LAB MANUAL

Practical 1

- **Aim : Configure Routers**

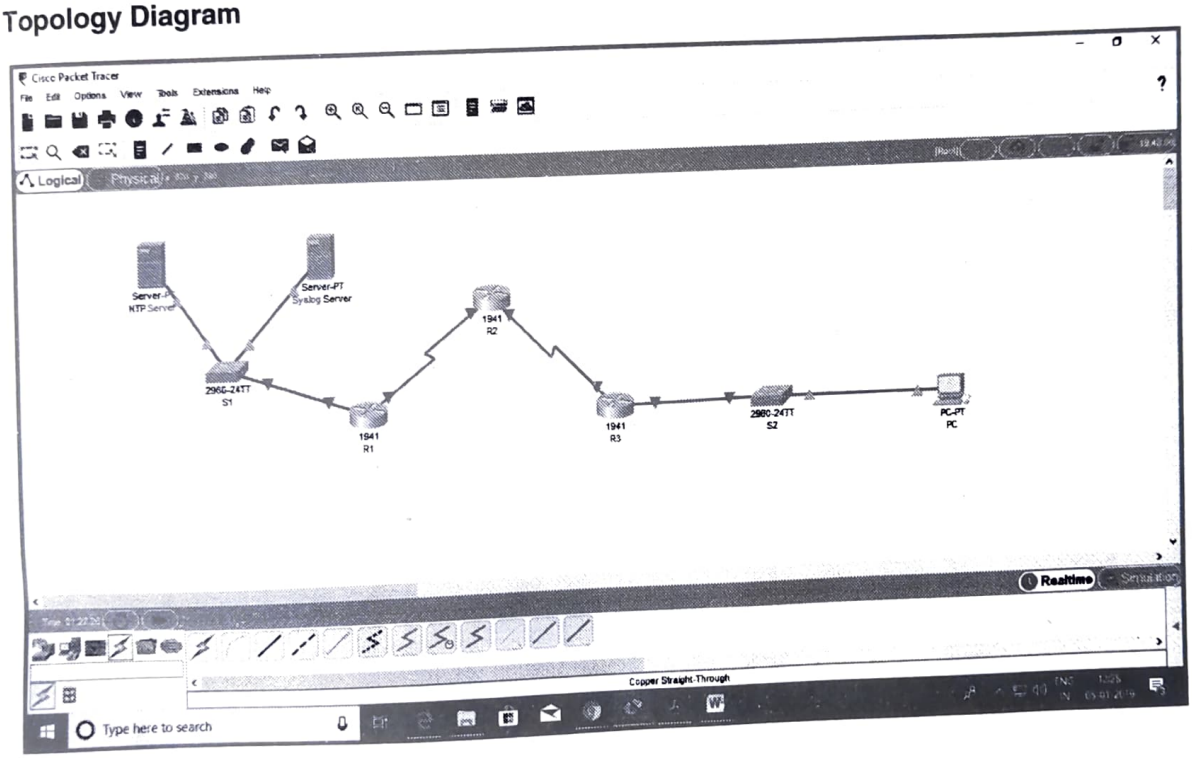
a. OSPF MD5 authentication.

b. NTP.

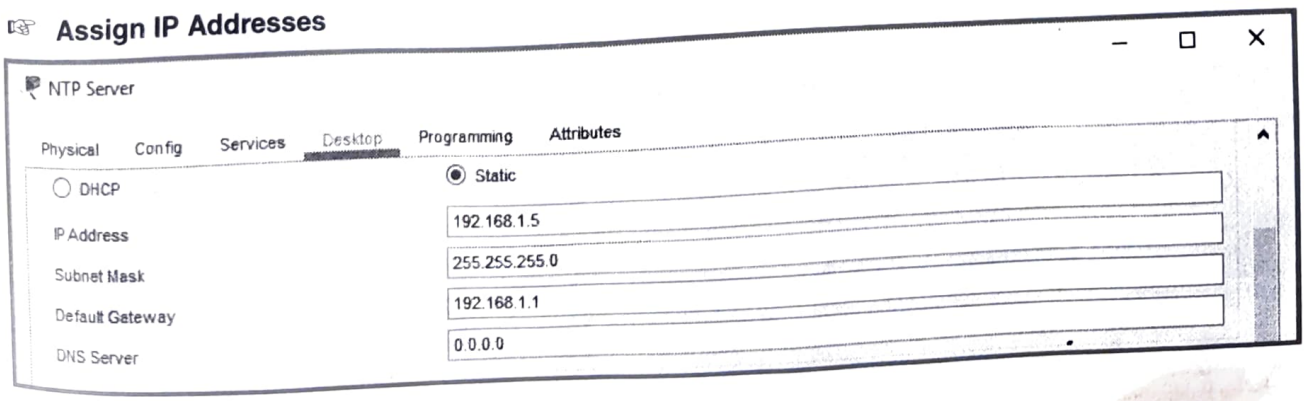
c. to log messages to the syslog server.

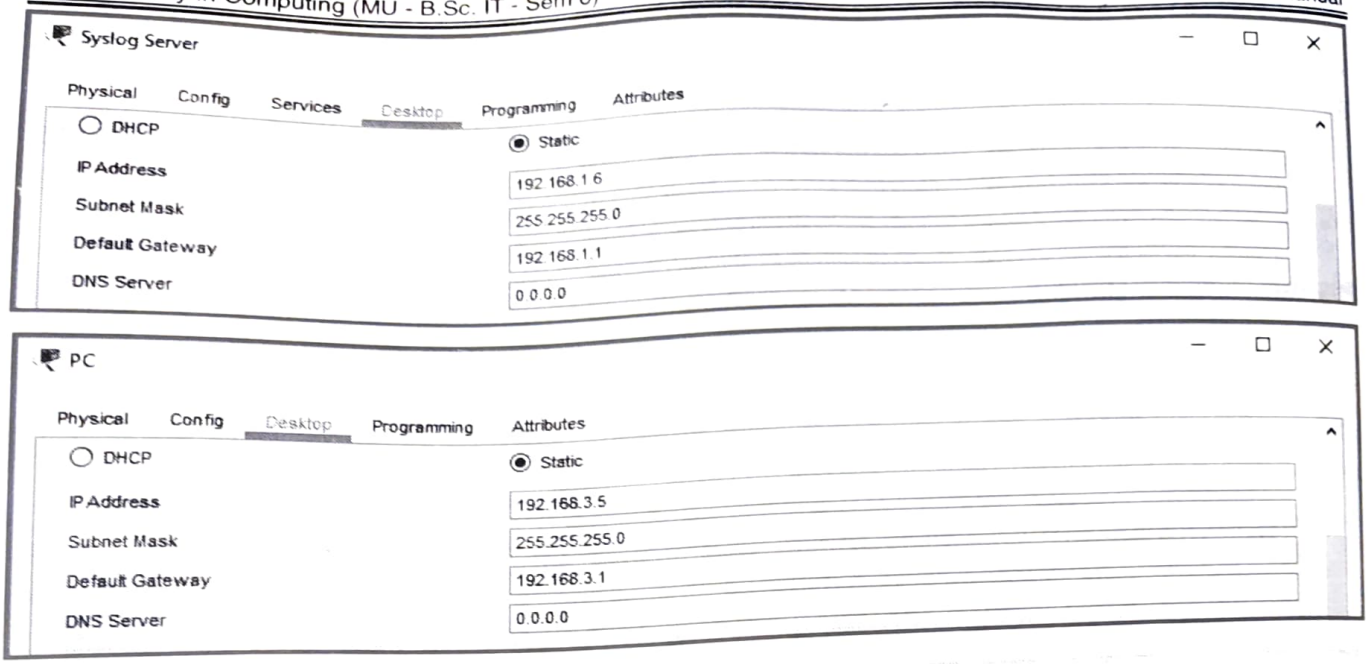
d. to support SSH connections.

☞ Topology Diagram



☞ Assign IP Addresses






```
Router>en
Router#conf t
Router(config)#host R1
R1(config)#interface GigabitEthernet0/0
R1(config-if)#ip address 192.168.1.1 255.255.255.0
R1(config-if)#no shut
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)#^Z
R1#exit
```

```
Router>en
Router#conf t
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)#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#exit
```

```
Router>en
Router#conf t
Router(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)#interface GigabitEthernet0/0
R3 (config-if)#ip address 192.168.3.1 255.255.255.0
R3(config-if)# ^Z
R3#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 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
```

```
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
```

```
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
Vlan1 unassigned YES unset administratively down down
```

☞ Configure OSPF on routers

```
R1>en
R1#conf t
R1(config)#router ospf 1
R1(config-router)#network 192.168.1.0 0.0.0.255 area 0
R1(config-router)#network 10.1.1.0 0.0.0.3 area 0
R1(config-router)#^Z
R1#exit
```

```
R2>en
R2#conf t
R2(config)#router ospf 1
R2(config-router)#network 10.1.1.0 0.0.0.3 area 0
R2(config-router)#network 10.2.2.0 0.0.0.3 area 0
R2(config-router)#^Z
R2#exit
```

```
R3>en
R3#conf t
R3(config)#router ospf 1
R3(config-router)#network 192.168.3.0 0.0.0.255 area 0
R3(config-router)#network 10.2.2.0 0.0.0.3 area 0
R3(config-router)#^Z
R3#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
O 10.2.2.0/30 [110/128] via 10.1.1.2, 00:16:28, 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, 00:01:37, Serial0/0/0

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
O 192.168.1.0/24 [110/65] via 10.1.1.1, 00:17:07, Serial0/0/0
O 192.168.3.0/24 [110/65] via 10.2.2.1, 00:02:15, Serial0/0/1

```
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
O 10.1.1.0/30 [110/128] via 10.2.2.2, 00:08:22, 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, 00:08:22, 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

```
R1>en
R1#conf t
R1(config)#router ospf 1
R1(config-router)#area 0 authentication message-digest
R1(config-router)# ^Z
R1#exit
```

```
R2>en
R2#conf t
R2(config)#router ospf 1
R2(config-router)#area 0 authentication message-digest
R2(config-router)# ^Z
R2#exit
```

```
R3>en
```

```
R3#conf t
R3(config)#router ospf 1
R3(config-router)#area 0 authentication message-digest
R3(config-router)#^Z
R3#exit
```

Configure the MD5 key for all the routers

```
R1>en
R1#conf t
R1(config)#interface Serial0/0/0
R1(config-if)#ipospf message-digest-key 1 md5 mdpwd
R1(config-if)#^Z
R1#exit
```

```
R2>en
R2#conf t
R2(config)#interface Serial0/0/0
R2(config-if)#ipospf message-digest-key 1 md5 mdpwd
R2(config)#interface Serial0/0/1
R2(config-if)#ipospf message-digest-key 1 md5 MD5pa55
R2(config-if)#^Z
R2#exit
```

```
R3>en
R3#conf t
R3(config)#interface Serial0/0/0
R3(config-if)#ipospf message-digest-key 1 md5 MD5pa55
R3(config-if)#^Z
R3#exit
```

Displaying OSPF Details of the Routers

```
R1>show ipospf 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 00:00:05
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**

R2>show ipospf 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 00:00:00
Index 1/1, 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**

R2>show ipospf 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 00:00:00

  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 10.2.2.1
- Suppress hello for 0 neighbor(s)
- **Message digest authentication enabled**
- **Youngest key id is 1**

  R3>show ipospf 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 10.2.2.1, 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 00:00:00

  Index 1/1, flood queue length 0

  Next 0x0(0)/0x0(0)

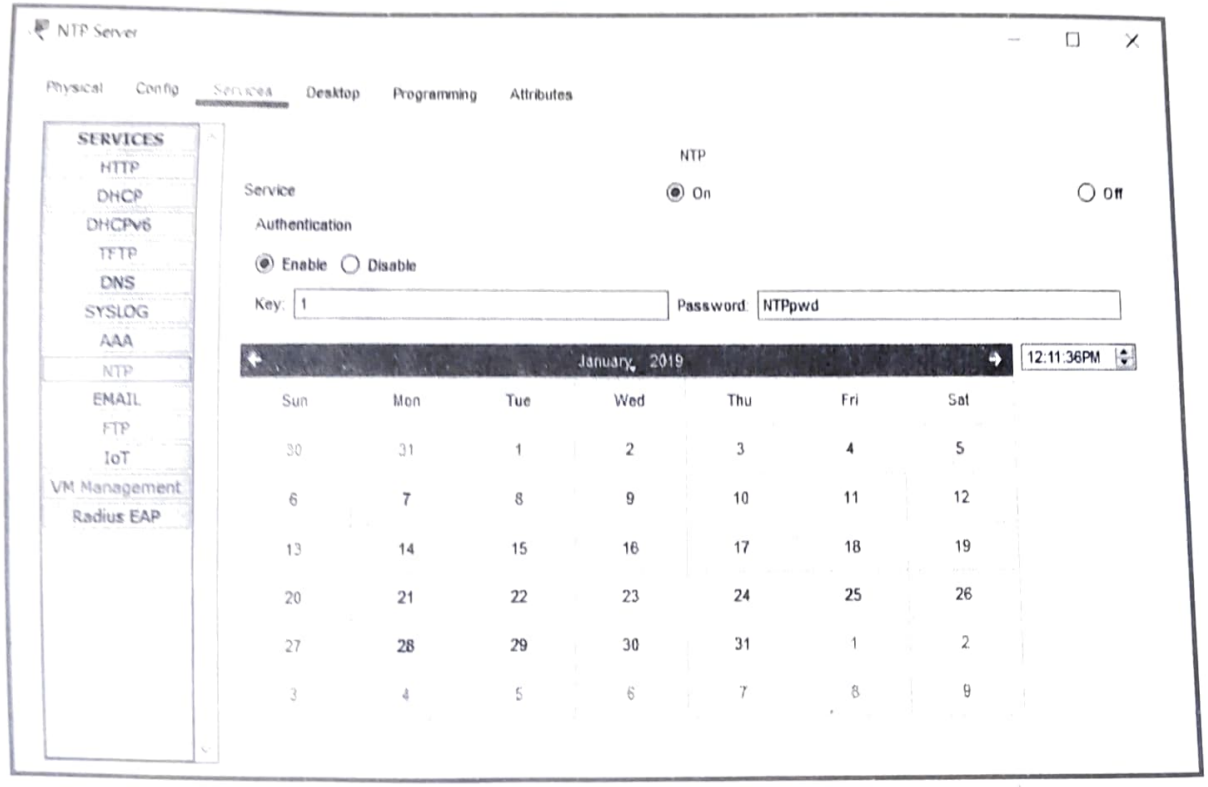
- Last flood scan length is 1, maximum is 1
- Last flood scan time is 0 msec, maximum is 0 msec
- Neighbor Count is 1 , Adjacent neighbor count is 1
- Adjacent with neighbor 10.2.2.2
- Suppress hello for 0 neighbor(s)
- **Message digest authentication enabled**
- **Youngest key id is 1**

(B) NTP

Check Clock Time in the routers

```
R1>show clock
*0:22:34.253 UTC Mon Mar 1 1993
R2>show clock
*0:22:34.253 UTC Mon Mar 1 1993
R3>show clock
*0:22:34.253 UTC Mon Mar 1 1993
```

Configure NTP Server



Configure NTP Client:

```
R1>en
R1#conf t
R1(config)#ntp server 192.168.1.5
R1(config)#ntp update-calendar
R1(config)# ^Z
R1#exit
```

```
R2>en
R2#conf t
R2(config)#ntp server 192.168.1.5
R2(config)#ntp update-calendar
R2(config)#^Z
R2#exit
```

```
R3>en
R3#conf t
R3(config)#ntp server 192.168.1.5
R3(config)#ntp update-calendar
R3(config)#^Z
R3#exit
```

☞ **Configure NTP authentication and to timestamp log messages on the routers**

```
R1>en
R1#conf t
R1(config)#ntp authenticate
R1(config)#ntp trusted-key 1
R1(config)#ntp authentication-key 1 md5 NTPpwd
R1(config)#service timestamps log datetimemsec
R1(config)#^Z
R1#exit
```

```
R2>en
R2#conf t
R2(config)#ntp authenticate
R2(config)#ntp trusted-key 1

R2(config)#ntp authentication-key 1 md5 NTPpwd
R2(config)#service timestamps log datetimemsec
R2(config)#^Z
R2#exit
```

```
R3>en
R3#conf t
R3(config)#ntp authenticate
R3(config)#ntp trusted-key 1
R3(config)#ntp authentication-key 1 md5 NTPpwd
R3(config)#service timestamps log datetimemsec
R3(config)# ^ Z
R3#exit
```

☞ Check updated UTC Clock Time in the routers

```
R1>show clock
12:20:53.244 UTC Sat Jan 5 2019
R2>show clock
12:20:53.244 UTC Sat Jan 5 2019
R3>show clock
12:20:53.244 UTC Sat Jan 5 2019
```

(C) Syslog

☞ Configure Routers to Log Messages to the Syslog Server

```
R1>en
R1#conf t
R1(config)#logging host 192.168.1.6
R1(config)# ^ Z
R1(config)#exit
```

```
R2>en
R2#conf t
R2(config)#logging host 192.168.1.6
R2(config)# ^ Z
R2(config)#exit
```

```
R3>en
R3#conf t
R3(config)#logging host 192.168.1.6
R3(config)# ^ Z
R3(config)#exit
```

Verify logging configuration on Routers

```
R1#show logging
```

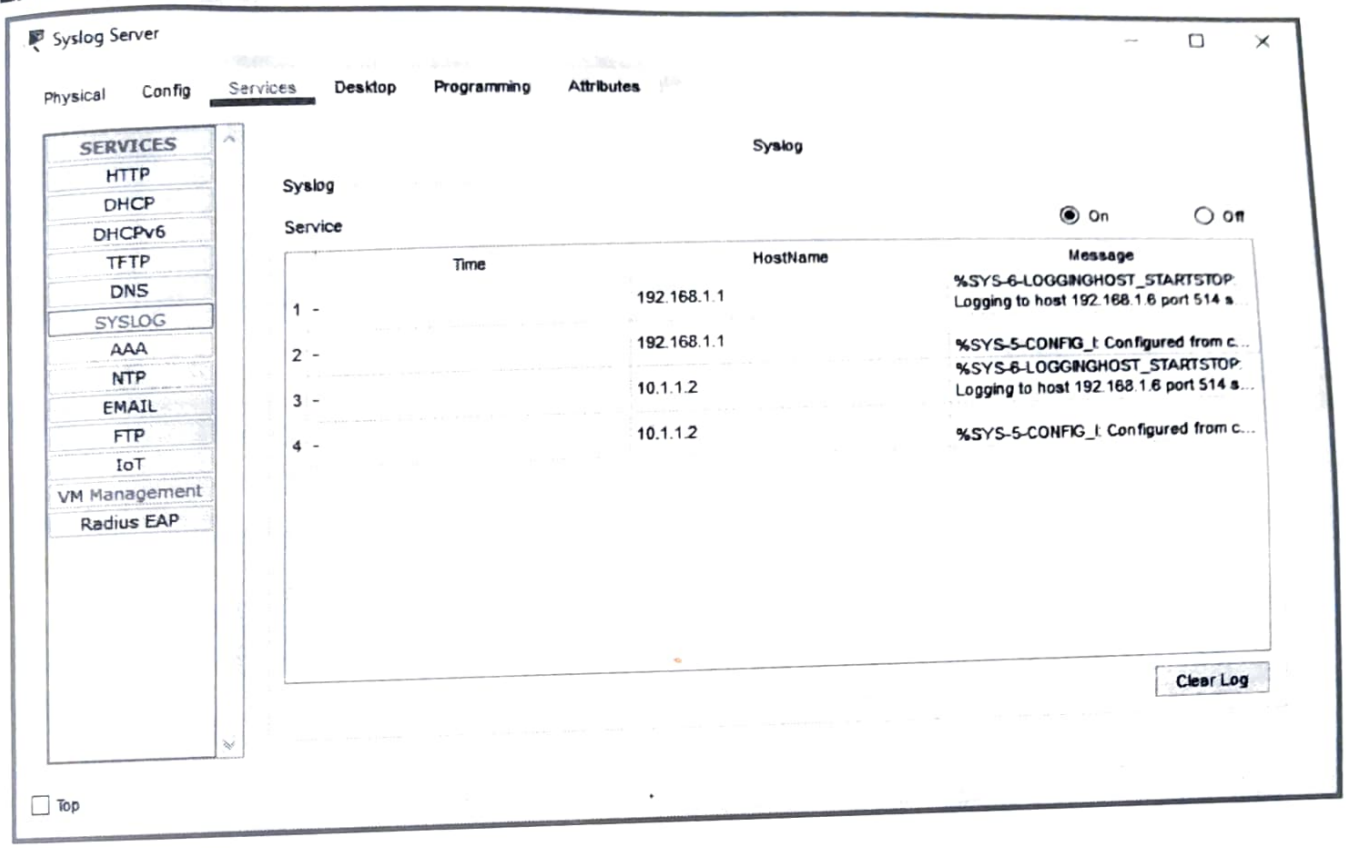
- **Syslog logging : enabled** (0 messages dropped, 0 messages rate-limited, 0 flushes, 0 overruns, xml disabled, filtering disabled)
- No Active Message Discriminator.
- No Inactive Message Discriminator.
- **Console logging :** level debugging, 6 messages logged, xml disabled, filtering disabled
- **Monitor logging :** level debugging, 6 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, 6 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

```
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, 6 messages logged, xml disabled,filtering disabled
- **Monitor logging :** level debugging, 6 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, 6 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.
- R3#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, 6 messages logged, xml disabled, filtering disabled
- Monitor logging: level debugging, 6 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, 6 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



(D) SSH

Configure SSH on R3

```
R3>en
R3#conf t
R3(config)#ip domain-name securityincomputing.com
R3(config)#username SSHadmin privilege 15 secret sshpwd
R3(config)#line vty 0 4
R3(config-line)#login local
R3(config-line)#transport input ssh
R3(config-line)#crypto key zeroizersa
% No Signature RSA Keys found in configuration.
R3(config)#crypto key generate rsa

The name for the keys will be: R3.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]

```
R3(config)#ipssh time-out 90
*Mar 1 1:51:24.621: %SSH-5-ENABLED: SSH 1.99 has been enabled
R3(config)#ipssh authentication-retries 2
R3(config)#ipssh version 2
R3(config)#^Z
R3#exit
```

☞ **Connect to R3 using telnet and SSH on PC**