

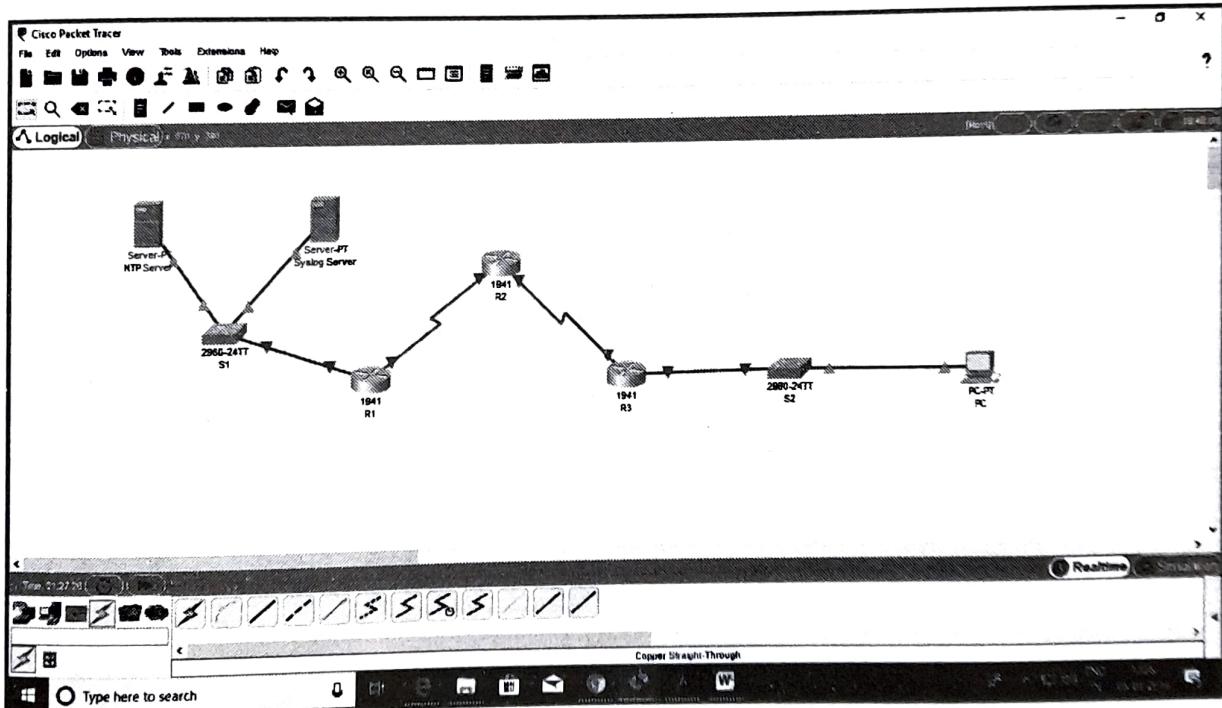
LAB MANUAL

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

Physical	Config	Services	Desktop	Programming	Attributes
<input type="radio"/> DHCP				<input checked="" type="radio"/> Static	
IP Address: 192.168.1.5					
Subnet Mask: 255.255.255.0					
Default Gateway: 192.168.1.1					
DNS Server: 0.0.0.0					



Syslog Server

Physical	Config	Services	Desktop	Programming	Attributes
<input type="radio"/> DHCP	<input checked="" type="radio"/> Static				
IP Address	192.168.1.6				
Subnet Mask	255.255.255.0				
Default Gateway	192.168.1.1				
DNS Server	0.0.0.0				

PC

Physical	Config	Desktop	Programming	Attributes	
<input type="radio"/> DHCP	<input checked="" type="radio"/> Static				
IP Address	192.168.3.5				
Subnet Mask	255.255.255.0				
Default Gateway	192.168.3.1				
DNS Server	0.0.0.0				

```
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
0 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
0 192.168.3.0/24 [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
0 192.168.1.0/24 [110/65] via 10.1.1.1, 00:17:07, Serial0/0/0
0 192.168.3.0/24 [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

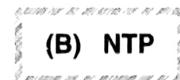
- Neighbor Count is 1, Adjacent neighbor count is 1

- Adjacent with neighbor 10.2.2.2

- Suppress hello for 0 neighbor(s)

- **Message digest authentication enabled**

- **Youngest key id is 1**



☛ Check Clock Time in the routers

R1> show clock

*0:22:34.253 UTC Mon Mar 1 1993

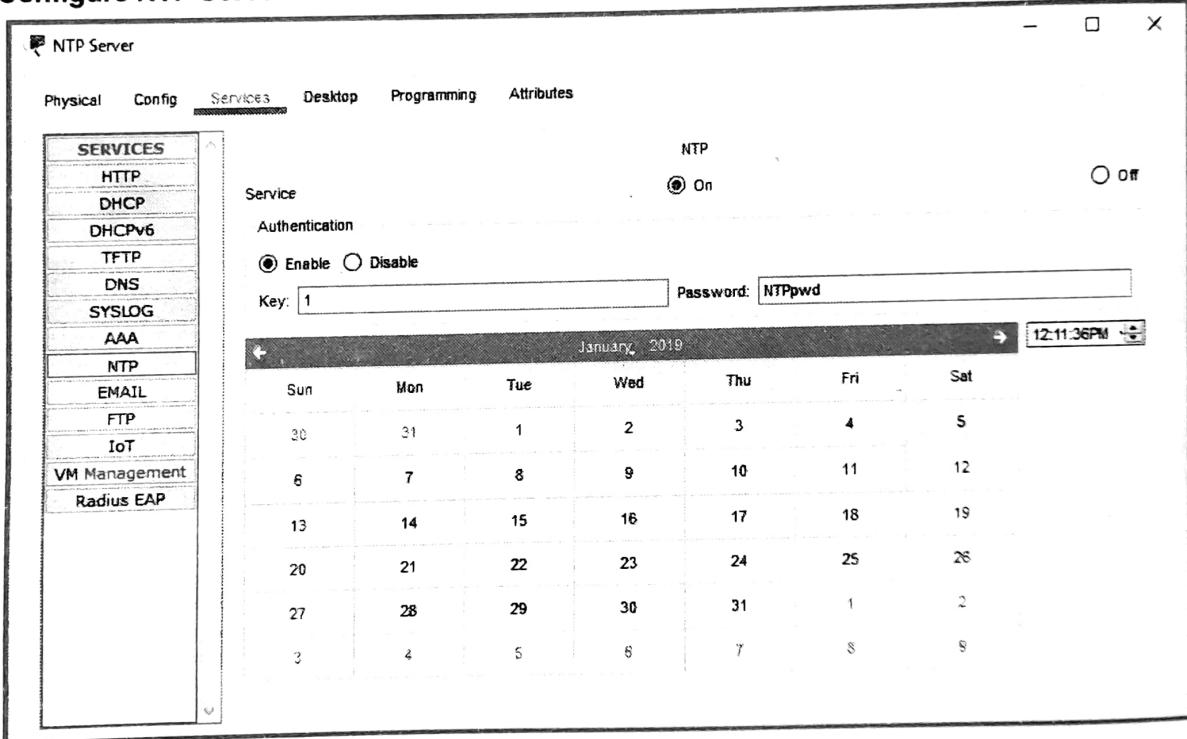
R2> show clock

*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
```



```
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
```

15 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

The screenshot shows a Windows-style application window titled "Syslog Server". The menu bar includes "Physical", "Config", "Services", "Desktop", "Programming", and "Attributes". The "Services" tab is selected. On the left, a sidebar lists various services: HTTP, DHCP, DHCPv6, TFTP, DNS, SYSLOG (which is selected), AAA, NTP, EMAIL, FTP, IoT, VM Management, and Radius EAP. The main pane is titled "Syslog" and contains a table with columns "Time", "HostName", and "Message". There are four log entries:

Time	HostName	Message
1 -	192.168.1.1	%SYS-6-LOGGINGHOST_STARTSTOP Logging to host 192.168.1.8 port 514 s...
2 -	192.168.1.1	%SYS-5-CONFIG_I: Configured from c...
3 -	10.1.1.2	%SYS-6-LOGGINGHOST_STARTSTOP Logging to host 192.168.1.8 port 514 s...
4 -	10.1.1.2	%SYS-5-CONFIG_I: Configured from c...

At the bottom right is a "Clear Log" button, and at the bottom left is a "Top" checkbox.

(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



Examine logs of the Syslog Server

The screenshot shows a software interface titled "Syslog Server". The "Services" tab is selected. On the left, a sidebar lists various services: HTTP, DHCP, DHCPv6, TFTP, DNS, SYSLOG (which is selected), AAA, NTP, EMAIL, FTP, IoT, VM Management, and Radius EAP. The main pane is titled "Syslog" and shows a table of log entries for the "SYSLOG" service. The table has columns for "TIME", "HostName", and "Message". There are four entries:

TIME	HostName	Message
1 -	192.168.1.1	%SYS-6-LOGGINGHOST_STARTSTOP: Logging to host 192.168.1.6 port 514 s...
2 -	192.168.1.1	%SYS-5-CONFIG_I: Configured from c...
3 -	10.1.1.2	%SYS-6-LOGGINGHOST_STARTSTOP: Logging to host 192.168.1.6 port 514 s...
4 -	10.1.1.2	%SYS-5-CONFIG_I: Configured from c...

At the bottom right of the main pane is a "Clear Log" button. At the bottom left of the window is a "Top" checkbox.

(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

