access-list 199 permit ?
ahp       Authentication Header Protocol
eigrp    Cisco's EIGRP routing protocol
esp      Encapsulation Security Payload
gre      Cisco's GRE tunneling
icmp    Internet Control Message Protocol
ip       Any Internet Protocol
ospf    OSPF routing protocol
tcp     Transmission Control Protocol
udp     User Datagram Protocol
R1(config)#access-list 199 permit tcp ?
A.B.C.D  Source address
any      Any source host
host     A single source host
R1(config)#access-list 199 permit tcp 10.101.117.32 0.0.0.15 ?
A.B.C.D  Destination address
any      Any destination host
eq      Match only packets on a given port number
gt      Match only packets with a greater port number
host   A single destination host
lt      Match only packets with a lower port number
neq    Match only packets not on a given port number
range   Match only packets in the range of port numbers
R1(config)#access-list 199 permit tcp 10.101.117.32 0.0.0.15 10.101.117.0 ?
A.B.C.D  Destination wildcard bits
R1(config)#access-list 199 permit tcp 10.101.117.32 0.0.0.15 10.101.117.0 0.0.0.31 ?
dscp     Match packets with given dscp value
eq      Match only packets on a given port number
established  established
gt      Match only packets with a greater port number
```

Date : 24/01/2024

Practical No : 3B

R1

Physical Config CLI

IOS Command

```
R1(config)#access-list 199 permit tcp 10.101.117.32 0.0.0.15 10.101.117.0 0.0.0.31 eq ?
<0-65535> Port number
ftp File Transfer Protocol (21)
pop3 Post Office Protocol v3 (110)
smtp Simple Mail Transport Protocol (25)
telnet Telnet (23)
www World Wide Web (HTTP, 80)
R1(config)#access-list 199 permit tcp 10.101.117.32 0.0.0.15 10.101.117.0 0.0.0.31 eq telnet
R1(config)#access-list 199 ?
deny Specify packets to reject
permit Specify packets to forward
remark Access list entry comment
R1(config)#access-list 199 permit ?
ahp Authentication Header Protocol
eigrp Cisco's EIGRP routing protocol
esp Encapsulation Security Payload
gre Cisco's GRE tunneling
icmp Internet Control Message Protocol
ip Any Internet Protocol
ospf OSPF routing protocol
tcp Transmission Control Protocol
udp User Datagram Protocol
R1(config)#access-list 199 permit icmp ?
A.B.C.D Source address
any Any source host
host A single source host
R1(config)#access-list 199 permit icmp any ?
A.B.C.D Destination address
any Any destination host
host A single destination host
R1(config)#access-list 199 permit icmp any any
R1(config)#interface GigabitEthernet0/2
R1(config-if)#ip access-group 199 out
R1(config-if)#^Z
R1#
*SYS-5-CONFIG_I: Configured from console by console
exit
```

◆ Verify the extended ACL implementation

PC-B

```
PC>ping 10.101.117.51
Pinging 10.101.117.51 with 32 bytes of data:
Reply from 10.101.117.51: bytes=32 time=0ms TTL=127
Reply from 10.101.117.51: bytes=32 time=0ms TTL=127
Reply from 10.101.117.51: bytes=32 time=20ms TTL=127
Reply from 10.101.117.51: bytes=32 time=0ms TTL=127

Ping statistics for 10.101.117.51:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 20ms, Average = 5ms

PC>telnet 10.101.117.2
Trying 10.101.117.2 ...Open

User Access Verification

Username: admin
Password:
S3>
```

Date : 24/01/2024  
Practical No : 3B

PC-A

```
PC>ping 10.101.117.35

Pinging 10.101.117.35 with 32 bytes of data:

Reply from 10.101.117.35: bytes=32 time=1ms TTL=127
Reply from 10.101.117.35: bytes=32 time=3ms TTL=127
Reply from 10.101.117.35: bytes=32 time=10ms TTL=127
Reply from 10.101.117.35: bytes=32 time=0ms TTL=127

Ping statistics for 10.101.117.35:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 10ms, Average = 3ms

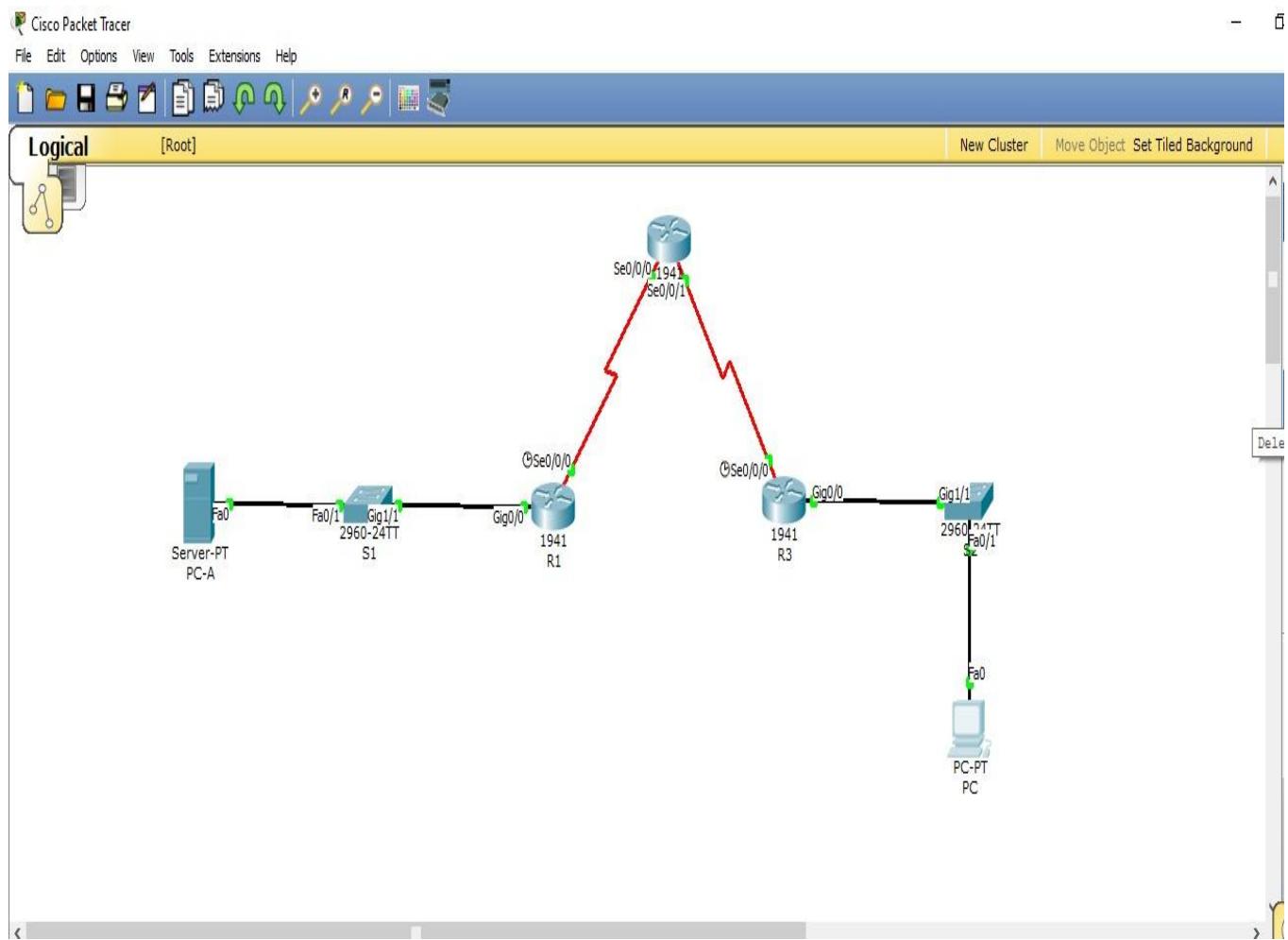
PC>telnet 10.101.117.2
Trying 10.101.117.2 ...
% Connection timed out; remote host not responding
PC>
```

**Date:- 31/01/2024**

**Practical no :- 4**

➤ **Aim:- Configure IP ACLs to Mitigate Attacks**

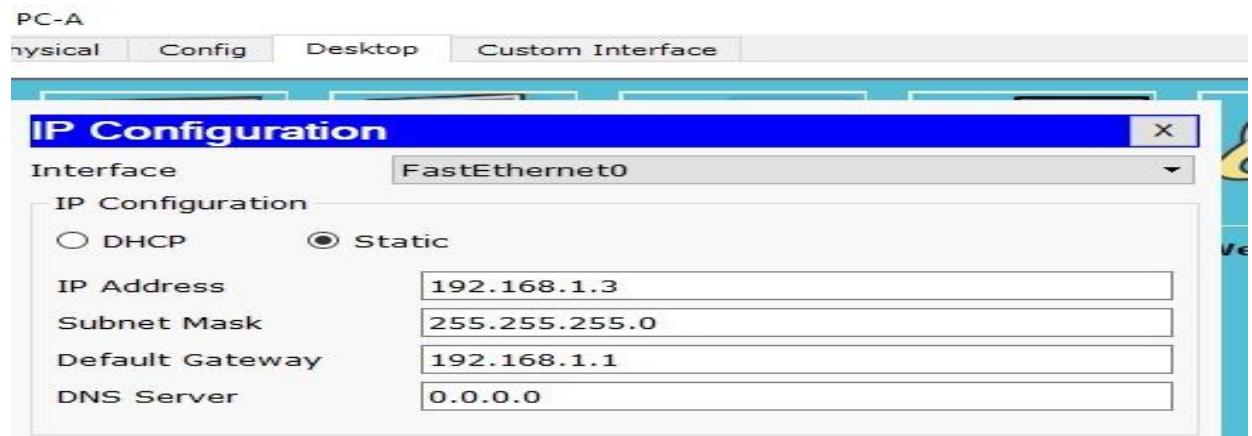
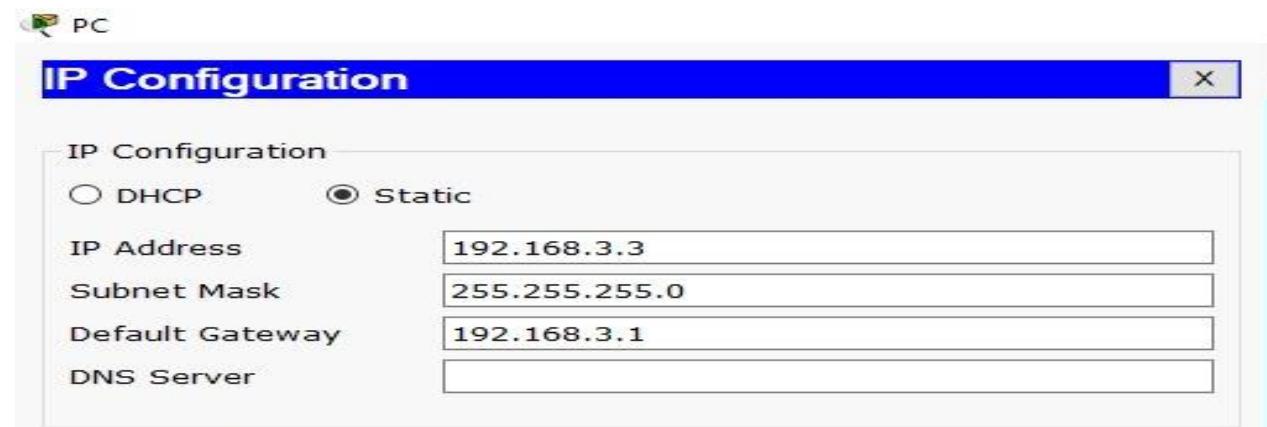
➤ **Topology Diagram**



➤ **Assign IP Addresses**

Date:- 31/01/2024

Practical no :- 4



```
R1>en
R1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#host R1
R1(config)#interface Serial0/0/0
R1(config-if)#ip address 10.1.1.1 255.255.255.252
R1(config-if)#no shut
R1(config-if)#interface GigabitEthernet0/0
R1(config-if)#ip address 192.168.1.1 255.255.255.0
R1(config-if)#no shut
R1(config-if)#^Z
R1#
%SYS-5-CONFIG_I: Configured from console by console
exit
```

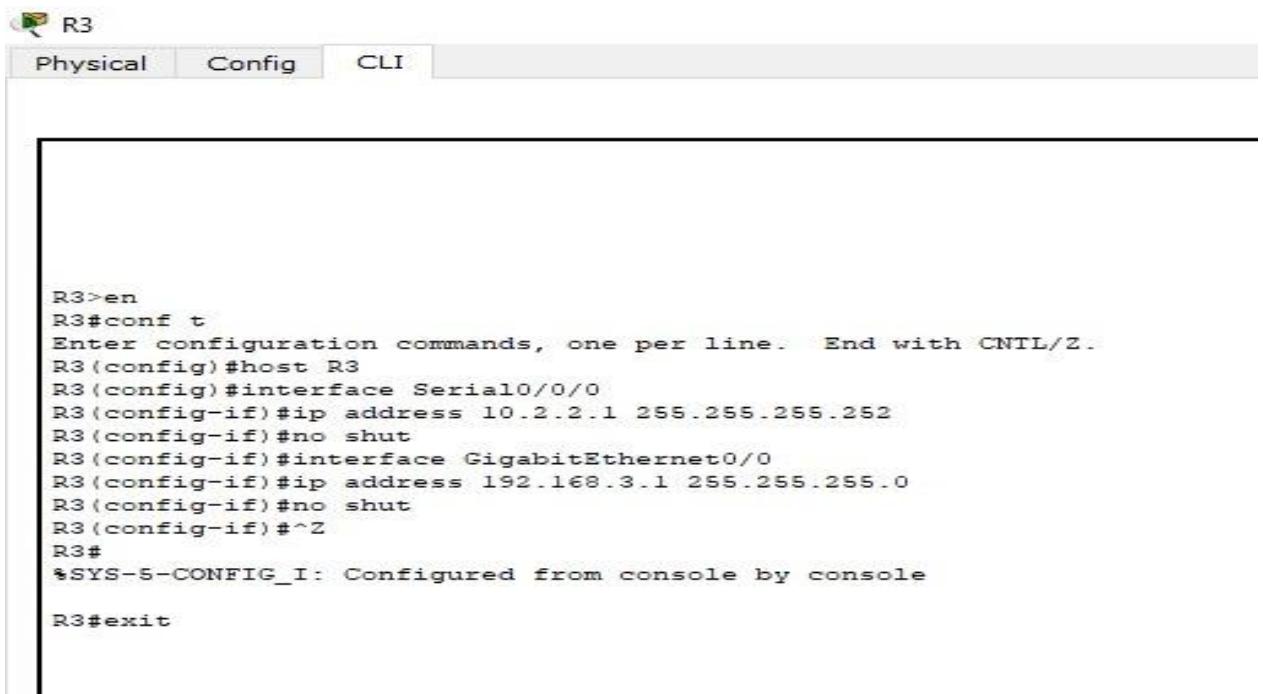
```
R2>en
R2#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#host R2
R2(config)#interface Serial0/0/0
R2(config-if)#ip address 10.1.1.2 255.255.255.252
R2(config-if)#no shut
R2(config-if)#interface Serial0/0/1
R2(config-if)#ip address 10.2.2.2 255.255.255.252
R2(config-if)#no shut
R2(config-if)#int loopback1

R2(config-if)#
%LINK-5-CHANGED: Interface Loopback1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback1, changed state to up
ip address 192.168.2.1 255.255.255.0
R2(config-if)#no shut
R2(config-if)#^Z
R2#
%SYS-5-CONFIG_I: Configured from console by console
exit
```

Date:- 31/01/2024

Practical no :- 4



R3>en  
R3#conf t  
Enter configuration commands, one per line. End with CNTL/Z.  
R3(config)#host R3  
R3(config)#interface Serial0/0/0  
R3(config-if)#ip address 10.2.2.1 255.255.255.252  
R3(config-if)#no shut  
R3(config-if)#interface GigabitEthernet0/0  
R3(config-if)#ip address 192.168.3.1 255.255.255.0  
R3(config-if)#no shut  
R3(config-if)#^Z  
R3#  
%SYS-5-CONFIG\_I: Configured from console by console  
R3#exit

#### ✧ Displaying IP Address Details of Routers

Interface	IP-Address	OK?	Method	Status	Protocol
GigabitEthernet0/0	192.168.1.1	YES	manual	up	up
GigabitEthernet0/1	unassigned	YES	unset	administratively down	down
Serial0/0/0	10.1.1.1	YES	manual	up	up
Serial0/0/1	unassigned	YES	unset	administratively down	down
Serial0/1/0	unassigned	YES	unset	administratively down	down
Serial0/1/1	unassigned	YES	unset	administratively down	down
Vlan1	unassigned	YES	unset	administratively down	down

R1>

**Date:- 31/01/2024**

**Practical no :- 4**

```
R2>show ip interface brief
Interface          IP-Address      OK? Method Status      Protocol
GigabitEthernet0/0    unassigned     YES unset   administratively down down
GigabitEthernet0/1    unassigned     YES unset   administratively down down
Serial0/0/0           10.1.1.2      YES manual  up            up
Serial0/0/1           10.2.2.2      YES manual  up            up
Serial0/1/0           unassigned     YES unset   administratively down down
Serial0/1/1           unassigned     YES unset   administratively down down
Loopback1             192.168.2.1    YES manual  up            up
Vlan1                unassigned     YES unset   administratively down down
R2>
```

```
R3>show ip interface brief
Interface          IP-Address      OK? Method Status      Protocol
GigabitEthernet0/0    192.168.3.1    YES manual  up            up
GigabitEthernet0/1    unassigned     YES unset   administratively down down
Serial0/0/0           10.2.2.1      YES manual  up            up
Serial0/0/1           unassigned     YES unset   administratively down down
Serial0/1/0           unassigned     YES unset   administratively down down
Serial0/1/1           unassigned     YES unset   administratively down down
Vlan1                unassigned     YES unset   administratively down down
R3>
```

➤ **Configure RIP on routers**

```
R1>en
R1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#router rip
R1(config-router)#network 192.168.1.0
R1(config-router)#network 10.1.1.0
R1(config-router)#^Z
R1#
%SYS-5-CONFIG_I: Configured from console by console
exit
```

Date:- 31/01/2024

Practical no :- 4

```
--  
R2>en  
R2#conf t  
Enter configuration commands, one per line. End with CNTL/Z.  
R2(config)#router rip  
R2(config-router)#network 10.1.1.0  
R2(config-router)#network 10.2.2.0  
R2(config-router)#network 192.168.2.0  
R2(config-router)#^Z  
R2#  
%SYS-5-CONFIG_I: Configured from console by console  
  
R2#exit
```

```
--  
R3>  
R3>en  
R3#conf t  
Enter configuration commands, one per line. End with CNTL/Z.  
R3(config)#router rip  
R3(config-router)#network 10.2.2.0  
R3(config-router)#network 192.168.3.0  
R3(config-router)#^Z  
R3#  
%SYS-5-CONFIG_I: Configured from console by console  
exit
```

## ➤ Displaying routing table of routers

```
R1>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, 3 subnets, 2 masks  
C        10.1.1.0/30 is directly connected, Serial0/0/0  
L        10.1.1.1/32 is directly connected, Serial0/0/0  
R        10.2.2.0/30 [120/1] via 10.1.1.2, 00:00:02, Serial0/0/0  
          192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks  
C        192.168.1.0/24 is directly connected, GigabitEthernet0/0  
L        192.168.1.1/32 is directly connected, GigabitEthernet0/0  
R        192.168.2.0/24 [120/1] via 10.1.1.2, 00:00:02, Serial0/0/0  
R        192.168.3.0/24 [120/2] via 10.1.1.2, 00:00:02, Serial0/0/0  
R1>
```

**Date:- 31/01/2024**

**Practical no :- 4**

```
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

  10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks
C        10.1.1.0/30 is directly connected, Serial0/0/0
L        10.1.1.2/32 is directly connected, Serial0/0/0
C        10.2.2.0/30 is directly connected, Serial0/0/1
L        10.2.2.2/32 is directly connected, Serial0/0/1
R        192.168.1.0/24 [120/1] via 10.1.1.1, 00:00:27, Serial0/0/0
          192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.2.0/24 is directly connected, Loopback1
L        192.168.2.1/32 is directly connected, Loopback1
R        192.168.3.0/24 [120/1] via 10.2.2.1, 00:00:04, Serial0/0/1
R2>
```

```
R3>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, 3 subnets, 2 masks
R        10.1.1.0/30 [120/1] via 10.2.2.2, 00:00:03, Serial0/0/0
C        10.2.2.0/30 is directly connected, Serial0/0/0
L        10.2.2.1/32 is directly connected, Serial0/0/0
R        192.168.1.0/24 [120/2] via 10.2.2.2, 00:00:03, Serial0/0/0
R        192.168.2.0/24 [120/1] via 10.2.2.2, 00:00:03, Serial0/0/0
          192.168.3.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.3.0/24 is directly connected, GigabitEthernet0/0
L        192.168.3.1/32 is directly connected, GigabitEthernet0/0
R3>
```

Date:- 31/01/2024  
Practical no :- 4

### ➤ Configure SSH on R2

```
R2>en
R2#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#ip domain-name securityincomputing.com
R2(config)#username admin secret pwd
R2(config)#line vty 0 4
R2(config-line)#login local
R2(config-line)#transport input ssh
R2(config-line)#crypto key zeroizersa
^
% Invalid input detected at '^' marker.

R2(config-line)#crypto key zeroize rsa
% No Signature RSA Keys found in configuration.

R2(config)#crypto key generate rsa
The name for the keys will be: R2.securityincomputing.com
Choose the size of the key modulus in the range of 360 to 2048 for your
General Purpose Keys. Choosing a key modulus greater than 512 may take
a few minutes.

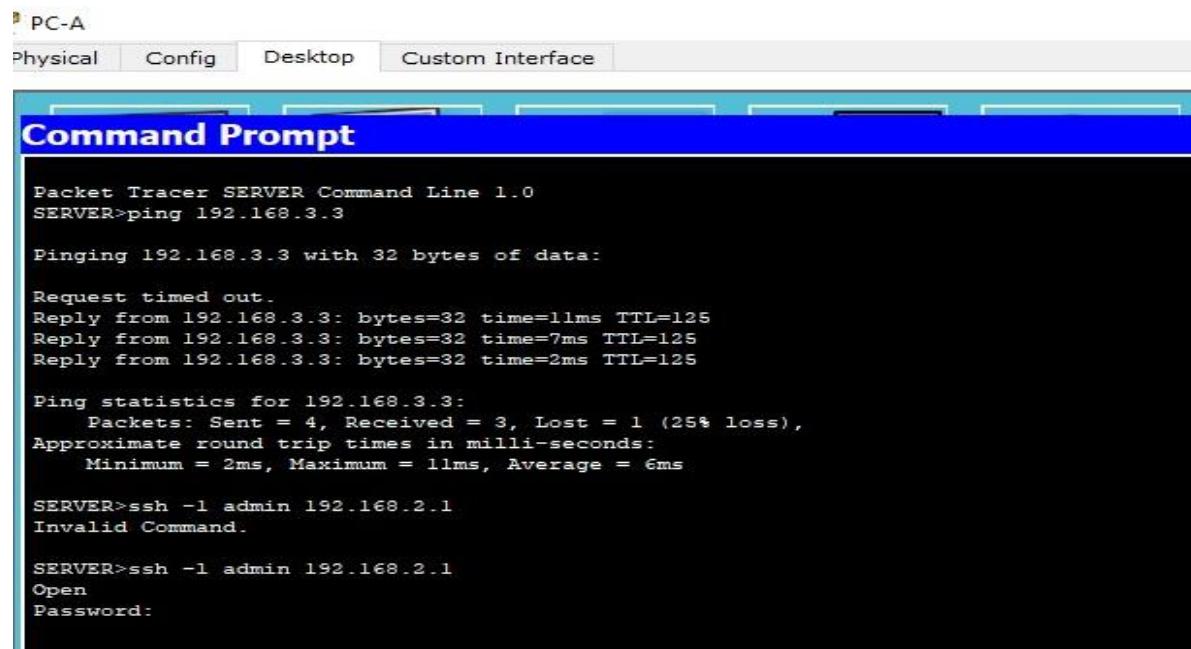
How many bits in the modulus [512]: 1024
% Generating 1024 bit RSA keys, keys will be non-exportable...[OK]

R2(config)#ip ssh time-out 90
*Mar 2 0:49:12.552: %SSH-5-ENABLED: SSH 1.99 has been enabled
^
% Invalid input detected at '^' marker.

R2(config)#ip ssh time-out 90
R2(config)#ip ssh authentication-retries 2
^
% Invalid input detected at '^' marker.

R2(config)#ip ssh authentication-retries 2
R2(config)#ip ssh version 2
R2(config)#^Z
R2#
%SYS-5-CONFIG_I: Configured from console by console
exit
```

### ◆ Verify Basic Network Connectivity before ACL Configuration



Date:- 31/01/2024

Practical no :- 4

The screenshot shows the Packet Tracer PC Command Line 1.0 interface. The title bar says "Command Prompt". The menu bar includes "Physical", "Config", "Desktop", and "Custom Interface". The main window displays the following command-line session:

```
Packet Tracer PC Command Line 1.0
PC>ping 192.168.1.3

Pinging 192.168.1.3 with 32 bytes of data:

Reply from 192.168.1.3: bytes=32 time=10ms TTL=125
Reply from 192.168.1.3: bytes=32 time=2ms TTL=125
Reply from 192.168.1.3: bytes=32 time=3ms TTL=125
Reply from 192.168.1.3: bytes=32 time=9ms TTL=125

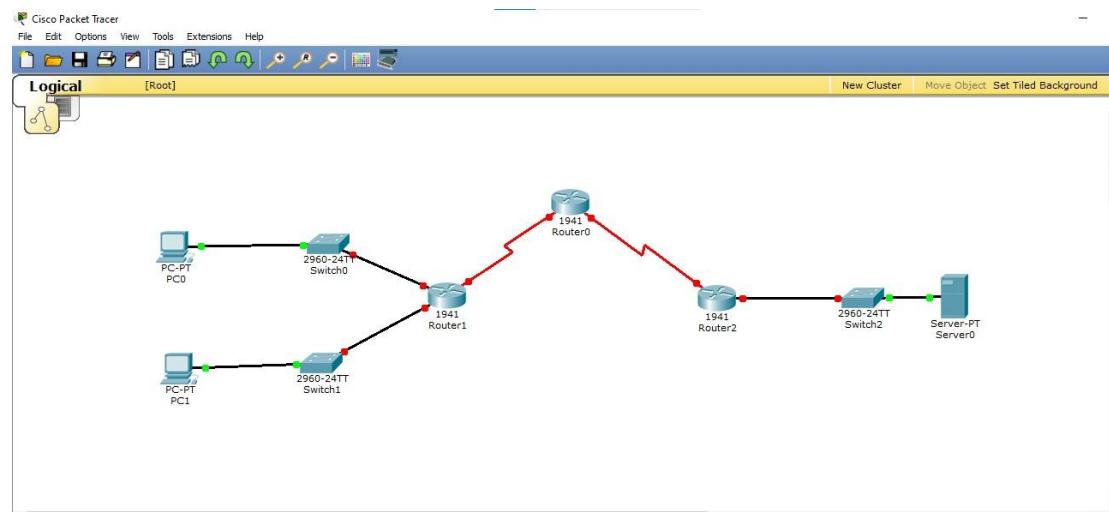
Ping statistics for 192.168.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 10ms, Average = 6ms

PC>ssh -l admin 192.168.2.1
Open
Password:
```

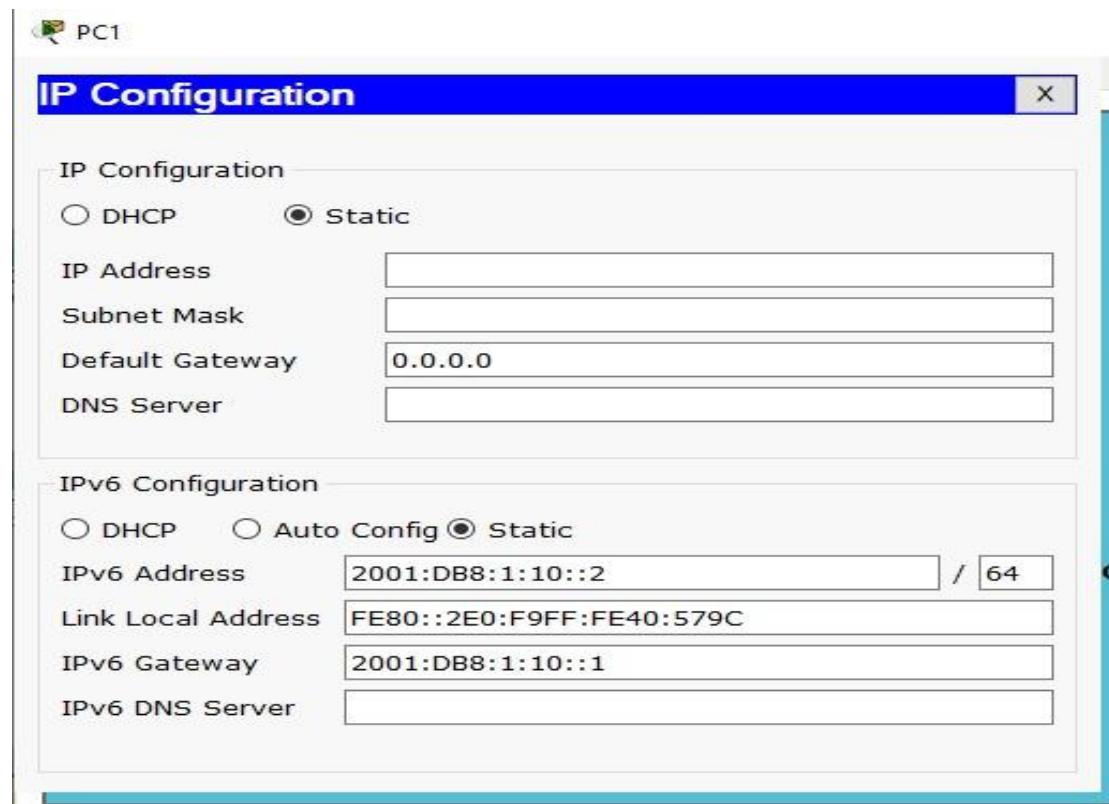
## Practical 5

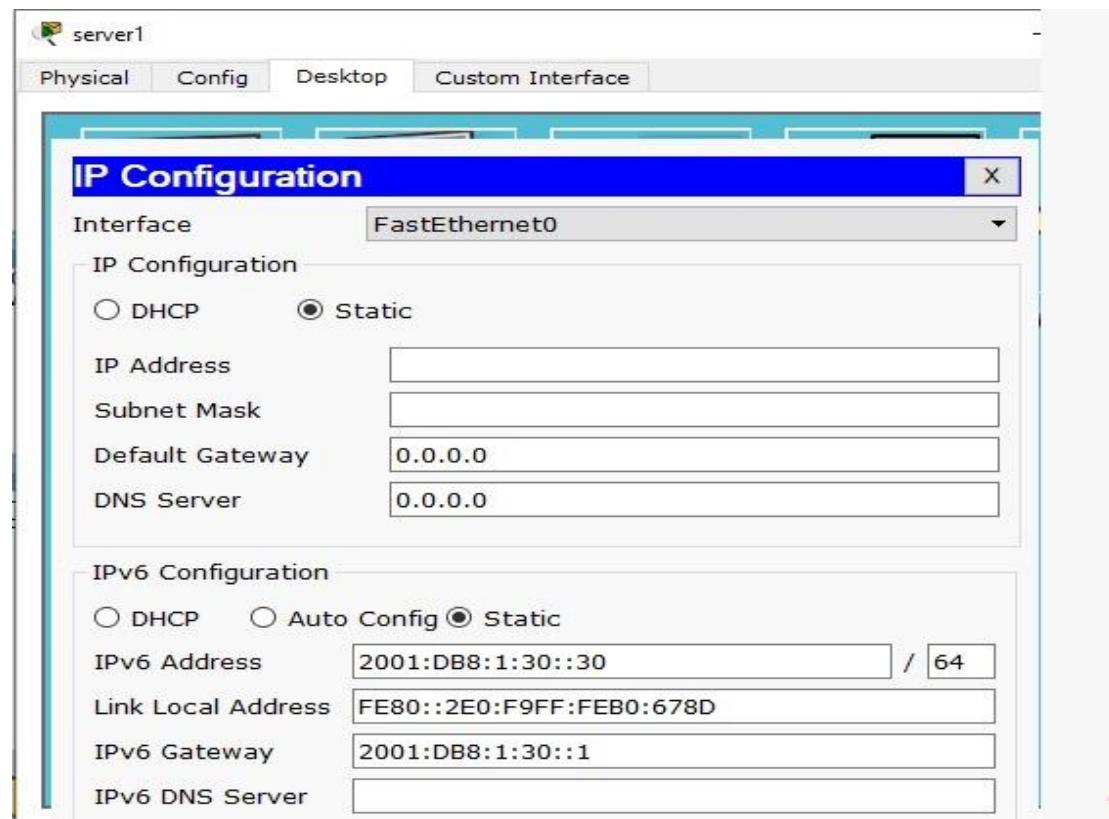
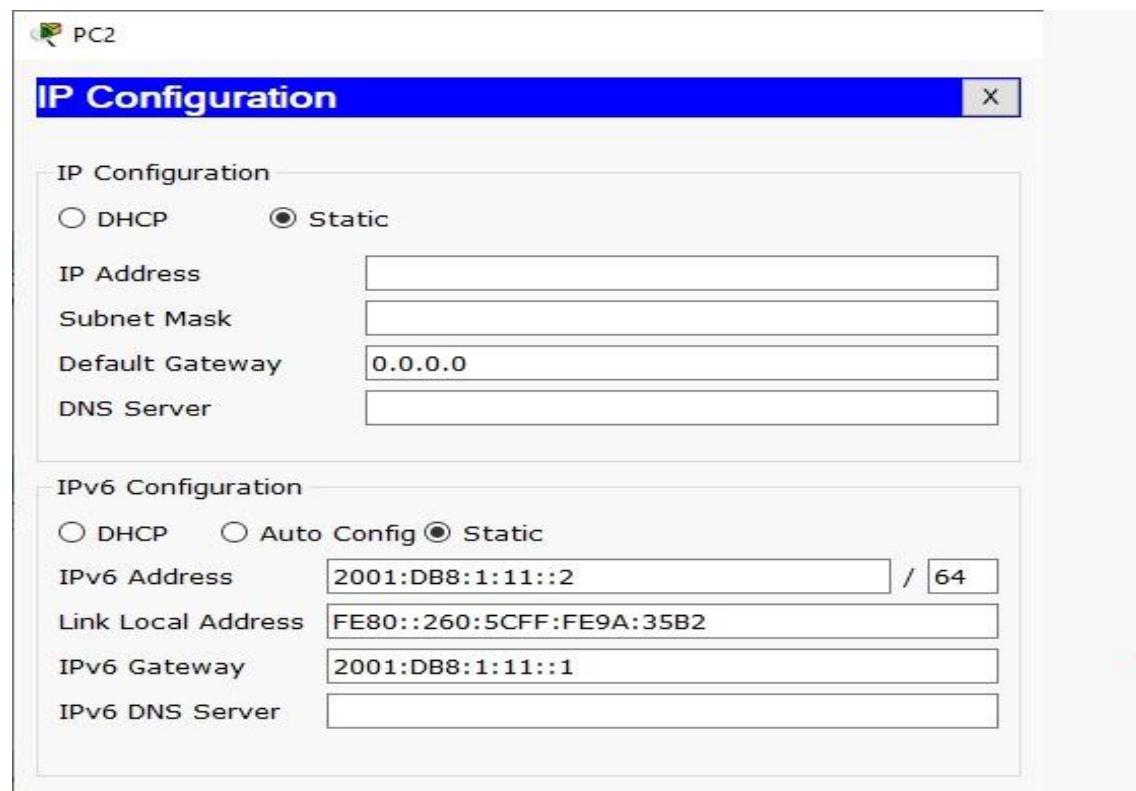
Aim:Configuring IPv6 ACLs

### TOPOLOGY DIAGRAM



### ASSIGNNING IP ADRESSES





Router0

Physical Config CLI

### IOS Command Line Interface

```
R0(config)#ipv6 unicast-routing
R0(config)#interface GigabitEthernet0/0
R0(config-if)#ipv6 enable
R0(config-if)#ipv6 address 2001:DB8:1:10::1/64
R0(config-if)#no shut

R0(config-if)#
*LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to up

*LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed stat
e to up
R0(config-if)#interface GigabitEthernet0/1
R0(config-if)#ipv6 enable
R0(config-if)#ipv6 address 2001:DB8:1:11::1/64
R0(config-if)#no shut

R0(config-if)#
*LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to up

*LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed stat
e to up

R0(config-if)#interface Serial0/0/0
R0(config-if)#ipv6 enable
R0(config-if)#ipv6 address 2001:DB8:1:28::1/64
R0(config-if)#no shut
```

Copy Paste

Router1

Physical Config CLI

### IOS Command Line Interface

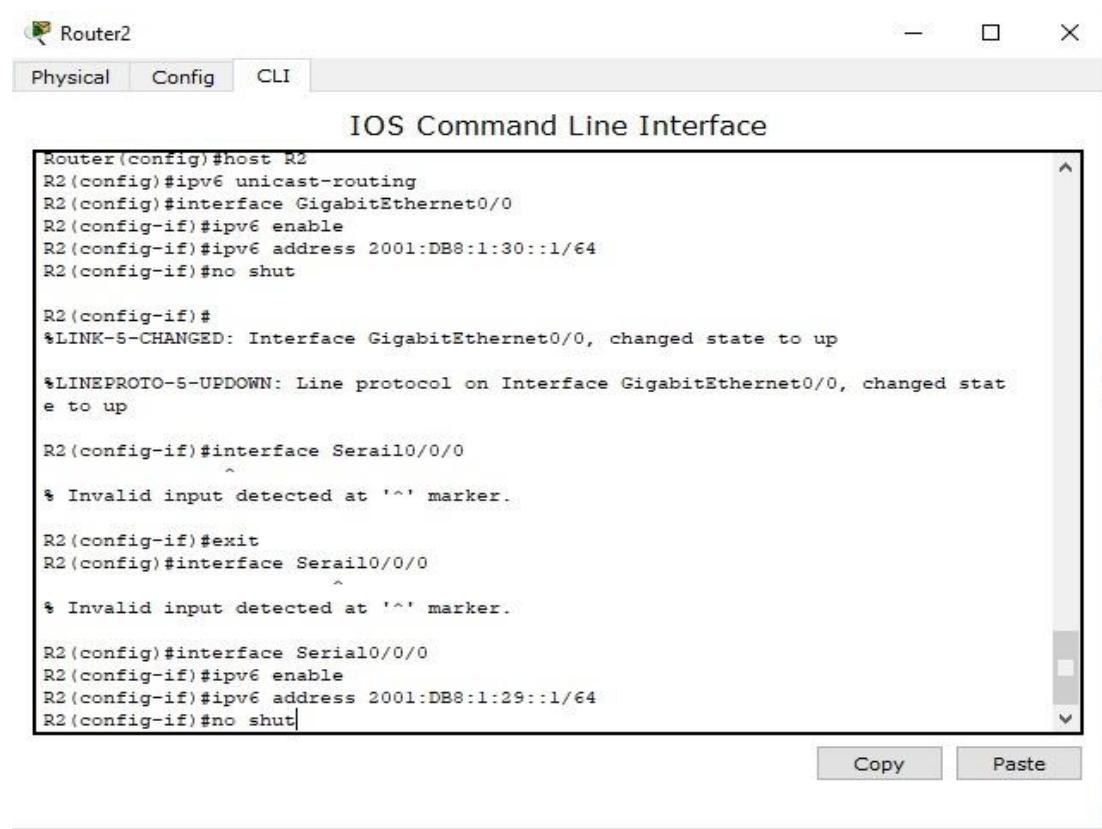
```
Router>en
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#host R1
R1(config)#ipv6 unicast-routing
R1(config)#interface Serial0/0/0
R1(config-if)#ipv6 enable
R1(config-if)#ipv6 address 2001:DB8:1:28::2/64
R1(config-if)#no shut

R1(config-if)#
*LINK-5-CHANGED: Interface Serial0/0/0, changed state to up
R1(config-if)#interface Serial0/0/0
*LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0, changed state to up

R1(config-if)#interface Serial0/0/1
R1(config-if)#ipv6 enable
R1(config-if)#ipv6 address 2001:DB8:1:29::2/64
R1(config-if)#no shut

*LINK-5-CHANGED: Interface Serial0/0/1, changed state to down
R1(config-if)#^Z
R1#
*SYS-5-CONFIG_I: Configured from console by console
```

Copy Paste



Router2

Physical Config CLI

### IOS Command Line Interface

```

Router(config)#host R2
R2(config)#ipv6 unicast-routing
R2(config)#interface GigabitEthernet0/0
R2(config-if)#ipv6 enable
R2(config-if)#ipv6 address 2001:DB8:1:30::1/64
R2(config-if)#no shut

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)#interface Serial0/0/0
^
% Invalid input detected at '^' marker.

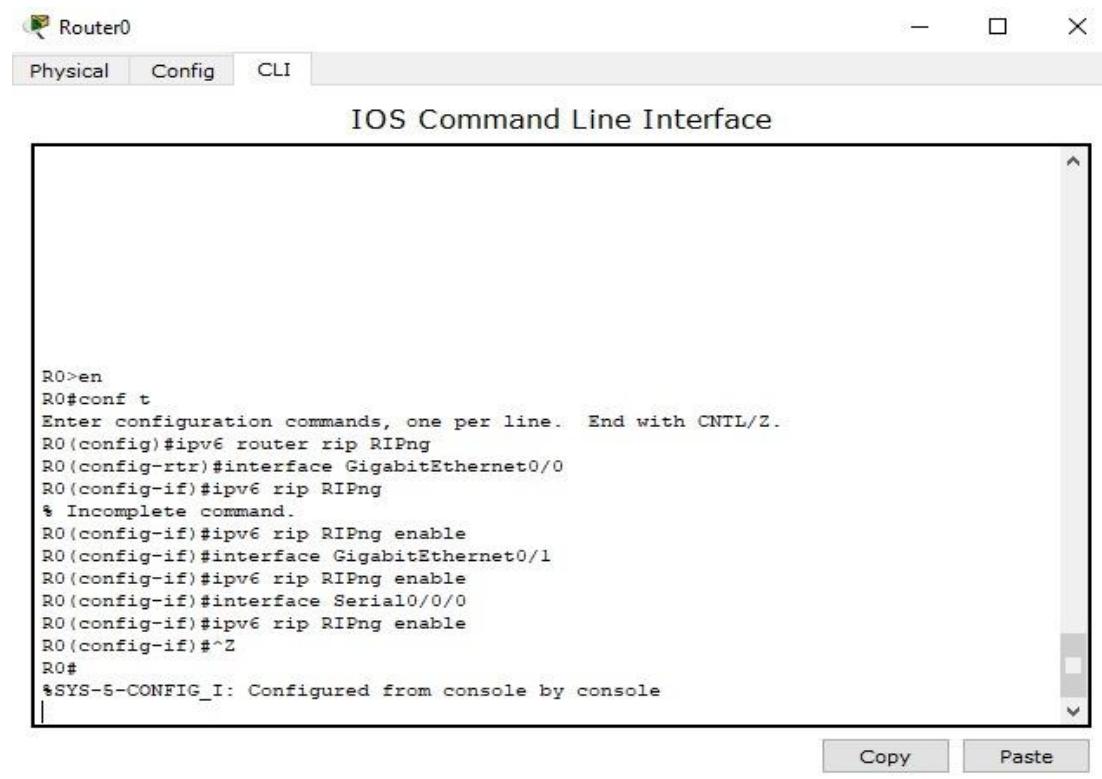
R2(config-if)#exit
R2(config)#interface Serial0/0/0
^
% Invalid input detected at '^' marker.

R2(config)#interface Serial0/0/0
R2(config-if)#ipv6 enable
R2(config-if)#ipv6 address 2001:DB8:1:29::1/64
R2(config-if)#no shut

```

Copy Paste

## CONFIGURING RIPng ON ROUTERS



Router0

Physical Config CLI

### IOS Command Line Interface

```

R0>en
R0#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R0(config)#ipv6 router rip RIPng
R0(config-rtr)#interface GigabitEthernet0/0
R0(config-if)#ipv6 rip RIPng
% Incomplete command.
R0(config-if)#ipv6 rip RIPng enable
R0(config-if)#interface GigabitEthernet0/1
R0(config-if)#ipv6 rip RIPng enable
R0(config-if)#interface Serial0/0/0
R0(config-if)#ipv6 rip RIPng enable
R0(config-if)^Z
R0#
%SYS-5-CONFIG_I: Configured from console by console

```

Copy Paste

Router1

Physical Config CLI

IOS Command Line Interface

Press RETURN to get started.

```
R1>en
R1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#ipv6 router rip RIPng
R1(config-rtr)#interface Serial0/0/0
R1(config-if)#ipv6 rip RIPng enable
R1(config-if)#interface Serial0/0/1
R1(config-if)#ipv6 rip RIPng enable
R1(config-if)#+Z
R1#
%SYS-5-CONFIG_I: Configured from console by console
```

Copy Paste

Router2

Physical Config CLI

IOS Command Line Interface

Press RETURN to get started.

```
R2>en
R2#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#ipv6 router rip RIPng
R2(config-rtr)#interface GigabitEthernet0/0
R2(config-if)#ipv6 rip RIPng enable
R2(config-if)#+Z
R2#
%SYS-5-CONFIG_I: Configured from console by console
exit|
```

Copy Paste

## CHECKING THE NETWORK CONNECTIVITY

PC1

Physical Config Desktop Custom Interface

**Command Prompt**

```
PC>ping 2001:DB8:1:11::2
Pinging 2001:DB8:1:11::2 with 32 bytes of data:
Reply from 2001:DB8:1:11::2: bytes=32 time=0ms TTL=127
Reply from 2001:DB8:1:11::2: bytes=32 time=0ms TTL=127
Reply from 2001:DB8:1:11::2: bytes=32 time=1ms TTL=127
Reply from 2001:DB8:1:11::2: bytes=32 time=0ms TTL=127

Ping statistics for 2001:DB8:1:11::2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

PC>ping 2001:DB8:1:30::30
Pinging 2001:DB8:1:30::30 with 32 bytes of data:
Reply from 2001:DB8:1:30::30: bytes=32 time=2ms TTL=125
Reply from 2001:DB8:1:30::30: bytes=32 time=10ms TTL=125
Reply from 2001:DB8:1:30::30: bytes=32 time=5ms TTL=125
Reply from 2001:DB8:1:30::30: bytes=32 time=2ms TTL=125

Ping statistics for 2001:DB8:1:30::30:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 10ms, Average = 4ms
```

PC2

Physical Config Desktop Custom Interface

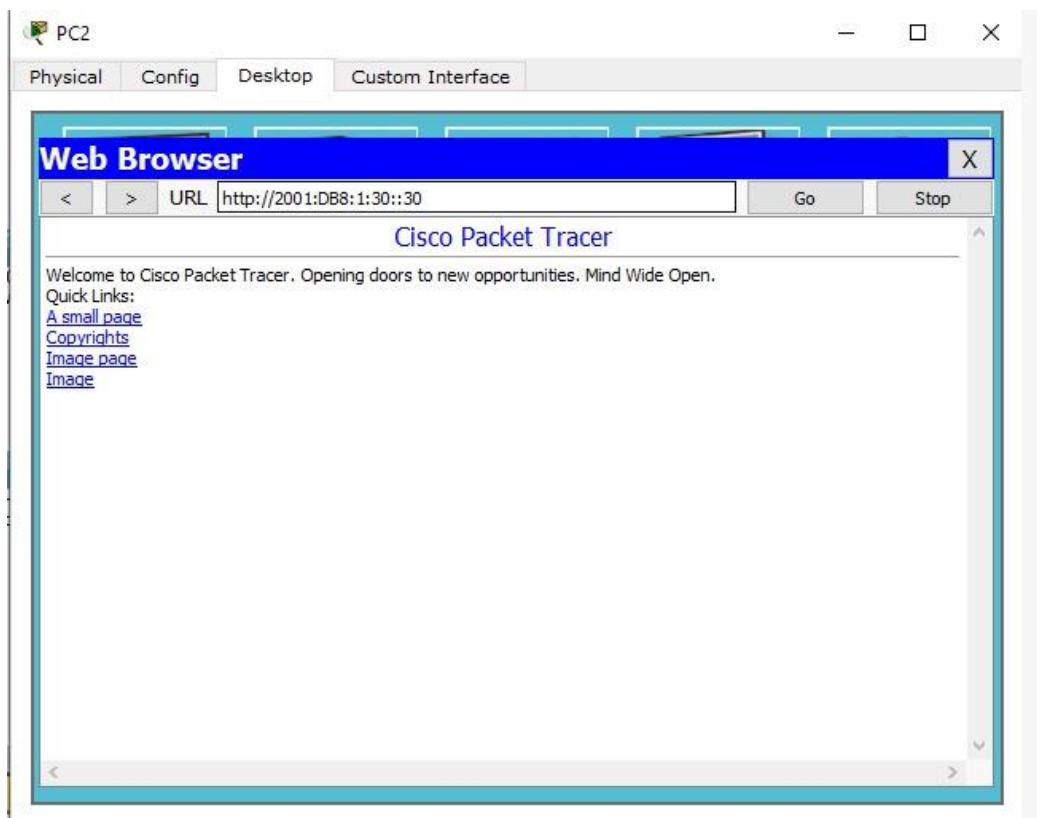
**Command Prompt**

```
PC>ping 2001:DB8:1:10::2
Pinging 2001:DB8:1:10::2 with 32 bytes of data:
Reply from 2001:DB8:1:10::2: bytes=32 time=0ms TTL=127
Reply from 2001:DB8:1:10::2: bytes=32 time=0ms TTL=127
Reply from 2001:DB8:1:10::2: bytes=32 time=0ms TTL=127
Reply from 2001:DB8:1:10::2: bytes=32 time=1ms TTL=127

Ping statistics for 2001:DB8:1:10::2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

PC>ping 2001:DB8:1:30::30
Pinging 2001:DB8:1:30::30 with 32 bytes of data:
Reply from 2001:DB8:1:30::30: bytes=32 time=2ms TTL=125
Reply from 2001:DB8:1:30::30: bytes=32 time=5ms TTL=125
Reply from 2001:DB8:1:30::30: bytes=32 time=2ms TTL=125
Reply from 2001:DB8:1:30::30: bytes=32 time=2ms TTL=125

Ping statistics for 2001:DB8:1:30::30:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 5ms, Average = 2ms
```



## CONFIGURING ACL

A screenshot of the Cisco IOS Command Line Interface (CLI) window titled "Router0". The tab bar shows "Physical", "Config", and "CLI", with "CLI" selected. The main area displays the following configuration commands:

```
R0>en
R0#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R0(config)#ipv6 access-list BLOCK_HTTPS_ACL
R0(config-ipv6-acl)#deny tcp any host 2001:DB8:1:30::30 eq www
R0(config-ipv6-acl)#deny tcp any host 2001:DB8:1:30::30 eq 443
R0(config-ipv6-acl)#permit ipv6 any any
R0(config-ipv6-acl)#interface GigabitEthernet0/0
R0(config-if)#ipv6 traffic-filter BLOCK_HTTPS_ACL in
R0(config-if)#^Z
R0#
%SYS-5-CONFIG_I: Configured from console by console
exit
```

At the bottom right of the CLI window are "Copy" and "Paste" buttons.

## VERIFYING THE WORKING OF ACL

PC1

Physical Config Desktop Custom Interface

**Command Prompt**

```
PC>ping 2001:DB8:1:11::2
Pinging 2001:DB8:1:11::2 with 32 bytes of data:
Reply from 2001:DB8:1:11::2: bytes=32 time=0ms TTL=127
Reply from 2001:DB8:1:11::2: bytes=32 time=1ms TTL=127
Reply from 2001:DB8:1:11::2: bytes=32 time=0ms TTL=127
Reply from 2001:DB8:1:11::2: bytes=32 time=0ms TTL=127

Ping statistics for 2001:DB8:1:11::2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

PC>ping 2001:DB8:1:30::30
Pinging 2001:DB8:1:30::30 with 32 bytes of data:
Reply from 2001:DB8:1:30::30: bytes=32 time=10ms TTL=125
Reply from 2001:DB8:1:30::30: bytes=32 time=2ms TTL=125
Reply from 2001:DB8:1:30::30: bytes=32 time=2ms TTL=125
Reply from 2001:DB8:1:30::30: bytes=32 time=2ms TTL=125

Ping statistics for 2001:DB8:1:30::30:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 10ms, Average = 4ms
```

PC2

Physical Config Desktop Custom Interface

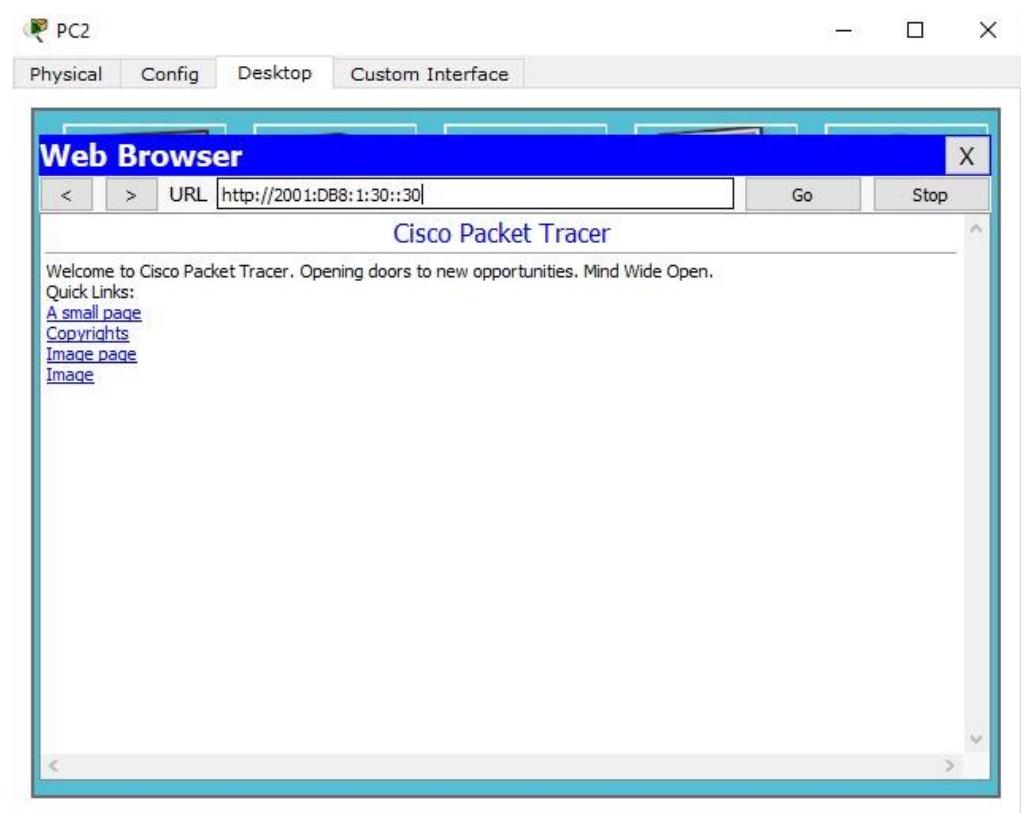
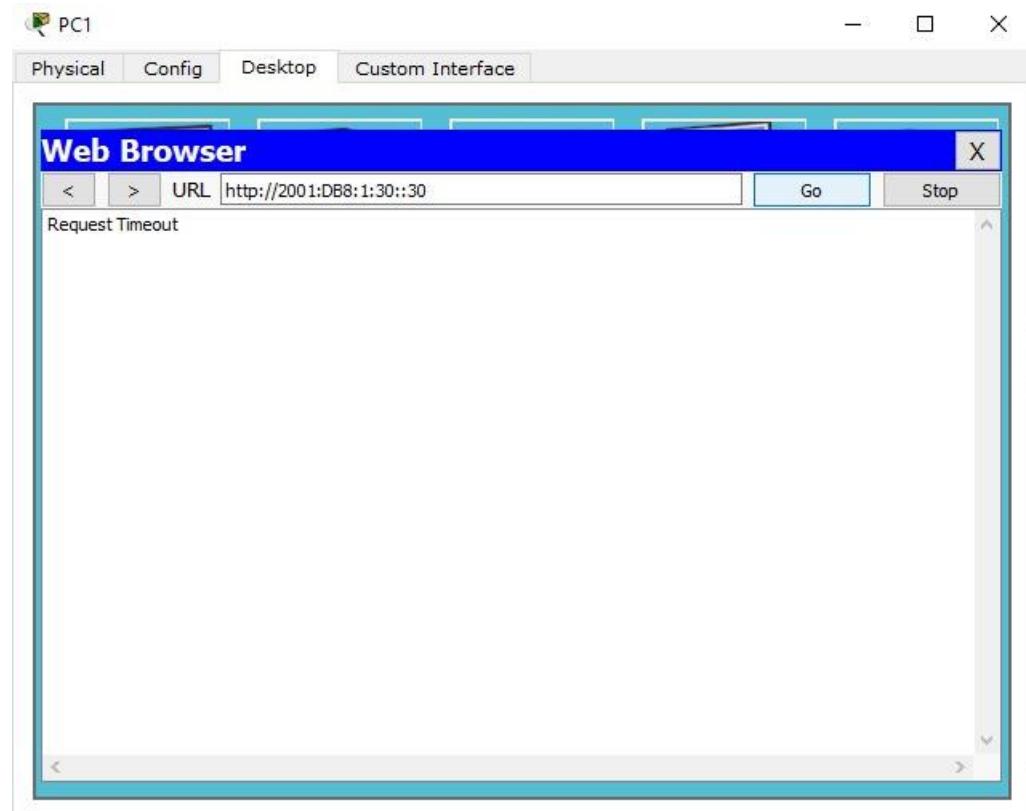
**Command Prompt**

```
PC>ping 2001:DB8:1:10::2
Pinging 2001:DB8:1:10::2 with 32 bytes of data:
Reply from 2001:DB8:1:10::2: bytes=32 time=0ms TTL=127

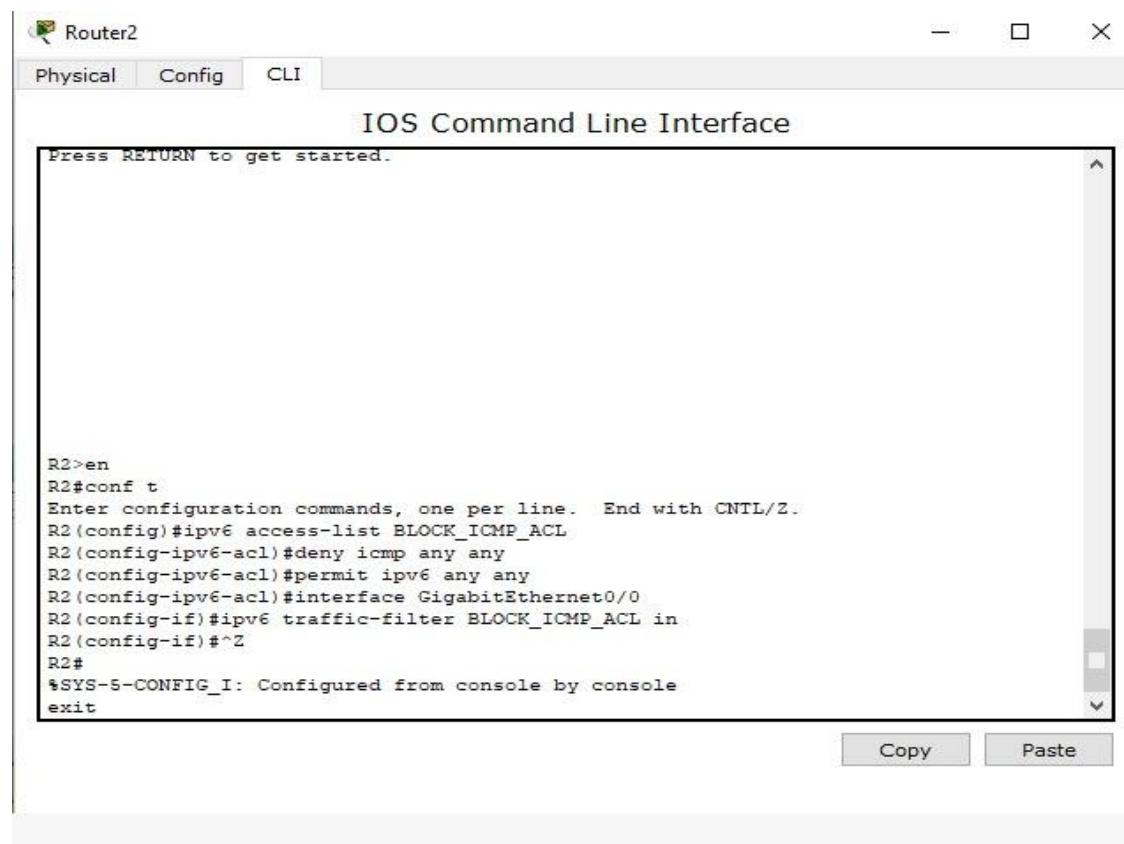
Ping statistics for 2001:DB8:1:10::2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

PC>ping 2001:DB8:1:30::30
Pinging 2001:DB8:1:30::30 with 32 bytes of data:
Reply from 2001:DB8:1:30::30: bytes=32 time=9ms TTL=125
Reply from 2001:DB8:1:30::30: bytes=32 time=2ms TTL=125
Reply from 2001:DB8:1:30::30: bytes=32 time=2ms TTL=125
Reply from 2001:DB8:1:30::30: bytes=32 time=4ms TTL=125

Ping statistics for 2001:DB8:1:30::30:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 9ms, Average = 4ms
```



## CONFIGURING ACL

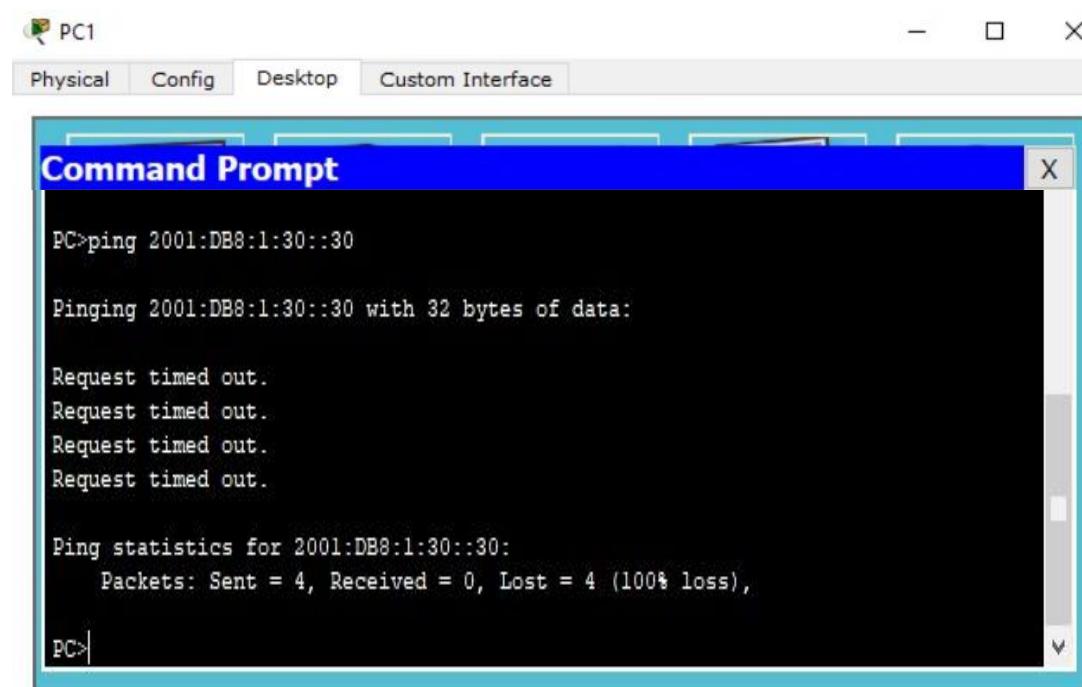


The screenshot shows the IOS Command Line Interface (CLI) running on a device named Router2. The window title is "Router2" and the tab selected is "CLI". The interface displays the configuration commands entered by the user:

```
R2>en
R2#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#ipv6 access-list BLOCK_ICMP_ACL
R2(config-ipv6-acl)#deny icmp any any
R2(config-ipv6-acl)#permit ipv6 any any
R2(config-ipv6-acl)#interface GigabitEthernet0/0
R2(config-if)#ipv6 traffic-filter BLOCK_ICMP_ACL in
R2(config-if)#+Z
R2#
%SYS-5-CONFIG_I: Configured from console by console
exit
```

At the bottom right of the CLI window, there are "Copy" and "Paste" buttons.

## VERIFYING THE WORKING OF ACL



The screenshot shows a Windows Command Prompt window titled "Command Prompt" running on a PC. The window title is "PC1". The tab selected is "Config". The command entered by the user is:

```
PC>ping 2001:DB8:1:30::30
```

The output shows the ping attempt failed due to an access control list (ACL) block:

```
Pinging 2001:DB8:1:30::30 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.
```

Finally, the ping statistics are displayed:

```
Ping statistics for 2001:DB8:1:30::30:
Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

The screenshot shows a Windows-style Command Prompt window titled "Command Prompt". The window is part of a software interface with tabs for "Physical", "Config", "Desktop", and "Custom Interface". The main area of the window displays the following command and its output:

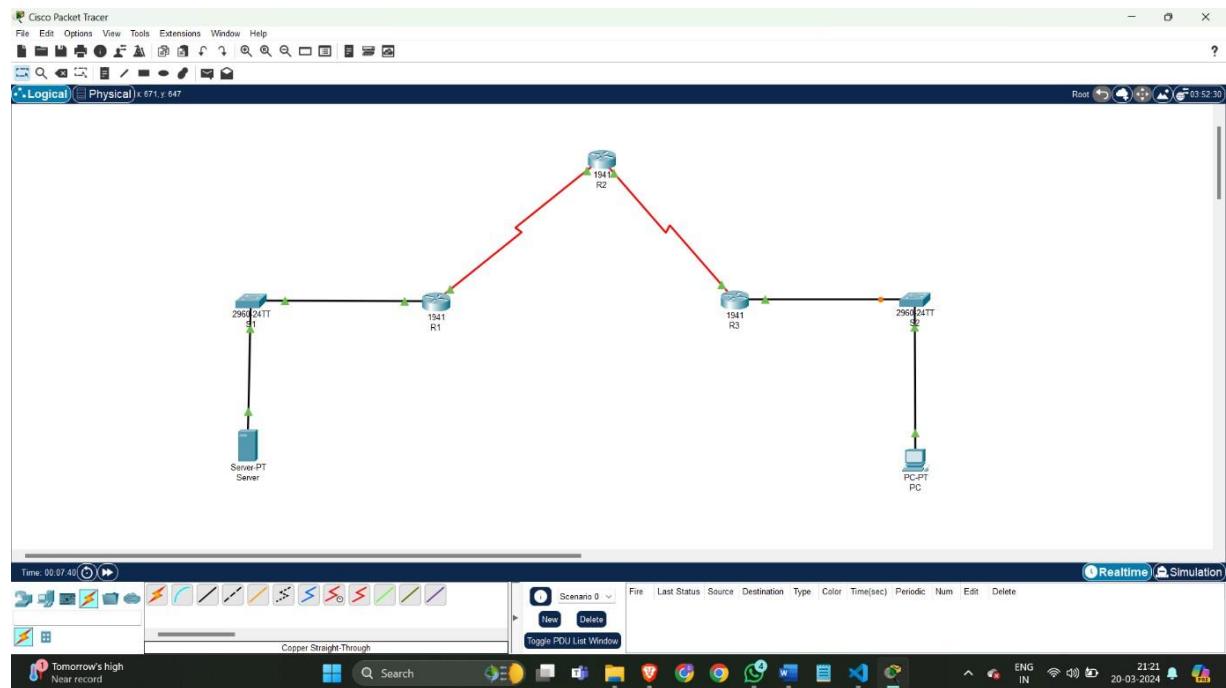
```
PC>ping 2001:DB8:1:30::30
Pinging 2001:DB8:1:30::30 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 2001:DB8:1:30::30:
  Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
PC>
```

## PRACTICAL 6

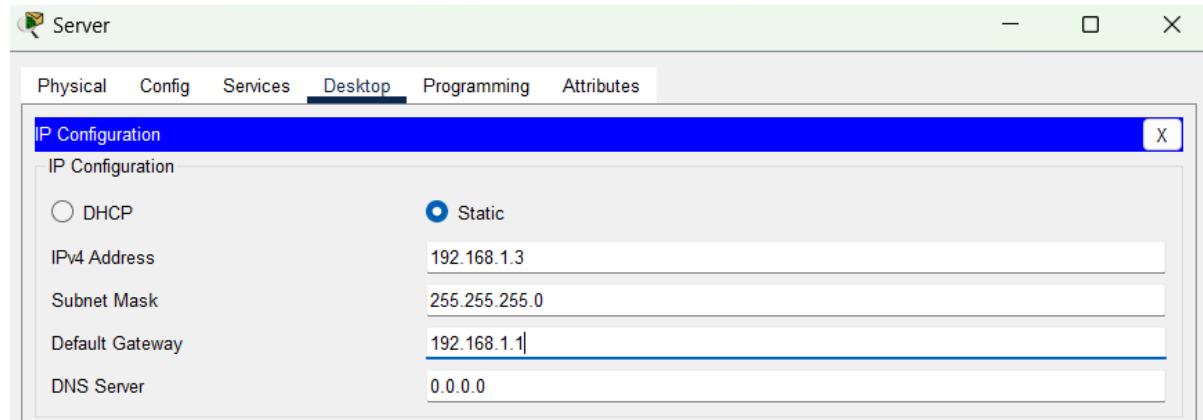
### AIM: CONFIGURING A ZONE-BASED POLICY FIREWALL

#### Topology Diagram:

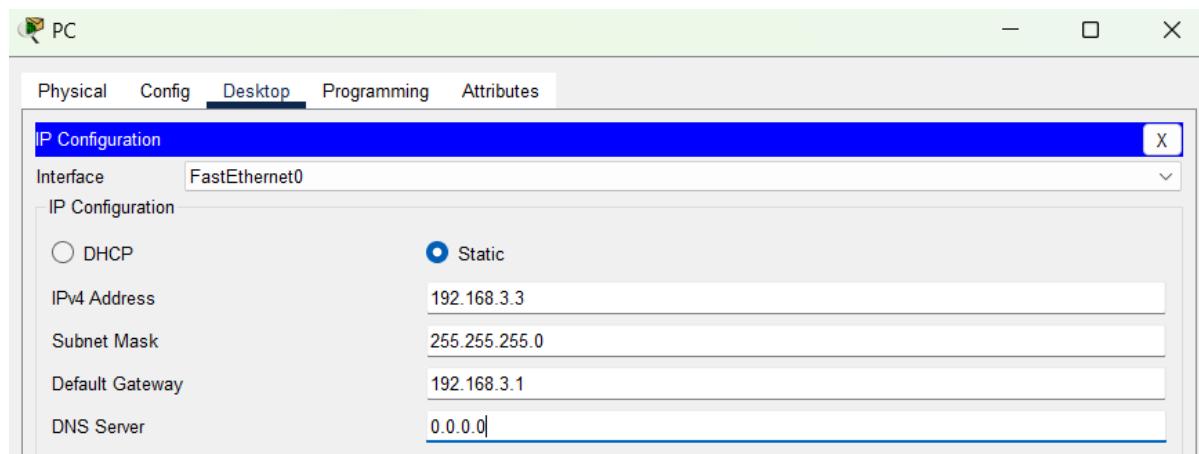


#### Assigning IP Addresses

##### 1. SERVER



## 2. PC



## 3. Router 1

```
Router>en
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#host R1
R1(config)#interface Serial0/0/0
R1(config-if)#ip address 10.1.1.1 255.255.255.252
R1(config-if)#no shut
R1(config-if)#interface GigabitEthernet0/0
R1(config-if)#ip address 192.168.1.1 255.255.255.0
R1(config-if)#no shut
R1(config-if)#^Z
R1#
%SYS-5-CONFIG_I: Configured from console by console
exit
```

## 4. Router 2

```
Router>en
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#host R2
R2(config)#interface Serial0/0/0
R2(config-if)#ip address 10.1.1.2 255.255.255.252
R2(config-if)#no shut
R2(config-if)#interface Serial0/0/1
R2(config-if)#ip address 10.2.2.2 255.255.255.252
R2(config-if)#no shut
R2(config-if)#^Z
R2#
%SYS-5-CONFIG_I: Configured from console by console
exit
```

### 5. Router 3

```
Router>en
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#host R3
R3(config)#interface Serial0/0/1
R3(config-if)#ip address 10.2.2.1 255.255.255.252
R3(config-if)#no shut
R3(config-if)#interface GigabitEthernet0/1
R3(config-if)#ip address 192.168.3.1 255.255.255.0
R3(config-if)#no shut
R3(config-if)#{^Z
R3#
%SYS-5-CONFIG_I: Configured from console by console
exit
```

### Displaying IP Address Details of Routers

#### Router 1

```
R1>show ip interface brief
Interface          IP-Address      OK? Method Status      Protocol
GigabitEthernet0/0  192.168.1.1    YES manual up       up
GigabitEthernet0/1  unassigned     YES unset administratively down down
Serial0/0/0         10.1.1.1      YES manual up       up
Serial0/0/1         unassigned     YES unset administratively down down
Vlan1              unassigned     YES unset administratively down down
```

#### Router 2

```
R2>show ip interface brief
Interface          IP-Address      OK? Method Status      Protocol
GigabitEthernet0/0  unassigned     YES unset administratively down down
GigabitEthernet0/1  unassigned     YES unset administratively down down
Serial0/0/0         10.1.1.2      YES manual up       up
Serial0/0/1         10.2.2.2      YES manual up       up
Vlan1              unassigned     YES unset administratively down down
```

#### Router 3

```
R3>show ip interface brief
Interface          IP-Address      OK? Method Status      Protocol
GigabitEthernet0/0  unassigned     YES unset administratively down down
GigabitEthernet0/1  192.168.3.1    YES manual up       up
Serial0/0/0         unassigned     YES unset administratively down down
Serial0/0/1         10.2.2.1      YES manual up       up
Vlan1              unassigned     YES unset administratively down down
```

Configure RIP on routers

Router 1

```
R1>en
R1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#router rip
R1(config-router)#network 192.168.1.0
R1(config-router)#network 10.1.1.0
R1(config-router)#^Z
R1#
%SYS-5-CONFIG_I: Configured from console by console
exit
```

Router 2

```
R2>en
R2#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#router rip
R2(config-router)#network 10.1.1.0
R2(config-router)#network 10.2.2.0
R2(config-router)#^Z
R2#
%SYS-5-CONFIG_I: Configured from console by console
exit
```

Router 3

```
R3>en
R3#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R3(config)#router rip
R3(config-router)#network 10.2.2.0
R3(config-router)#network 192.168.3.0
R3(config-router)#^Z
R3#
%SYS-5-CONFIG_I: Configured from console by console
exit
```

### Displaying routing table of routers

#### Router 1

```
R1>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, 3 subnets, 2 masks
C        10.1.1.0/30 is directly connected, Serial0/0/0
L        10.1.1.1/32 is directly connected, Serial0/0/0
R        10.2.2.0/30 [120/1] via 10.1.1.2, 00:00:26, Serial0/0/0
  192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.1.0/24 is directly connected, GigabitEthernet0/0
L        192.168.1.1/32 is directly connected, GigabitEthernet0/0
R        192.168.3.0/24 [120/2] via 10.1.1.2, 00:00:26, Serial0/0/0
```

#### Router 2

```
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

  10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks
C        10.1.1.0/30 is directly connected, Serial0/0/0
L        10.1.1.2/32 is directly connected, Serial0/0/0
C        10.2.2.0/30 is directly connected, Serial0/0/1
L        10.2.2.2/32 is directly connected, Serial0/0/1
R        192.168.1.0/24 [120/1] via 10.1.1.1, 00:00:08, Serial0/0/0
R        192.168.3.0/24 [120/1] via 10.2.2.1, 00:00:08, Serial0/0/1
```

#### Router 3

```
R3>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, 3 subnets, 2 masks
R        10.1.1.0/30 [120/1] via 10.2.2.2, 00:00:09, Serial0/0/1
C        10.2.2.0/30 is directly connected, Serial0/0/1
L        10.2.2.1/32 is directly connected, Serial0/0/1
R        192.168.1.0/24 [120/2] via 10.2.2.2, 00:00:09, Serial0/0/1
  192.168.3.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.3.0/24 is directly connected, GigabitEthernet0/1
L        192.168.3.1/32 is directly connected, GigabitEthernet0/1
```

### Configure SSH on R2

#### Router 2

```
R2>en
R2#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#ip domain-name securityincomputing.com
R2(config)#username admin secret pwd
R2(config)#line vty 0 4
R2(config-line)#login local
R2(config-line)#transport input ssh
R2(config-line)#crypto key zeroize rsa
% No Signature RSA Keys found in configuration.

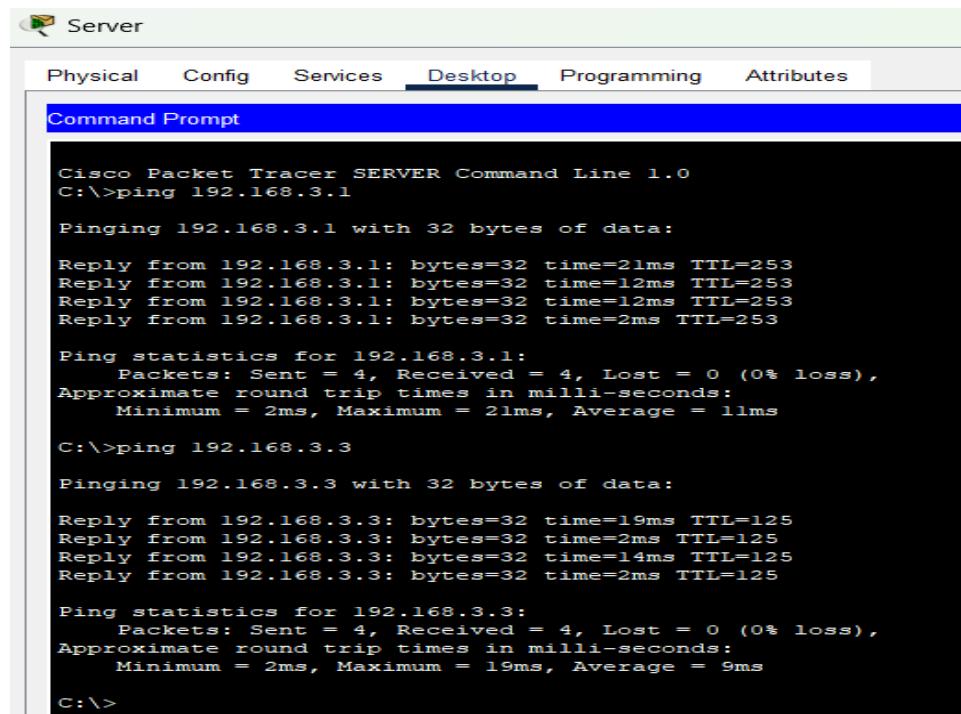
R2(config)#crypto key generate rsa
The name for the keys will be: R2.securityincomputing.com
Choose the size of the key modulus in the range of 360 to 4096 for your
General Purpose Keys. Choosing a key modulus greater than 512 may take
a few minutes.

How many bits in the modulus [512]: 1024
% Generating 1024 bit RSA keys, keys will be non-exportable...[OK]

R2(config)#ip ssh time-out 90
*Mar 1 0:19:52.966: %SSH-5-ENABLED: SSH 1.99 has been enabled
R2(config)#ip ssh authentication-retries 2
R2(config)#ip ssh version 2
R2(config)#^Z
R2#
%SYS-5-CONFIG_I: Configured from console by console
exit
```

### Verify Basic Network Connectivity before ACL Configuration

#### SERVER



The screenshot shows a Cisco Packet Tracer interface. The top menu bar includes 'Physical', 'Config', 'Services', 'Desktop' (which is highlighted in blue), 'Programming', and 'Attributes'. Below the menu is a 'Command Prompt' window. The command line shows several 'ping' operations between two hosts, demonstrating successful network connectivity.

```
Cisco Packet Tracer SERVER Command Line 1.0
C:\>ping 192.168.3.1

Pinging 192.168.3.1 with 32 bytes of data:

Reply from 192.168.3.1: bytes=32 time=21ms TTL=253
Reply from 192.168.3.1: bytes=32 time=12ms TTL=253
Reply from 192.168.3.1: bytes=32 time=12ms TTL=253
Reply from 192.168.3.1: bytes=32 time=2ms TTL=253

Ping statistics for 192.168.3.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 21ms, Average = 11ms

C:\>ping 192.168.3.3

Pinging 192.168.3.3 with 32 bytes of data:

Reply from 192.168.3.3: bytes=32 time=19ms TTL=125
Reply from 192.168.3.3: bytes=32 time=2ms TTL=125
Reply from 192.168.3.3: bytes=32 time=14ms TTL=125
Reply from 192.168.3.3: bytes=32 time=2ms TTL=125

Ping statistics for 192.168.3.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 19ms, Average = 9ms

C:\>
```

PC

Physical Config Desktop Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.1.3

Pinging 192.168.1.3 with 32 bytes of data:

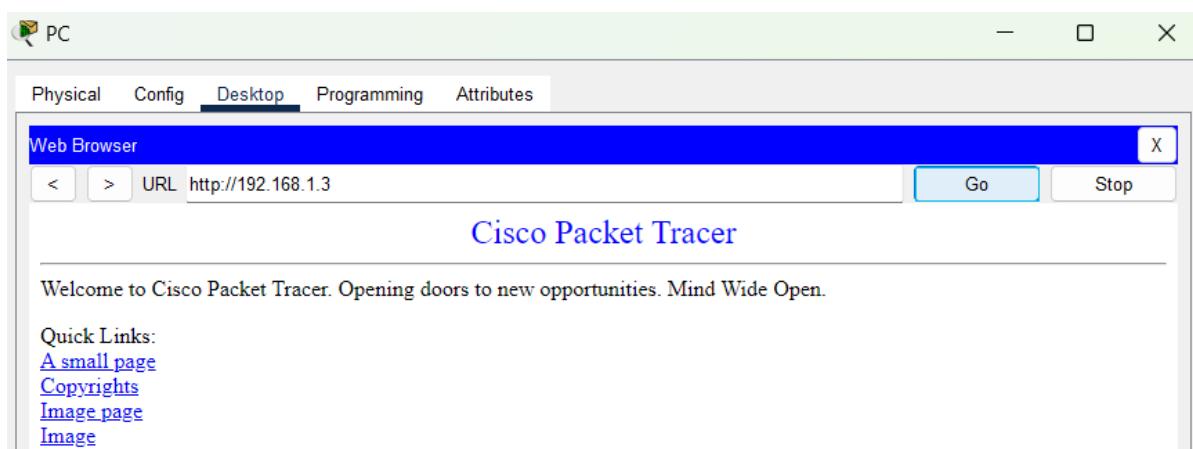
Reply from 192.168.1.3: bytes=32 time=2ms TTL=125
Reply from 192.168.1.3: bytes=32 time=2ms TTL=125
Reply from 192.168.1.3: bytes=32 time=2ms TTL=125
Reply from 192.168.1.3: bytes=32 time=11ms TTL=125

Ping statistics for 192.168.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 11ms, Average = 4ms

C:\>ssh -l admin 10.2.2.2

Password:

R2>|
```



Enable the Security Technology package on R

Router 3

```
| R3>show version

Technology Package License Information for Module:'cl900'
-----
Technology      Technology-package          Technology-package
                Current        Type            Next reboot
-----
ipbase         ipbasek9      Permanent      ipbasek9
security       None          None           None
data           None          None           None

Configuration register is 0x2102

| R3>en
| R3#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R3(config)#license boot module cl900 technology-package securityk9

ACCEPT? [yes/no]: yes
% use 'write' command to make license boot config take effect on next boot

| R3(config)#exit
R3#
%SYS-5-CONFIG_I: Configured from console by console
reload
System configuration has been modified. Save? [yes/no]:yes
Building configuration...
[OK]
Proceed with reload? [confirm]
System Bootstrap, Version 15.1(4)M4, RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 2010 by cisco Systems, Inc.
Total memory size = 512 MB - On-board = 512 MB, DIMM0 = 0 MB
CISCO1941/K9 platform with 524288 Kbytes of main memory
Main memory is configured to 64/-1(On-board/DIMM0) bit mode with ECC disabled

 Readonly ROMMON initialized

program load complete, entry point: 0x80803000, size: 0xb340
program load complete, entry point: 0x80803000, size: 0xb340

IOS Image Load Test

Digitally Signed Release Software
program load complete, entry point: 0x81000000, size: 0x2bb1c58
Self decompressing the image :
#####
[OK]
Smart Init is enabled
smart init is sizing iomem
    TYPE      MEMORY_REQ
    HWIC Slot 0   0x00200000    Onboard devices &
    buffer pools  0x01E8F000
-----
        TOTAL:      0x0268F000
Rounded IOMEM up to: 40Mb.
Using 6 percent iomem. [40Mb/512Mb]
```

```
| R3>show version

Technology Package License Information for Module:'cl900'

-----
Technology      Technology-package          Technology-package
                Current        Type            Next reboot
-----
ipbase         ipbasek9      Permanent      ipbasek9
security       securityk9    Evaluation    securityk9
data           disable       None          None

Configuration register is 0x2102
```

Create the Firewall Zones, Class Maps and ACLs on R3:-  
(Permit all IP protocols from the 192.168.3.0/24 source network to any destination.)

### Router 3

```
R3>en
R3#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R3(config)#zone security IN-ZONE
R3(config-sec-zone)#exit
R3(config)#zone security OUT-ZONE
R3(config-sec-zone)#exit
R3(config)#access-list 101 permit ip 192.168.3.0 0.0.0.255 any
R3(config)#class-map type inspect match-all IN-NET-CLASS-MAP
R3(config-cmap)#match access-group 101
R3(config-cmap)#exit
R3(config)#policy-map type inspect IN-2-OUT-PMAP
R3(config-pmap)#class type inspect IN-NET-CLASS-MAP
R3(config-pmap-c)#inspect
%No specific protocol configured in class IN-NET-CLASS-MAP for inspection. All protocols will be
inspected
R3(config-pmap-c)#exit
R3(config-pmap)#exit

R3(config)#zone-pair security IN-2-OUT-ZPAIR source IN-ZONE destination OUT-ZONE
R3(config-sec-zone-pair)#service-policy type inspect IN-2-OUT-PMAP
R3(config-sec-zone-pair)#exit
R3(config)#interface GigabitEthernet0/1
R3(config-if)#zone-member security IN-ZONE
R3(config-if)#exit
R3(config)#interface Serial0/0/1
R3(config-if)#zone-member security OUT-ZONE
R3(config-if)#exit
R3(config)#exit
R3#
%SYS-5-CONFIG_I: Configured from console by console

R3#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
R3#exit
```

Test Firewall Functionality from IN-ZONE to OUT-ZONE

PC

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.1.3

Pinging 192.168.1.3 with 32 bytes of data:

Reply from 192.168.1.3: bytes=32 time=2ms TTL=125
Reply from 192.168.1.3: bytes=32 time=2ms TTL=125
Reply from 192.168.1.3: bytes=32 time=2ms TTL=125
Reply from 192.168.1.3: bytes=32 time=11ms TTL=125

Ping statistics for 192.168.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 11ms, Average = 4ms

C:\>ssh -l admin 10.2.2.2

Password:

R2>
```

Router 3

```
R3>en
R3#show policy-map type inspect zone-pair sessions

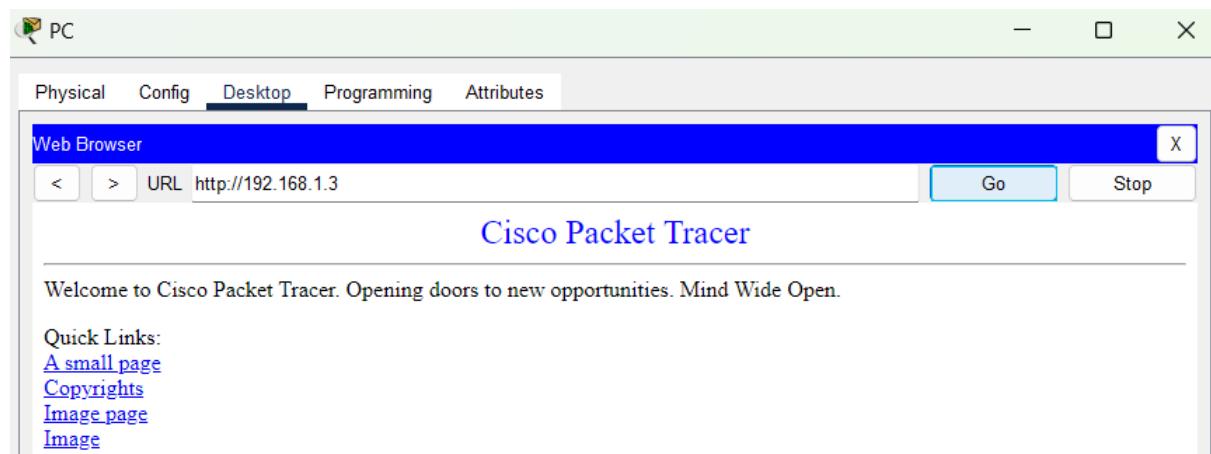
policy exists on zp IN-2-OUT-ZPAIR
Zone-pair: IN-2-OUT-ZPAIR

Service-policy inspect : IN-2-OUT-PMAP

    Class-map: IN-NET-CLASS-MAP (match-all)
        Match: access-group 101
        Inspect

            Number of Established Sessions = 1
            Established Sessions
                Session 911617136 (192.168.3.3:1027)=>(10.2.2.2:22)  tcp SIS_OPEN/TCP_ESTAB
                    Created 00:00:46, Last heard 00:00:42
                    Bytes sent (initiator:responder) [578:656]
    Class-map: class-default (match-any)
        Match: any
        Drop (default action)
            0 packets, 0 bytes
```

PC



Router 3

```
R3>en
R3#show policy-map type inspect zone-pair sessions

policy exists on zp IN-2-OUT-ZPAIR
Zone-pair: IN-2-OUT-ZPAIR

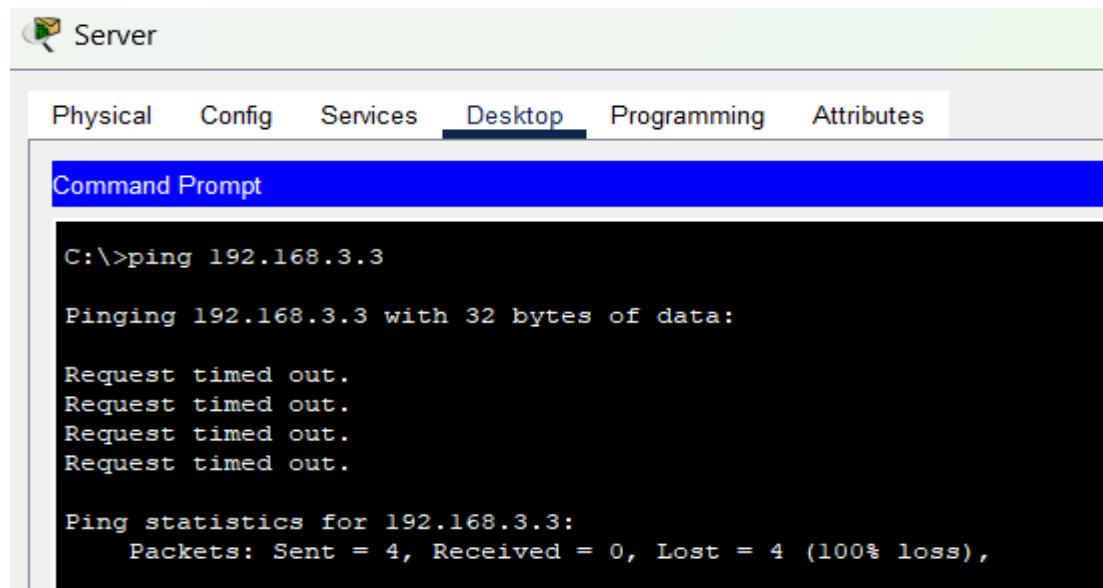
Service-policy inspect : IN-2-OUT-PMAP

    Class-map: IN-NET-CLASS-MAP (match-all)
        Match: access-group 101
        Inspect

    Class-map: class-default (match-any)
        Match: any
        Drop (default action)
            0 packets, 0 bytes
```

#### Testing Firewall Functionality from OUT-ZONE to IN-ZONE

SERVER



Router 2

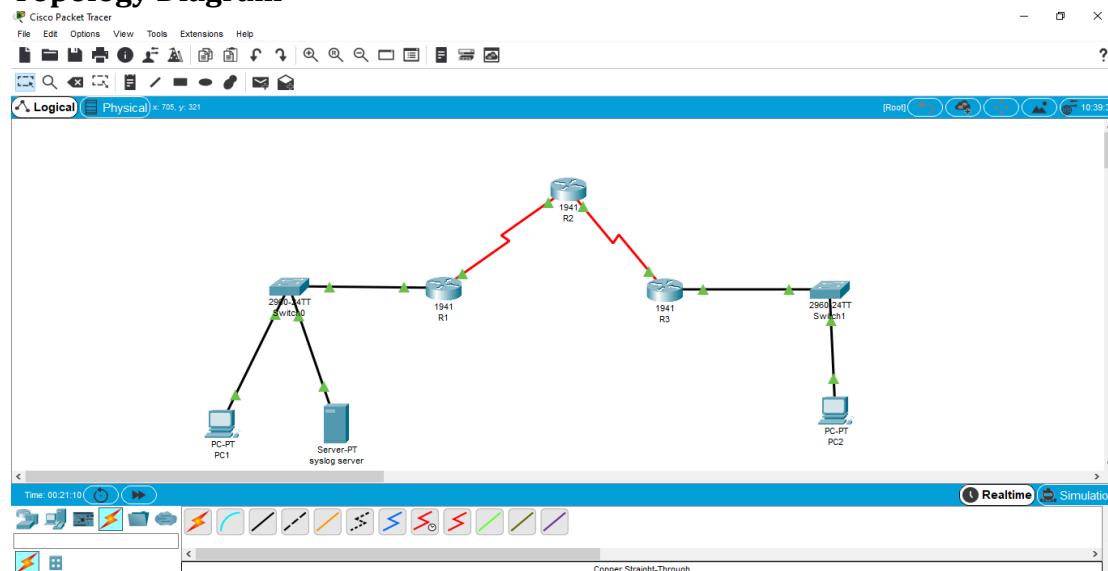
```
R2>ping 192.168.3.3
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.3.3, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
```

### PRACTICAL NO 7

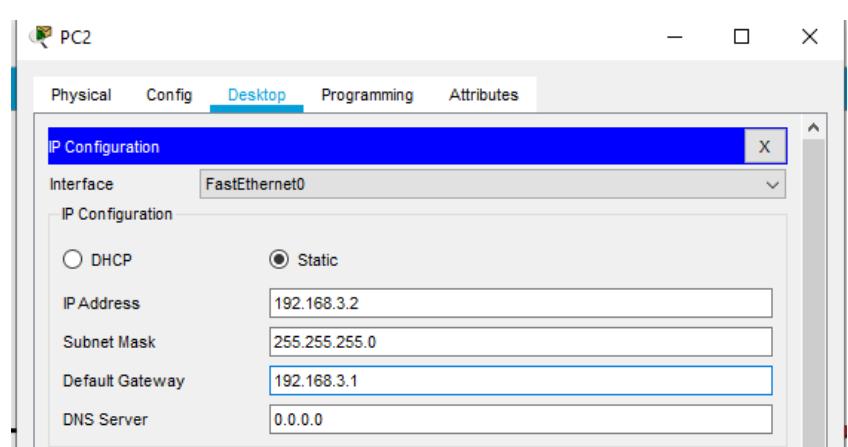
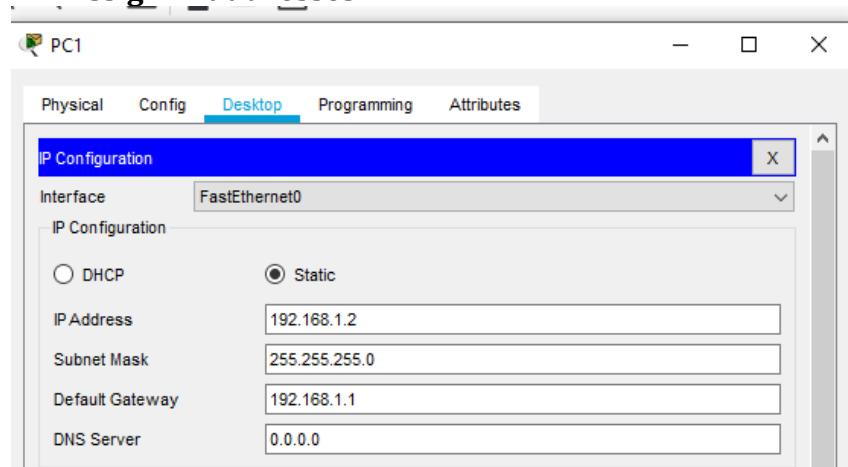
#### AIM: CONFIGURE IOS INTRUSION PREVENTION SYSTEM(IPS) USING THE CLI

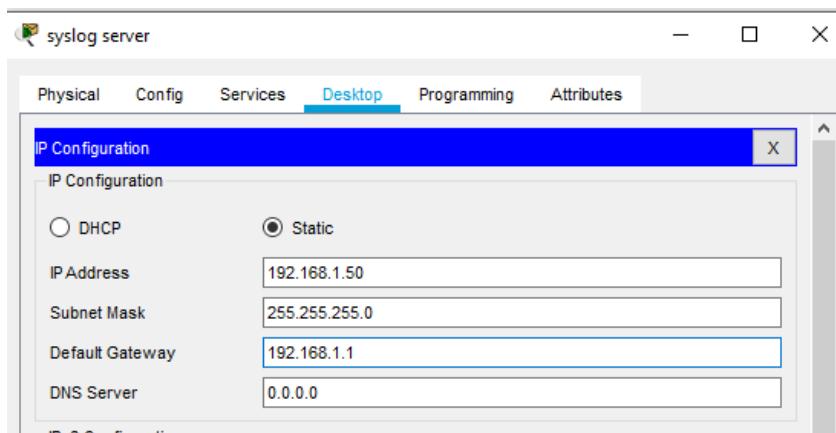
- Enable IOS IPS
- Modify an IPS signature

#### Topology Diagram



#### Assign IP addresses:





The screenshot shows the Cisco Network Assistant interface for a device named 'R1'. The 'CLI' tab is selected. The terminal window displays the IOS Command Line Interface (CLI) configuration for Router R1. The configuration includes setting the host name to 'R1', enabling the serial interface 'serial0/1/0', and assigning static IP addresses to both the serial and gigabit interfaces.

```
state to up

R1>en
R1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#host R#
R#(config)#host R3
R3(config)#interface serial0/1/0
R3(config-if)#ip address 10.1.1.1 255.255.255.252
R3(config-if)#no shut
R3(config-if)#interface gigabittethernet0/0
R3(config-if)#ip address 192.168.1.1 255.255.255.0
R3(config-if)#no shut

R3(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

R3(config-if)#
R3(config-if)#
R3(config-if)#exit
R3(config)exit
```

The screenshot shows the Cisco Network Assistant interface for a device named 'R2'. The 'CLI' tab is selected. The terminal window displays the IOS Command Line Interface (CLI) configuration for Router R2. The configuration includes setting the host name to 'R2', enabling the serial interface 'serial0/1/0', and assigning static IP addresses to both the serial and gigabit interfaces.

```
R2>en
R2#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#host R2
R2(config)#interface serial0/1/0
R2(config-if)#ip address 10.1.1.2 255.255.255.252
R2(config-if)#no shut
R2(config-if)#interface serial0/1/1
R2(config-if)#ip address 10.2.2.2 255.255.255.252
R2(config-if)#no shut
R2(config-if)#exit
R2(config)#exit
R2#
%SYS-5-CONFIG_I: Configured from console by console
exit
```

R3>en  
R3#conf t  
Enter configuration commands, one per line. End with CNTL/Z.  
R3(config)#host R3  
R3(config)#interface serial0/1/0  
R3(config-if)#ip address 10.2.2.1 255.255.255.252  
R3(config-if)#nos hut  
^  
% Invalid input detected at '^' marker.  
  
R3(config-if)#no shut  
R3(config-if)#interface gigabitethernet0/0  
R3(config-if)#ip address 192.168.3.1 255.255.255.0  
R3(config-if)#no shut  
  
R3(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  
exit  
R3(config)#exit

### Displaying IP address Details of Routers

R1>show ip interface brief  
Interface IP-Address OK? Method Status  
Protocol  
GigabitEthernet0/0 192.168.1.1 YES manual up  
up  
GigabitEthernet0/1 unassigned YES NVRAM administratively  
down down  
Serial0/1/0 10.1.1.1 YES manual up  
up  
Serial0/1/1 unassigned YES unset down  
down  
Vlan1 unassigned YES NVRAM administratively  
down down

R2>show ip interface brief  
Interface IP-Address OK? Method Status  
Protocol  
GigabitEthernet0/0 unassigned YES NVRAM administratively  
down down  
GigabitEthernet0/1 unassigned YES NVRAM administratively  
down down  
Serial0/1/0 10.1.1.2 YES manual up  
up  
Serial0/1/1 10.2.2.2 YES manual up  
up  
Vlan1 unassigned YES NVRAM administratively  
down down  
R2>



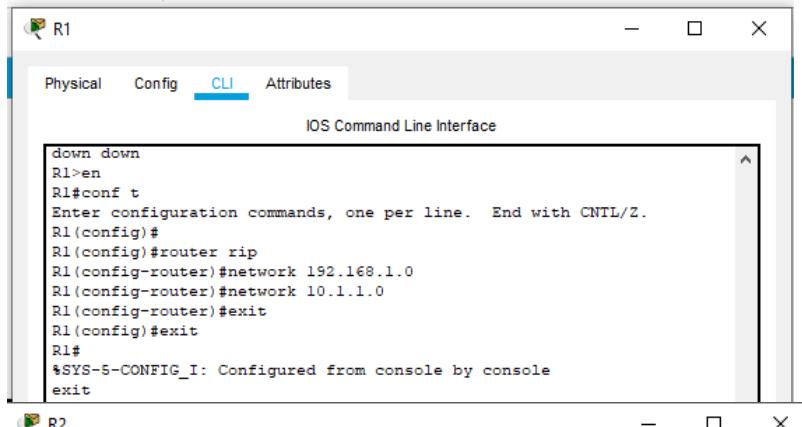
R3

Physical Config CLI Attributes

IOS Command Line Interface

```
R3>show ip interface brief
Interface          IP-Address      OK? Method Status
Protocol
GigabitEthernet0/0    192.168.3.1    YES manual up
up
GigabitEthernet0/1    unassigned     YES NVRAM administratively
down down
Serial0/1/0           10.2.2.1      YES manual up
up
Serial0/1/1           unassigned     YES unset down
down
Vlan1                unassigned     YES NVRAM administratively
down down
R3>
```

### Configure RIP on routers

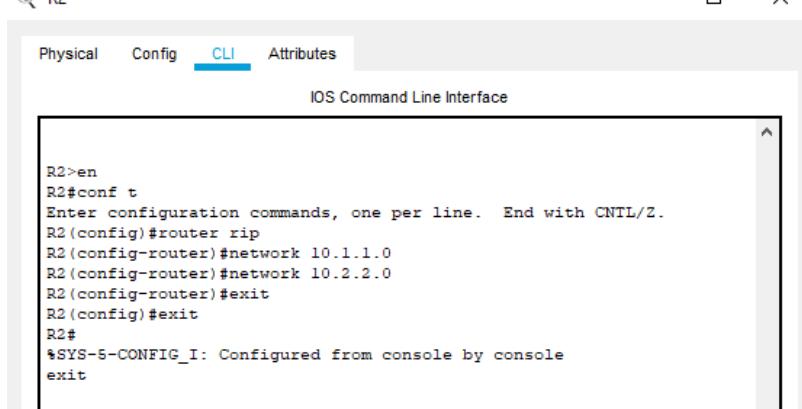


R1

Physical Config CLI Attributes

IOS Command Line Interface

```
down down
R1>en
R1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#
R1(config)#router rip
R1(config-router)#network 192.168.1.0
R1(config-router)#network 10.1.1.0
R1(config-router)#exit
R1(config)#exit
R1#
%SYS-5-CONFIG_I: Configured from console by console
exit
```



R2

Physical Config CLI Attributes

IOS Command Line Interface

```
R2>en
R2#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#router rip
R2(config-router)#network 10.1.1.0
R2(config-router)#network 10.2.2.0
R2(config-router)#exit
R2(config)#exit
R2#
%SYS-5-CONFIG_I: Configured from console by console
exit
```

R3

Physical Config **CLI** Attributes

IOS Command Line Interface

```
R3>en
R3>conf t
Enter configuration commands, one per line. End with CNTL/Z.
R3(config)#router rip
R3(config-router)#network 10.2.2.0
R3(config-router)#network 192.168.3.0
R3(config-router)#exit
R3(config)#exit
R3#
%SYS-5-CONFIG_I: Configured from console by console
exit
```

R1

Physical Config **CLI** Attributes

IOS Command Line Interface

```
R1>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, 3 subnets, 2 masks
C    10.1.1.0/30 is directly connected, Serial0/1/0
L    10.1.1.1/32 is directly connected, Serial0/1/0
R    10.2.2.0/30 [120/1] via 10.1.1.2, 00:00:25, Serial0/1/0
      192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C    192.168.1.0/24 is directly connected, GigabitEthernet0/0
L    192.168.1.1/32 is directly connected, GigabitEthernet0/0
R    192.168.3.0/24 [120/2] via 10.1.1.2, 00:00:25, Serial0/1/0

R1>
```

R2

Physical Config **CLI** Attributes

IOS Command Line Interface

```
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

  10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks
C    10.1.1.0/30 is directly connected, Serial0/1/0
L    10.1.1.2/32 is directly connected, Serial0/1/0
C    10.2.2.0/30 is directly connected, Serial0/1/1
L    10.2.2.2/32 is directly connected, Serial0/1/1
R    192.168.1.0/24 [120/1] via 10.1.1.1, 00:00:09, Serial0/1/0
R    192.168.3.0/24 [120/1] via 10.2.2.1, 00:00:13, Serial0/1/1

R2>
```

The image displays three windows from a network simulation application, labeled R3, PC1, and PC2, illustrating network configuration and ping tests.

**R3 Window:** This window shows the IOS Command Line Interface for router R3. It displays the output of the command `show ip route`, which lists various routes including direct connections and entries via Serial and Gigabit Ethernet interfaces. It also shows the output of the `ping` command to 192.168.1.50.

```
R3>
R3>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, 3 subnets, 2 masks
R     10.1.1.0/30 [120/1] via 10.2.2.2, 00:00:15, Serial0/1/0
C     10.2.2.0/30 is directly connected, Serial0/1/0
L     10.2.2.1/32 is directly connected, Serial0/1/0
R     192.168.1.0/24 [120/2] via 10.2.2.2, 00:00:15, Serial0/1/0
      192.168.3.0/24 is variably subnetted, 2 subnets, 2 masks
C     192.168.3.0/24 is directly connected, GigabitEthernet0/0
L     192.168.3.1/32 is directly connected, GigabitEthernet0/0
```

**PC1 Window:** This window shows the Command Prompt for PC1. It displays the output of the `ping` command to 192.168.1.50 and 192.168.3.2, showing round-trip times and packet loss.

```
C:\>ping 192.168.1.50

Pinging 192.168.1.50 with 32 bytes of data:
Reply from 192.168.1.50: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.1.50:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 192.168.3.2

Pinging 192.168.3.2 with 32 bytes of data:
Request timed out.
Reply from 192.168.3.2: bytes=32 time=2ms TTL=125
Reply from 192.168.3.2: bytes=32 time=4ms TTL=125
Reply from 192.168.3.2: bytes=32 time=3ms TTL=125

Ping statistics for 192.168.3.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
```

**PC2 Window:** This window shows the Command Prompt for PC2. It displays the output of the `ping` command to 192.168.1.2 and 192.168.1.50, showing round-trip times and packet loss.

```
C:\>ping 192.168.1.2

Pinging 192.168.1.2 with 32 bytes of data:
Reply from 192.168.1.2: bytes=32 time=6ms TTL=125
Reply from 192.168.1.2: bytes=32 time=2ms TTL=125
Reply from 192.168.1.2: bytes=32 time=2ms TTL=125
Reply from 192.168.1.2: bytes=32 time=3ms TTL=125

Ping statistics for 192.168.1.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 6ms, Average = 3ms

C:\>ping 192.168.1.50

Pinging 192.168.1.50 with 32 bytes of data:
Request timed out.
Reply from 192.168.1.50: bytes=32 time=2ms TTL=125
Reply from 192.168.1.50: bytes=32 time=2ms TTL=125
Reply from 192.168.1.50: bytes=32 time=2ms TTL=125

Ping statistics for 192.168.1.50:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 2ms, Average = 2ms
```

The image displays three windows from a network management interface:

- syslog server**: A window titled "Command Prompt" showing ping results. It includes two sections of ping output: one for 192.168.1.2 and another for 192.168.3.2. Both show 100% packet loss.
- R1**: An IOS Command Line Interface window showing license information for module 'cl900'. It lists device details and technology package configurations for ipbase, security, and data modules.
- R1**: Another IOS Command Line Interface window showing a license acceptance prompt. It asks for acceptance of the software evaluation terms and provides options to exit or proceed with a reload.

```
DRAM configuration is 64 bits wide with parity disabled.  
255K bytes of non-volatile configuration memory.  
249856K bytes of ATA System CompactFlash 0 (Read/Write)  
  
License Info:  
  
License UDI:  
  
-----  
Device# PID SN  
-----  
*0 CISCO1941/K9 FTX1524CKB9-  
  
Technology Package License Information for Module:'c1900'  
  
-----  
Technology Technology-package Technology-package  
Current Type Next reboot  
-----  
ipbase ipbasek9 Permanent ipbasek9  
security securityk9 Evaluation securityk9  
data disable None None  
  
Configuration register is 0x2102  
  
Ctrl+F6 to exit CLI focus
```

Top

### Enable IPS on R1

```
R1>en  
R1#mkdir ipsdir  
Create directory filename [ipsdir]?  
*Error Creating dir flash:ipsdir (Can't create a directory that exists)  
  
R1#conf t  
Enter configuration commands, one per line. End with CNTL/Z.  
R1(config)#ip ips config location flash:ipsdir  
R1(config)#ip ips name iosips  
R1(config)#ip ips notify log  
R1(config)#exit  
R1#  
*SYS-5-CONFIG_I: Configured from console by console  
clock set 13:13:46 6 February 2019  
^  
* Invalid input detected at '^' marker.  
R1#clock set 13:13:46 6 February 2019  
^  
* Invalid input detected at '^' marker.  
  
R1#clock set  
* Incomplete command.  
R1#clock set 13:13:46 6 February 2019  
R1#conf t  
Enter configuration commands, one per line. End with CNTL/Z.  
R1(config)#service timestamps log datetime msec  
R1(config)#logging host 192.168.1.50  
R1(config)#ip ips signature-category  
R1(config-ips-category)#category all  
R1(config-ips-category-action)#retired true  
R1(config-ips-category-action)#exit  
R1(config-ips-category)#category ios_ips basic  
R1(config-ips-category-action)#retired false  
R1(config-ips-category-action)#exit  
R1(config-ips-category)#exit  
Do you want to accept these changes? [confirm]  
Applying Category configuration to signatures ...  
*IPS=ENGINE BUILDING: around-in = 258 signatures = 6 of 12 engines
```



R1#

Physical Config **CLI** Attributes

IOS Command Line Interface

```
R1(config-ips-category-action)#exit
R1(config-ips-category)#exit
Do you want to accept these changes? [confirm]
Applying Category configuration to signatures ...
IPS-6-ENGINE_BUILDING: atomic-ip - 208 signatures - 6 of 13 engines
IPS-6-ENGINE_READY: atomic-ip - build time 30 ms - packets for this engine will be scanned

R1(config)#interface gigabitethernet0/0
R1(config-if)#ip ips iosipre out
R1(config-if)#t
*Feb 06, 13:16:00.1616: %IPS-6-ENGINE_BUILDING_STARTED: 13:16:02 UTC Feb 06 2010
*Feb 06, 13:16:02.1616: %IPS-6-ENGINE_BUILDING: atomic-ip - 3 signatures - 1 of 13 engines
*Feb 06, 13:16:02.1616: %IPS-6-ENGINE_READY: atomic-ip - build time 8 ms - packets for this engine will be scanned
*Feb 06, 13:16:02.1616: %IPS-6-ALL_ENGINE_BUILD_COMPLETE: elapsed time 8 msec
R1(config)#exit
R1#
*Feb 06, 13:16:08.1616: SYS-5-CONFIG_I: Configured from console by console
*Feb 06, 13:16:08.1616: %SYS-6-LOGGINGHOST_STARTSTOP: Logging to host 192.168.1.50 port 514 started - CLI initiated
R1#exit
```

R1

Physical Config **CLI** Attributes

IOS Command Line Interface

```
R1>en
R1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#ip ips signature-definition
R1(config-sigdef)#signature 2004 0
R1(config-sigdef-sig)#status
R1(config-sigdef-sig-status)#retired false
R1(config-sigdef-sig-status)#enabled true
R1(config-sigdef-sig-status)#exit
R1(config-sigdef-sig)#engine
R1(config-sigdef-sig-engine)#evnet-action produce-alert
% Invalid input detected at `~` marker.

R1(config-sigdef-sig-engine)#event-action produce-alert
R1(config-sigdef-sig-engine)#event-action deny-packet-inline
R1(config-sigdef-sig-engine)#exit
R1(config-sigdef-sig)#exit
R1(config-sigdef-sig)#exit
Do you want to accept these changes? [confirm]
%IPS-6-ENGINE_BUILDING_STARTED:
%IPS-6-ENGINE_BUILDING: atomic-ip - 303 signatures - 3 of 13 engines
%IPS-6-ENGINE_READY: atomic-ip - build time 480 ms - packets for this engine will be scanned
%IPS-6-ALL_ENGINE_BUILD_COMPLETE: elapsed time 648 ms

R1(config)#exit
R1#
*Feb 06, 13:19:56.1919: SYS-5-CONFIG_I: Configured from console by console|
```

R1>en

R1#

R1#show ip ips all

IPS Signature File Configuration Status

- Configured Config Locations: flash:ipsdir
- Last signature default load time:
- Last signature delta load time:
- Last event action (SEAP) load time: -none-

General SEAP Config:

- Global Deny Timeout: 3600 seconds
- Global Overrides Status: Enabled
- Global Filters Status: Enabled

IPS Auto Update is not currently configured

IPS Syslog and SDEE Notification Status

- Event notification through syslog is enabled
- Event notification through SDEE is enabled

IPS Signature Status

- Total Active Signatures: 1
- Total Inactive Signatures: 0

IPS Packet Scanning and Interface Status

- More--

**PC1**

Physical Config Desktop Programming Attributes

Command Prompt

```
Pinging 192.168.3.2 with 32 bytes of data:
Request timed out.
Reply from 192.168.3.2: bytes=32 time=2ms TTL=125
Reply from 192.168.3.2: bytes=32 time=4ms TTL=125
Reply from 192.168.3.2: bytes=32 time=3ms TTL=125

Ping statistics for 192.168.3.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 4ms, Average = 3ms

C:\>ping 192.168.3.2

Pinging 192.168.3.2 with 32 bytes of data:
Request timed out.
Reply from 192.168.3.2: bytes=32 time=11ms TTL=125
Reply from 192.168.3.2: bytes=32 time=10ms TTL=125
Reply from 192.168.3.2: bytes=32 time=3ms TTL=125

Ping statistics for 192.168.3.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 3ms, Maximum = 11ms, Average = 8ms

C:\>
```

**PC2**

Physical Config Desktop Programming Attributes

Command Prompt

```
Pinging 192.168.1.50 with 32 bytes of data:
Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
C:\>ping 192.168.1.50

Pinging 192.168.1.50 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 192.168.1.50:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
C:\>ping 192.168.1.2

Pinging 192.168.1.2 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 192.168.1.2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
C:\>
```

**syslog server**

Physical Config Services Desktop Programming Attributes

SERVICES

- HTTP
- DHCP
- DHCPv6
- TFTP
- DNS
- SYSLOG
- AAA
- NTP
- EMAIL
- FTP
- IoT
- VM Management
- Radius EAP

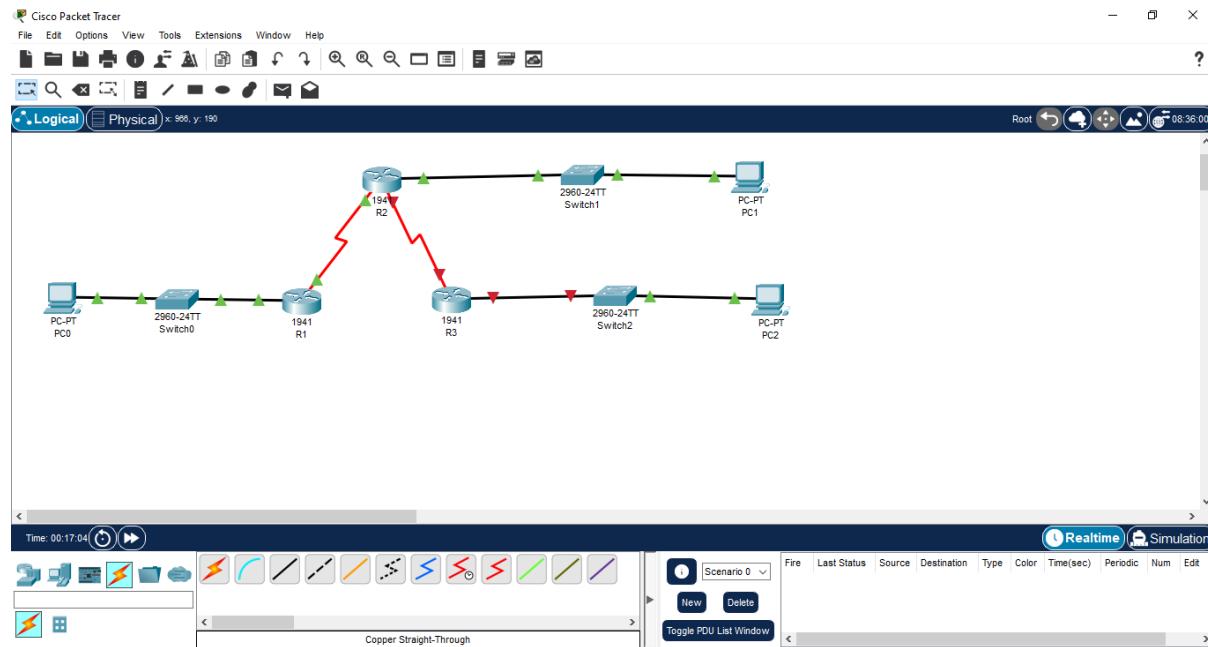
Syslog

Time	HostName	Message
02.06.2019 01:16:08.074 PM	192.168.1.1	%SYS-5-CONFIG_I: Configured from ...
02.06.2019 01:16:08.074 PM	192.168.1.1	: %SYS-6- LOGGINGHOST_ST...
02.06.2019 01:19:56.016 PM	192.168.1.1	%SYS-5-CONFIG_I: Configured from ...
02.06.2019 01:21:49.628 PM	192.168.1.1	%IPS-4-SIGNATURE...
02.06.2019 01:21:55.856 PM	192.168.1.1	%IPS-4-SIGNATURE...
02.06.2019 01:22:01.859 PM	192.168.1.1	%IPS-4-SIGNATURE...
02.06.2019 01:22:07.877 PM	192.168.1.1	%IPS-4-SIGNATURE...
02.06.2019 01:22:22.760 PM	192.168.1.1	%IPS-4-SIGNATURE...
02.06.2019 01:22:26.778 PM	192.168.1.1	%IPS-4-SIGNATURE...
02.06.2019 01:22:34.809 PM	192.168.1.1	%IPS-4-SIGNATURE...
02.06.2019 01:22:40.863 PM	192.168.1.1	%IPS-4-SIGNATURE...

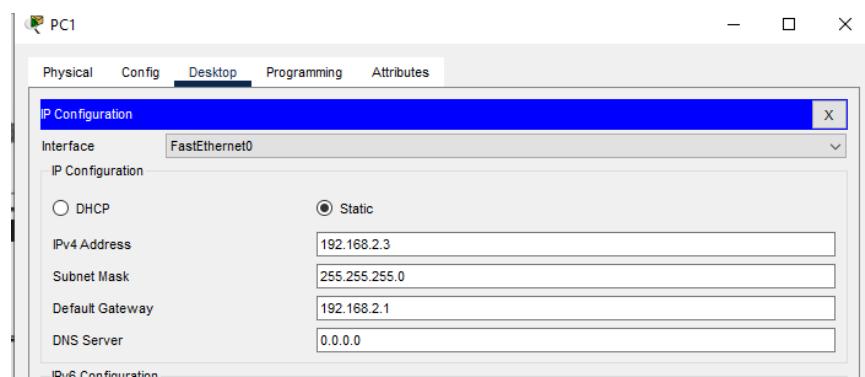
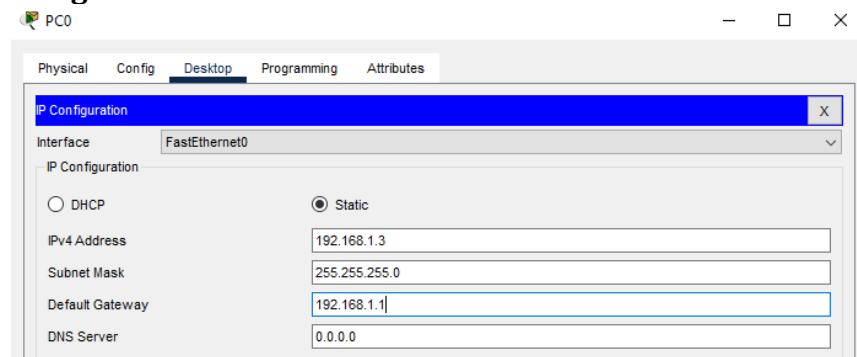
**Clear Log**

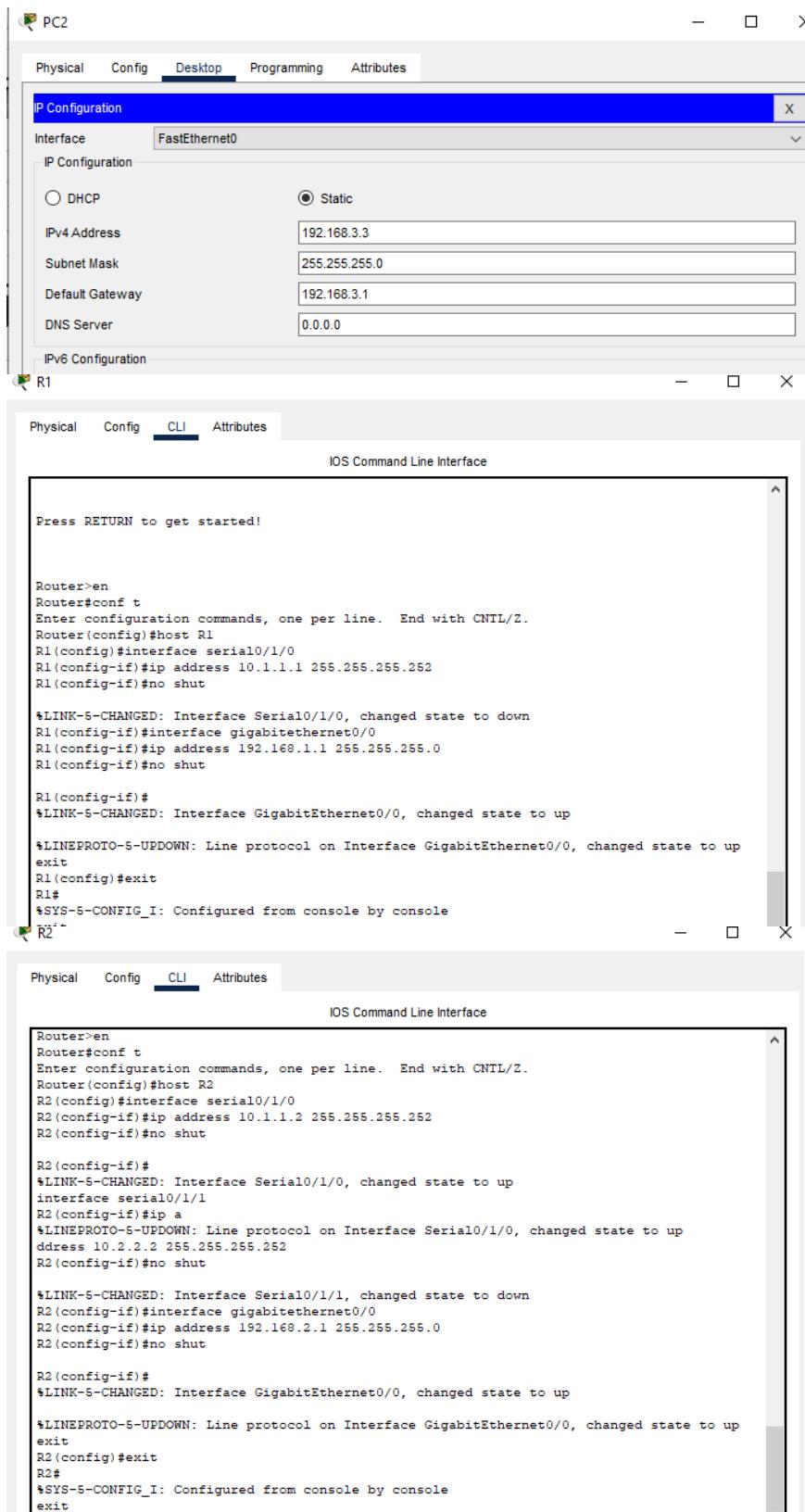
## PRACTICAL NO.8

### AIM: Configure and Verify a Site-to-Site IPsec VPN using CLI



### Assign IP Address





The image shows three separate terminal windows, each titled 'R3' in the top-left corner. Each window has tabs for 'Physical', 'Config', 'CLI' (which is selected), and 'Attributes'. The windows are labeled 'IOS Command Line Interface' at the top.

**R1 Terminal:**

```
Router>en
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#host R3
R3(config)#interface serial0/1/0
R3(config-if)#ip address 10.2.2.1 255.255.255.252
R3(config-if)#no shut

R3(config-if)#
*LINK-5-CHANGED: Interface Serial0/1/0, changed state to up
interface gigabitetherent
*LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/interface gigabitethernet0/0
R3(config-if)#ip address 192.168.3.1 255.255.255.0
R3(config-if)#no shut

R3(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
exit
R3(config)#exit
R3#
$SYS-5-CONFIG_I: Configured from console by console
exit

R1>show ip interface brief
Interface          IP-Address      OK? Method Status      Protocol
GigabitEthernet0/0  192.168.1.1    YES manual up        up
GigabitEthernet0/1  unassigned      YES unset administratively down down
Serial0/1/0         10.1.1.1      YES manual up        up
Serial0/1/1         unassigned      YES unset administratively down down
Vlan1              unassigned      YES unset administratively down down
R1>
```

**R2 Terminal:**

```
%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

R2>show ip interface briefr
^
* Invalid input detected at '^' marker.

R2>show ip interface brief
Interface          IP-Address      OK? Method Status      Protocol
GigabitEthernet0/0  192.168.2.1    YES manual up        up
GigabitEthernet0/1  unassigned      YES unset administratively down down
Serial0/1/0         10.1.1.2      YES manual up        up
Serial0/1/1         10.2.2.2      YES manual up        up
Vlan1              unassigned      YES unset administratively down down
R2>
```

**R3 Terminal:**

```
R3>show ip interface brief
Interface          IP-Address      OK? Method Status      Protocol
GigabitEthernet0/0  192.168.3.1    YES manual up        up
GigabitEthernet0/1  unassigned      YES unset administratively down down
Serial0/1/0         10.2.2.1      YES manual up        up
Serial0/1/1         unassigned      YES unset administratively down down
Vlan1              unassigned      YES unset administratively down down
R3>
```

## Configure routing on RIP

The image shows three separate windows, each representing a router (R1, R2, and R3) running the Cisco IOS Command Line Interface (CLI). Each window has tabs for Physical, Config, CLI (which is selected), and Attributes. The CLI pane displays the configuration commands entered to enable RIP and specify network segments.

**R1 Configuration:**

```
R1>en
R1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#router rip
R1(config-router)#network 192.168.1.0
R1(config-router)#network 10.1.1.0
R1(config-router)#exit
R1(config)#exit
R1#
%SYS-5-CONFIG_I: Configured from console by console
exit
```

**R2 Configuration:**

```
R2>en
R2#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#router rip
R2(config-router)#network 10.1.1.0
R2(config-router)#network 10.2.2.0
R2(config-router)#exit
R2(config)#exit
R2#
%SYS-5-CONFIG_I: Configured from console by console
exit
```

**R3 Configuration:**

```
R3>en
R3#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R3(config)#router rip
R3(config-router)#network 10.2.2.0
R3(config-router)#network 192.168.3.0
R3(config-router)#exit
R3(config)#exit
R3#
%SYS-5-CONFIG_I: Configured from console by console
exit
Translating "exit"...domain server (255.255.255.255)
% Unknown command or computer name, or unable to find computer address
R3#exit
```

## Displaying routing tables of routers

The image shows a single window displaying the output of the `show ip route` command on router R1. The output provides a detailed view of the routing table, including route types (C, L, S, R, etc.), subnet information, and interface details.

```
R1>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, 3 subnets, 2 masks
    C      10.1.1.0/30 is directly connected, Serial0/1/0
    L      10.1.1.1/32 is directly connected, Serial0/1/0
    R      10.2.2.0/30 [120/1] via 10.1.1.2, 00:00:20, Serial0/1/0
          192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
    C      192.168.1.0/24 is directly connected, GigabitEthernet0/0
    L      192.168.1.1/32 is directly connected, GigabitEthernet0/0
    R      192.168.3.0/24 [120/2] via 10.1.1.2, 00:00:20, Serial0/1/0

R1>
```

```
R2>show ip route
^
* Invalid input detected at '^' marker.

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

      10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks
C        10.1.1.0/30 is directly connected, Serial0/1/0
L          10.1.1.2/32 is directly connected, Serial0/1/0
C        10.2.2.0/30 is directly connected, Serial0/1/1
L          10.2.2.2/32 is directly connected, Serial0/1/1
R        192.168.1.0/24 [120/1] via 10.1.1.1, 00:00:01, Serial0/1/0
      192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.2.1/32 is directly connected, GigabitEthernet0/0
L          192.168.2.1/32 is directly connected, GigabitEthernet0/0
R        192.168.3.0/24 [120/1] via 10.2.2.1, 00:00:28, Serial0/1/1

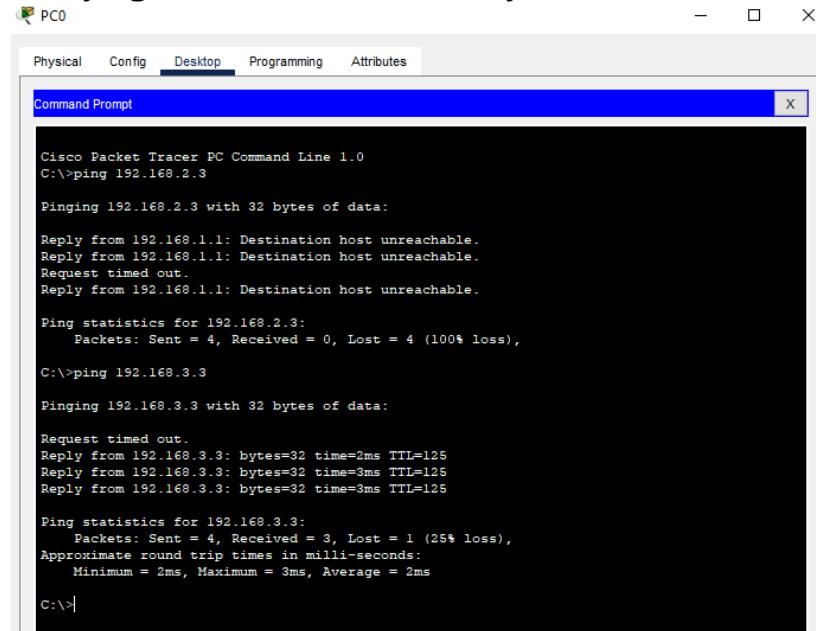
R3>show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
      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, 3 subnets, 2 masks
R        10.1.1.0/30 [120/1] via 10.2.2.2, 00:00:11, Serial0/1/0
C        10.2.2.0/30 is directly connected, Serial0/1/0
L          10.2.2.1/32 is directly connected, Serial0/1/0
R        192.168.1.0/24 [120/2] via 10.2.2.2, 00:00:11, Serial0/1/0
      192.168.3.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.3.0/24 is directly connected, GigabitEthernet0/0
L          192.168.3.1/32 is directly connected, GigabitEthernet0/0

R3>
```

## Verifying full network connectivity:



```
C:\>ping 192.168.1.3

Pinging 192.168.1.3 with 32 bytes of data:

Reply from 192.168.1.3: bytes=32 time=2ms TTL=125
Reply from 192.168.1.3: bytes=32 time=12ms TTL=125
Reply from 192.168.1.3: bytes=32 time=15ms TTL=125
Reply from 192.168.1.3: bytes=32 time=3ms TTL=125

Ping statistics for 192.168.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 15ms, Average = 8ms

C:\>ping 192.168.2.3

Pinging 192.168.2.3 with 32 bytes of data:

Reply from 192.168.2.3: bytes=32 time=2ms TTL=126
Reply from 192.168.2.3: bytes=32 time=3ms TTL=126
Reply from 192.168.2.3: bytes=32 time=1ms TTL=126
Reply from 192.168.2.3: bytes=32 time=1ms TTL=126

Ping statistics for 192.168.2.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 3ms, Average = 1ms
```

### Enable the Security Technology package on R1 and R3 :

```
R1>show version
Technology Package License Information for Module:'c1900'

-----
Technology      Technology-package          Technology-package
                Current        Type            Next reboot
-----
ipbase         ipbasek9      Permanent     ipbasek9
security       None          None          None
data           None          None          None

Configuration register is 0x2102
R1>en
R1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#license boot module c1900 technology-package securityk9
ACCEPT? [yes/no]: yes
% use 'write' command to make license boot config take effect on next
boot

R1(config)#!%IOS_LICENSE_IMAGE_APPLICATION-6-LICENSE_LEVEL: Module
name = C1900 Next reboot level = securityk9 and License = securityk9
exit
R1#
%SYS-5-CONFIG_I: Configured from console by console
reload
System configuration has been modified. Save? [yes/no]:yes

R1>show version
Technology Package License Information for Module:'c1900'

-----
Technology      Technology-package          Technology-package
                Current        Type            Next reboot
-----
ipbase         ipbasek9      Permanent     ipbasek9
security       securityk9    Evaluation   securityk9
data           disable       None          None

Configuration register is 0x2102
```

```
R3>show version
Technology Package License Information for Module:'c1900'

-----
Technology      Technology-package      Technology-package
                Current          Type           Next reboot
-----
ipbase         ipbasek9        Permanent       ipbasek9
security       None            None           None
data           None            None           None

Configuration register is 0x2102
R3>en
R3#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R3(config)#license boot module c1900 technology-package securityk9
ACCEPT? [yes/no]: yes
% use 'write' command to make license boot config take effect on next
boot

R3(config)#!%IOS_LICENSE_IMAGE_APPLICATION-6-LICENSE_LEVEL: Module
name = C1900 Next reboot level = securityk9 and License = securityk9
exit
R3#
%SYS-5-CONFIG_I: Configured from console by console
reload
System configuration has been modified. Save? [yes/no]:yes
R3>show version
Technology Package License Information for Module:'c1900'

-----
Technology      Technology-package      Technology-package
                Current          Type           Next reboot
-----
ipbase         ipbasek9        Permanent       ipbasek9
security       securityk9       Evaluation     securityk9
data           disable          None           None

Configuration register is 0x2102
```

### Configure ACL, IKE Phase 1 ISAKMP policy and IKE Phase 2 IPsec policy on R1 and R3

```
R1>en
R1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#access-list 110 permit ip 192.168.1.0 0.0.0.255 192.168.3.0 0.0.0.255
R1(config)#crypto isakmp policy 10
R1(config-isakmp)#encryption aes 256
R1(config-isakmp)#authentication pre-share
R1(config-isakmp)#group 5
R1(config-isakmp)#exit
R1(config)#crypto isakmp key vnpwd address 10.2.2.1
R1(config)#crypto ipsec transform-set VPN-SET esp-aes esp-sha-hmac
R1(config)#crypto map VPN-MAP 10 ipsec-isakmp
% NOTE: This new crypto map will remain disabled until a peer
and a valid access list have been configured.
R1(config-crypto-map)#description VPN connection to R3
R1(config-crypto-map)#set peer 10.2.2.1
R1(config-crypto-map)#set transform-set VPN-SET
R1(config-crypto-map)#match address 110
R1(config-crypto-map)#exit
R1(config)#interface Serial0/0/0
R1(config-if)#crypto map VPN-MAP
*Jan 3 07:16:26.785: %CRYPTO-6-ISAKMP_ON_OFF: ISAKMP is ON
R1(config-if)#^Z
R1#
%SYS-5-CONFIG_I: Configured from console by console
exit
```

```
R3>en
R3#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R3(config)#access-list 110 permit ip 192.168.3.0 0.0.0.255 192.168.1.0 0.0.0.255
R3(config)#crypto isakmp policy 10
R3(config-isakmp)#encryption aes 256
R3(config-isakmp)#authentication pre-share
R3(config-isakmp)#group 5
R3(config-isakmp)#exit
R3(config)#crypto isakmp key vpnpwd address 10.1.1.1
R3(config)#crypto ipsec transform-set VPN-SET esp-aes esp-sha-hmac
R3(config)#crypto map VPN-MAP 10 ipsec-isakmp
% NOTE: This new crypto map will remain disabled until a peer
      and a valid access list have been configured.
R3(config-crypto-map)#description VPN connection to R1
R3(config-crypto-map)#set peer 10.1.1.1
R3(config-crypto-map)#set transform-set VPN-SET
R3(config-crypto-map)#match address 110
R3(config-crypto-map)#exit
R3(config)#interface Serial0/0/0
R3(config-if)#crypto map VPN-MAP
*Jan  3 07:16:26.785: %CRYPTO-6-ISAKMP_ON_OFF: ISAKMP is ON
R3(config-if)#{^Z
R3#
%SYS-5-CONFIG_I: Configured from console by console
exit
```

### Verify the working of IPsec VPN for interesting traffic on R1 :

```
R1>en
R1#show crypto ipsec sa
interface: Serial0/0/0
  Crypto map tag: VPN-MAP, local addr 10.1.1.1
  protected vrf: (none)
  local ident (addr/mask/prot/port): (192.168.1.0/255.255.255.0/0/0)
  remote ident (addr/mask/prot/port): (192.168.3.0/255.255.255.0/0/0)
  current_peer 10.2.2.1 port 500
    PERMIT, flags={origin_is_acl,}
  #pkts encaps: 0, #pkts encrypt: 0, #pkts digest: 0
  #pkts decaps: 0, #pkts decrypt: 0, #pkts verify: 0
  #pkts compressed: 0, #pkts decompressed: 0
  #pkts not compressed: 0, #pkts compr. failed: 0
  #pkts not decompressed: 0, #pkts decompress failed: 0
  #send errors 0, #recv errors 0
    local crypto endpt.: 10.1.1.1, remote crypto endpt.:10.2.2.1
    path mtu 1500, ip mtu 1500, ip mtu idb Serial0/0/0
    current outbound spi: 0x0(0)

  inbound esp sas:
  inbound ah sas:
  inbound pcp sas:
  outbound esp sas:
  outbound ah sas:
  outbound pcp sas:
```

```
C:\>ping 192.168.3.3
Pinging 192.168.3.3 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Reply from 192.168.3.3: bytes=32 time=3ms TTL=126

Ping statistics for 192.168.3.3:
    Packets: Sent = 4, Received = 1, Lost = 3 (75% loss),
Approximate round trip times in milli-seconds:
    Minimum = 3ms, Maximum = 3ms, Average = 3ms

C:\>ping 192.168.3.3
Pinging 192.168.3.3 with 32 bytes of data:
Reply from 192.168.3.3: bytes=32 time=4ms TTL=126
Reply from 192.168.3.3: bytes=32 time=10ms TTL=126
Reply from 192.168.3.3: bytes=32 time=2ms TTL=126
Reply from 192.168.3.3: bytes=32 time=2ms TTL=126

Ping statistics for 192.168.3.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 10ms, Average = 4ms

R1#show crypto ipsec sa

interface: Serial0/0/0
  Crypto map tag: VPN-MAP, local addr 10.1.1.1
  protected vrf: (none)
  local  ident (addr/mask/prot/port): (192.168.1.0/255.255.255.0/0/0)
  remote ident (addr/mask/prot/port): (192.168.3.0/255.255.255.0/0/0)
  current_peer 10.2.2.1 port 500
    PERMIT, flags={origin_is_acl,}
  #pkts encaps: 7, #pkts encrypt: 7, #pkts digest: 0
  #pkts decaps: 6, #pkts decrypt: 6, #pkts verify: 0
  #pkts compressed: 0, #pkts decompressed: 0
  #pkts not compressed: 0, #pkts compr. failed: 0
  #pkts not decompressed: 0, #pkts decompress failed: 0
  #send errors 1, #recv errors 0

  local crypto endpt.: 10.1.1.1, remote crypto endpt.:10.2.2.1
  path mtu 1500, ip mtu 1500, ip mtu idb Serial0/0/0
  current outbound spi: 0x134F7395(323974037)

  inbound esp sas:
    spi: 0x03545F4E(55861070)
      transform: esp-aes esp-sha-hmac ,
      in use settings ={Tunnel, }
      conn id: 2007, flow_id: FPGA:1, crypto map: VPN-MAP
      sa timing: remaining key lifetime (k/sec): (4525504/3513)
      IV size: 16 bytes
      replay detection support: N
      Status: ACTIVE

  inbound ah sas:

  inbound pcp sas:

  outbound esp sas:
    spi: 0x134F7395(323974037)
      transform: esp-aes esp-sha-hmac ,
      in use settings ={Tunnel, }
      conn id: 2008, flow_id: FPGA:1, crypto map: VPN-MAP
      sa timing: remaining key lifetime (k/sec): (4525504/3513)
      IV size: 16 bytes
      replay detection support: N
      Status: ACTIVE

  outbound ah sas:

  outbound pcp sas:
```