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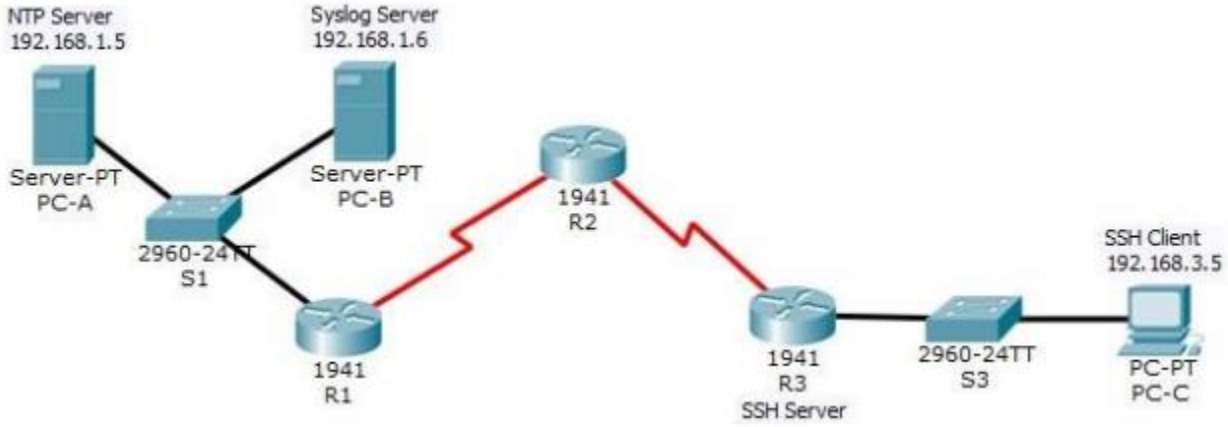
a	Assign the Central switch as the root bridge.			
b	Secure spanning-tree parameters to prevent STP manipulation attacks.			
c	Enable port security to prevent CAM table overflow attacks.			

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. 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.

!!!Scripts for R1!!!!

```
conf  t  interface
s0/0/0

 ip ospf message-digest-key 1 md5 MD5pa55
router ospf 1

area 0 authentication message-digest
service timestamps log datetime msec
logging 192.168.1.6

ntp server 192.168.1.5 ntp update-
calendar

ntp authentication-key 1 md5 NTPpa55
ntp authenticate ntp trusted-key 1
end
```

!!!Scripts for R2!!!!

```
conf  t  interface
s0/0/0

 ip ospf message-digest-key 1 md5 MD5pa55
interface s0/0/1

 ip ospf message-digest-key 1 md5 MD5pa55
router ospf 1

area 0 authentication message-digest
service timestamps log datetime msec
logging 192.168.1.6

ntp server 192.168.1.5 ntp update-
calendar

ntp authentication-key 1 md5 NTPpa55
ntp authenticate ntp trusted-key 1
```

```
end
```

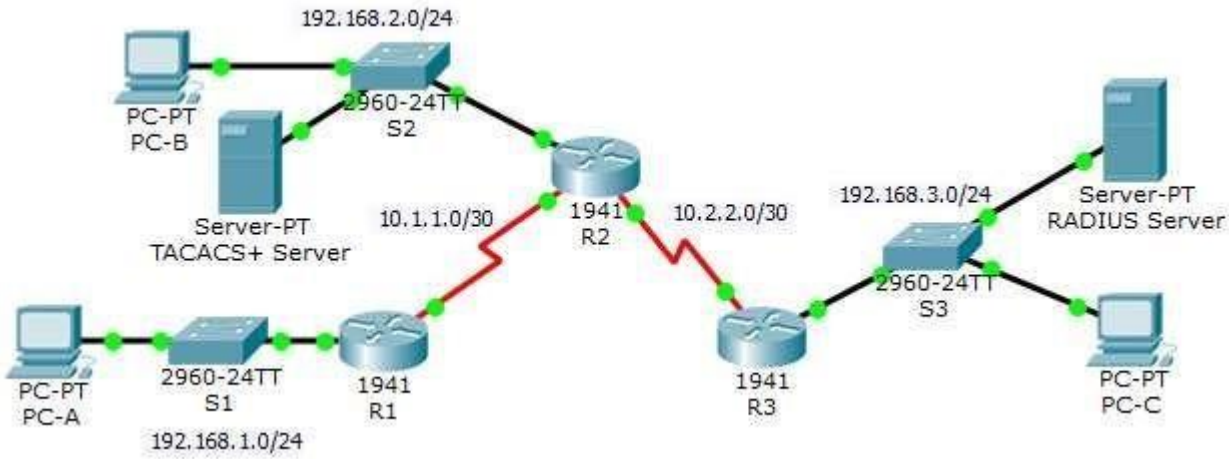
!!!Scripts for R3!!!!

```
conf  t  interface
s0/0/1

 ip ospf message-digest-key 1 md5 MD5pa55
router ospf 1

 area 0 authentication message-digest
service timestamps log datetime msec
logging 192.168.1.6

ntp server 192.168.1.5 ntp update-
calendar

ntp authentication-key 1 md5 NTPpa55 ntp
authenticate

ntp trusted-key 1

ip domain-name ccnasecurity.com username SSHadmin
privilege 15 secret ciscosshpa55  line vty 0 4
login local  transport input ssh crypto key
zeroize rsa crypto key generate rsa

1024 ip ssh time-out 90 ip ssh
authentication-retries 2

ip ssh version 2
end
```

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+.
- Verify server-based AAA authentication from the PC-B client.
- Configure server-based AAA authentication using RADIUS.
- 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**

You will then configure router R2 to support server-based authentication using the TACACS+ protocol. The TACACS+ server has been pre-configured with the following:

- Client: **R2** using the keyword **tacacspa55** ○ User account: **Admin2**

  and password **admin2pa55**

Finally, you will configure router R3 to support server-based authentication using the RADIUS protocol. The RADIUS server has been pre-configured with the following:

- Client: **R3** using the keyword **radiuspa55** ○ User account: **Admin3**

  and password **admin3pa55**

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.

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

```
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

```
Open

Password: admin1pa55
```

Part 3: Configure Server-Based AAA Authentication Using TACACS+ on R2

Step 1: Configure a backup local database entry called Admin.

For backup purposes, configure a local username of **Admin2** and a secret password of **admin2pa55**.

```
R2(config)# username Admin2 secret admin2pa55
```

Step 2: Verify the TACACS+ Server configuration.

Click the TACACS+ Server. On the Services tab, click **AAA**. Notice that there is a Network configuration entry for **R2** and a User Setup entry for **Admin2**.

Step 3: Configure the TACACS+ server specifics on R2.

Configure the AAA TACACS server IP address and secret key on **R2**.

Note: The commands **tacacs-server host** and **tacacs-server key** are deprecated. Currently, Packet Tracer does not support the new command **tacacs server**.

```
R2(config)# tacacs-server host 192.168.2.2 R2(config)#

tacacs-server key tacacspa55
```

Step 4: Configure AAA login authentication for console access on R2.

Enable AAA on **R2** and configure all logins to authenticate using the AAA TACACS+ server. If it is not available, then use the local database.

```
R2(config)# aaa new-model

R2(config)# aaa authentication login default group tacacs+ local
```

Step 5: Configure the line console to use the defined AAA authentication method.

Configure AAA authentication for console login to use the default AAA authentication method.

```
R2(config)# line console 0

R2(config-line)# login authentication default
```

Step 6: Verify the AAA authentication method

Verify the user EXEC login using the AAA TACACS+ server.

```
R2(config-line)# end

%SYS-5-CONFIG_I: Configured from console by console
R2# exit



R2 con0 is now available Press
RETURN to get started.
```

```
************ AUTHORIZED ACCESS ONLY *************
UNAUTHORIZED ACCESS TO THIS DEVICE IS PROHIBITED.
```

```
User Access Verification
```

```
Username: Admin2
Password: admin2pa55
R2>
```

Part 4: Configure Server-Based AAA Authentication Using RADIUS on R3

Step 1: Configure a backup local database entry called Admin.

For backup purposes, configure a local username of **Admin3** and a secret password of **admin3pa55**.

```
R3(config)# username Admin3 secret admin3pa55
```

Step 2: Verify the RADIUS Server configuration.

Click the RADIUS Server. On the Services tab, click **AAA**. Notice that there is a Network configuration entry for **R3** and a User Setup entry for **Admin3**.

Step 3: Configure the RADIUS server specifics on R3.

Configure the AAA RADIUS server IP address and secret key on **R3**.

Note: The commands **radius-server host** and **radius-server key** are deprecated. Currently Packet Tracer does not support the new command **radius server**.

```
R3(config)# radius-server host 192.168.3.2 R3(config)#

radius-server key radiuspa55
```

Step 4: Configure AAA login authentication for console access on R3.

Enable AAA on **R3** and configure all logins to authenticate using the AAA RADIUS server. If it is not available, then use the local database.

```
R3(config)# aaa new-model

R3(config)# aaa authentication login default group radius local
```

Step 5: Configure the line console to use the defined AAA authentication method.

Configure AAA authentication for console login to use the default AAA authentication method.

```
R3(config)# line console 0


R3(config-line)# login authentication default
```

Step 6: Verify the AAA authentication method.

Verify the user EXEC login using the AAA RADIUS server.

```
R3(config-line)# end

%SYS-5-CONFIG_I: Configured from console by console
R3# exit


R3 con0 is now available Press
RETURN to get started.


************ AUTHORIZED ACCESS ONLY *************
UNAUTHORIZED ACCESS TO THIS DEVICE IS PROHIBITED.




User Access Verification
```

```
Username: Admin3
Password: admin3pa55 R3>
```

Step 7: Check results.

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

!!!Script for R1

```
!!!Part 1 config t username Admin1
secret admin1pa55 aaa new-model aaa
authentication login default local
line console 0

 login authentication default

!!!Part 2

ip domain-name ccnasecurity.com crypto
key generate rsa

1024

aaa authentication login SSH-LOGIN local
line vty 0 4  login authentication SSH-
LOGIN  transport input ssh
```

!!!!Script for R2

```
conf t

username Admin2 secret admin2pa55
tacacs-server host 192.168.2.2
tacacs-server key tacacspa55 aaa
new-model

aaa authentication login default group tacacs+ local
line console 0  login authentication default
```

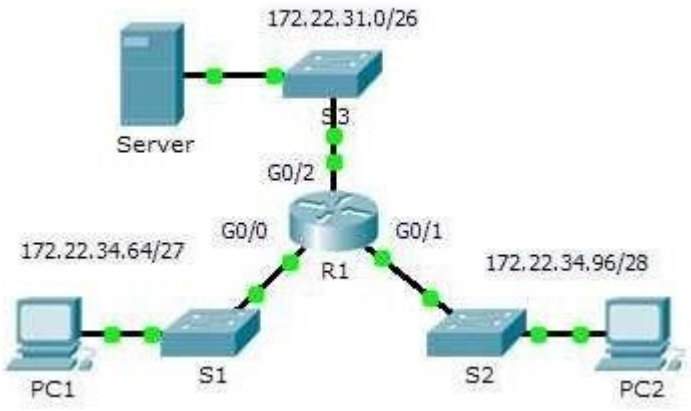
!!!!Script for R3

```
conf t username Admin3 secret admin3pa55 radius-
server host 192.168.3.2

radius-server key radiuspa55 aaa new-model aaa
authentication login default group radius local
line console 0 login authentication default
```

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.

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

  <100-199>  IP extended access list
```

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 ?

  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

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.

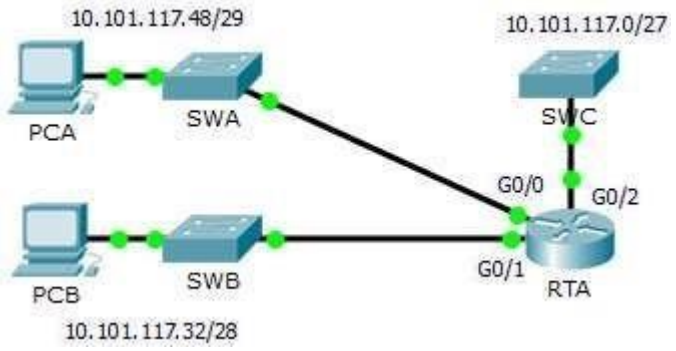
b. FTP from **PC2** to **Server**. The connection should fail.

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

Part 1: Configure, Apply and Verify an Extended Numbered ACL
Part 2: Reflection Questions

Background / Scenario

In this scenario, devices on one LAN are allowed to remotely access devices in another LAN using the SSH protocol. Besides ICMP, all traffic from other networks is denied.

The switches and router have also been pre-configured with the following:

- Enable secret password: **ciscoenpa55**
- Console password: **ciscoconpa55**
- Local username and password: **Admin** / **Adminpa55**

Packet Tracer - Configuring Extended ACLs - Scenario 2

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

Configure, apply and verify an ACL to satisfy the following policy:

- SSH traffic from devices on the 10.101.117.32/28 network is allowed to devices on the 10.101.117.0/27 networks.
- ICMP traffic is allowed from any source to any destination.
- All other traffic to 10.101.117.0/27 is blocked.

Step 1: Configure the extended ACL.

a. From the appropriate configuration mode on **RTA**, use the last valid extended access list number to configure the ACL. Use the following steps to construct the first ACL statement:

1) The last extended list number is 199.
2) The protocol is TCP.
3) The source network is 10.101.117.32.
4) The wildcard can be determined by subtracting 255.255.255.240 from 255.255.255.255.
5) The destination network is 10.101.117.0.
6) The wildcard can be determined by subtracting 255.255.255.224 from 255.255.255.255.
7) The protocol is SSH (port 22).

What is the first ACL statement?

```
access-list 199 permit tcp 10.101.117.32 0.0.0.15 10.101.117.0 0.0.0.31 eq 22
```

b. ICMP is allowed, and a second ACL statement is needed. Use the same access list number to permit all ICMP traffic, regardless of the source or destination address. What is the second ACL statement? (Hint: Use the **any** keywords)

```
access-list 199 permit icmp any any
```

c. All other IP traffic is denied, by default.

Step 2: Apply the extended ACL.

The general rule is to place extended ACLs close to the source. However, because access list 199 affects traffic originating from both networks 10.101.117.48/29 and 10.101.117.32/28, the best placement for this ACL might be on interface Gigabit Ethernet 0/2 in the outbound direction. What is the command to apply ACL 199 to the Gigabit Ethernet 0/2 interface?

```
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. If the pings are unsuccessful, verify the IP addresses before continuing.

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

PC> ssh -l Admin 10.101.117.2

c. Exit the SSH session to **SWC**.

d. Ping from **PCA** to all of the other IP addresses in the network. If the pings are unsuccessful, verify the IP addresses before continuing.

e. SSH from **PCA** to **SWC**. The access list causes the router to reject the connection.

Packet Tracer - Configuring Extended ACLs - Scenario 2

f. SSH from **PCA** to **SWB**. The access list is placed on **G0/2** and does not affect this connection. The username is **Admin**, and the password is **Adminpa55**.

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

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

Part 2: Reflection Questions

1. How was PCA able to bypass access list 199 and SSH to SWC?

   Two steps were used: First, PCA used SSH to access SWB. From SWB, SSH was allowed to SWC.

2. What could have been done to prevent PCA from accessing SWC indirectly, while allowing PCB SSH access to SWC?

   Because it was requested to block all traffic to 10.101.117.0/27 except SSH traffic originating from 10.101.117.32/28 the access list could be written as is. Instead of applying the ACL to G0/2 outbound apply the same ACL to both G0/0 and G0/1 inbound.

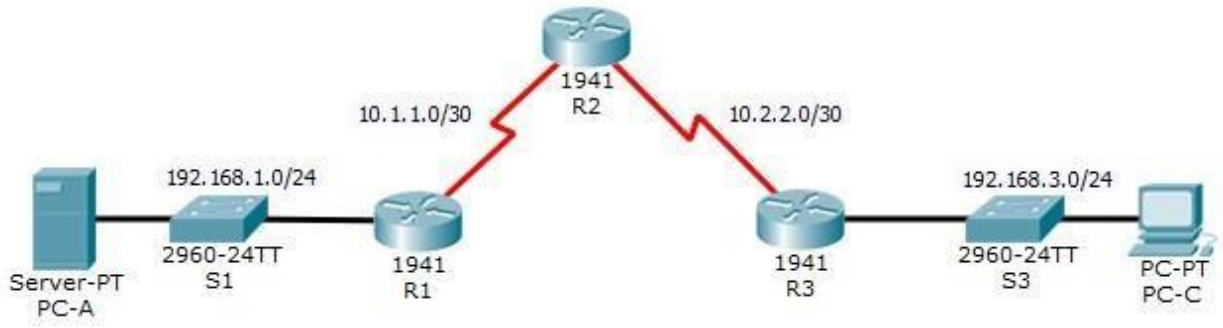
Suggested Scoring Rubric

Activity Section	Question Location	Possible Points	Earned Points
Part 1: Configure, Apply and Verify an Extended Numbered ACL	Step 1a	4	
	Step 1b	4	
	Step 2	4	
	Part 1 Total	**12**	
Part 2: Reflection Questions	Question 1	4	
	Question 2	4	
	Part 2 Total	**8**	
	Packet Tracer Score	**80**	
	Total Score	**100**	

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**
- SSH logon username and password:

SSHadmin/ciscosshpa55

- IP addressing
- Static routing

Part 1: Verify Basic Network Connectivity

Verify network connectivity prior to configuring the IP ACLs.

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

a. 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. **access-list 100 permit tcp 10.0.0.0**

```
R3(config)#
```

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.

!!!Script for R1

```
access-list 10 permit host 192.168.3.3
line vty 0 4

 access-class 10 in

access-list 120 permit udp any host 192.168.1.3 eq domain
access-list 120 permit tcp any host 192.168.1.3 eq smtp

access-list 120 permit tcp any host 192.168.1.3 eq ftp access-
list 120 deny tcp any host 192.168.1.3 eq 443 access-list 120
permit tcp host 192.168.3.3 host 10.1.1.1 eq 22 interface
s0/0/0  ip access-group 120 in

access-list 120 permit icmp any any echo-reply
access-list 120 permit icmp any any unreachable
access-list 120 deny icmp any any access-list
120 permit ip any any
```

!!!Script for R2

```
access-list 10 permit host 192.168.3.3
```

```
line vty 0 4


 access-class 10 in
```

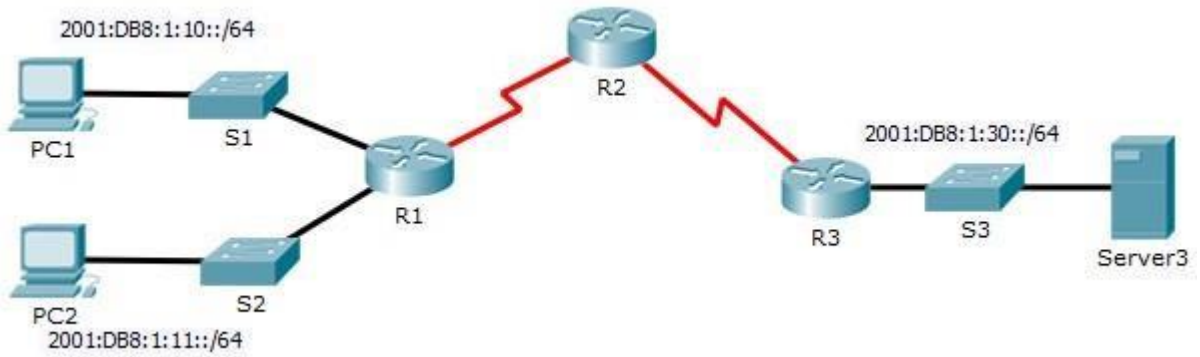
!!!Script for R3

```
access-list 10 permit host 192.168.3.3
line vty 0 4

 access-class 10 in

access-list 100 permit tcp 10.0.0.0 0.255.255.255 eq 22 host 192.168.3.3
access-list 100 deny ip 10.0.0.0 0.255.255.255 any access-list

100 deny ip 172.16.0.0 0.15.255.255 any access-list 100 deny
ip 192.168.0.0 0.0.255.255 any access-list 100 deny ip

127.0.0.0 0.255.255.255 any access-list 100 deny ip 224.0.0.0
15.255.255.255 any

access-list 100


permit ip any any interface s0/0/1
ip access-group 100 in

access-list 110 permit ip 192.168.3.0 0.0.0.255 any
interface g0/1  ip access-group 110 in
```

Practical 5

Configuring IPv6 ACLs

Topology



Addressing Table

Device	Interface	IPv6 Address/Prefix	Default Gateway
Server3	NIC	2001:DB8:1:30::30/64	FE80::30

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.

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

Configure an ACL named **BLOCK_HTTP** on **R1** with the following statements. a.

Block HTTP and HTTPS traffic from reaching **Server3**.

```
R1(config)# deny tcp any host 2001:DB8:1:30::30 eq www

R1(config)# deny tcp any host 2001:DB8:1:30::30 eq 443
```

b. Allow all other IPv6 traffic to pass.

```
R1(config)# permit ipv6 any any
```

Step 2: Apply the ACL to the correct interface. Apply the ACL on the interface closest to the source of the traffic to be blocked.

```
R1(config)# interface GigabitEthernet0/1

R1(config-if)# ipv6 traffic-filter BLOCK_HTTP in
```

Step 3: Verify the ACL implementation.

Verify that the ACL is operating as intended by conducting the following tests:

- Open the **web browser** of **PC1** to http://2001:DB8:1:30::30 or https://2001:DB8:1:30::30. The website should appear.
- Open the **web browser** of **PC2** to http://2001:DB8:1:30::30 or https://2001:DB8:1:30::30. The website should be blocked.
- Ping from **PC2** to 2001:DB8:1:30::30. The ping should be successful.

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

The logs now indicate that your server is receiving pings from many different IPv6 addresses in a Distributed Denial of Service (DDoS) attack. You must filter ICMP ping requests to your server.

Step 1: Create an access list to block ICMP.

Configure an ACL named **BLOCK_ICMP** on **R3** with the following statements: a.

Block all ICMP traffic from any hosts to any destination.

```
R3(config)# deny icmp any any
```

b. Allow all other IPv6 traffic to pass.

```
R3(config)# permit ipv6 any any
```

Step 2: Apply the ACL to the correct interface.

In this case, ICMP traffic can come from any source. To ensure that ICMP traffic is blocked, regardless of its source or any changes that occur to the network topology, apply the ACL closest to the destination.

```
R3(config)# interface GigabitEthernet0/0
```

```
R3(config-if)# ipv6 traffic-filter BLOCK_ICMP out
```

Step 3: Verify that the proper access list functions.

a. Ping from **PC2** to 2001:DB8:1:30::30. The ping should fail.

b. Ping from **PC1** to 2001:DB8:1:30::30. The ping should fail.

Open the **web browser** of **PC1** to http://2001:DB8:1:30::30 or https://2001:DB8:1:30::30. The website should display.

Part 1: Verify Basic Network Connectivity

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

Step 1: From the PC-A command prompt, ping PC-C at 192.168.3.3. 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.

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**.

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.

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.

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

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

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 **101**.

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
```

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
OUTZONE
```

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.

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 **101**.

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
```

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
OUTZONE
```

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.

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. 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.

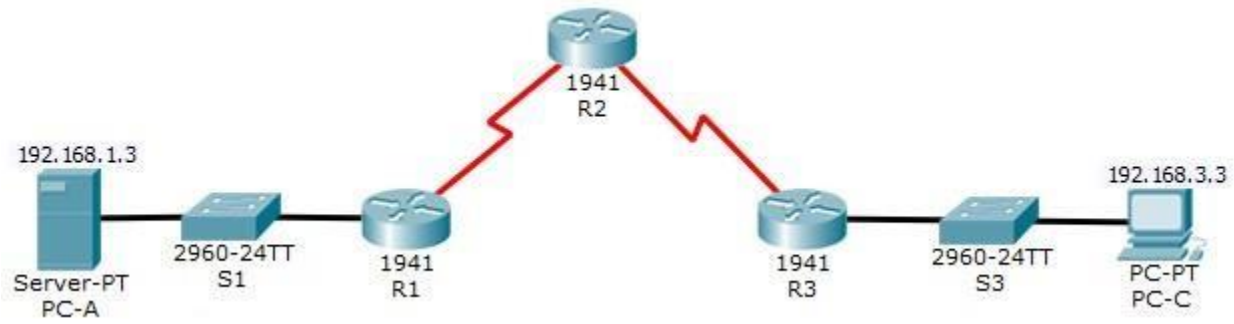
Step 3: Check results.

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

Practical 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
	G0/1	192.168.3.1	255.255.255.0	N/A	S3 F0/5

R3	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.

The routers have been pre-configured with the following:

- Console password: **ciscoconpa55**
- Password for vty lines: **ciscovtypa55** ○ Enable password: **ciscoenpa55**
- Host names and IP addressing ○ Local username and password:

Admin / **Adminpa55** ○ Static routing

Part 1: Verify Basic Network Connectivity

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

Step 1: From the PC-A command prompt, ping PC-C at 192.168.3.3. Step 2:

Access R2 using SSH.

c. 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`

d. Exit the SSH session.

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

b. 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**.

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.

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

g. 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

h. Accept the end-user license agreement.

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

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

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 **101**.

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
```

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
OUTZONE
```

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.

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. 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.

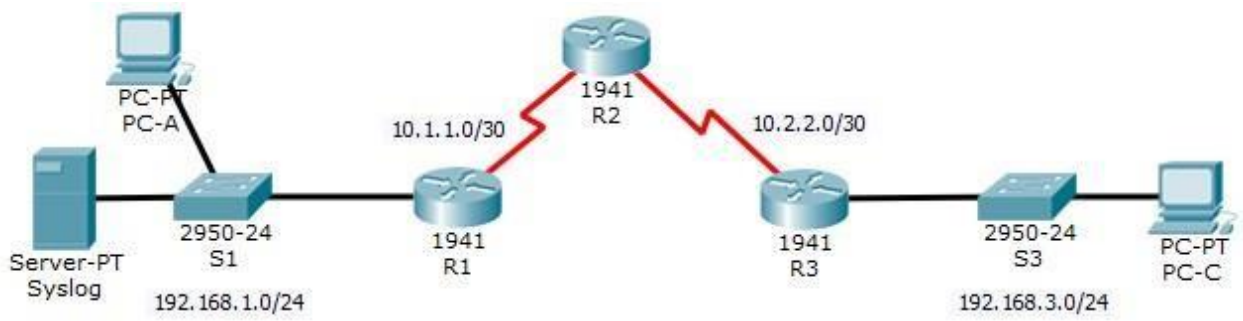
Your completion percentage should be 100%. Click **Check Results** to see feedback and verification of which

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

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.

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.

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

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
```

b. If necessary, use the **clock set** command 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.

!!!Script for R1

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

 config
t

license boot module c1900 technology-package securityk9
yes end reload  config t

ip ips config location flash:ipsdir
ip ips name iosips ip ips notify log
service timestamps log datetime msec
logging host 192.168.1.50

 ip ips signature-category
category all  retired true  exit
category ios_ips basic  retired
false  exit  exit  interface
g0/1  ip ips iosips out  exit ip
ips signature-definition
signature 2004 0  status
retired false  enabled true

exit  engine  event-action
produce-alert  event-action
deny-packet-inline  exit  exit
exit
```