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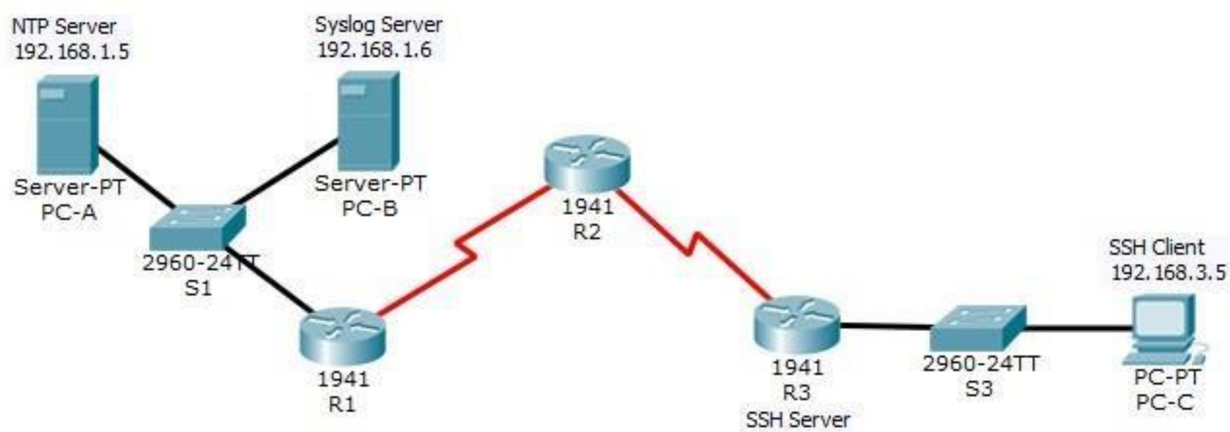
**Practical 1**

**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 |

**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 serverand 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 learnedfrom NTP.

The Syslog Server will provide message logging in this activity. You will configure the routers to identify the remotehost (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 inSyslog 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 havebeen 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.

**A . 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

serialinterfaces 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 MD5p**

**Step 4: Verify configurations.**

a. Verify the MD5 authentication configurations using the commands **show ip ospf interface**. b.Verify end-to-end connectivity.

**B. 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 periodicallyupdate 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 NTPauthentication 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**

**Practical 2**

**A. 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 thelogging 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 mayneed to click a different service and then click **Syslog** again to refresh the message display.

**B. Configure R3 to Support SSH Connections**

**Step 1: Configure a domain name.** Configure

adomain 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

formandatory 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 existingRSA key pairs should be erased on the router.

R3(config)# **crypto key zeroize rs**

**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 theRSA 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 inthe lab.

**Step 6: Verify the SSH configuration.**

Use the **show ip ssh** command to see the current settings. Verify that the authentication timeout and retriesare 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 thetimeout 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 virtualterminal 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 toR3 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. Fromthe 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 ofwhich required components have been completed.

**!!!Scripts for R1!!!!**

```
conf t interface s0/0/0
 ip ospf message-digest-key 1 md5 MD5pa55router
ospf 1
area 0 authentication message-digestservice
timestamps log datetime msec logging
192.168.1.6
ntp server 192.168.1.5 ntp update-
calendar
ntp authentication-key 1 md5 NTPpa55ntp
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 MD5pa55router
ospf 1
area 0 authentication message-digestservice
timestamps log datetime msec logging
192.168.1.6
ntp server 192.168.1.5 ntp update-
calendar
ntp authentication-key 1 md5 NTPpa55ntp
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-digestservice
timestamps log datetime mseclogging
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 ciscosshpa55login line vty 0 4
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

# BHAVANS COLLEGE AUTONOMOUS, ANDHERI WEST

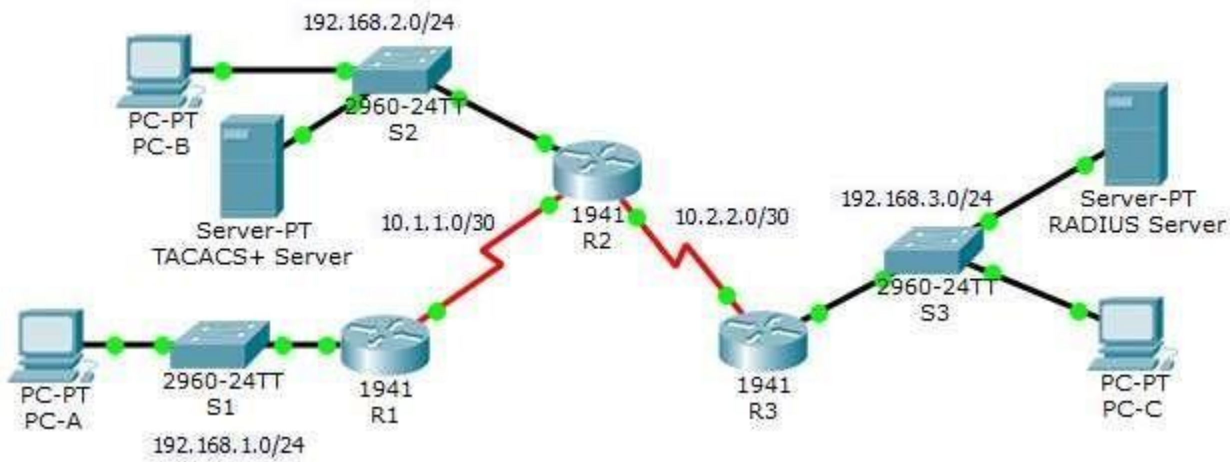
## PRACTICAL JOURNAL

**Class: TYBSCIT** **Sem: VI** **Roll No. :TYIT18**

**Course Name: Security in Computing** **Course Number: - BH.USITS603**

**Practical 3: Packet Tracer - Configure AAA Authentication onCisco 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 |

**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 AAAsolutions.

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

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

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

- Client: **R2** using the keyword **tacacspa55** o User account: **Admin2** and password **admin2pa55**

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

- Client: **R3** using the keyword **radiuspa55** o 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 versionthat is currently supported in Packet Tracer uses MD5. Always use the most secure option available on yourequipment.

**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 consoleR1#
**exit**

R1 con0 is now available Press RETURN to get started.

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 yourGeneral Purpose Keys. Choosing a key modulus greater than 512 may takea few minutes.

How many bits in the modulus [512]: **1024**

% Generating 1024 bit RSA keys, keys will be non-exportable...[OK] **Step2: 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 configurationentry 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 Tracerdoes 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 notavailable, 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 consoleR2#
**exit**

R2 con0 is now availableRETURN to get started.

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 entryfor **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 Tracerdoes 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 consoleR3#

**exit**

R3 con0 is now availableRETURN to get started.

Press

************* 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 whichrequired 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 cryptokey generate rsa
1024
aaa authentication login SSH-LOGIN localline 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 aaanew-model
aaa authentication login default group tacacs+ localline 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 localline console
0 login authentication default

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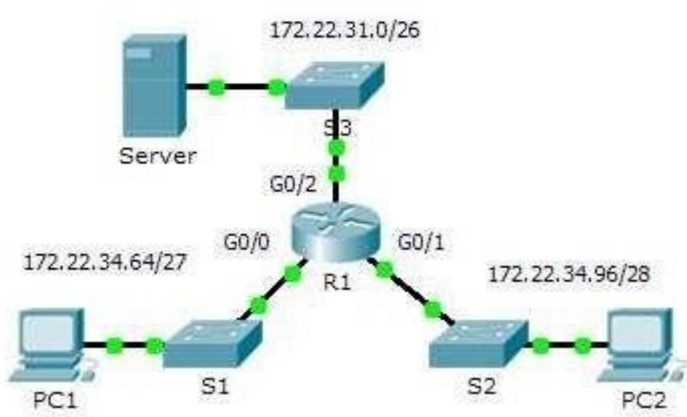
## PRACTICAL JOURNAL

**Class: TYBSCIT** **Sem: VI** **Roll No. :TYIT18**

**Course Name: Security in Computing** **Course Number: - BH.USITS603**

**Practical 4: 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 ACLPart 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 numberfor 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.**11111111.11111111.11111111.111**00000 = 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

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

h. .

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 portnumber neq Match only packets not on a given portnumber 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 172.22.34.62eq ?**

<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 thatthe 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 GigabitEthernet 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 explicitlypermitted.

**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 followingcommand, 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 PacketTracer 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: Theprompt 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 Step3:**

**Verify the ACL implementation.**

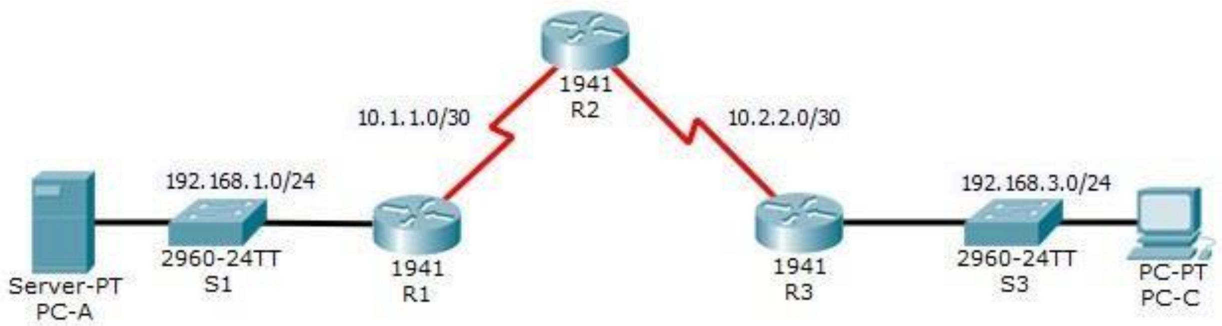
a. Ping from **PC2** to **Server**. The ping should be successful, if the ping is unsuccessful, verify the IPaddresses before continuing.

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 besuccessful.

**Practical 5: 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 |

**Background/Scenario**

Access to routers R1, R2, and R3 should only be permitted from PC-C, the management station. PC-C is alsoused 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 sourceand 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** o

  Password for console: **ciscoconpa55**
- SSH logon username and password:

**SSHadmin/ciscosshpa55** o IP addressing o

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 usernameSSHadmin 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 whendone.

**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:

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

**PC-A.** o Deny any outside host access to HTTPS services on **PC-A.** o

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 theaccess 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. Part5:**

**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.**

Usethe **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 theaccess 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 RFC1918 private addresses, 127.0.0.0/8, and any IP multicast address. Since **PC-C** is being used for remoteadministration, 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 theaccess 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 ACLsince 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 whichrequired components have been completed.

**!!!Script for R1**
access-list 10 permit host 192.168.3.3line vty 0
4
access-class 10 in
access-list 120 permit udp any host 192.168.1.3 eq domainaccess-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 unreachableaccess-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

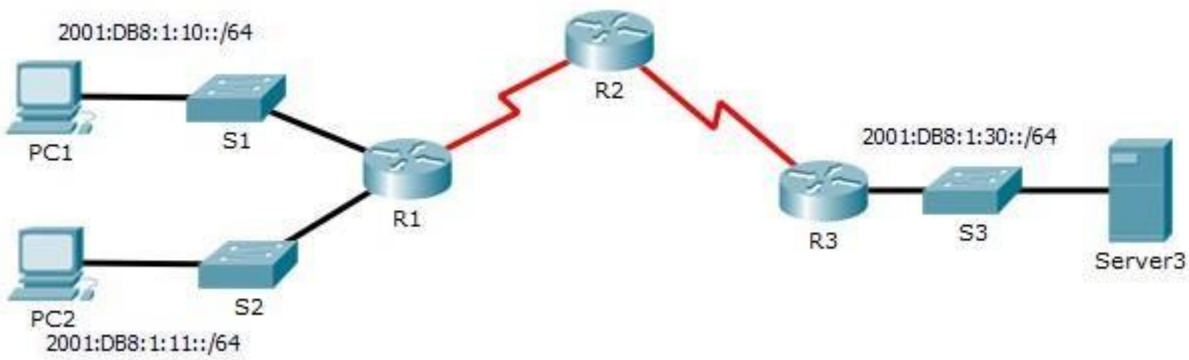
access-class 10 in

**!!!Script for R3**

access-list 10 permit host 192.168.3.3line vty 0
4
access-class 10 in
access-list 100 permit tcp 10.0.0.0 0.255.255.255 eq 22 host 192.168.3.3access-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 224.0.0.015.255.255.255 any
access-list 100 permit ip any anyinterface
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

**Configuring IPv6 ACLs**

**Topology**




**Addressing Table**

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

**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. Thisis 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 theinterface 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 websiteshould appear.
- Open the **web browser** of **PC2** to http://2001:DB8:1:30::30 or https://2001:DB8:1:30::30. The websiteshould 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 DistributedDenial 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 itssource 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**

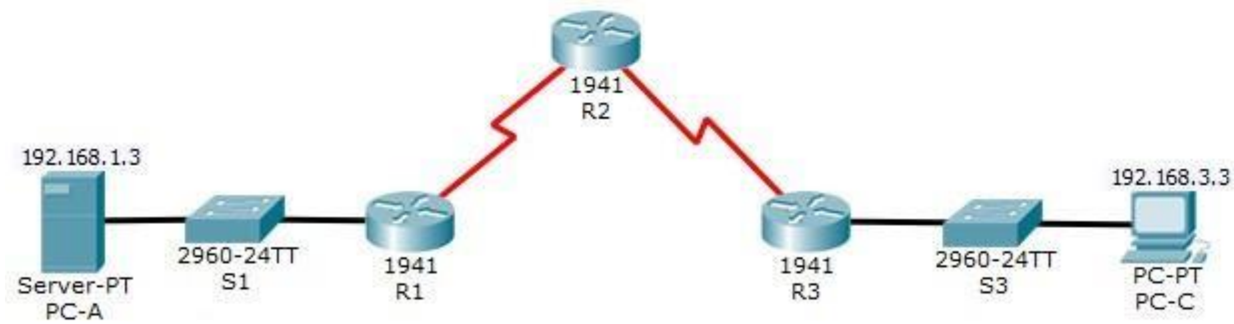
**Step 3: Verify that the proper access list functions.**

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 websiteshould display.

**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 |

**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 internaland external hosts.

The routers have been pre-configured with the following:

- Console password: **ciscoconpa55**
- Password for vty lines: **ciscovtypa55** o Enable password: **ciscoenpa55**

o Host names and IP addressing o Local username and password:

**Admin** / **Adminpa55** o Static rou

**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 thepackage.

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

tocreate 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 anddrop).

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 anddestination 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** andS0/0/1 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-pairsessions** 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-pairsessions** 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.**

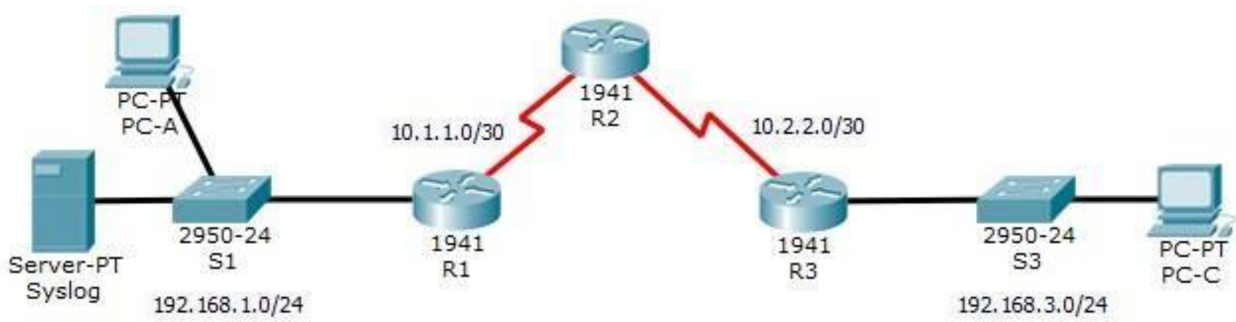
From **R2**, ping **PC-C** at 192.168.3.3. The ping should fail.

**Step 3: Check results.**

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

o Enable password: **ciscoenpa55** o Console

password: **ciscoconpa55** o SSH username and

password:

**SSHadmin** / **ciscosshpa55** o 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 amanual 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 thepackage.

   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

adirectory in flash using the **mkdir** command. Name the directory **ipsdir**.

R1# **mkdir ipsdir**

Create directory filename [ipsdir]? <**Enter**> Createddir
flash:ipsdir

**Step 4: Configure the IPS signature storage location.** On **R1**, configure the

IPSsignature 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. Namethe 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. Iflogging 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 tothe 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 thatIPS inspects only traffic going out of the interface.

R1(config)# **interface g0/1**

R1(config-if)# **ip ips iosips out** **Part2: 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 actionto 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 whichrequired components have been completed.

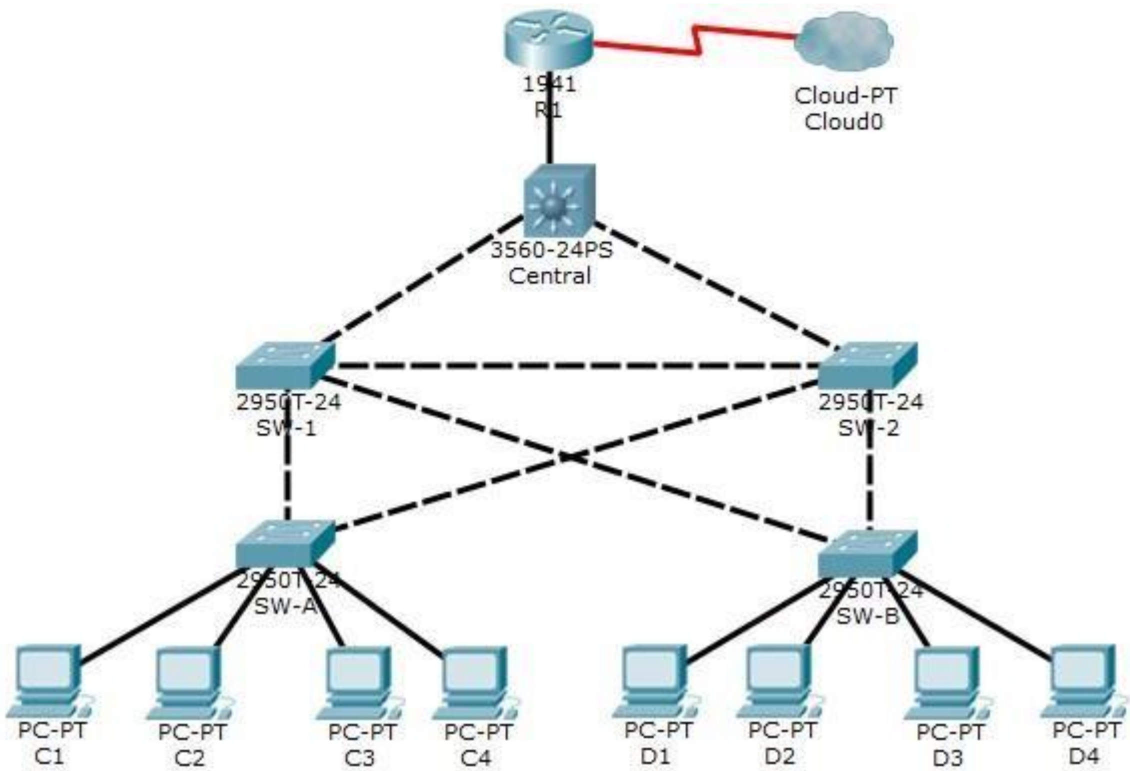
**!!!Script for R1**

clock set 10:20:00 10 january 2014 mkdiripsdir
configt
license boot module c1900 technology-package securityk9yes end
reload config t
ip ips config location flash:ipsdir ip ips name
iosips ip ips notify logservice timestamps
log datetime mseclogging host 192.168.1.50
ip ips signature-category category all
retired true exitcategory ios_ips basic
retired false exit exit interface g0/1

ip ips iosips out exit ipips signature-
definition signature 2004 0 status
retired false enabled true
exit engine event-action produce-
alert event-action deny-packet-inline
exit exitexit

**Practical 8: Packet Tracer - Layer 2 Security**

**Topology**




**Background / Scenario**

There have been a number of attacks on the network recently. For this reason, the network administrator hasassigned 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 STPparameters 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** oConsole 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 portsin 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 rootprimary** 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-treeportfast** 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 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 bpduguarddefault** 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 theroot 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 andF0/24.

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 oflearned 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 sticky**

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 networkfunctionality.

**Step 2: Verify port security.**

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

```
Port Security              : Enabled
```

SW-A# **show port-security interface f0/1**

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 theswitch 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 whichof the required components have been completed.

**!!!Script for Central**

conf t

spanning-tree vlan 1 root primary end

**!!!Script for SW-1** conft

spanning-tree vlan 1 root secondary
interface range f0/23 - 24
spanning-tree guard root
end

**!!!Script for SW-2**
conf t
interface range f0/23 - 24
spanning-tree guard rootend

**!!!Script for SW-A**
conf t
interface range f0/1 -4

spanning-tree portfast spanning-tree
bpduguard enable
interface range f0/1 - 22
switchport mode access switchport port-
security switchport port-security maximum 2
switchport port-security violation shutdown
switchport port-security mac-address sticky
interface range f0/5 - 22 shutdown end

**!!!Script for SW-B**

Same as above commands

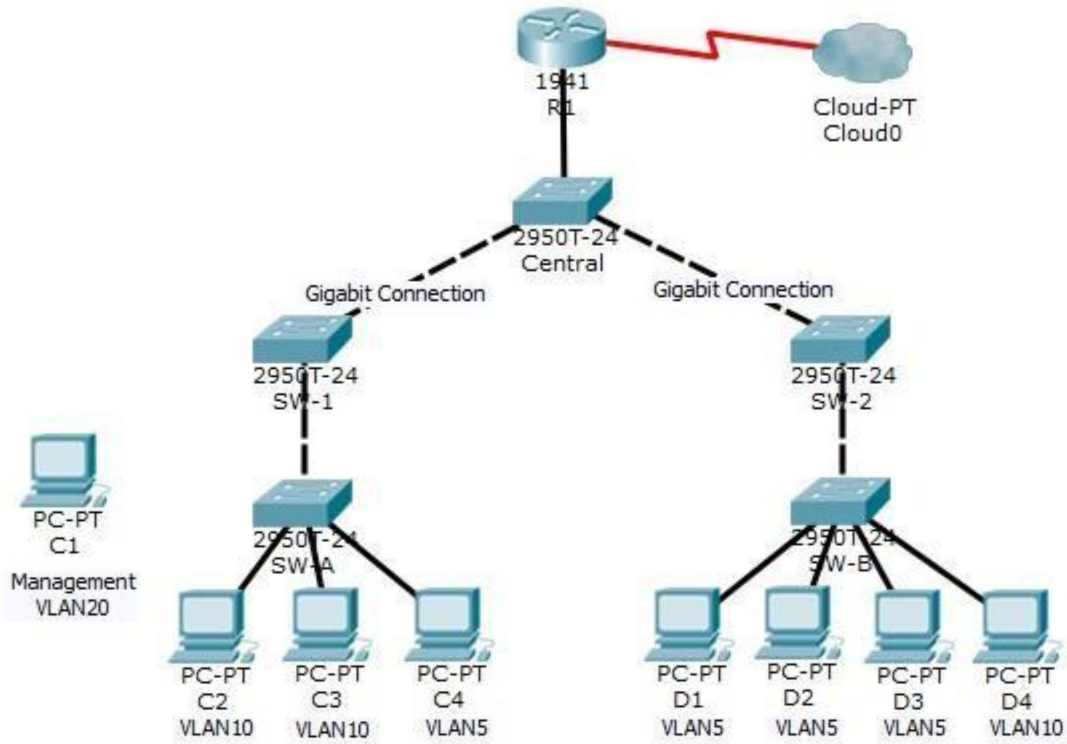
# BHAVANS COLLEGE AUTONOMOUS, ANDHERI WEST

## PRACTICAL JOURNAL

**Class: TYBSCIT** **Sem: VI** **Roll No. :TYIT18**

**Course Name: Security in Computing** **Course Number: - BH.USITS603**

**Practical 9: Layer 2 VLAN Security**
**Topology**




**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 shouldbe 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 newVLAN 20 for management purposes.

All devices have been preconfigured

with: o Enable secret password:

**ciscoenpa55** oConsole password:

**ciscoconpa55**

oSSH username and password: **SSHadmin** / **ciscosshpa55**

**Part1: 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 fortrunking, 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 192.168.20.0/24network.

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 withinthe 192.168.20.0/24 network.

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

InterfaceF0/1 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 themanagement VLAN.

a. Create an ACL that allows only the Management PC to access the router. Example:

(may varyfrom 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 thisreason, 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.

   ____________________

   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.

   ____________________

   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 whichrequired components have been completed.

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

**!!! Script for SW-1** conf t interface f0/23 switchport mode trunk switchport trunk native vlan 15 switchport nonegotiate no shutdown vlan 20 exit interface vlan 20
ip address 192.168.20.3 255.255.255.0

**!!! Script for SW-2** conf t interface f0/23 switchport mode trunk switchport

trunk native vlan 15 switchport
nonegotiate no shutdown vlan 20 exit
interface vlan 20
ip address 192.168.20.4 255.255.255.0

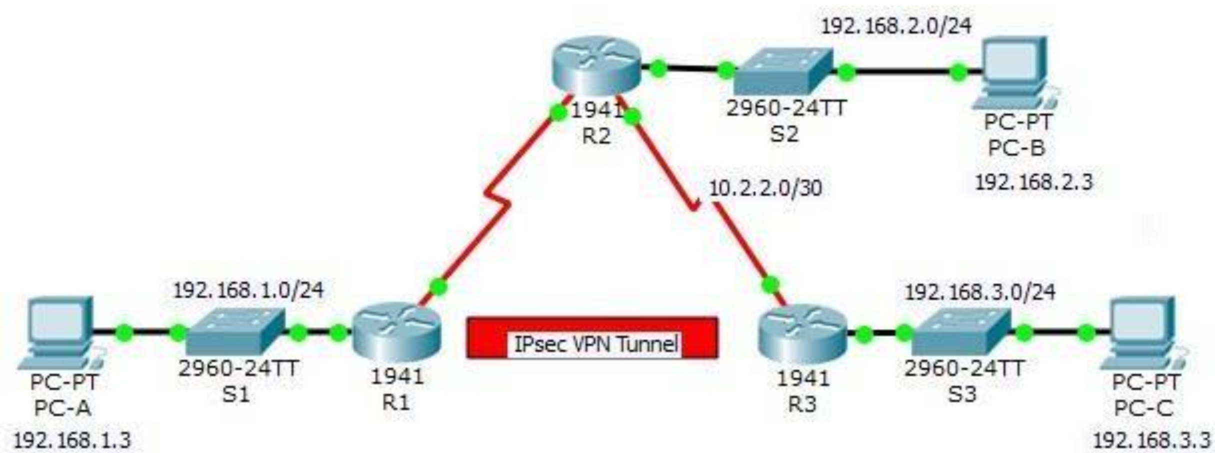
**!!! Script for SW-A**
conf t vlan 20 exit
interfacevlan 20
ip address 192.168.20.1 255.255.255.0
interface f0/1 switchport access vlan
20 no shutdown
**!!! Script for SW-B** conf t vlan 20 exitinterface
vlan 20 ip address 192.168.20.2 255.255.255.0

**!!! Script for Central** conf t vlan 20 exit
interface vlan 20 ip address 192.168.20.5
255.255.255.0

**!!! Script for R1** conft
interface GigabitEthernet0/0.1 ip access-group 101 in
interface GigabitEthernet0/0.2 ip access- group 101 in
interface g0/0.3 encapsulation dot1q20 ip address
192.168.20.100 255.255.255.0
access-list 101 deny ip any 192.168.20.0 0.0.0.255access-list
101 permit ip any any access-list
102 permit ip host 192.168.20.50 any line vty 04
access-class 102 in

**Practical 10: Configure and Verify a Site-to-Site IPsec VPN UsingCLI**

**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 |

**Background / Scenario**

The network topology shows three routers. Your task is to configure R1 and R3 to support a site-to-site IPsecVPN 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 sensitiveinformation 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 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

**Part 1: Configure IPsec Parameters on R1**

**Step 1: Test connectivity.**

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.

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

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 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 othertraffic 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**. Referto 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, youwould 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 sequencenumber 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 Part2:**

**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 licenseinformation has been enabled.

b. If the Security Technology package has not been enabled, enable the package and reload R3.

**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 tothe 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 ISAKMPpolicy 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 sequencenumber 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

cryptomap 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 whichrequired components have been completed.

!!! Script for R1

config t

license boot module c1900 technology-package securityk9yes end
copy running-config startup-configreload
config t
access-list 110 permit ip 192.168.1.0 0.0.0.255 192.168.3.0 0.0.0.255
crypto isakmp policy 10 encryption aes 256 authentication pre-share group 5
exit
crypto isakmp key vpnpa55 address 10.2.2.2 crypto ipsectransform-
set VPN-SET esp-aes esp-sha-hmac crypto map VPN-MAP 10
ipsec-isakmp description VPN connection to R3 set peer 10.2.2.2
set transform-set VPN-SET matchaddress 110 exit
interface S0/0/0
crypto map VPN-
MAP

!!! Script for R3

config t

access-list 110 permit ip 192.168.3.0 0.0.0.255 192.168.1.0 0.0.0.255
crypto isakmp policy 10
encryption aes 256 authentication pre-share group 5 exit

crypto isakmp key vpnpa55 address 10.1.1.2 crypto ipsec
transform-set VPN-SET esp-aes esp-sha-hmac crypto map

VPN-MAP 10 ipsec-isakmp description VPN connection to
R1 set peer 10.1.1.2

set transform-set VPN-SET match address 110 exit

interface S0/0/1 crypto map VPN-MAP