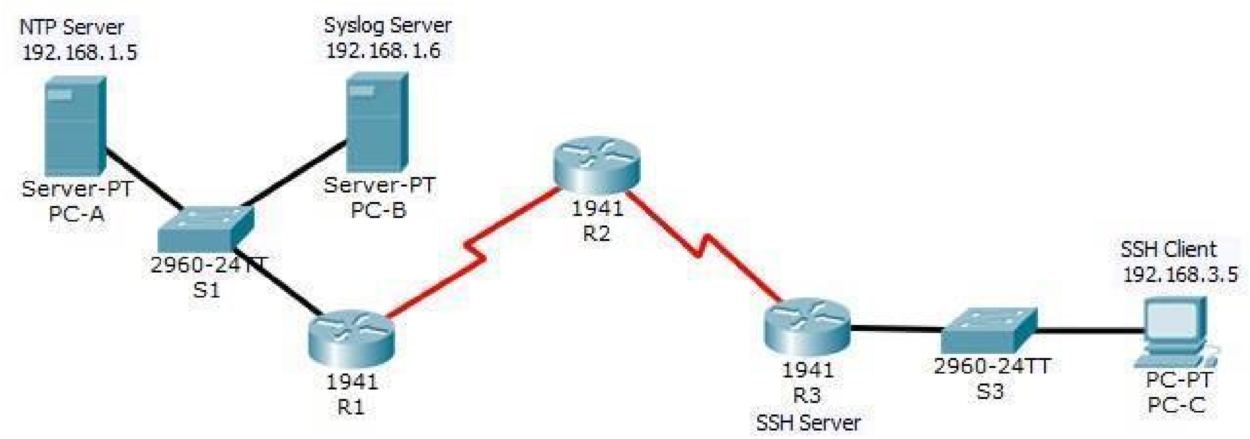
Practical 1: Packet Tracer - Configure Cisco Routers for Syslog, NTP, and SSH Operations

Topology



Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway	Switch Port
R1	G0/1	192.168.1.1	255.255.255.0	N/A	S1 F0/5
	S0/0/0 (DCE)	10.1.1.1	255.255.255.252	N/A	N/A
R2	S0/0/0	10.1.1.2	255.255.255.252	N/A	N/A
	S0/0/1 (DCE)	10.2.2.2	255.255.255.252	N/A	N/A
R3	G0/1	192.168.3.1	255.255.255.0	N/A	S3 F0/5
	S0/0/1	10.2.2.1	255.255.255.252	N/A	N/A
PC-A	NIC	192.168.1.5	255.255.255.0	192.168.1.1	S1 F0/6
PC-B	NIC	192.168.1.6	255.255.255.0	192.168.1.1	S2 F0/18
PC-C	NIC	192.168.3.5	255.255.255.0	192.168.3.1	S3 F0/18

Objectives

- Configure OSPF MD5 authentication.

- Configure NTP.
- Configure routers to log messages to the syslog server.
- Configure R3 to support SSH connections.

Background / Scenario

In this activity, you will configure OSPF MD5 authentication for secure routing updates.

The NTP Server is the master NTP server in this activity. You will configure authentication on the NTP server and the routers. You will configure the routers to allow the software clock to be synchronized by NTP to the time server. Also, you will configure the routers to periodically update the hardware clock with the time learned from NTP.

The Syslog Server will provide message logging in this activity. You will configure the routers to identify the remote host (Syslog server) that will receive logging messages.

You will need to configure timestamp service for logging on the routers. Displaying the correct time and date in Syslog messages is vital when using Syslog to monitor a network.

You will configure R3 to be managed securely using SSH instead of Telnet. The servers have been preconfigured for NTP and Syslog services respectively. NTP will not require authentication. The routers have been pre-configured with the following passwords:

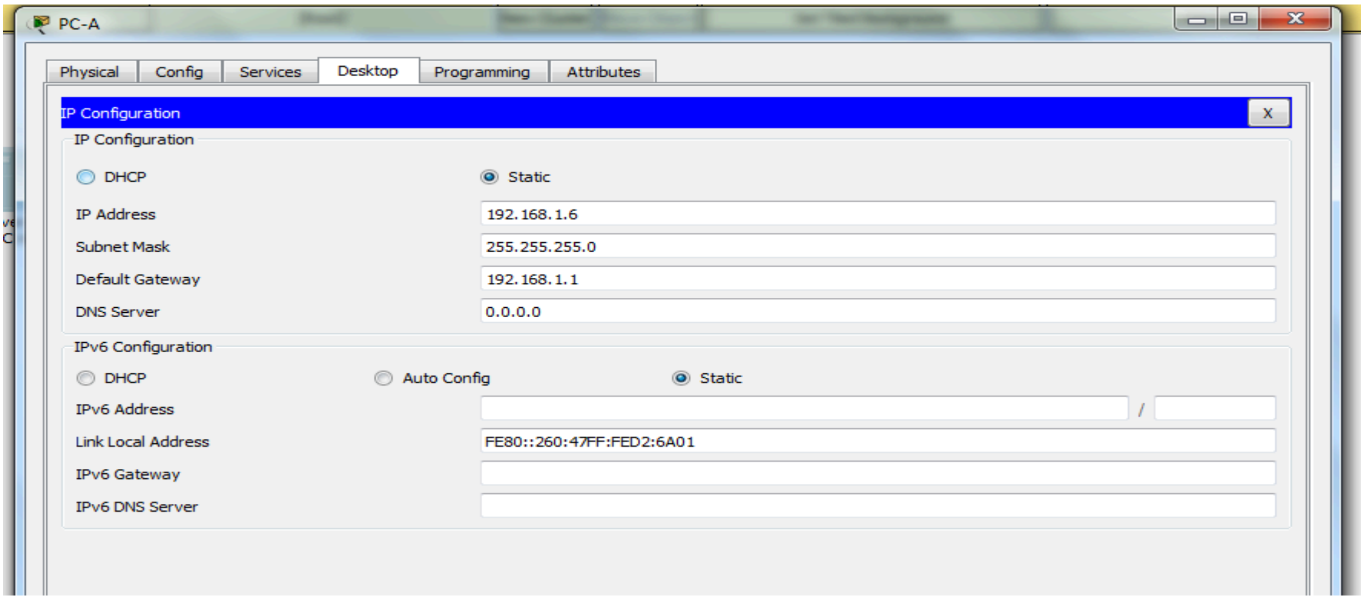
- Enable password: **ciscoenpa55**
- Password for vty lines: **ciscovtypa55**

Note: Note: MD5 is the strongest encryption supported in the version of Packet Tracer used to develop this activity (v6.2). Although MD5 has known vulnerabilities, you should use the encryption that meets the security requirements of your organization. In this activity, the security requirement specifies MD5.

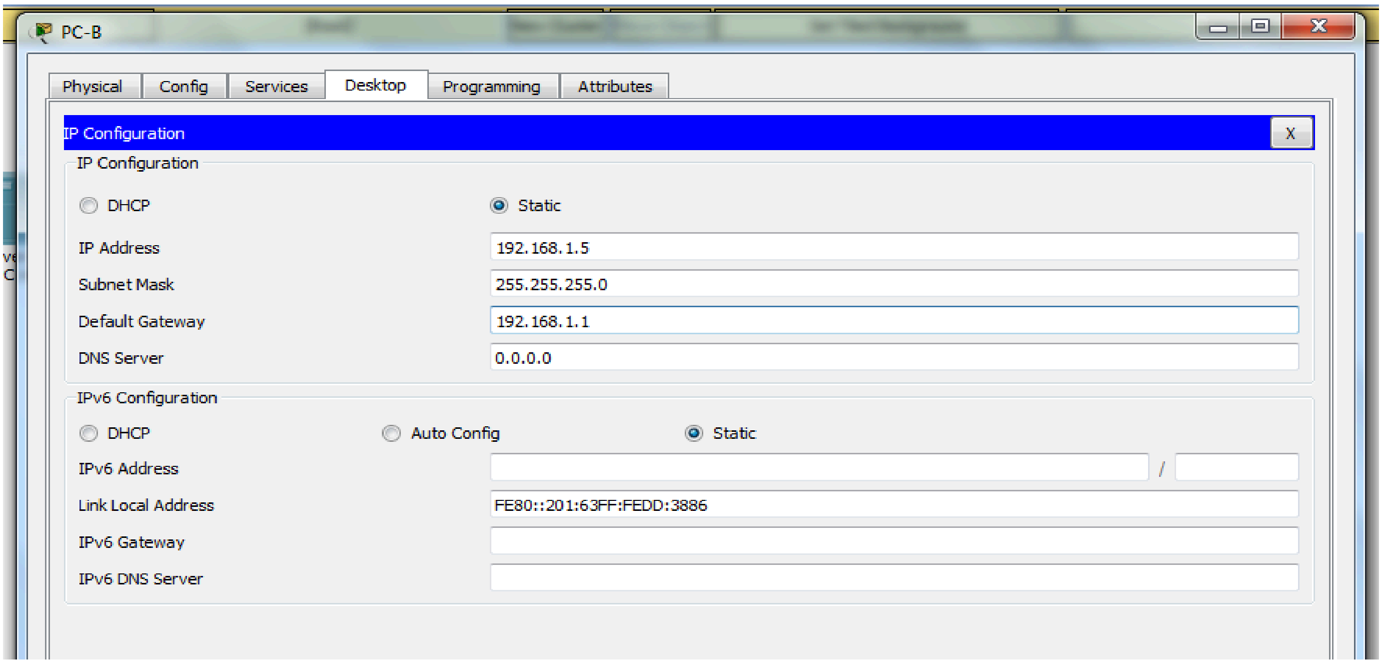
Part 1: Configure OSPF MD5 Authentication

Step 1: Test connectivity. All devices should be able to ping all other IP addresses.

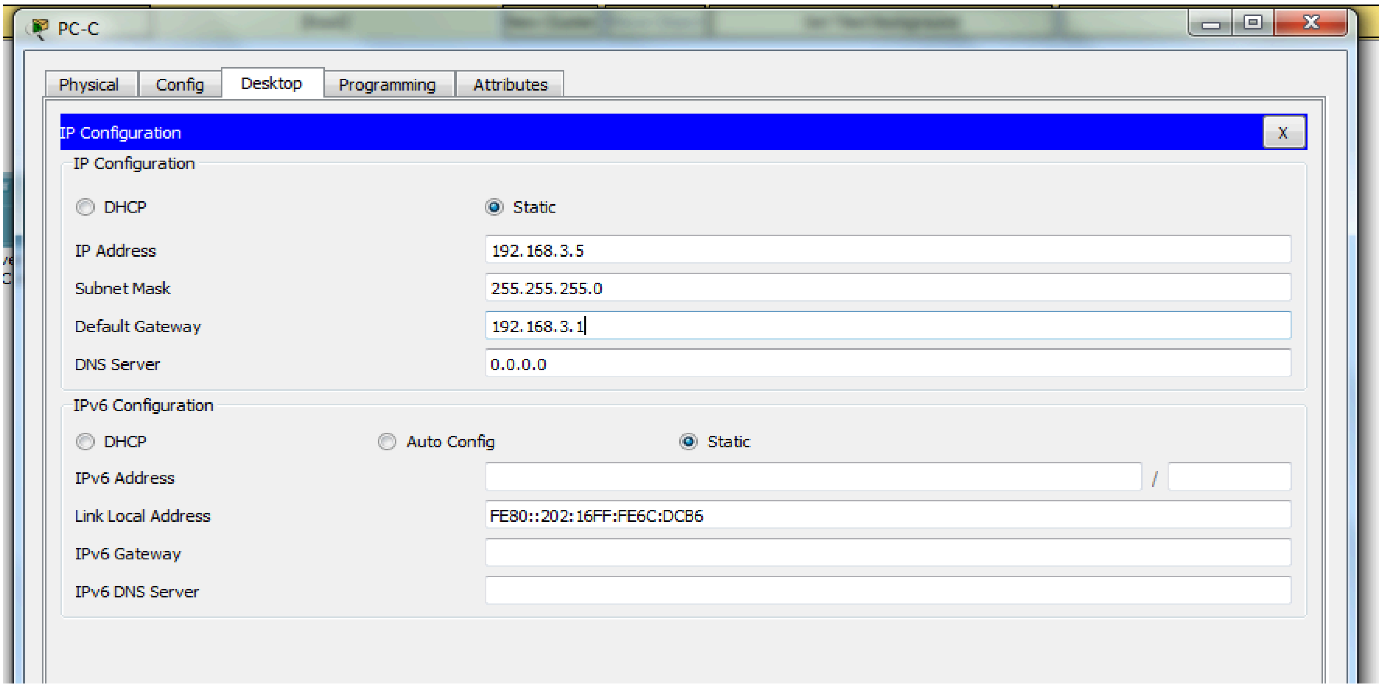
Configure first PC



Configure second PC



Configure third PC



Configure R1

Router>enable
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#
Router(config)#hostname R1
R1(config)#
R1(config)#enable password ciscoenpa55
R1(config)#enable secret abcd
R1(config)#exit
R1>en
Password:
Password:
R1#
R1(config)#interface GigabitEthernet0/0
R1(config-if)#ip address 192.168.1.1 255.255.255.0
R1(config-if)#no shutdown
R1(config)#interface Serial0/1/0
R1(config-if)#ip address 10.1.1.1 255.255.255.252
R1(config-if)#no shutdown
R1(config-if)#

Configure R2

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

```
Router(config)#hostname R2
R2(config)#enable password ciscoenpa55
R2(config)#enable secret abcd
R2(config)#^Z
R2#exit
R2>
R2>en
Password:
Password:
R2#
R2#config t
R2(config)#interface Serial0/1/0
R2(config-if)#ip address 10.1.1.2 255.255.255.252
R2(config-if)#no shutdown
R2(config)#interface Serial0/1/1
R2(config-if)#ip address 10.2.2.2 255.255.255.252
R2(config-if)#no shutdown
```

Configure R3

```
Router>enable
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#
Router(config)#hostname R3
R3(config)#enable password ciscoenpa55
R3(config)#enable secret abcd
R3(config)#^Z
R3#exit
R3>
R3>en
Password:
Password:
R3#
R3#config t
R3(config)#interface Serial0/1/0
R3(config-if)#ip address 10.2.2.1 255.255.255.252
R3(config-if)#no shutdown
R3(config)#interface GigabitEthernet0/0
R3(config-if)#ip address 192.168.3.1 255.255.255.0
R3(config-if)#no shutdown
R3(config-if)#exit
R3#
```

Configure OSPF on R1, R2, R3

```
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#

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#

R3(config)#router ospf 1
R3(config-router)#network 10.2.2.0 0.0.0.3 area 0
R3(config-router)#network 192.168.3.0 0.0.0.255 area 0
R3(config-router)#^Z
R3#

Test the connectivity of the all the devices A-B / A-C / B-C
For PC-A
Go to desktop – command prompt
Ping the devices path-wise
C:> ping 192.168.1.1
C:> ping 10.1.1.2
C:> ping 10.2.2.2
C:> ping 192.168.3.1

All packets should be successfully reached to the destination.

Step 2: Configure OSPF MD5 authentication for all the routers in area 0.

Configure OSPF MD5 authentication for all the routers in area 0.

```
R1(config)# router ospf 1
R1(config-router)# area 0 authentication message-digest

R2(config)# router ospf 1
R2(config-router)# area 0 authentication message-digest

R3(config)# router ospf 1
R3(config-router)# area 0 authentication message-digest
```

Step 3: Configure the MD5 key for all the routers in area 0.

Configure an MD5 key on the serial interfaces on **R1**, **R2** and **R3**. Use the password **MD5pa55** for key **1**.

```
R1(config)# interface s0/0/0

R1(config-if)# ip ospf message-digest-key 1 md5 MD5pa55
```

```
R2(config)# interface s0/0/0

R2(config-if)# ip ospf message-digest-key 1 md5 MD5pa55

R2(config-if)# interface s0/0/1

R2(config-if)# ip ospf message-digest-key 1 md5 MD5pa55

R3(config)# interface s0/0/1

R3(config-if)# ip ospf
message-digest-key 1 md5 MD5pa55
```

Step 4: Verify configurations.

a. Verify the MD5 authentication configurations using the commands **show ip ospf interface**.

b. Verify end-to-end connectivity.

Part 2: Configure NTP

Step 1: Enable NTP authentication on PC-A.

a. On **PC-A**, click **NTP** under the Services tab to verify NTP service is enabled.
b. To configure NTP authentication, click **Enable** under Authentication. Use key **1** and password **NTPpa55** for authentication.

Step 2: Configure R1, R2, and R3 as NTP clients.

```
R1(config)# ntp server 192.168.1.5

R2(config)# ntp server 192.168.1.5

R3(config)# ntp server 192.168.1.5
```

Verify client configuration using the command **show ntp status**.

Step 3: Configure routers to update hardware clock. Configure **R1**, **R2**, **and R3** to periodically update the hardware clock with the time learned from NTP.

```
R1(config)# ntp update-calendar

R2(config)# ntp update-calendar

R3(config)# ntp update-calendar
```

Exit global configuration and verify that the hardware clock was updated using the command **show clock**.

Step 4: Configure NTP authentication on the routers.

Configure NTP authentication on **R1**, **R2**, and **R3** using key **1** and password **NTPpa55**.

```
R1(config)# ntp authenticate
R1(config)# ntp trusted-key 1
R1(config)# ntp authentication-key 1 md5 NTPpa55

R2(config)# ntp authenticate
R2(config)# ntp trusted-key 1
R2(config)# ntp authentication-key 1 md5 NTPpa55

R3(config)# ntp authenticate
R3(config)# ntp trusted-key 1
R3(config)# ntp authentication-key 1 md5 NTPpa55
```

Step 5: Configure routers to timestamp log messages.

Configure timestamp service for logging on the routers.

```
R1(config)# service timestamps log datetime msec
R2(config)# service timestamps log datetime msec
R3(config)# service timestamps log datetime msec
```

Part 3: Configure Routers to Log Messages to the Syslog Server

Step 1: Configure the routers to identify the remote host (Syslog Server) that will receive logging messages.

```
R1(config)# logging host 192.168.1.6
R2(config)# logging host 192.168.1.6
R3(config)# logging host 192.168.1.6
```

The router console will display a message that logging has started.

Step 2: Verify logging configuration.

Use the command **show logging** to verify logging has been enabled.

Step 3: Examine logs of the Syslog Server.

From the **Services** tab of the **Syslog Server**'s dialogue box, select the **Syslog** services button. Observe the logging messages received from the routers.

Note: Log messages can be generated on the server by executing commands on the router. For example, entering and exiting global configuration mode will generate an informational configuration message. You may need to click a different service and then click **Syslog** again to refresh the message display.

Part 4: Configure R3 to Support SSH Connections

Step 1: Configure a domain name. Configure a

domain name of **ccnasecurity.com** on **R3**.

```
R3(config)# ip domain-name ccnasecurity.com
```

Step 2: Configure users for login to the SSH server on R3.

Create a user ID of **SSHadmin** with the highest possible privilege level and a secret password of **ciscosshpa55**.

```
R3(config)# username SSHadmin privilege 15 secret ciscosshpa55
```

Step 3: Configure the incoming vty lines on R3. Use the local user accounts for

mandatory login and validation. Accept only SSH connections.

```
R3(config)# line vty 0 4
R3(config-line)# login local
R3(config-line)# transport input ssh
```

Step 4: Erase existing key pairs on R3. Any existing

RSA key pairs should be erased on the router.

```
R3(config)# crypto key zeroize rsa
```

Note: If no keys exist, you might receive this message: `% No Signature RSA Keys found in configuration`.

Step 5: Generate the RSA encryption key pair for R3.

The router uses the RSA key pair for authentication and encryption of transmitted SSH data. Configure the RSA keys with a modulus of **1024**. The default is 512, and the range is from 360 to 2048.

```
R3(config)# crypto key generate rsa

The name for the keys will be: R3.ccnasecurity.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]
```

Note: The command to generate RSA encryption key pairs for **R3** in Packet Tracer differs from those used in the lab.

Step 6: Verify the SSH configuration.

Use the **show ip ssh** command to see the current settings. Verify that the authentication timeout and retries are at their default values of 120 and 3.

Step 7: Configure SSH timeouts and authentication parameters.

The default SSH timeouts and authentication parameters can be altered to be more restrictive. Set the timeout to **90** seconds, the number of authentication retries to **2**, and the version to **2**.

```
R3(config)# ip ssh time-out 90

R3(config)# ip ssh authentication-retries 2

R3(config)# ip ssh version 2
```

Issue the **show ip ssh** command again to confirm that the values have been changed.

Step 8: Attempt to connect to R3 via Telnet from PC-C.

Open the Desktop of **PC-C**. Select the Command Prompt icon. From **PC-C**, enter the command to connect to **R3** via Telnet.

```
PC> telnet 192.168.3.1
```

This connection should fail because **R3** has been configured to accept only SSH connections on the virtual terminal lines.

Step 9: Connect to R3 using SSH on PC-C.

Open the Desktop of **PC-C**. Select the Command Prompt icon. From **PC-C**, enter the command to connect to R3 via SSH. When prompted for the password, enter the password configured for the administrator **ciscosshpa55**.

```
PC> ssh –l SSHadmin 192.168.3.1
```

Step 10: Connect to R3 using SSH on R2.

To troubleshoot and maintain **R3**, the administrator at the ISP must use SSH to access the router CLI. From the CLI of **R2**, enter the command to connect to **R3** via SSH version **2** using the **SSHadmin** user account. When prompted for the password, enter the password configured for the administrator: **ciscosshpa55**.

```
R2# ssh –v 2 –l SSHadmin 10.2.2.1
```

Step 11: Check results.

Your completion percentage should be 100%. Click **Check Results** to view the feedback and verification of which required components have been completed.

OSPF MD5 authentication for all the routers in area 0.

Rewrite the script for R1

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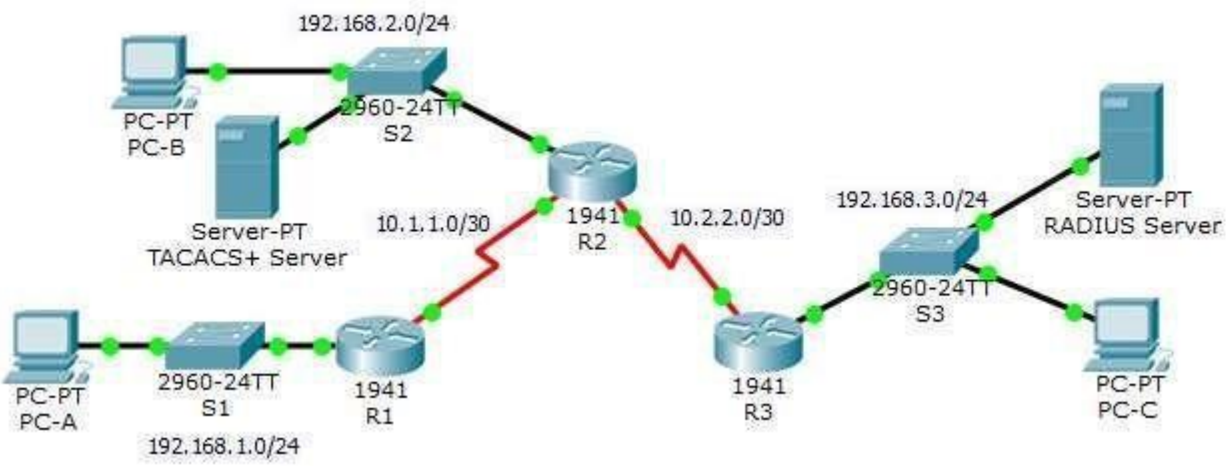
Practical 2: Packet Tracer - Configure AAA Authentication on Cisco Routers

Topology



Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway	Switch Port
R1	G0/1	192.168.1.1	255.255.255.0	N/A	S1 F0/1
	S0/0/0 (DCE)	10.1.1.2	255.255.255.252	N/A	N/A
R2	G0/0	192.168.2.1	255.255.255.0	N/A	S2 F0/2
	S0/0/0	10.1.1.1	255.255.255.252	N/A	N/A
	S0/0/1 (DCE)	10.2.2.1	255.255.255.252	N/A	N/A
R3	G0/1	192.168.3.1	255.255.255.0	N/A	S3 F0/5
	S0/0/1	10.2.2.2	255.255.255.252	N/A	N/A
TACACS+ Server	NIC	192.168.2.2	255.255.255.0	192.168.2.1	S2 F0/6
RADIUS Server	NIC	192.168.3.2	255.255.255.0	192.168.3.1	S3 F0/1
PC-A	NIC	192.168.1.3	255.255.255.0	192.168.1.1	S1 F0/2
PC-B	NIC	192.168.2.3	255.255.255.0	192.168.2.1	S2 F0/1
PC-C	NIC	192.168.3.3	255.255.255.0	192.168.3.1	S3 F0/18

Objectives

- Configure a local user account on R1 and configure authenticate on the console and vty lines using local AAA.
- Verify local AAA authentication from the R1 console and the PC-A client.
- Configure server-based AAA authentication using TACACS+.

Terminal Access Controller Access-Control System

- Verify server-based AAA authentication from the PC-B client.
- Configure server-based AAA authentication using RADIUS. **Remote Authentication Dial-In User Service**
- Verify server-based AAA authentication from the PC-C client.

Background / Scenario

The network topology shows routers R1, R2 and R3. Currently, all administrative security is based on knowledge of the enable secret password. Your task is to configure and test local and server-based AAA solutions.

You will create a local user account and configure local AAA on router R1 to test the console and vty logins.
○

User account: **Admin1** and password **admin1pa55**

The routers have also been pre-configured with the following:

- Enable secret password: **ciscoenpa55**
- OSPF routing protocol with MD5 authentication using password:

  MD5pa55

Note: The console and vty lines have not been pre-configured.

Note: IOS version 15.3 uses SCRYPT as a secure encryption hashing algorithm; however, the IOS version that is currently supported in Packet Tracer uses MD5. Always use the most secure option available on your equipment.

Part 1: Configure Local AAA Authentication for Console Access on R1

Step 1: Test connectivity.----------OSPF connectivity

- Ping from **PC-A** to **PC-B**.
- Ping from **PC-A** to **PC-C**.
- Ping from **PC-B** to **PC-C**.

Configure 3 PCs and 2 servers

Configure R1
Router>enable
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#
Router(config)#hostname R1
R1(config)#
R1(config)#enable password ciscoenpa55
R1(config)#exit
R1>en
Password:
R1#
Perform Menu driven option

R1(config)#interface GigabitEthernet0/1

R1(config-if)#ip address 192.168.1.1 255.255.255.0
R1(config-if)#no shutdown

R1(config)#interface Serial0/0/0
R1(config-if)#ip address 10.1.1.2 255.255.255.252
R1(config-if)#no shutdown

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

Configure R2
Router>enable
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#
Router(config)#hostname R2
R2(config)#
R2(config)#enable password ciscoenpa55
R2(config)#exit
R2>en
Password:
R2#
R2(config)#interface GigabitEthernet0/0
R2(config-if)#ip address 192.168.2.1 255.255.255.0
R2(config-if)#no shutdown

R2(config)#interface Serial0/0/0
R2(config-if)#ip address 10.1.1.1 255.255.255.252
R2(config-if)#no shutdown

R2(config)#interface Serial0/0/1
R2(config-if)#ip address 10.2.2.1 255.255.255.252
R2(config-if)#no shutdown

R2(config)#router ospf 1
R2(config-router)#network 192.168.2.0 0.0.0.255 area 0
R2(config-router)#network 10.2.2.0 0.0.0.3 area 0
R2(config-router)#network 10.1.1.0 0.0.0.3 area 0
R2(config-router)#^Z
R2#

Configure R3
Router>enable
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#
Router(config)#hostname R2
R3(config)#

R3(config)#enable password ciscoenpa55
R3(config)#exit
R3>en
Password:
R3#

R3(config)#interface Serial0/0/1
R3(config-if)#ip address 10.2.2.2 255.0.0.0
R3(config-if)#no shutdown

R3(config)#interface GigabitEthernet0/1
R3(config-if)#ip address 192.168.3.1 255.255.255.0
R3(config-if)#no shutdown

R3(config)#router ospf 1
R3(config-router)#network 10.2.2.0 0.0.0.3 area 0
R3(config-router)#network 192.168.3.0 0.0.0.255 area 0
R3(config-router)#^Z

Test the connectivity on PC-A to PC-B

Click on Desktop – command prompt
PC> ping 192.168.2.3

Similarly PC-A to PC-C and PC-B to PC-C

Step 2: Configure a local username on R1.

Configure a username of **Admin1** with a secret password of **admin1pa55**.

```
R1(config)# username Admin1 secret admin1pa55
```

Step 3: Configure local AAA authentication for console access on R1.

Enable AAA on R1 and configure AAA authentication for the console login to use the local database.

```
R1(config)# aaa new-model
```

```
R1(config)# aaa authentication login default local
```

Step 4: Configure the line console to use the defined AAA authentication method.

Enable AAA on **R1** and configure AAA authentication for the console login to use the default method list.

```
R1(config)# line console 0
```

```
R1(config-line)# login authentication default
```

Step 5: Verify the AAA authentication method.

Verify the user EXEC login using the local database.

```
R1(config-line)# end

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

R1# exit

R1 con0 is now available Press

RETURN to get started.

************ AUTHORIZED ACCESS ONLY *************

UNAUTHORIZED ACCESS TO THIS DEVICE IS PROHIBITED.

User Access Verification

Username: Admin1

Password:  admin1pa55

R1>
```

Part 2: Configure Local AAA Authentication for vty Lines on R1

Step 1: Configure domain name and crypto key for use with SSH.

a. Use ccnasecurity.com as the domain name on R1.

```
R1(config)# ip domain-name ccnasecurity.com
```

b. Create an RSA crypto key using 1024 bits.—prime no theory

```
R1(config)# crypto key generate rsa

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]
```

Step 2 : Configure a named list AAA authentication method for the vty lines on R1.

Configure a named list called **SSH-LOGIN** to authenticate logins using local AAA.

```
R1(config)# aaa authentication login SSH-LOGIN local
```

Step 3: Configure the vty lines to use the defined AAA authentication method.

Configure the vty lines to use the named AAA method and only allow SSH for remote access.

```
R1(config)# line vty 0 4

R1(config-line)# login authentication SSH-LOGIN
```

```
R1(config-line)# transport input ssh
R1(config-line)# end
```

Step 4: Verify the AAA authentication method.

Verify the SSH configuration SSH to **R1** from the command prompt of **PC-A**..

```
PC> ssh -l Admin1 192.168.1.1-----gateway
```

```
Open
```

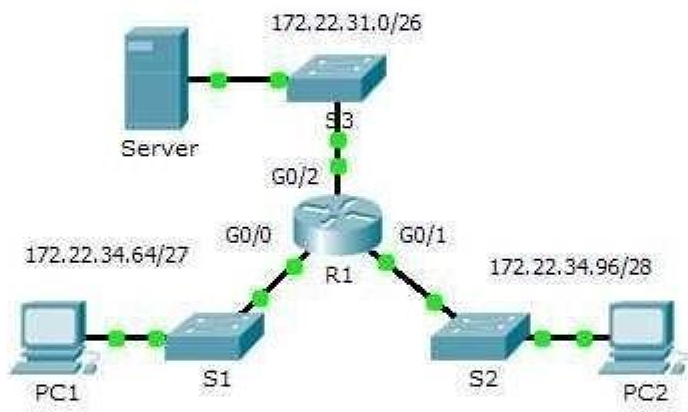
```
Password:
```

```
admin1pa55
```

```
R1>
```

Practical 3: Configuring Extended ACLs - Scenario 1

Topology



Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway
R1	G0/0	172.22.34.65	255.255.255.224	N/A
	G0/1	172.22.34.97	255.255.255.240	N/A
	G0/2	172.22.34.1	255.255.255.192	N/A
Server	NIC	172.22.34.62	255.255.255.192	172.22.34.1
PC1	NIC	172.22.34.66	255.255.255.224	172.22.34.65
PC2	NIC	172.22.34.98	255.255.255.240	172.22.34.97

Objectives

Part 1: Configure, Apply and Verify an Extended Numbered ACL

Part 2: Configure, Apply and Verify an Extended Named ACL

Background / Scenario

Two employees need access to services provided by the server. **PC1** needs only FTP access while **PC2** needs only web access. Both computers are able to ping the server, but not each other.

The topology has to be statically configured by shoeing overall connectivity.

Part 1: Configure, Apply and Verify an Extended Numbered ACL

Step 1: Configure an ACL to permit FTP and ICMP.

a. From global configuration mode on **R1**, enter the following command to determine the first valid number for an extended access list.

```
R1(config)# access-list ?
  <1-99> IP standard access list-----------Source dest IP
  <100-199> IP extended access list--------extra
```

b. Add **100** to the command, followed by a question mark.

```
R1(config)#  access-list  100  ?
deny     Specify  packets  to  reject
permit  Specify  packets  to
forward remark Access list entry
comment
```

c. To permit FTP traffic, enter **permit,** followed by a question mark.

R1(config)# access-list 100 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
```

d. This ACL permits FTP and ICMP. ICMP is listed above, but FTP is not, because FTP uses TCP. Therefore,enter **tcp** to further refine the ACL help.

R1(config)# access-list 100 permit tcp ?

```
  A.B.C.D  Source  address  any
Any  source  host    host    A
single source host
```

e. Notice that we could filter just for **PC1** by using the **host** keyword or we could allow **any** host. In this case, any device is allowed that has an address belonging to the 172.22.34.64/27 network. Enter the network address, followed by a question mark.

R1(config)# access-list 100 permit tcp 172.22.34.64 ?-----------S1

```
  A.B.C.D  Source wildcard bits
```

f. Calculate the wildcard mask determining the binary opposite of a subnet mask.

11111111.11111111.11111111.11100000 = 255.255.255.224 -----(255-224=31)

00000000.00000000.00000000.000**11111** = 0.0.0.31

g. Enter the wildcard mask, followed by a question mark.

R1(config)# access-list 100 permit tcp 172.22.34.64 0.0.0.31 ?

```
  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
```

h. Configure the destination address. In this scenario, we are filtering traffic for a single destination, which is the server. Enter the **host** keyword followed by the server's IP address.

R1(config)# access-list 100 permit tcp 172.22.34.64 0.0.0.31 host 172.22.34.62 ?

```
  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   lt            Match only packets with a lower
port number   neq                Match only packets not on a
given port number     precedence    Match packets with given
precedence value range         Match only packets in the range
of port numbers
  <cr>
```

i. Notice that one of the options is **<cr>** (carriage return). In other words, you can press **Enter** and the statement would permit all TCP traffic. However, we are only permitting FTP traffic; therefore, enter the **eq** keyword, followed by a question mark to display the available options. Then, enter **ftp** and press **Enter**.

R1(config)# access-list 100 permit tcp 172.22.34.64 0.0.0.31 host

```
172.22.34.62 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 100 permit tcp 172.22.34.64 0.0.0.31 host 172.22.34.62 eq ftp

j. Create a second access list statement to permit ICMP (ping, etc.) traffic from **PC1** to **Server**. Note that the access list number remains the same and no particular type of ICMP traffic needs to be specified.

R1(config)# **access-list 100 permit icmp 172.22.34.64 0.0.0.31 host 172.22.34.62**

k. All other traffic is denied, by default.

Step 2: Apply the ACL on the correct interface to filter traffic.

From **R1**'s perspective, the traffic that ACL 100 applies to is inbound from the network connected to Gigabit Ethernet 0/0 interface. Enter interface configuration mode and apply the ACL.

R1(config)# interface gigabitEthernet 0/0

R1(config-if)# ip access-group 100 in

Step 3:

Verify the ACL implementation.

a. Ping from **PC1** to **Server**. If the pings are unsuccessful, verify the IP addresses before continuing.

b. FTP from **PC1** to **Server**. The username and password are both **cisco**.

PC> **ftp 172.22.34.62**

c. Exit the FTP service of the **Server**.

ftp> **quit**

d. Ping from **PC1** to **PC2**. The destination host should be unreachable, because the traffic was not explicitly permitted.

Part 2: Configure, Apply and Verify an Extended Named ACL

Step 1: Configure an ACL to permit HTTP access and ICMP.

a. Named ACLs start with the **ip** keyword. From global configuration mode of **R1**, enter the following command, followed by a question mark.

R1(config)# ip access-list ?

```
 extended         Extended    Access    List
standard  Standard Access List
```

b. You can configure named standard and extended ACLs. This access list filters both source and destination IP addresses; therefore, it must be extended. Enter **HTTP_ONLY** as the name. (For Packet Tracer scoring, the name is case-sensitive.)

```
R1(config)# ip access-list extended HTTP_ONLY
```

c. The prompt changes. You are now in extended named ACL configuration mode. All devices on the **PC2** LAN need TCP access. Enter the network address, followed by a question mark.

```
R1(config-ext-nacl)# permit tcp 172.22.34.96 ?
  A.B.C.D  Source wildcard bits
```

d. An alternative way to calculate a wildcard is to subtract the subnet mask from 255.255.255.255.

```
     255.255.255.255
   - 255.255.255.240
 --------------------
=    0.  0.  0. 15
```

```
R1(config-ext-nacl)# permit tcp 172.22.34.96 0.0.0.15 ?
```

e. Finish the statement by specifying the server address as you did in Part 1 and filtering **www** traffic.

```
R1(config-ext-nacl)# permit tcp 172.22.34.96 0.0.0.15 host 172.22.34.62 eq www
```

f. Create a second access list statement to permit ICMP (ping, etc.) traffic from **PC2** to **Server**. Note: The prompt remains the same and a specific type of ICMP traffic does not need to be specified.

```
R1(config-ext-nacl)# permit icmp 172.22.34.96 0.0.0.15 host 172.22.34.62
```

g. All other traffic is denied, by default. Exit out of extended named ACL configuration mode.

Step 2: Apply the ACL on the correct interface to filter traffic.

From **R1**'s perspective, the traffic that access list **HTTP_ONLY** applies to is inbound from the network connected to Gigabit Ethernet 0/1 interface. Enter the interface configuration mode and apply the ACL.

```
R1(config)# interface gigabitEthernet 0/1
R1(config-if)# ip access-group HTTP_ONLY in
```

Step 3 :Verify the ACL implementation.

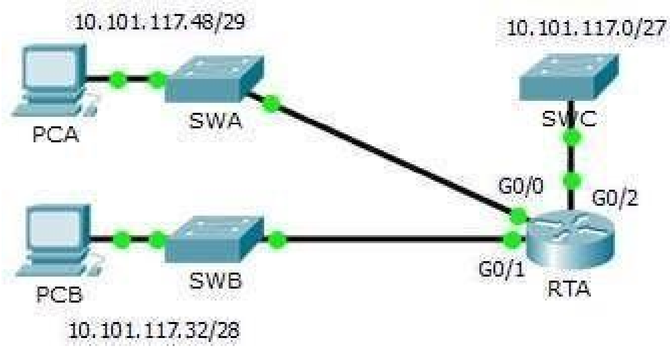
a. Ping from **PC2** to **Server**. The ping should be successful, if the ping is unsuccessful, verify the IP addresses before continuing.

b. FTP from **PC2** to **Server**. The connection should fail.

c. Open the web browser on **PC2** and enter the IP address of **Server** as the URL. The connection should be successful.

Practical 3: Configuring Extended ACLs - Scenario 2

Topology



Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway
RTA	G0/0	10.101.117.49	255.255.255.248	N/A
	G0/1	10.101.117.33	255.255.255.240	N/A
	G0/2	10.101.117.1	255.255.255.224	N/A
PCA	NIC	10.101.117.51	255.255.255.248	10.101.117.49
PCB	NIC	10.101.117.35	255.255.255.240	10.101.117.33
SWA	VLAN 1	10.101.117.50	255.255.255.248	10.101.117.49
SWB	VLAN 1	10.101.117.34	255.255.255.240	10.101.117.33
SWC	VLAN 1	10.101.117.2	255.255.255.224	10.101.117.1

Objectives

1: Configure, Apply and Verify an Extended Numbered ACL

Part 1: Configure Switch and Router

Step 1: Configure the IP address on switch

```
SW(config)# int vlan 1
SW(config)# ip address ipaddress subnetmask
SW(config)# no shut
SW(config)# ip default-gateway defaultgateway
```

Step 2: Configure the secret on router and switch

```
RTA/SW(config)# enable secret ciscoenpa55
```

Step 3: Configure the console password on router and switch

```
RTA/SW(config)# line console 0
RTA/SW(config)# password tyit
```

RTA/SW(config)# **login**

Step 4: Test connectivity

- Ping from PC-A to PC-B.
- Ping from PC-A to SWC.
- Ping from PC-B to SWC.

Part 2: Configure Switch and Router to support SSH Connection

Step 1: Configure domain name and crypto key for use with SSH.

RTA/SW(config)# ip domain-name ccnasecurity.com

Step 2: Configure users to login to SSH

RTA/SW(config)# username admin secret adminpa55

Step 3: Configure incoming vty lines

RTA/SW(config)# **line vty 0 4**

RTA/SW(config-line)# **login** local

RTA/SW(config)# **crypto key generate rsa**

How many bits in the modulus [512]: 1024

Part 3: Configure, Apply and Verify an Extended Numbered ACL

Step 1: Configure the extended ACL.

RTA(config)# access-list 199 permit tcp 10.101.117.32 0.0.0.15 10.101.117.0 0.0.0.31 eq 22

RTA(config)# access-list 199 permit icmp any any

Step 2: Apply the extended ACL.

RTA(config)# int gig0/2

RTA(config)# ip access-group 199 out

Step 3: Verify the extended ACL implementation.

a. Ping from **PCB** to all of the other IP addresses in the network.

PC> ping 10.101.117.51

PC> ping 10.101.117.2

b. SSH from **PCB** to **SWC**. The username is **Admin**, and the password is **Adminpa55**.

PC> ssh -l Admin 10.101.117.2

```
Password:
```

c. Exit the SSH session to SWC.

```
SWC>exit
```

d. Ping from **PCA** to all of the other IP addresses in the network.

```
PC> ping 10.101.117.35
PC> ping 10.101.117.2
```

e. SSH from **PCA** to **SWC**

```
PC> ssh -l Admin 10.101.117.2
Connection timed out. Remote host not responding
```

f. SSH from **PCA** to **SWB**. The username is **Admin**, and the password is **Adminpa55**.

```
PC> ssh -l Admin 10.101.117.34
Password:
```

g. After logging into **SWB**, do not log out. SSH to **SWC** in privileged EXEC mode.

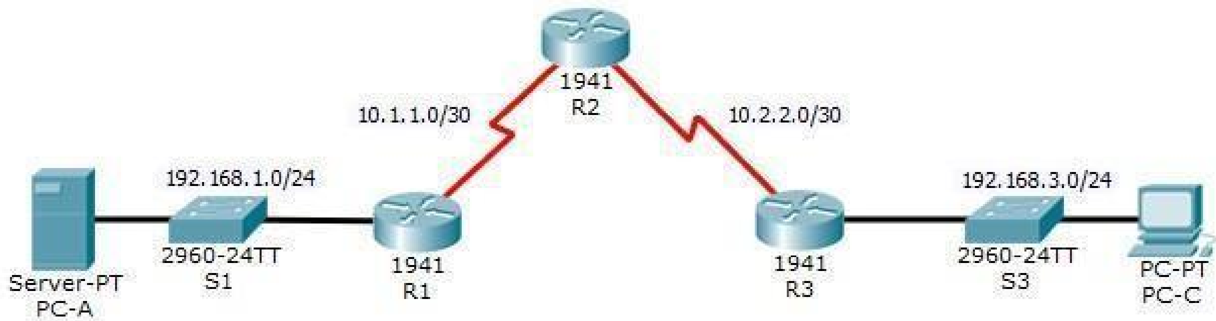
```
SWB# ssh -l Admin 10.101.117.2
Password:
```

Rewrite the script of RTA

Rewrite the script of switch

Practical 4: Configure IP ACLs to Mitigate Attacks

Topology



Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway	Switch Port
R1	G0/1	192.168.1.1	255.255.255.0	N/A	S1 F0/5
	S0/0/0 (DCE)	10.1.1.1	255.255.255.252	N/A	N/A
R2	S0/0/0	10.1.1.2	255.255.255.252	N/A	N/A
	S0/0/1 (DCE)	10.2.2.2	255.255.255.252	N/A	N/A
	Lo0	192.168.2.1	255.255.255.0	N/A	N/A
R3	G0/1	192.168.3.1	255.255.255.0	N/A	S3 F0/5
	S0/0/1	10.2.2.1	255.255.255.252	N/A	N/A
PC-A	NIC	192.168.1.3	255.255.255.0	192.168.1.1	S1 F0/6
PC-C	NIC	192.168.3.3	255.255.255.0	192.168.3.1	S3 F0/18

Objectives

- Verify connectivity among devices before firewall configuration.
- Use ACLs to ensure remote access to the routers is available only from management station PC-C.
- Configure ACLs on R1 and R3 to mitigate attacks.
- Verify ACL functionality.

Background/Scenario

Access to routers R1, R2, and R3 should only be permitted from PC-C, the management station. PC-C is also used for connectivity testing to PC-A, which is a server providing DNS, SMTP, FTP, and HTTPS services.

Standard operating procedure is to apply ACLs on edge routers to mitigate common threats based on source and destination IP address. In this activity, you will create ACLs on edge routers R1 and R3 to achieve this goal. You will then verify ACL functionality from internal and external hosts.

The routers have been pre-configured with the following:

○ Enable password: **ciscoenpa55** ○

Password for console: **ciscoconpa55**

o SSH logon username and password:

SSHadmin/ciscosshpa55 ○ IP addressing ○

Static routing

Create SSHadmin on all routers as per the first practical.

Part 1: Verify Basic Network Connectivity

Verify network connectivity prior to configuring the IP ACLs.

Configure OSPF on the whole topology

To set the loopback interface on R2

```
R2(config)# interface loopback 0 R2(config)#
ip add 192.168.2.1 255.255.255.0
```

Step 1: From PC-A, verify connectivity to PC-C and R2.

a. From the command prompt, ping **PC-C** (192.168.3.3).

b. From the command prompt, establish an SSH session to **R2** Lo0 interface (192.168.2.1) using username **SSHadmin** and password **ciscosshpa55**. When finished, exit the SSH session.

```
SERVER> ssh –l SSHadmin 192.168.2.1
```

Step 2: From PC-C, verify connectivity to PC-A and R2.

a. From the command prompt, ping **PC-A** (192.168.1.3).

b. From the command prompt, establish an SSH session to **R2** Lo0 interface (192.168.2.1) using username **SSHadmin** and password **ciscosshpa55**. Close the SSH session when finished.

```
PC> ssh –l SSHadmin 192.168.2.1
```

c. Open a web browser to the **PC-A** server (192.168.1.3) to display the web page. Close the browser when done.

Part 2: Secure Access to Routers

Step 1: Configure ACL 10 to block all remote access to the routers except from PC-C. Use the **access-list** command to create a numbered IP ACL on **R1**, **R2**, and **R3**.

```
R1(config)# access-list 10 permit host 192.168.3.3
R2(config)# access-list 10 permit host 192.168.3.3
R3(config)# access-list 10 permit host 192.168.3.3
```

Step 2: Apply ACL 10 to ingress traffic on the VTY lines. Use the **access-class** command to apply the access list to incoming traffic on the VTY lines.

```
R1(config-line)# access-class 10 in
R2(config-line)# access-class 10 in
R3(config-line)# access-class 10 in
```

Step 3: Verify exclusive access from management station PC-C.

a. Establish an SSH session to 192.168.2.1 from **PC-C** (should be successful).

```
PC> ssh –l SSHadmin 192.168.2.1
```

b. Establish an SSH session to 192.168.2.1 from **PC-A** (should fail).

Part 3: Create a Numbered IP ACL 120 on R1

Create an IP ACL numbered 120 with the following rules:

- Permit any outside host to access DNS, SMTP, and FTP services on server

PC-A. ○Deny any outside host access to HTTPS services on **PC-A.** ○ Permit **PC-C** to access **R1** via SSH.

Note: Check Results will not show a correct configuration for ACL 120 until you modify it in Part 4.

Step 1: Verify that PC-C can access the PC-A via HTTPS using the web browser.

Be sure to disable HTTP and enable HTTPS on server **PC-A**.

Step 2: Configure ACL 120 to specifically permit and deny the specified traffic.

Use the **access-list** command to create a numbered IP ACL.

```
R1(config)# access-list 120 permit udp any host 192.168.1.3 eq domain
R1(config)# access-list 120 permit tcp any host 192.168.1.3 eq smtp
R1(config)# access-list 120 permit tcp any host 192.168.1.3 eq ftp
R1(config)# access-list 120 deny tcp any host 192.168.1.3 eq 443
R1(config)# access-list 120 permit tcp host 192.168.3.3 host 10.1.1.1 eq 22
```

Step 3: Apply the ACL to interface S0/0/0.

Use the **ip access-group** command to apply the access list to incoming traffic on interface S0/0/0.

```
R1(config)# interface s0/0/0
R1(config-if)# ip access-group 120 in
```

Step 4: Verify that PC-C cannot access PC-A via HTTPS using the web browser.

Part 4: Modify an Existing ACL on R1

Permit ICMP echo replies and destination unreachable messages from the outside network (relative to **R1**). Deny all other incoming ICMP packets.

Step 1: Verify that PC-A cannot successfully ping the loopback interface on R2.

Step 2: Make any necessary changes to ACL 120 to permit and deny the specified traffic.

Use the **access-list** command to create a numbered IP ACL.

```
R1(config)# access-list 120 permit icmp any any echo-reply
R1(config)# access-list 120 permit icmp any any unreachable
R1(config)# access-list 120 deny icmp any any
R1(config)# access-list 120 permit ip any any
```

Step 3: Verify that PC-A can successfully ping the loopback interface on R2.

Part 5: Create a Numbered IP ACL 110 on R3

Deny all outbound packets with source address outside the range of internal IP addresses on **R3**.

Step 1: Configure ACL 110 to permit only traffic from the inside network.

Use the **access-list** command to create a numbered IP ACL.

```
R3(config)# access-list 110 permit ip 192.168.3.0 0.0.0.255 any
```

Step 2: Apply the ACL to interface G0/1.

Use the **ip access-group** command to apply the access list to incoming traffic on interface G0/1.

```
R3(config)# interface g0/1
R3(config-if)# ip access-group 110 in
```

Part 6: Create a Numbered IP ACL 100 on R3

On **R3**, block all packets containing the source IP address from the following pool of addresses: any RFC 1918 private addresses, 127.0.0.0/8, and any IP multicast address. Since **PC-C** is being used for remote administration, permit SSH traffic from the 10.0.0.0/8 network to return to the host **PC-C**.

Step 1: Configure ACL 100 to block all specified traffic from the outside network.

You should also block traffic sourced from your own internal address space if it is not an RFC 1918 address. In this activity, your internal address space is part of the private address space specified in RFC 1918. Use the **access-list** command to create a numbered IP ACL.

```
R3(config)# access-list 100 permit tcp 10.0.0.0 0.255.255.255 eq 22 host 192.168.3.3

R3(config)# access-list 100 deny ip 10.0.0.0 0.255.255.255 any
R3(config)# access-list 100 deny ip 172.16.0.0 0.15.255.255 any
R3(config)# access-list 100 deny ip 192.168.0.0 0.0.255.255 any
R3(config)# access-list 100 deny ip 127.0.0.0 0.255.255.255 any
R3(config)# access-list 100 deny ip 224.0.0.0 15.255.255.255 any
R3(config)# access-list 100 permit ip any any
```

Step 2: Apply the ACL to interface Serial 0/0/1. Use the **ip access-group** command to apply the

access list to incoming traffic on interface Serial 0/0/1.

```
R3(config)# interface s0/0/1
R3(config-if)# ip access-group 100 in
```

Step 3: Confirm that the specified traffic entering interface Serial 0/0/1 is handled correctly.

a. From the PC-C command prompt, ping the PC-A server. The ICMP echo replies are blocked by the ACL since they are sourced from the 192.168.0.0/16 address space.

b. Establish an SSH session to 192.168.2.1 from **PC-C** (should be successful).

Step 4: Check results.

Your completion percentage should be 100%. Click **Check Results** to see feedback and verification of which required components have been completed.

Rewrite the script of R1

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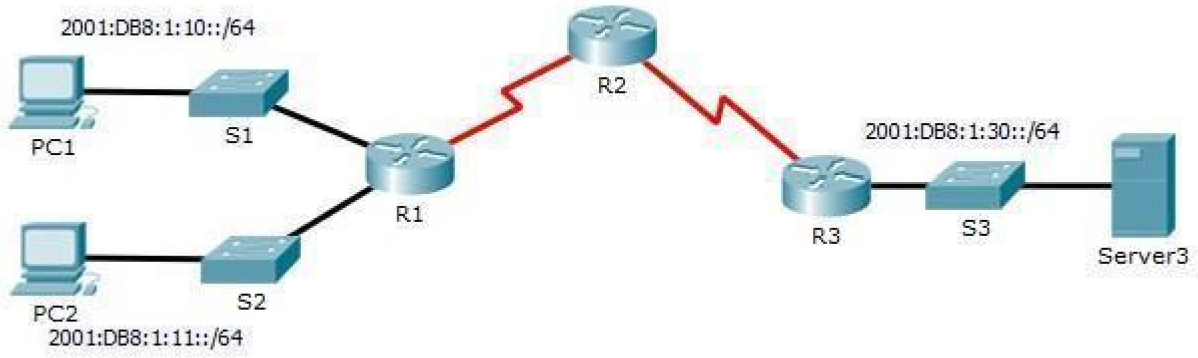
Practical 5: Configuring IPv6 ACLs-----128 ----

Topology



Addressing Table

Device	Interface	IPv6 Address/Prefix	Default Gateway
PC1	NIC	2001:DB8:1:10::10/64	FE80::1
PC2	NIC	2001:DB8:1:11::11/64	FE80::1
R1	Gig0/0	2001:DB8:1:10::1/64	FE80::1
	Gig0/1	2001:DB8:1:11::1/64	FE80::1
	Se0/1/0	2001:DB8:1:1::1/64	FE80::1
R2	Se0/1/0	2001:DB8:1:1::2/64	FE80::2
	Se0/1/1	2001:DB8:1:2::2/64	FE80::2
R3	Gig0/0	2001:DB8:1:30::1/64	FE80::3
	Se0/1/0	2001:DB8:1:2::1/64	FE80::3
Server	NIC	2001:DB8:1:30::30/64	FE80::3

Objectives

Part 1: Configure, Apply, and Verify an IPv6 ACL

Part 2: Configure, Apply, and Verify a Second IPv6 ACL

Part 1: Configure, Apply, and Verify an IPv6 ACL

Logs indicate that a computer on the 2001:DB8:1:11::0/64 network is repeatedly refreshing a web page. This is causing a Denial-of-Service (DoS) attack against **Server3**. Until the client can be identified and cleaned, you must block HTTP and HTTPS access to that network with an access list.

Part 1: Configure Router

Step 1: Configure secret on router

```
Execute command on all routers
R(config)# enable secret enpa55
```

Step 2: Assign static ipv6 address

```
Execute command on all routers
R(config)# int intname
R(config-if)# ipv6 address address/mask
R(config-if)# ipv6 address gatewayaddress link-local
R(config-if)# no shut
R(config-if)# exit
```

Step 3: Enable IPv6 routing

```
Execute command on all routers
R(config)# ipv6 unicast-routing
R(config)#ipv6 route networkaddress/mask nexthopdestinationaddress
```

Step 4: Verify connectivity

```
PC1> ping 2001:DB8:1:30::30
(Successful)
PC2> ping 2001:DB8:1:30::30
(Successful)
```

Part 2: Configure, Apply, and Verify an IPv6 ACL

Step 1: Configure an ACL that will block HTTP and HTTPS access.

```
R1(config)# ipv6 access-list BLOCK_HTTP
R1(config-ipv6-acl)# deny tcp any host 2001:DB8:1:30::30 eq www
R1(config-ipv6-acl)# deny tcp any host 2001:DB8:1:30::30 eq 443
R1(config-ipv6-acl)# permit ipv6 any any
R1(config-ipv6-acl)# exit
```

Step 2: Apply the ACL to the correct interface.

```
R1(config)# int gig0/1
R1(config-if)# ipv6 traffic-filter BLOCK_HTTP in
```

Step 3: Verify the ACL implementation

Open a web browser to the **PC1** to display the web page.
Desktop->Web Browser->http://2001:DB8:1:30::30
(Successful)

Open a web browser to the **PC2** to display the web page.
Desktop->Web Browser->http://2001:DB8:1:30::30
(Unsuccessful) – Request Timeout

```
PC2> ping 2001:DB8:1:30::30
(Successful)
```

Part 3: Configure, Apply, and Verify a Second IPv6 ACL

Step 1: Create an access list to block ICMP.

```
R3(config)# ipv6 access-list BLOCK_ICMP
R3(config-ipv6-acl)# deny icmp any any
R3(config-ipv6-acl)# permit ipv6 any any
R3(config-ipv6-acl)# exit
```

Step 2: Apply the ACL to the correct interface.

```
R3(config)# int gig0/0
R3(config-if)# ipv6 traffic-filter BLOCK_ICMP out
```

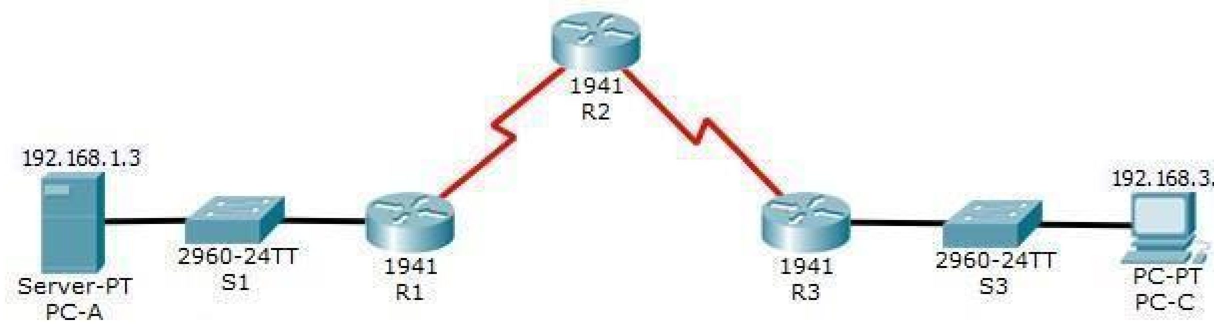
Step 3: Verify that the proper access list functions.

```
PC2> ping 2001:DB8:1:30::30
(Unsuccessful) – Destination host unreachable
PC1> ping 2001:DB8:1:30::30
(Unsuccessful) – Destination host unreachable
```

Open a web browser to the **PC1** to display the web page.
Desktop->Web Browser->http://2001:DB8:1:30::30
(Successful)

Practical 6: Configuring a Zone-Based Policy Firewall (ZPF)

Topology



Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway	Switch Port
R1	G0/1	192.168.1.1	255.255.255.0	N/A	S1 F0/5
	S0/0/0 (DCE)	10.1.1.1	255.255.255.252	N/A	N/A
R2	S0/0/0	10.1.1.2	255.255.255.252	N/A	N/A
	S0/0/1 (DCE)	10.2.2.2	255.255.255.252	N/A	N/A
R3	G0/1	192.168.3.1	255.255.255.0	N/A	S3 F0/5
	S0/0/1	10.2.2.1	255.255.255.252	N/A	N/A
PC-A	NIC	192.168.1.3	255.255.255.0	192.168.1.1	S1 F0/6
PC-C	NIC	192.168.3.3	255.255.255.0	192.168.3.1	S3 F0/18

Objectives

- Verify connectivity among devices before firewall configuration.
- Configure a zone-based policy (ZPF) firewall on R3.
- Verify ZPF firewall functionality using ping, SSH, and a web browser.

Background/Scenario

ZPFs are the latest development in the evolution of Cisco firewall technologies. In this activity, you will configure a basic ZPF on an edge router R3 that allows internal hosts access to external resources and blocks external hosts from accessing internal resources. You will then verify firewall functionality from internal and external hosts.

Part 1: Verify Basic Network Connectivity

Verify network connectivity prior to configuring the zone-based policy firewall.

All the routers have been pre-configured with the following password and username and password (highlighted lines)

Router(config)#enable secret cisco
Router(config)#username admin secret admin-1
Router (config)#exit

Router>en
Password: cisco
Router#

Change the display setting of all the routers as R1,R2,R3 as well for PCs For all the routers

R2#config t
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#aaa new-model
R2(config)#aaa authentication login default local
R2(config)#line console 0
R2(config-line)#login authentication default
R2(config-line)#end
R2#
%SYS-5-CONFIG_I: Configured from console by console

R2#
R2#exit
User Access Verification
Username:
Username: admin
Password: admin-1
R2>en
Password: cisco
R2# config t
R2(Config)# ip domain-name ccnasecurity.com
R2(Config)# crypto key generate rsa
R2(Config)#aaa authentication login SSH-LOGIN local
R2(Config)#line vty 0 4
R2(Config-line)#login authentication
SSH-LOGIN R2(Config-line)#end
R2#

Step 2: Access R2 using SSH.

a. From the **PC-C** command prompt, SSH to the S0/0/1 interface on **R2** at **10.2.2.2**. Use the username **Admin** and password **Adminpa55** to log in. PC> **ssh -l Admin 10.2.2.2**

b. Exit the SSH session. On PC-C command prompt C:\> ssh – l admin 10.2.2.2
Password: admin-1
R2>

Step 3: From PC-C, open a web browser to the PC-A server.

a. Click the **Desktop** tab and then click the **Web Browser** application. Enter the **PC-A** IP address **192.168.1.3** as the URL. The Packet Tracer welcome page from the web server should be displayed. b.

Close the browser on **PC-C**.

on web browser of PC-C Write in URL
http://192.168.1.3
connecting

Part 2: Create the Firewall Zones on R3

Note: For all configuration tasks, be sure to use the exact names as specified.

Step 1: Enable the Security Technology package.

a. On **R3**, issue the **show version** command to view the Technology Package license information.

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#
```

b. If the Security Technology package has not been enabled, use the following command to enable the package.

R3(config)# **license boot module c1900 technology-package securityk9**

c. Accept the end-user license agreement.===Accept(Yes/No)? yes

d. Save the running-config and reload the router to enable the security license.
R3(config) # do copy run start
R3# reload

R3> en
Password: cisco
R3#

e. Verify that the Security Technology package has been enabled by using the **show version** command.

R3# show version

Step 2: Create an internal zone.

Use the **zone security** command to create a zone named **IN-ZONE**.

```
R3(config)# zone security IN-ZONE
R3(config-sec-zone) exit
```

Step 3: Create an external zone.

Use the **zone security** command to create a zone named **OUT-ZONE**.

```
R3(config-sec-zone)# zone security OUT-ZONE
R3(config-sec-zone)# exit
```

Part 3: Identify Traffic Using a Class-Map

Step 1: Create an ACL that defines internal traffic.

Use the **access-list** command to create extended ACL **101** to permit all IP protocols from the **192.168.3.0/24** source network to any destination.

```
R3(config)# access-list 101 permit ip 192.168.3.0 0.0.0.255 any
```

Step 2: Create a class map referencing the internal traffic ACL.

Use the **class-map type inspect** command with the **match-all** option to create a class map named **IN- NETCLASS-MAP**. Use the **match access-group** command to match ACL 10

```
R3(config)# class-map type inspect match-all IN-NET-CLASS-MAP
R3(config-cmap)# match access-group 101
R3(config-cmap)# exit
```

Part 4: Specify Firewall Policies

Step 1: Create a policy map to determine what to do with matched traffic. Use the

policy-map type inspect command and create a policy map named **IN-2-OUT-PMAP**.

```
R3(config)# policy-map type inspect IN-2-OUT-PMAP
```

Step 2: Specify a class type of inspect and reference class map IN-NET-CLASS-MAP.

```
R3(config-pmap)# class type inspect IN-NET-CLASS-MAP
```

Step 3: Specify the action of inspect for this policy map.

The use of the **inspect** command invokes context-based access control (other options include pass and drop).

```
R3(config-pmap-c)# inspect
```

`%No specific protocol configured in class IN-NET-CLASS-MAP for inspection. All protocols will be inspected.` Issue the **exit** command twice to leave **config-pmap-c** mode and return to **config** mode.

```
R3(config-pmap-c)# exit
R3(config-pmap)# exit
```

```
R3 (config)#
```

Part 5: Apply Firewall Policies

Step 1: Create a pair of zones.

Using the **zone-pair security** command, create a zone pair named **IN-2-OUT-ZPAIR**. Specify the source and destination zones that were created in Task 1.

```
R3(config)# zone-pair security IN-2-OUT-ZPAIR source IN-ZONE
destination OUT-ZONE
```

Step 2: Specify the policy map for handling the traffic between the two zones.

Attach a policy-map and its associated actions to the zone pair using the **service-policy type inspect** command and reference the policy map previously created, **IN-2-OUT-PMAP**.

```
R3(config-sec-zone-pair)# service-policy type inspect IN-2-OUT-PMAP
R3(config-sec-zone-pair)# exit
R3(config)#
```

Step 3: Assign interfaces to the appropriate security zones.

Use the **zone-member security** command in interface configuration mode to assign G0/1 to **IN-ZONE** and S0/0/1 to **OUT-ZONE**.

```
R3(config)# interface g0/1
R3(config-if)# zone-member security IN-ZONE
R3(config-if)# exit
R3(config)# interface s0/0/1
R3(config-if)# zone-member security OUT-ZONE
R3(config-if)# exit
```

Step 4: Copy the running configuration to the startup configuration.

R3(config) # do copy run start
R3# reload
R3> en
Password: cisco
R3#

Part 6: Test Firewall Functionality from IN-ZONE to OUT-ZONE

Verify that internal hosts can still access external resources after configuring the ZPF.

Step 1: From internal PC-C, ping the external PC-A server.

From the **PC-C** command prompt, ping **PC-A** at 192.168.1.3. The ping should succeed.

Step 2: From internal PC-C, SSH to the R2 S0/0/1 interface.

a. From the **PC-C** command prompt, SSH to **R2** at 10.2.2.2. Use the username **Admin** and the password **Adminpa55** to access R2. The SSH session should succeed.

b. While the SSH session is active, issue the command **show policy-map type inspect zone-pair sessions** on **R3** to view established sessions.

```
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 175216232 (192.168.3.3:1028)=>(10.2.2.2:22) tcp SIS_OPEN/TCP_ESTAB
Created 00:00:25, Last heard 00:00:20
Bytes sent (initiator:responder)
[1195:1256] Class-map:  class-default
(match-any) Match: any
Drop (default action)
0 packets, 0 bytes
```

What is the source IP address and port number?

____

192.168.3.3:1028 (port 1028 is random)

What is the destination IP address and port number?

____

10.2.2.2:22 (SSH = port 22)

Step 3: From PC-C, exit the SSH session on R2 and close the command prompt window.

C:\> ping 192.168.1.3
C:\> Ssh –l admin 10.2.2.2
Password: admin-1
R2# exit
C:\>

Step 4: From internal PC-C, open a web browser to the PC-A server web page.

Enter the server IP address **192.168.1.3** in the browser URL field, and click **Go**. The HTTP session should succeed. While the HTTP session is active, issue the command **show policy-map type inspect zone-pair sessions** on **R3** to view established sessions.

Note: If the HTTP session times out before you execute the command on **R3**, you will have to click the **Go** button on **PC-C** to generate a session between **PC-C** and **PC-A**.

```
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 565266624 (192.168.3.3:1031)=>(192.168.1.3:80) tcp SIS_OPEN/TCP_ESTAB
Created 00:00:01, Last heard 00:00:01
Bytes sent (initiator:responder) [284:552]
Class-map: class-default (match-any)
Match: any
Drop (default action)
0 packets, 0 bytes
```

What is the source IP address and port number?

____

192.168.3.3:1031 (port 1031 is random)

What is the destination IP address and port number?

____

192.168.1.3:80 (HTTP web = port 80)

Step 5: Close the browser on PC-C.

Part 7: Test Firewall Functionality from OUT-ZONE to IN-ZONE

Verify that external hosts CANNOT access internal resources after configuring the ZPF.

Step 1: From the PC-A server command prompt, ping PC-C.

From the **PC-A** command prompt, ping **PC-C** at 192.168.3.3. The ping should fail.

Step 2: From R2, ping PC-C.

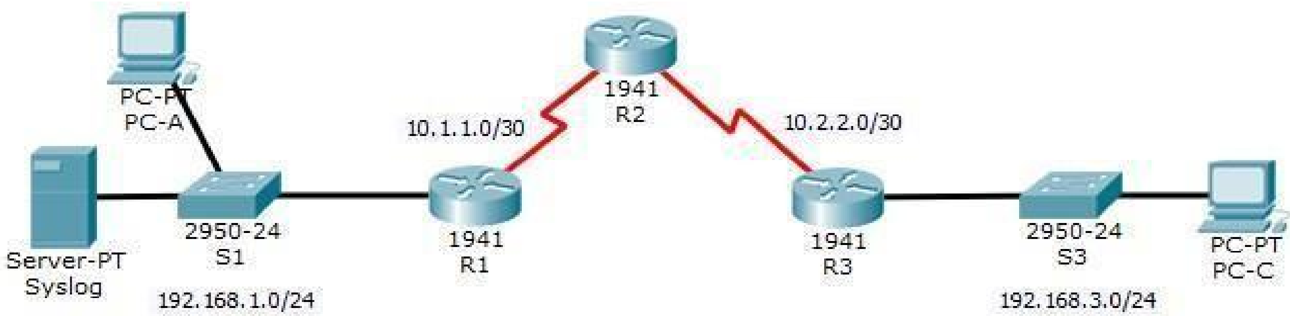
From **R2**, ping **PC-C** at 192.168.3.3. The ping should fail.

Step 3: Check results.

Your completion percentage should be 100%. Click **Check Results** to see feedback and verification of which required components have been completed.

Practical 7: Configure IOS Intrusion Prevention System (IPS) Using the CLI

Topology



Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway	Switch Port
R1	G0/1	192.168.1.1	255.255.255.0	N/A	S1 F0/1
	S0/0/0	10.1.1.1	255.255.255.252	N/A	N/A
R2	S0/0/0 (DCE)	10.1.1.2	255.255.255.252	N/A	N/A
	S0/0/1 (DCE)	10.2.2.2	255.255.255.252	N/A	N/A
R3	G0/1	192.168.3.1	255.255.255.0	N/A	S3 F0/1
	S0/0/0	10.2.2.1	255.255.255.252	N/A	N/A
Syslog	NIC	192.168.1.50	255.255.255.0	192.168.1.1	S1 F0/2
PC-A	NIC	192.168.1.2	255.255.255.0	192.168.1.1	S1 F0/3
PC-C	NIC	192.168.3.2	255.255.255.0	192.168.3.1	S3 F0/2

Objectives

- Enable IOS IPS.
- Configure logging.
- Modify an IPS signature.
- Verify IPS.

Background / Scenario

Your task is to enable IPS on R1 to scan traffic entering the 192.168.1.0 network.

The server labeled Syslog is used to log IPS messages. You must configure the router to identify the syslog server to receive logging messages. Displaying the correct time and date in syslog messages is vital when using syslog to monitor the network. Set the clock and configure the timestamp service for logging on the routers. Finally, enable IPS to produce an alert and drop ICMP echo reply packets inline.

The server and PCs have been preconfigured. The routers have also been preconfigured with the following:

- Enable password: **ciscoenpa55**
- Console password: **ciscoconpa55**
- SSH username and password: **SSHadmin** / **ciscosshpa55**
- OSPF 101

All the routers have been pre-configured with the following password and username and password (highlighted lines)

Router(config)#enable secret cisco
Router(config)#username admin secret admin-1
Router (config)#exit
Router>en
Password: cisco
Router#

Change the display setting of all the routers as R1,R2,R3 as well for PCs For all the routers

R2#config t
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#aaa new-model
R2(config)#aaa authentication login default local
R2(config)#line console 0
R2(config-line)#login authentication default
R2(config-line)#end
R2#
%SYS-5-CONFIG_I: Configured from console by console

R2#
R2#exit
User Access Verification
Username:
Username: admin
Password: admin-1
R2>en
Password: cisco
R2# config t
R2(Config)# ip domain-name ccnasecurity.com
R2(Config)# crypto key generate rsa
R2(Config)#aaa authentication login SSH-LOGIN local

R2(Config)#line vty 0 4
R2(Config-line)#login authentication
SSH-LOGIN R2(Config-line)#end
R2#

Step 2: Access R2 using SSH.

a. From the **PC-C** command prompt, SSH to the S0/0/1 interface on **R2** at **10.2.2.2**. Use the username **Admin** and password **Adminpa55** to log in. `PC>` **`ssh -l Admin 10.2.2.2`**

b. Exit the SSH session. On PC-C command prompt C:\> ssh – l admin 10.2.2.2
Password: admin-1
R2>

Part 1: Enable IOS IPS

Note: Within Packet Tracer, the routers already have the signature files imported and in place. They are the default xml files in flash. For this reason, it is not necessary to configure the public crypto key and complete a manual import of the signature files.

Step 1: Enable the Security Technology package.

a. On **R1**, issue the **show version** command to view the Technology Package license information.
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#
```

b. If the Security Technology package has not been enabled, use the following command to enable the package.
`R1(config)#` **`license boot module c1900 technology-package securityk9`**

c. Accept the end user license agreement.==== Accept(Yes/No)? yes

d. Save the running-config and reload the router to enable the security license.

R1(config) # do copy run start
R1# reload
R1> en
Password: cisco
R1#

e. Verify that the Security Technology package has been enabled by using the **show version** command.

R1# show version

Step 2: Verify network connectivity.

a. Ping from **PC-C** to **PC-A**. The ping should be successful.

b. Ping from **PC-A** to **PC-C**. The ping should be successful.

Step 3: Create an IOS IPS configuration directory in flash.

On **R1**, create a directory in flash using the **mkdir** command. Name the directory **ipsdir**.

```
R1# mkdir ipsdir
Create directory filename [ipsdir]? <Enter>
Created dir flash:ipsdir
```

Step 4: Configure the IPS signature storage location.

On **R1**, configure the IPS signature storage location to be the directory you just created.

```
R1(config)# ip ips config location flash:ipsdir
```

Step 5: Create an IPS rule.

On **R1**, create an IPS rule name using the **ip ips name** *name* command in global configuration mode. Name the IPS rule **iosips**.

```
R1(config)# ip ips name iosips
```

Step 6: Enable logging.

IOS IPS supports the use of syslog to send event notification. Syslog notification is enabled by default. If logging console is enabled, IPS syslog messages display. a. Enable syslog if it is not enabled.

```
R1(config)# ip ips notify log
```

from privileged EXEC mode to reset the clock. `R1#`

```
clock set 10:20:00 10 january 2014
```

c. Verify that the timestamp service for logging is enabled on the router using the **show run** command.
Enable the timestamp service if it is not enabled.

```
R1(config)# service timestamps log datetime msec
```

d. Send log messages to the syslog server at IP address 192.168.1.50. `R1(config)#`

```
logging host 192.168.1.50
```

Step 7: Configure IOS IPS to use the signature categories.

Retire the **all** signature category with the **retired true** command (all signatures within the signature release). Unretire the **IOS_IPS Basic** category with the **retired false** command. `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-cateogry)# exit
Do you want to accept these changes? [confirm] <Enter>
```

Step 8: Apply the IPS rule to an interface.

Apply the IPS rule to an interface with the **ip ips name** *direction* command in interface configuration mode. Apply the rule outbound on the G0/1 interface of **R1**. After you enable IPS, some log messages will be sent to the console line indicating that the IPS engines are being initialized.

Note: The direction **in** means that IPS inspects only traffic going into the interface. Similarly, **out** means that IPS inspects only traffic going out of the interface.

```
R1(config)# interface g0/1
R1(config-if)# ip ips iosips out
```

Part 2: Modify the Signature

Step 1: Change the event-action of a signature.

Un-retire the echo request signature (signature 2004, subsig ID 0), enable it, and change the signature action to alert and drop.

```
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)# 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)# exit
Do you want to accept these changes? [confirm] <Enter>
```

Step 2: Use show commands to verify IPS.

Use the **show ip ips all** command to view the IPS configuration status summary.

To which interfaces and in which direction is the **iosips** rule applied?

____

G0/1 outbound.

Step 3: Verify that IPS is working properly.

a. From **PC-C**, attempt to ping **PC-A**. Were the pings successful? Explain.

   The pings should fail. This is because the IPS rule for event-action of an echo request was set to "deny-packet-
   inline".

b. From **PC-A**, attempt to ping **PC-C**. Were the pings successful? Explain.

   The ping should be successful. This is because the IPS rule does not cover echo reply. When PC-A pings PC-C, PC-C responds with an echo reply.

Step 4: View the syslog messages.

a. Click the **Syslog** server.

b. Select the **Services** tab.

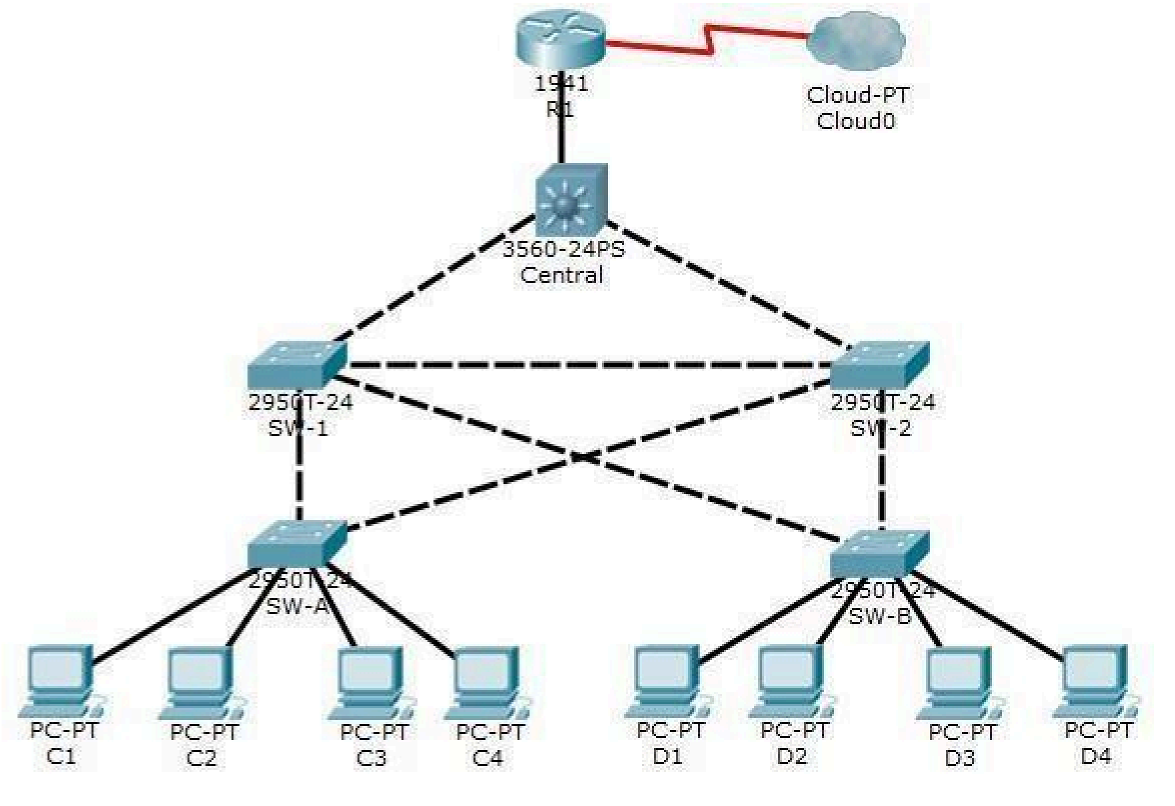
c. In the left navigation menu, select **SYSLOG** to view the log file.

Step 5: Check results.

Your completion percentage should be 100%. Click **Check Results** to see feedback and verification of which required components have been completed.

Practical 8: Packet Tracer - Layer 2 Security

Topology



Device	Interface	IP Address	Subnet Mask	Default Gateway
R1	G0/1	10.1.1.1	255.0.0.0	N/A
	S0/0/0	209.165.200.1	255.255.255.0	N/A
C1	fa0/1	10.1.1.10	255.0.0.0.0	10.1.1.1
C2	fa0/2	10.1.1.11	255.0.0.0.0	10.1.1.1
C3	fa0/3	10.1.1.12	255.0.0.0.0	10.1.1.1
C4	fa0/4	10.1.1.13	255.0.0.0.0	10.1.1.1
D1	fa0/1	10.1.1.14	255.0.0.0.0	10.1.1.1
D2	fa0/2	10.1.1.15	255.0.0.0.0	10.1.1.1
D3	fa0/3	10.1.1.16	255.0.0.0.0	10.1.1.1
D4	fa0/4	10.1.1.17	255.0.0.0.0	10.1.1.1

Objectives

- Assign the Central switch as the root bridge.
- Secure spanning-tree parameters to prevent STP **(spanning tree protocol)** manipulation attacks.

- Enable port security to prevent CAM table overflow attacks.

Background / Scenario

There have been a number of attacks on the network recently. For this reason, the network administrator has assigned you the task of configuring Layer 2 security.

For optimum performance and security, the administrator would like to ensure that the root bridge is the 3560 Central switch. To prevent spanning-tree manipulation attacks, the administrator wants to ensure that the STP parameters are secure. To prevent against CAM table overflow attacks, the network administrator has decided to configure port security to limit the number of MAC addresses each switch port can learn. If the number of MAC addresses exceeds the set limit, the administrator would like the port to be shutdown. All switch devices have been preconfigured with the following:

- Enable password: **ciscoenpa55** ○ Console password:

  ciscoconpa55

- SSH username and password: **SSHadmin** / **ciscosshpa55**

Part 1: Configure Root Bridge

Step 1: Determine the current root bridge.

From **Central**, issue the **show spanning-tree** command to determine the current root bridge, to see the ports in use, and to see their status.

Which switch is the current root bridge?

____

Current root is SW-1.

Based on the current root bridge, what is the resulting spanning tree? (Draw the spanning-tree topology.)

Step 2: Assign Central as the primary root bridge. Using the **spanning-tree vlan 1 root primary** command, and assign **Central** as the root bridge.

```
Central(config)# spanning-tree vlan 1 root primary
```

Step 3: Assign SW-1 as a secondary root bridge. Assign **SW-1** as the secondary root bridge using the **spanning-tree vlan 1 root secondary** command.

```
SW-1(config)# spanning-tree vlan 1 root secondary
```

Step 4: Verify the spanning-tree configuration. Issue the **show spanning-tree** command to verify that **Central** is the root bridge.

```
Central# show spanning-tree VLAN0001
   Spanning tree enabled protocol ieee
   Root ID  Priority      24577
            Address       00D0.D31C.634C
            This bridge  is the root
            Hello Time  2 sec  Max Age  20 sec   Forward Delay  15 sec
```

Which switch is the current root bridge?

____

Current root is Central

Based on the new root-bridge, what is the resulting spanning tree? (Draw the spanning-tree topology.)

Part 2: Protect Against STP Attacks

Secure the STP parameters to prevent STP manipulation attacks.

Step 1: Enable PortFast on all access ports.

PortFast is configured on access ports that connect to a single workstation or server to enable them to become active more quickly. On the connected access ports of the **SW-A** and **SW-B**, use the **spanning-tree portfast** command.

```
SW-A(config)# interface range f0/1 - 4
SW-A(config-if-range)# spanning-tree portfast
```

```
SW-B(config)# interface range f0/1 - 4
SW-B(config-if-range)# spanning-tree portfast
```

Step 2: Enable BPDU Bridge Protocol Data Unit guard on all access ports

BPDU guard is a feature that can help prevent rogue switches and spoofing on access ports. Enable BPDU guard on **SW-A** and **SW-B** access ports.

```
SW-A(config)# interface range f0/1 - 4
SW-A(config-if-range)# spanning-tree bpduguard enable

SW-B(config)# interface range f0/1 - 4
SW-B(config-if-range)# spanning-tree bpduguard enable
```

Note: Spanning-tree BPDU guard can be enabled on each individual port using the **spanning-tree bpduguard enable** command in interface configuration mode or the **spanning-tree portfast bpduguard default** command in global configuration mode. For grading purposes in this activity, please use the **spanning-tree bpduguard enable** command.

Step 3: Enable root guard.

Root guard can be enabled on all ports on a switch that are not root ports. It is best deployed on ports that connect to other non-root switches. Use the **show spanning-tree** command to determine the location of the root port on each switch.

On **SW-1**, enable root guard on ports F0/23 and F0/24. On **SW-2**, enable root guard on ports F0/23 and F0/24.

```
SW-1(config)# interface range f0/23 - 24
SW-1(config-if-range)# spanning-tree guard root

SW-2(config)# interface range f0/23 - 24
SW-2(config-if-range)# spanning-tree guard root
```

Part 3: Configure Port Security and Disable Unused Ports

Step 1: Configure basic port security on all ports connected to host devices.

This procedure should be performed on all access ports on **SW-A** and **SW-B**. Set the maximum number of learned MAC addresses to **2**, allow the MAC address to be learned dynamically, and set the violation to **shutdown**. **Note**: A switch port must be configured as an access port to enable port security.

```
SW-A(config)# interface range f0/1 - 22
SW-A(config-if-range)# switchport mode access
SW-A(config-if-range)# switchport port-security
SW-A(config-if-range)# switchport port-security maximum 2
SW-A(config-if-range)# switchport port-security violation shutdown
SW-A(config-if-range)# switchport port-security mac-address sticky

SW-B(config)# interface range f0/1 - 22
```

```
SW-B(config-if-range)# switchport mode access
SW-B(config-if-range)# switchport port-security
SW-B(config-if-range)# switchport port-security maximum 2
SW-B(config-if-range)# switchport port-security violation shutdown
SW-B(config-if-range)# switchport port-security mac-address stick
```

Why is port security not enabled on ports that are connected to other switch devices?

Ports connected to other switch devices have a multitude of MAC addresses learned for that single port. Limiting the number of MAC addresses that can be learned on these ports can significantly impact network functionality.

Step 2: Verify port security.

a. On **SW-A**, issue the command **show port-security interface f0/1** to verify that port security has been configured.

```
SW-A# show port-security interface f0/1
Port Security              : Enabled
Port Status                : Secure-up
Violation Mode             : Shutdown
Aging Time                 : 0 mins
Aging Type                 : Absolute
SecureStatic Address Aging : Disabled
Maximum MAC Addresses      : 2
Total MAC Addresses        : 0
Configured MAC Addresses   : 0
Sticky MAC Addresses       : 0
Last Source Address:Vlan   : 0000.0000.0000:0
Security Violation Count   : 0
```

b. Ping from **C1** to **C2** and issue the command **show port-security interface f0/1** again to verify that the switch has learned the MAC address for **C1**.

Step 3: Disable unused ports.

Disable all ports that are currently unused.

```
SW-A(config)# interface range f0/5 - 22
SW-A(config-if-range)# shutdown

SW-B(config)# interface range f0/5 - 22
SW-B(config-if-range)# shutdown
```

Step 4: Check results.

Your completion percentage should be 100%. Click **Check Results** to view feedback and verification of which of the required components have been completed.

Rewrite the script of switch A,B, central switch, SW-1-2

Practical 9: Layer 2 VLAN Security

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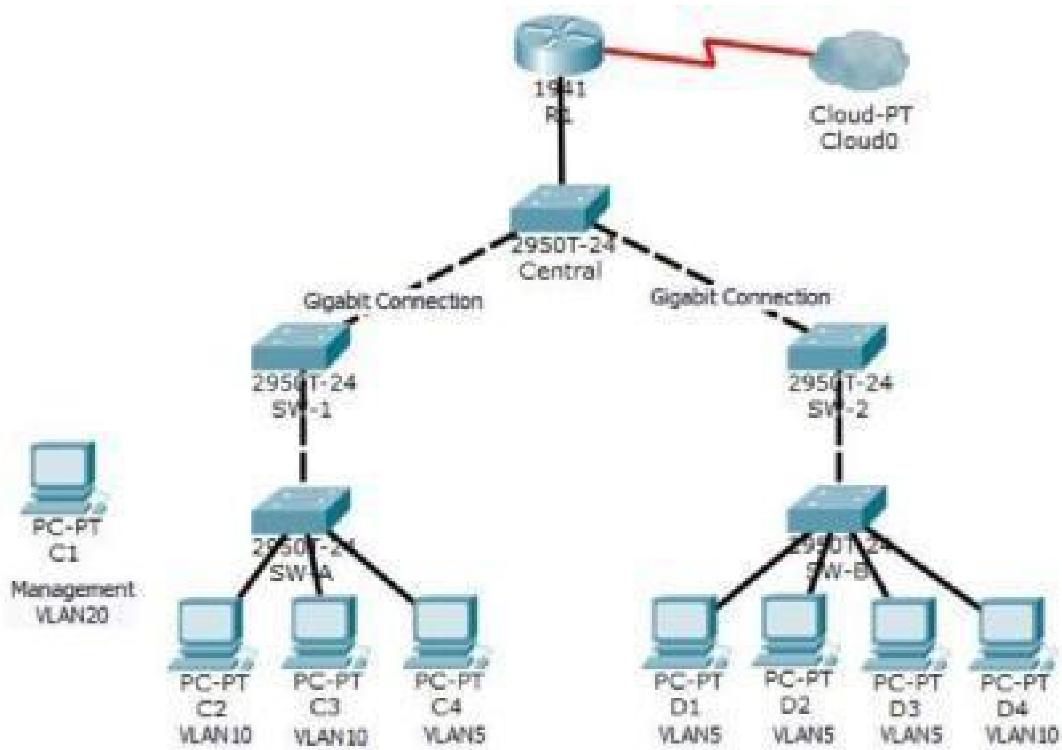
Topology



Objectives

- Connect a new redundant link between SW-1 and SW-2.
- Enable trunking and configure security on the new trunk link between SW-1 and SW-2.
- Create a new management VLAN (VLAN 20) and attach a management PC to that VLAN.
- Implement an ACL to prevent outside users from accessing the management VLAN.

Background / Scenario

A company's network is currently set up using two separate VLANs: VLAN 5 and VLAN 10. In addition, all trunk ports are configured with native VLAN 15. A network administrator wants to add a redundant link between switch SW-1 and SW-2. The link must have trunking enabled and all security requirements should be in place.

In addition, the network administrator wants to connect a management PC to switch SW-A. The administrator would like to enable the management PC to connect to all switches and the router, but does not want any other devices to connect to the management PC or the switches. The administrator would like to create a new VLAN 20 for management purposes.

All devices have been preconfigured with: ○

Enable secret password: **ciscoenpa55** ○

Console password: **ciscoconpa55**

○ SSH username and password: **SSHadmin** / **ciscosshpa55** **Part**

1: Verify Connectivity

Step 1: Verify connectivity between C2 (VLAN 10) and C3 (VLAN 10).
Step 2: Verify connectivity between C2 (VLAN 10) and D1 (VLAN 5).

Note: If using the simple PDU GUI packet, be sure to ping twice to allow for ARP.

Part 2: Create a Redundant Link Between SW-1 and SW-2

Step 1: Connect SW-1 and SW-2.

Using a crossover cable, connect port F0/23 on **SW-1** to port F0/23 on **SW-2**.

Step 2: Enable trunking, including all trunk security mechanisms on the link between SW-1 and SW-2.

Trunking has already been configured on all pre-existing trunk interfaces. The new link must be configured for trunking, including all trunk security mechanisms. On both **SW-1** and **SW-2**, set the port to trunk, assign native VLAN 15 to the trunk port, and disable auto-negotiation.

```
SW-1(config)# interface f0/23
SW-1(config-if)# switchport mode trunk
SW-1(config-if)# switchport trunk native vlan 15
SW-1(config-if)# switchport nonegotiate
SW-1(config-if)# no shutdown

SW-2(config)# interface f0/23
SW-2(config-if)# switchport mode trunk
SW-2(config-if)# switchport trunk native vlan 15
SW-2(config-if)# switchport nonegotiate
SW-2(config-if)# no shutdown
```

Part 3: Enable VLAN 20 as a Management VLAN

The network administrator wants to access all switch and routing devices using a management PC. For security purposes, the administrator wants to ensure that all managed devices are on a separate VLAN.

Step 1: Enable a management VLAN (VLAN 20) on SW-A.

a. Enable VLAN 20 on **SW-A**.

```
SW-A(config)# vlan 20
SW-A(config-vlan)#
exit
```

b. Create an interface VLAN 20 and assign an IP address within the 192.168.20.0/24 network.

```
SW-A(config)# interface vlan 20
SW-A(config-if)# ip address 192.168.20.1 255.255.255.0
```

Step 2: Enable the same management VLAN on all other switches.

a. Create the management VLAN on all switches: **SW-B**, **SW-1**, **SW-2**, and **Central**.

```
SW-B(config)# vlan 20
SW-B(config-vlan)# exit

SW-1(config)# vlan 20
SW-1(config-vlan)# exit

SW-2(config)# vlan 20
SW-2(config-vlan)# exit

Central(config)# vlan 20
```

```
Central(config-vlan)# exit
```

b. Create an interface VLAN 20 on all switches and assign an IP address within the 192.168.20.0/24 network.

```
SW-B(config)# interface vlan 20
SW-B(config-if)# ip address 192.168.20.2  255.255.255.0

SW-1(config)# interface vlan 20
SW-1(config-if)# ip address 192.168.20.3  255.255.255.0

SW-2(config)# interface vlan 20
SW-2(config-if)# ip address 192.168.20.4  255.255.255.0

Central(config)# interface vlan 20 Central(config-if)#
ip address 192.168.20.5 255.255.255.0
```

Step 3: Connect and configure the management PC.

Connect the management PC to **SW-A** port F0/1 and ensure that it is assigned an available IP address within the 192.168.20.0/24 network.

Step 4: On SW-A, ensure the management PC is part of VLAN 20. Interface

F0/1 must be part of VLAN 20.

```
SW-A(config)# interface f0/1
SW-A(config-if)# switchport access vlan 20 SW-A(config-
if)# no shutdown
```

Step 5: Verify connectivity of the management PC to all switches.

The management PC should be able to ping **SW-A**, **SW-B**, **SW-1**, **SW-2**, and **Central**.

Part 4: Enable the Management PC to Access Router R1

Step 1: Enable a new subinterface on router R1.

a. Create subinterface g0/0.3 and set encapsulation to dot1q 20 to account for VLAN 20.

```
R1(config)# interface g0/0.3 R1(config-
subif)# encapsulation dot1q 20
```

b. Assign an IP address within the 192.168.20.0/24 network.

```
R1(config)# interface g0/0.3
R1(config-subif)# ip address 192.168.20.100 255.255.255.0
```

Step 2: Verify connectivity between the management PC and R1.

Be sure to configure the default gateway on the management PC to allow for connectivity.

Step 3: Enable security.

While the management PC must be able to access the router, no other PC should be able to access the management VLAN.

a. Create an ACL that allows only the Management PC to access the router. Example: (may vary from student configuration)

```
R1(config)# access-list 101 deny ip any 192.168.20.0
0.0.0.255 R1(config)# access-list 101 permit ip any any

R1(config)# access-list 102 permit ip host 192.168.20.50 any
```

b. Apply the ACL to the proper interface(s).

Example: (may vary from student configuration)

```
R1(config)# interface g0/0.1 R1(config-subif)# ip access-group 101 in
R1(config-subif)# interface g0/0.2
R1(config-subif)# ip access-group 101
in R1(config-subif)# line vty 0 4
R1(config-line)# access-class 102 in
```

Note: Access list 102 is used to only allow the Management PC (192.168.20.50 in this example) to access the router. This prevents an IP address change to bypass the ACL.

Note: There are multiple ways in which an ACL can be created to accomplish the necessary security. For this reason, grading on this portion of the activity is based on the correct connectivity requirements. The management PC must be able to connect to all switches and the router. All other PCs should not be able to connect to any devices within the management VLAN.

Step 4: Verify security.

a. Verify only the Management PC can access the router. Use SSH to access **R1** with username **SSHadmin** and password **ciscosshpa55**.

```
PC> ssh -l SSHadmin 192.168.20.100
```

b. From the management PC, ping **SW-A**, **SW-B**, and **R1**. Were the pings successful? Explain.

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The pings should have been successful because all devices within the 192.168.20.0 network should be able to ping one another. Devices within VLAN20 are not required to route through the router.

c. From **D1**, ping the management PC. Were the pings successful? Explain.

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The ping should have failed because for a device within a different VLAN to successfully ping a device within VLAN20, it must be routed. The router has an ACL that prevents all packets from accessing the 192.168.20.0 network.

Step 5: Check results.

Your completion percentage should be 100%. Click **Check Results** to view feedback and verification of which required components have been completed.

If all components appear to be correct and the activity still shows incomplete, it could be due to the connectivity tests that verify the ACL operation.

Rewrite the scrip of switches SW-A-B-1-2

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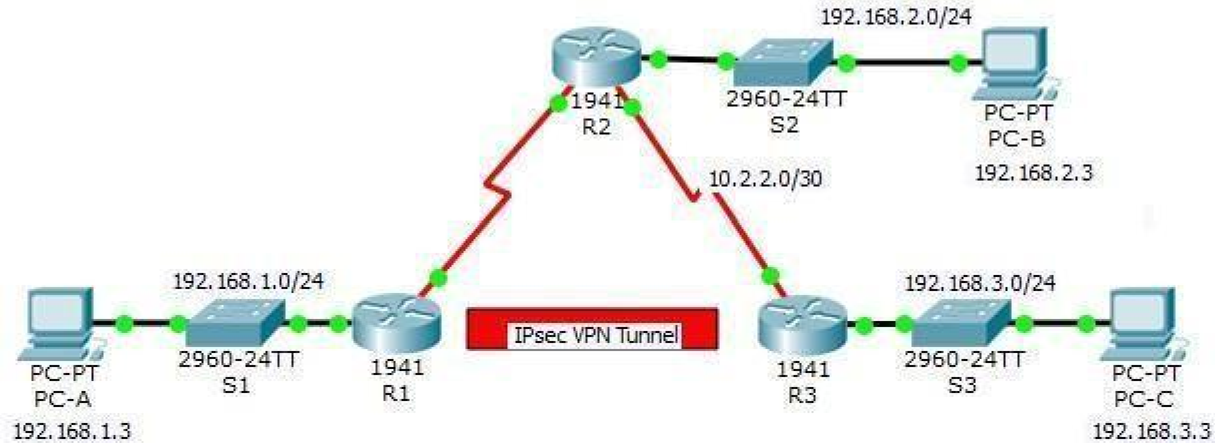
Pr actical 10: Configure and Verify a Site-to-Site IPsec VPN Using CLI

Topology



Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway	Switch Port
R1	G0/0	192.168.1.1	255.255.255.0	N/A	S1 F0/1
	S0/0/0 (DCE)	10.1.1.2	255.255.255.252	N/A	N/A
R2	G0/0	192.168.2.1	255.255.255.0	N/A	S2 F0/2
	S0/0/0	10.1.1.1	255.255.255.252	N/A	N/A
	S0/0/1 (DCE)	10.2.2.1	255.255.255.252	N/A	N/A
R3	G0/0	192.168.3.1	255.255.255.0	N/A	S3 F0/5
	S0/0/1	10.2.2.2	255.255.255.252	N/A	N/A
PC-A	NIC	192.168.1.3	255.255.255.0	192.168.1.1	S1 F0/2
PC-B	NIC	192.168.2.3	255.255.255.0	192.168.2.1	S2 F0/1
PC-C	NIC	192.168.3.3	255.255.255.0	192.168.3.1	S3 F0/18

Objectives

- Verify connectivity throughout the network.
- Configure R1 to support a site-to-site IPsec VPN with R3.

Background / Scenario

The network topology shows three routers. Your task is to configure R1 and R3 to support a site-to-site IPsec VPN when traffic flows between their respective LANs. The IPsec VPN tunnel is from R1 to R3 via R2. R2 acts as a pass-through and has no knowledge of the VPN. IPsec provides secure transmission of sensitive information over unprotected networks, such as the Internet. IPsec operates at the network layer and protects and authenticates IP packets between participating IPsec devices (peers), such as Cisco routers. **ISAKMP Internet security Association and key Management Protocol- Phase 1 Policy Parameters**

Parameters		R1	R3
Key Distribution Method	Manual or **ISAKMP**	**ISAKMP**	**ISAKMP**

Encryption Algorithm	**DES**, 3DES, or AES	AES 256	AES 256
Hash Algorithm	MD5 or **SHA-1**	**SHA-1**	**SHA-1**
Authentication Method	Pre-shared keys or **RSA**	pre-share	pre-share
Key Exchange	DH Group 1, 2, or 5	DH 5	DH 5
IKE SA Lifetime	86400 seconds or less	**86400**	**86400**
ISAKMP Key		vpnpa55	vpnpa55

Note: Bolded parameters are defaults. Only unbolded parameters have to be explicitly configured. **IPsec Phase 2 Policy Parameters**

Parameters	R1	R3
Transform Set Name	VPN-SET	VPN-SET
ESP Transform Encryption	esp-aes	esp-aes
ESP Transform Authentication	esp-sha-hmac	esp-sha-hmac
Peer IP Address	10.2.2.2	10.1.1.2
Traffic to be Encrypted	access-list 110 (source 192.168.1.0 dest 192.168.3.0)	access-list 110 (source 192.168.3.0 dest 192.168.1.0)
Crypto Map Name	VPN-MAP	VPN-MAP
SA Establishment	ipsec-isakmp	ipsec-isakmp

The routers have been pre-configured with the following:

- Password for console line: **ciscoconpa55**
- Password for vty lines: **ciscovtypa55**
- Enable password: **ciscoenpa55**
- SSH username and password: **SSHadmin / ciscosshpa55**
- OSPF 101

Configure the topology with the above information using last practical setup

Part 1: Configure IPsec Parameters on R1

Step 1: Test connectivity. (perform OSPF configuration on each router)

Ping from PC-A to PC-C.

Step 2: Enable the Security Technology package.

a. On R1, issue the **show version** command to view the Security Technology package license information.
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#
```

b. If the Security Technology package has not been enabled, use the following command to enable the package.

   R1(config)# **license boot module c1900 technology-package securityk9**

c. Accept the end-user license agreement.

d. Save the running-config and reload the router to enable the security license.

   R1(config) # do copy run start
   R1# reload
   R1> en
   Password: cisco
   R1#

e. Verify that the **Security Technology package has been enabled** by using the **show version** command.

   R1# show version

Step 3: Identify interesting traffic on R1.

Configure ACL 110 to identify the traffic from the LAN on R1 to the LAN on R3 as interesting. This interesting traffic will trigger the IPsec VPN to be implemented when there is traffic between the R1 to R3 LANs. All other traffic sourced from the LANs will not be encrypted. Because of the implicit **deny all**, there is no need to configure a **deny ip any any** statement.

R1(config)# **access-list 110 permit ip 192.168.1.0 0.0.0.255 192.168.3.0 0.0.0.255**

Step 4: Configure the IKE Phase 1 ISAKMP policy on R1.

Configure the **crypto ISAKMP policy 10** properties on R1 along with the shared crypto key **vpnpa55**. Refer to the ISAKMP Phase 1 table for the specific parameters to configure. Default values do not have to be configured. Therefore, only the encryption method, key exchange method, and DH method must be configured.

Note: The highest DH group currently supported by Packet Tracer is group 5. In a production network, you would configure at least DH 14.

```
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 vpnpa55 address 10.2.2.2
```

Step 5: Configure the IKE Phase 2 IPsec policy on R1.

a. Create the transform-set VPN-SET to use **esp-aes** and **esp-sha-hmac**.

   R1(config)# **crypto ipsec transform-set VPN-SET esp-aes esp-sha-hmac**

b. Create the crypto map VPN-MAP that binds all of the Phase 2 parameters together. Use sequence number 10 and identify it as an ipsec-isakmp map.

```
R1(config)# crypto map VPN-MAP 10 ipsec-isakmp
R1(config-crypto-map)# description VPN connection to R3
R1(config-crypto-map)# set peer 10.2.2.2
R1(config-crypto-map)# set transform-set VPN-SET
R1(config-crypto-map)# match address 110
R1(config-crypto-map)# exit
```

Step 6: Configure the crypto map on the outgoing interface.

Bind the **VPN-MAP** crypto map to the outgoing Serial 0/0/0 interface.

```
R1(config)# interface s0/0/0
R1(config-if)# crypto map VPN-MAP
```

Part 2: Configure IPsec Parameters on R3

Step 1: Enable the Security Technology package.

a. On R3, issue the **show version** command to verify that the Security Technology package license information has been enabled.
R3# show version

b. If the Security Technology package has not been enabled, enable the package and reload R3. R1(config) # do copy run start
R1# reload
R1> en
Password: cisco
R1#

c. R1# show crypto ipsecsa

Step 2: Configure router R3 to support a site-to-site VPN with R1.

Configure reciprocating parameters on R3. Configure ACL 110 identifying the traffic from the LAN on R3 to the LAN on R1 as interesting.

```
R3(config)# access-list 110 permit ip 192.168.3.0 0.0.0.255
192.168.1.0 0.0.0.255
```

Step 3: Configure the IKE Phase 1 ISAKMP properties on R3. Configure the crypto ISAKMP

policy 10 properties on R3 along with the shared crypto key vpnpa55.

```
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 vpnpa55 address 10.1.1.2
```

Step 4: Configure the IKE Phase 2 IPsec policy on R3.

a. Create the transform-set VPN-SET to use **esp-aes** and **esp-sha-hmac**.

```
R3(config)# crypto ipsec transform-set VPN-SET esp-aes esp-sha-hmac
```

b. Create the crypto map VPN-MAP that binds all of the Phase 2 parameters together. Use sequence number 10 and identify it as an ipsec-isakmp map.

```
R3(config)# crypto map VPN-MAP 10 ipsec-isakmp
R3(config-crypto-map)# description VPN connection to R1
R3(config-crypto-map)# set peer 10.1.1.2
R3(config-crypto-map)# set transform-set VPN-SET
R3(config-crypto-map)# match address 110
 R3(config-crypto-map)# exit
```

Step 5: Configure the crypto map on the outgoing interface. Bind the VPN-MAP crypto map to the outgoing Serial 0/0/1 interface. **Note**: This is not graded.

```
R3(config)# interface s0/0/1
R3(config-if)# crypto map VPN-MAP
```

Part 3: Verify the IPsec VPN

Step 1: Verify the tunnel prior to interesting traffic.

Issue the **show crypto ipsec sa** command on R1. Notice that the number of packets encapsulated, encrypted, decapsulated, and decrypted are all set to 0.

Step 2: Create interesting traffic.

Ping PC-C from PC-A.

Step 3: Verify the tunnel after interesting traffic.

On R1, re-issue the **show crypto ipsec sa** command. Notice that the number of packets is more than 0, which indicates that the IPsec VPN tunnel is working.

Step 4: Create uninteresting traffic.

Ping PC-B from PC-A. **Note**: Issuing a ping from router R1 to PC-C or R3 to PC-A is not interesting traffic.

Step 5: Verify the tunnel.

On R1, re-issue the **show crypto ipsec sa** command. Notice that the number of packets has not changed, which verifies that uninteresting traffic is not encrypted.

Step 6: Check results.

Your completion percentage should be 100%. Click **Check Results** to see feedback and verification of which required components have been completed.

Rewrite the script of R1

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