Practical 1

Aim: Packet Tracer OSPF MD5 authentication., NTP., to log messages to the syslog server., to support SSH connections.

Tools & Technologies used:

Tools and technologies used include router configuration software, command-line interfaces (CLI), routing protocols like RIP, OSPF, and BGP, and network management tools to optimize performance and ensure reliability.

Learning Objectives:

The objective of configuring routers is to ensure proper network communication by managing traffic flow, defining routing protocols, and setting security measures.

Theory : Configure Routers

Router configuration refers to configuration of a router in a network by assigning an IP address, identifying links to its adjacent routers, invoking one or more routing protocols for operational use, and so on.router configurations are the most elaborate among the VPLS routers. These configurations are rather lengthy, so comments are used throughout. The PE routers need BGP, MPLS, OSPF, and RSVP to be configured properly for the LSP to work correctly. RSVP sets up the MPLS LSPs, OSPF handles routine routing chores, and BGP is used to carry the VPLS MAC layer information between the PE routers.The PE routers also need to configure VLAN tagging and VPLS encapsulation on the interfaces (physical and logical) to the CE routers. The VLAN ID must match as well, but no IP address is needed for this “Layer 2” interface. There is a space between major sections of the configuration and liberal comments to help track what is being configured.

Steps To Configure A Router

At any rate, setting up a tightly managed, secure home network is possible by following these five steps

1. Connect your router

The broadband Wi-Fi router is the bridge between the Internet and your home network. It is how all the devices on your network communicate with one another. The device that has to be connected to the WiFi router, has to have an appropriate network adapter. The first step to configure is to physically connect your router to a modem provided by your ISP with an Ethernet cable, by following these steps:

- Firstly, unplug or turn off the cable or DSL modem.
- Plugin your wireless router and connect the network cable to the port on the router that is labelled "Internet" or "WAN."
- Connect the other end to the cable or DSL modem and start up the modem.
- Do not try to connect any devices such as laptops or tablets until you have a high-strength signal indicating a WAN connection on both the router and modem.

After accessing the router, the next order of business is getting the security, SSID, and IP addressing settings right. These settings are found under the "Basic" settings of the interface. They may also be under "Security" or "Wireless Settings". Further steps are

- Change the default administrator password which is usually under the "System" tab or page of the interface. Just enter a new password in the new password field.
- Change the router's default SSID. The SSID is the broadcasted name of the unique wireless network you own. Use a unique name to avoid confusion.

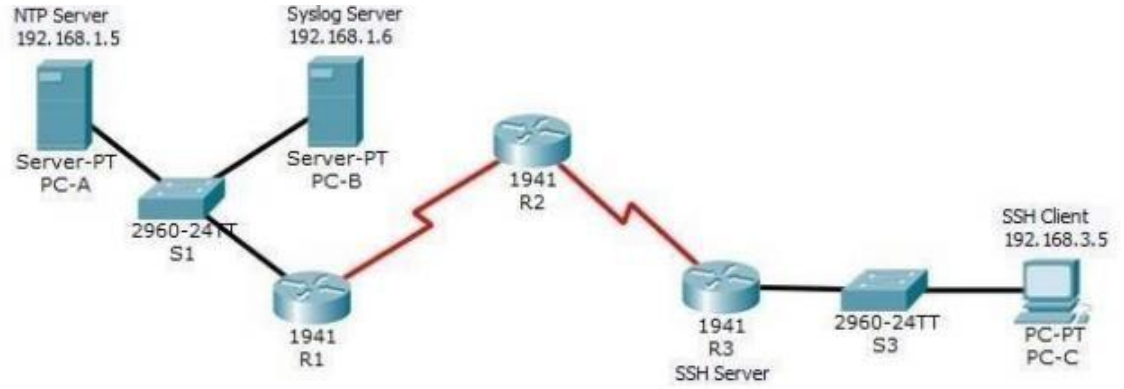
3. Set up sharing and control

Now that you have a network set up, you can set up a way for all the devices to access data on the network. This can be done by setting up a "Home Network" by using your current location.

4. Set up user accounts

- Further, try to set up user accounts with your WiFi router plans by adhering to the below steps:
- Select the user accounts icon. The user accounts settings will allow you to configure your account.
- To add and configure other devices to access the network, from user accounts, click on "Manage User Accounts," and then click on the "Advanced" tab.

Step:-



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

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

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

Learning Outcomes:

Gained practical skills in securing routing protocols, synchronizing time, monitoring network events, and configuring secure access.

Course Outcome:

Developed proficiency in network security, monitoring, and management tools

Conclusion:

Viva Question:

1-What is Router?

2-What is the work of router?

3-What is type of router?

For Faculty Use

Correction Parameter	**Formative Assessment [ ]**	**Timely completion of practical [ ]**	**Attendance Learning Attitude []**

Practical 2

Aim: Configure a local user account on Router and configure authenticate on the console and vty lines using local AAA and Verify local AAA authentication from the Router console and the PC-A client

Tools & Technologies used: Tools and technologies used include RADIUS, TACACS+, and network devices like routers and switches.

Learning Objectives: Learning objectives involve implementing secure access policies, managing user permissions, and tracking network activities to maintain security and compliance across the network infrastructure.

Theory :Configure AAA Authentication

Introduction

This document describes how to configure Authentication, Authorization, and Accounting (AAA) on a Cisco router with Radius or TACACS+ protocols.

Prerequisites

Requirements

There are no specific requirements for this document.

Conventions

For more information on document conventions, see the Cisco Technical Tips Conventions.

Components Used

The information in this document is based on Cisco IOS® software release 12 main line.

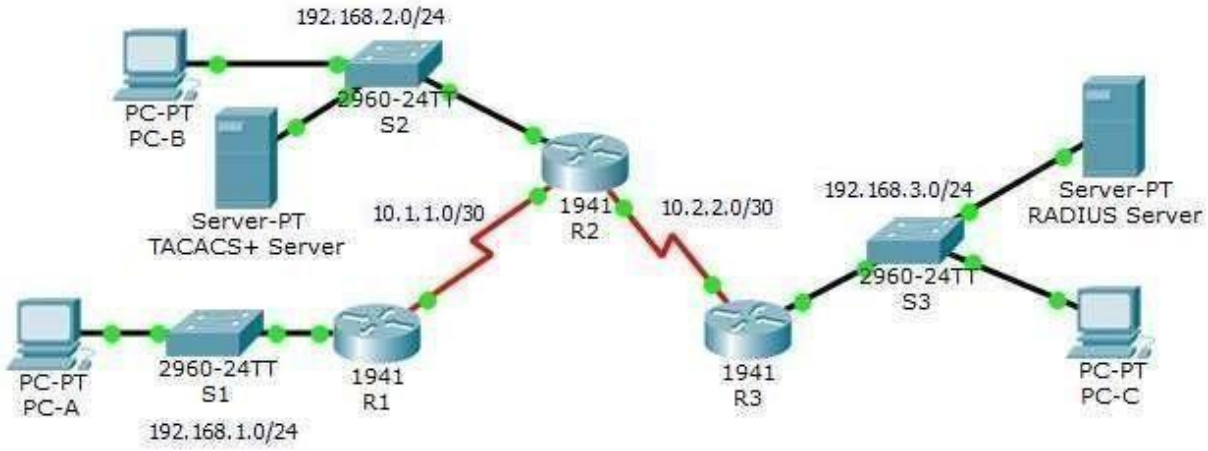
The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, ensure that you understand the potential impact of any command.

Background Information

This document explains how to configure Authentication, Authorization, and Accounting (AAA) on a Cisco router with Radius or TACACS+ protocols. The goal of this document is not to cover all AAA features, but to explain the main commands and provide some examples and guidelines.

step

Packet Tracer - Configure AAA Authentication on Cisco Routers



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. o 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 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

ip ssh time-out 90 ip ssh authentication-retries 2 ip ssh version 2 end

Learning Outcomes:

Learned how to configure and verify local AAA authentication for router access.

Course Outcome:

Gained hands-on experience in securing router access through local AAA and remote management.

Conclusion:

Viva Question:

1-What is the AAA?

2-What is the Authentication?

3- What is the type of Authentication?

For Faculty use

	Formative Assessment [ ]	**Timely completion of practical [ ]**	**Attendance Learning Attitude []**

Practical 3

Aim: Configure, Apply and Verify an Extended Numbered ACL

Tools & Technologies used: Tools and technologies include network routers, switches, and CLI-based configuration.

Learning Objectives: The learning objectives focus on enhancing network security, controlling traffic flow, and understanding the configuration of both inbound and outbound rules effectively.

Theory 3: Configuring Extended ACLs

To configure an extended ACL, first, use the "access-list" command to create a named extended ACL. Next, use the "permit" or "deny" commands to define the traffic that the ACL should allow or block.An extended access control list (ACL) is a type of ACL that can be used to filter traffic based on source and destination IP addresses, as well as port numbers and protocols. Extended ACLs can be used to allow or deny traffic from specific devices or groups of devices, as well as to specific ports and services.Extended ACLs provide more granular control over traffic than standard ACLs, which can only be used to filter traffic based on source IP address. In addition, extended ACLs can be applied inbound or outbound, while standard ACLs can only be applied inbound.In this blog, we will take a closer look at extended ACLs and how they can be used to protect your network. We will also compare extended ACLs to standard ACLs and discuss the benefits and drawbacks of each type of ACL.

What is an extended ACL?

An extended ACL is a type of access control list that provides detailed control over traffic flows on a network. An extended ACL can be used to filter traffic by source IP address, destination IP address, port number, and protocol.Moreover, extended ACLs can be applied inbound or outbound, to or from specific devices or groups of devices, as well as to specific ports and services.Extended ACLs are more flexible than standard ACLs because they can be used to filter traffic in more detail. For example, an extended ACL can be used to block requests to a web server from a particular IP address or range of IP addresses, while a standard ACL can only be used to filter traffic based on the source IP address.

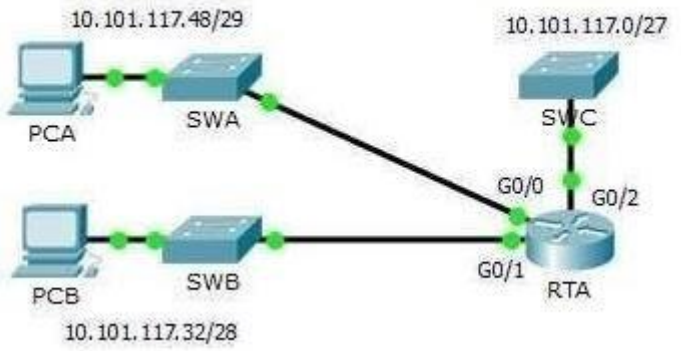
Why do you need an extended ACL?

Extended ACLs are essential for ensuring that only the desired traffic is allowed on a network. If a network does not have an extended ACL configured, malicious attackers can exploit the network by sending malicious traffic that bypasses security measures.

Furthermore, without an extended ACL, certain applications may not function correctly because the traffic associated with the application is being blocked or rate limit

Step

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: 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

00000000.00000000.00000000.00011111 = 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.

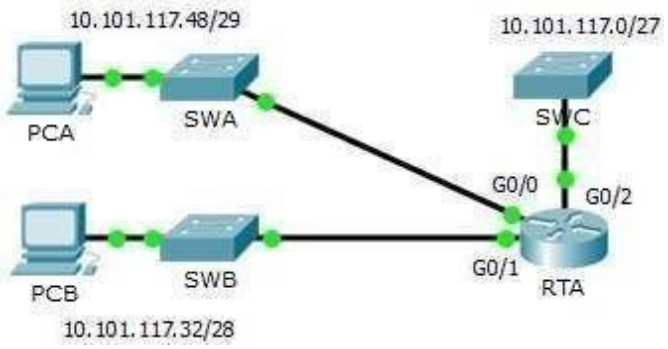
R1(config)# interface gigabitEthernet 0/1 R1(config-if)# ip access-group HTTP_ONLY in
Step 3: Verify the ACL implementation.

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.

Scenario -2



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:

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- 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.

Learning Outcomes:

Gained experience in configuring, applying, and verifying extended ACLs for fine-grained traffic filtering.

Course Outcome:

Developed practical skills in network security, traffic management, and access control within a network environment.

Conclusion:

Viva Question:

1-what is ACLs?

2-what is the ACLs stand for?

3-what is the work of ACLs?

For Faculty Use

	Formative Assessment [ ]	**Timely completion of practical [ ]**	**Attendance Learning Attitude []**

Practical 4

Aim: Verify connectivity among devices before firewall configuration., Use ACLs to ensure remote access to the routers is available only from management station PC-C., Use ACLs to ensure remote access to the routers is available only from management station PC-C. Configuring IPv6 ACLs

Tools & Technologies used: Tools like routers, switches, and CLI configuration interfaces are used for implementation.

Learning Objectives: The learning objectives focus on creating ACL rules to block malicious traffic, prevent unauthorized access, and secure network resources. It also includes understanding the differences between IPv4 and IPv6 ACLs, ensuring appropriate rules are applied for both protocols, and optimizing network security by monitoring and refining ACL configurations to minimize vulnerabilities and attacks.

Theory :Configure IP ACLs to Mitigate Attacks and IPV6 ACLs

Introduction

This document briefly describes what ACL is. The following describes the basic concept of ACL, ACL Matching Conditions, and ACL Configuration Guidelines.

Overview of ACLs

Definition

An Access Control List (ACL) is a packet filter that filters packets based on rules. One or more rules describe the packet matching conditions, such as the source address, destination address, and port number of packets.

For packets that match the ACL rules configured on a device, the device forwards or discards these packets according to the policies used by the service

Purpose

The fast growth of network technologies brings challenges to network security and Quality of Service (QoS). ACL is a security policy that is enforced on networks to prevent the following problems:

To prevent information leaks and unauthorized access of resources on key servers of an enterprise network

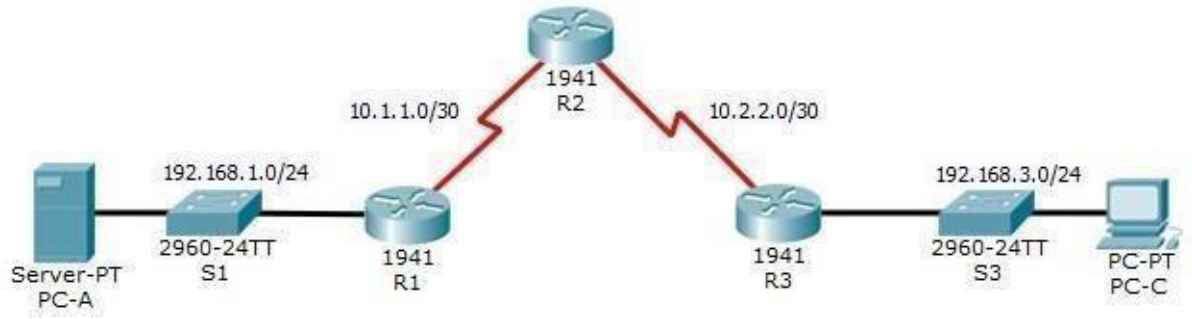
To prevent viruses on the Internet from entering and spreading on the enterprise intranet

To prevent random services from occupying network bandwidth, thereby guaranteeing bandwidth for delay-sensitive services such as voice and video

These problems are detrimental to network communication, so network security is critical.

ACL accurately identifies and controls packets on the network to manage network access behaviors, prevent network attacks, and improve bandwidth use

Step



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

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

Part 3: Create a Numbered IP ACL 120 on R1

Create an IP ACL numbered 120 with the following rules:

- Permit any outside host to access DNS, SMTP, and FTP services on server PC-A. 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 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 i

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

Learning Outcomes:

Gained hands-on experience configuring ACLs for both IPv4 and IPv6 to control remote access.

Course Outcome:

Developed skills in securing network devices and controlling access using ACLs, ensuring safe network management

Conclusion:

Viva Question:

1-what is the IP?

2-Uses of Mitigate attacks?

3-What is the IP version 6?

For Faculty use

	Formative Assessment [ ]	**Timely completion of practical [ ]**	**Attendance Learning Attitude []**

Practical 5

Aim: Configuring a Zone-Based Policy Firewall

Tools & Technologies used:- Technologies used include routers, Cisco Adaptive Security Appliances (ASA), and firewall configuration tools.

Learning Objectives: The learning objectives focus on understanding how to create zones, apply security policies to control traffic between them, and monitor the firewall to prevent unauthorized access. Additionally, students learn to configure interface zones, define security levels, and implement policies that help in traffic filtering, access control, and protecting the network from external and internal threats.

THEORY:- Configuring a Zone-Based Policy Firewall

Requirements

There are no specific requirements for this document.

Components Used

This document is not restricted to specific software and hardware versions.The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, ensure that you understand the potential impact of any command.

Conventions Refer to Cisco Technical Tips Conventions for more information on document conventions.

Background Information

This new configuration model offers intuitive policies for multiple-interface routers, increased granularity of firewall policy application, and a default deny-all policy that prohibits traffic between firewall security zones until an explicit policy is applied to allow desirable trafficNearly all classic Cisco IOS Firewall features implemented before Cisco IOS Software Release 12.4(6)T are supported in the new zone-based policy inspection interface:ZFW generally improves Cisco IOS performance for most firewall inspection activities. Neither Cisco IOS ZFW nor Classic Firewall include stateful inspection support for multicast traffic.

Zone-Based Policy Overview

Cisco IOS Classic Firewall stateful inspection (formerly known as Context-Based Access Control, or CBAC) employed an interface-based configuration model, in which a stateful inspection policy was applied to an interface. All traffic passes through that interface received the same inspection policy. This configuration model limited the granularity of the firewallpolicies and caused confusion of the proper application of firewall policies, particularly in scenarios when firewall policies must be applied between multiple interfaces.

Zone-Based Policy Firewall (also known as Zone-Policy Firewall, or ZFW) changes the firewall configuration from the older interface-based model to a more flexible, more easily understood zone-based model. Interfaces are assigned to zones, and inspection policy is applied to traffic that moves between the zones. Inter-zone policies offer considerable flexibility and granularity, so different inspection policies can be applied to multiple host groups connected to the same router interface.

Firewall policies are configured with the Cisco Policy Language (CPL), which employs a hierarchical structure to define inspection for network protocols and the groups of hosts to which the inspection can be applied.

Zone-Based Policy Configuration Model

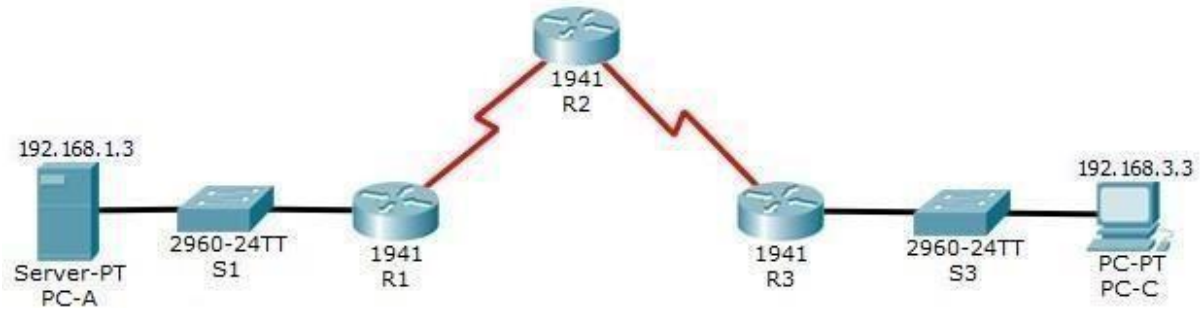
ZFW completely changes the way you configure a Cisco IOS Firewall inspection, as compared to the Cisco IOS Classic Firewall.

The first major change to the firewall configuration is the introduction of zone-based configuration. Cisco IOS Firewall is the first Cisco IOS Software threat defense feature to implement a zone configuration model. Other features can adopt the zone model over time. Cisco IOS Classic Firewall stateful inspection (or CBAC) interface-based configuration model that employs the ip inspect command set is maintained for a period of time. However, few, if any, new features are configurable with the classical command-line interface (CLI). ZFW does not use the stateful inspection or CBAC commands. The two configuration models can be used concurrently on routers, but not combined on interfaces. An interface cannot be configured as a security zone member and at the same time configured for ip inspect .

Zones establish the security borders of your network. A zone defines a boundary where traffic is subjected to policy restrictions as it crosses to another region of your network. ZFW default policy between zones is deny all. If no policy is explicitly configured, all traffic that moves between zones is blocked. This is a significant departure from stateful inspection model where traffic was implicitly allowed until explicitly blocked with an access control list (ACL).

The second major change is the introduction of a new configuration policy language known as CPL. Users familiar with the Cisco IOS Software Modular quality-of-service (QoS) CLI (MQC) can recognize that the format is similar to QoS use of class maps to specify which traffic is affected by the action applied in a policy map.

Step



Addressing Table

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

Objectives

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

Background/Scenario

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

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.

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.

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.

Learning Outcomes:

Gained hands-on experience in configuring and managing Zone-Based Policy Firewalls for network security.

Course Outcome:

Developed proficiency in implementing ZPFs to control and secure traffic between different network segments.

Conclusion:

Viva Question:

1-what is the Firewall?

2- what is the work of firewall?

3- what is the need of firewall?

For Faculty use

	Formative Assessment [ ]	**Timely completion of practical [ ]**	**Attendance Learning Attitude []**

Practical 6

Aim: Configure IOS Intrusion Prevention System (IPS) Using the CLI ,Enable IOS IPS.. Modify an IPS signature.

Tools & Technologies used:- Tools and technologies include Cisco routers or switches, IOS software, and command-line interfaces for configuration.

Learning Objectives: The learning objectives focus on configuring IPS signatures, setting up sensors to detect attacks, and defining actions to take when an attack is identified, such as blocking traffic or logging events. Students will learn to enable, configure, and manage IPS to protect network infrastructure, troubleshoot IPS-related issues, and ensure effective threat detection and mitigation.

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

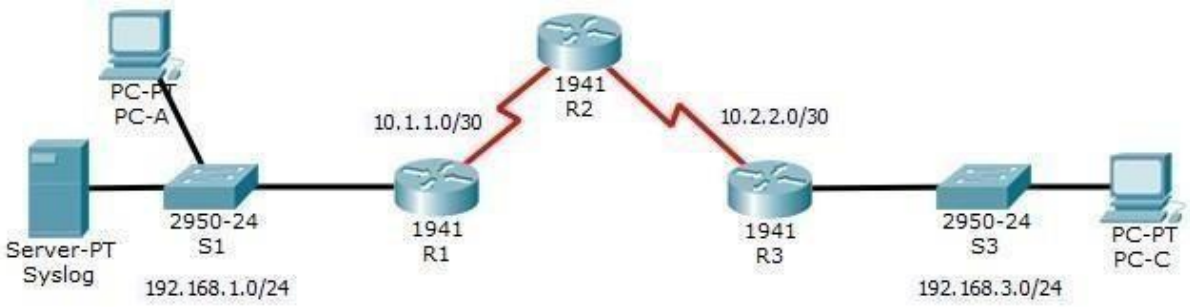
An Intrusion Prevention System (IPS) is a crucial component of any network security strategy. It monitors network traffic in real-time, compares it against known attack patterns and signatures, and blocks any malicious activity or traffic that violates network policies.

An intrusion prevention system (IPS) is a network security tool (which can be a hardware device or software) that continuously monitors a network for malicious activity and takes action to prevent it, including reporting, blocking, or dropping it, when it does occur.

The Cisco IOS Intrusion Prevention System (IPS) is an inline, deep-packet inspection-based solution that helps Cisco IOS Software effectively mitigate a wide range of network attacks.

A wireless intrusion prevention system (WIPS) monitors wireless network protocols for suspicious activity, like unauthorized users and devices accessing the company's wifi. If a WIPS detects an unknown entity on a wireless network, it can terminate the connection.

Step



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 all retired true exit category ios_ips basic retired false exit exit interface g0/1 ip ips iosips out exit ip ipsignaturdefinition signature 2004 0 status retired false enabled true exit engine event-action produce-alert event-action deny-packet-inline exit exit exit

Learning Outcomes:

Gained practical experience in configuring, enabling, and modifying IPS signatures to protect network infrastructure.

Course Outcome:

Developed expertise in utilizing IOS IPS for proactive network security and threat management.

Conclusion:

Viva Question:

1-what is IPS?

2-what is use work of IPS?

3-Explain IDS?

For Faculty use

	Formative Assessment [ ]	**Timely completion of practical [ ]**	**Attendance Learning Attitude []**

Practical 7

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

Tools & Technologies used. :- Tools and technologies used include switches, VLANs, port security features, 802.1X authentication, and BPDU Guard.

Learning Objectives: The learning objectives include implementing security measures such as restricting unauthorized device access, preventing MAC address spoofing, and ensuring VLAN segregation. Students will also learn to configure and monitor features like port security, Dynamic ARP Inspection (DAI), and Private VLANs (PVLANs) to strengthen LAN security, mitigate risks, and enhance network integrity.

Theory :Layer 2 Security

Today, let's talk about Layer 2 security techniques and whether they still hold their ground in the ever-evolving cybersecurity land scape. In simple terms, Layer 2 security refers to the measures taken to protect the data link layer in network communications. It encompasses protocols like Ethernet, VLANs (Virtual Local Area Networks), MAC address filtering, and more. These techniques have been widely used for years to enhance security within local networks. But with the rapid advancements in technology, the question arises – are they still relevant?While the focus has understandably shifted towards higher layers of the network, Layer 2 security still plays a vital role in safeguarding against certain vulnerabilities. Let's explore a few reasons why they remain useful:

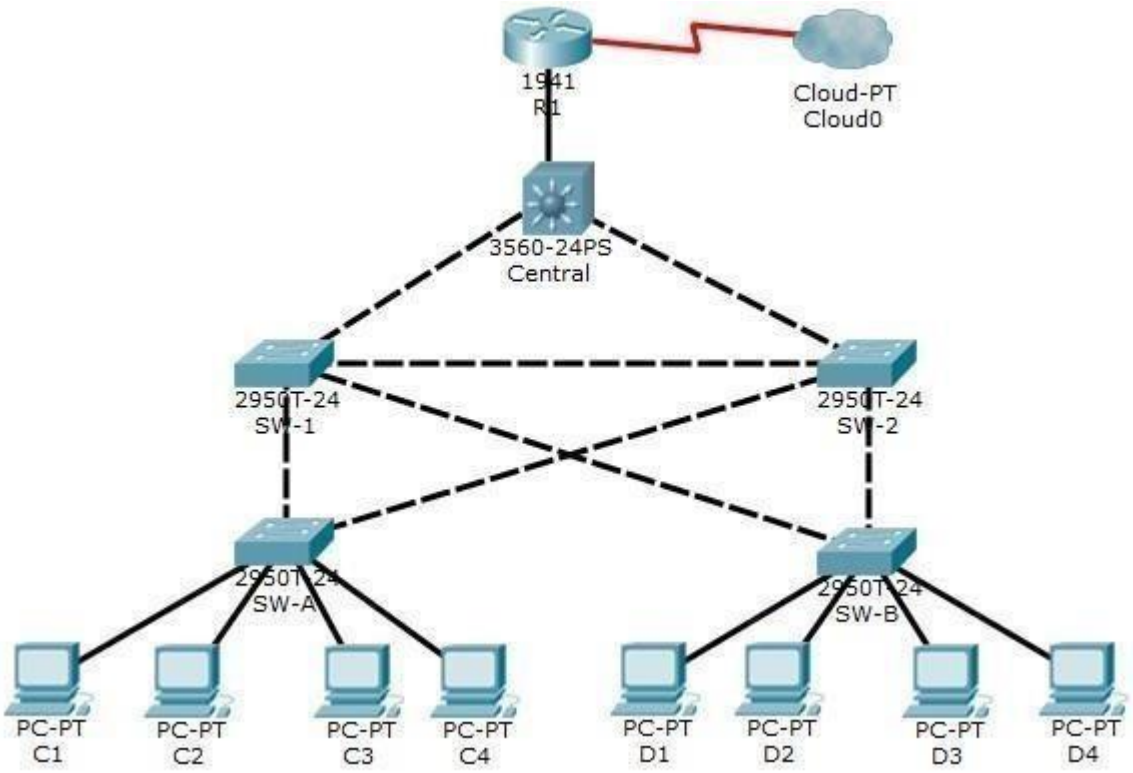
1. Insider Threats: Layer 2 security measures can help prevent unauthorized access and malicious activities within the network by implementing features like MAC address filtering and port security. These techniques contribute to controlling access rights and reducing the risks posed by insiders.

2. VLAN Segmentation: VLANs separate network traffic into distinct virtual networks, increasing control over communication and limiting the potential impact of security breaches. They provide an additional layer of defense, limiting access between devices and minimizing the lateral spread of attacks.

3. Mitigating ARP Spoofing: Address Resolution Protocol (ARP) spoofing attacks are still a prevalent threat. Layer 2 security techniques can help detect and mitigate these attacks, ensuring that network traffic flows correctly without being tampered with.

Now, let's be clear - Layer 2 security techniques alone may not be sufficient to combat all modern cybersecurity challenges. They are just one piece of the larger security puzzle.To maximize protection, it's crucial to adopt a multi-layered security approach. Integrating Layer 2 security techniques with various other security measures, such as firewalls, intrusion detection systems, and encryption protocols, can provide a holistic defense against threats targeting different layers of the network.

Step



Objectives

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

Background / Scenario

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

For optimum performance and security, the administrator would like to ensure that the root bridge is the 3560 Central switch. To prevent spanning-tree manipulation attacks, the administrator wants to ensure that the STP parameters are secure. To prevent against CAM table overflow attacks, the network administrator has decided to configure port security to

limit the number of MAC addresses each switch port can learn. If the number of MAC addresses exceeds the set limit, the administrator would like the port to be shutdown. All switch devices have been preconfigured with the following:

o Enable password: ciscoenpa55 o Console password: ciscoconpa55

o SSH username and password: SSHadmin / ciscosshpa55 Part 1: Configure Root Bridge

Step 1: Determine the current root bridge.

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

Current root is SW-1

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

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

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

Step 3: Assign SW-1 as a secondary root bridge. Assign SW-1 as the secondary root bridge using the spanning-tree vlan 1 root secondary command. SW-1(config)# spanning-tree vlan 1 root secondary

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

Central# show spanning-tree

VLAN0001

Spanning tree enabled protocol ieee

Root ID Priority 24577

Address00D0.D31C.634C This bridge is the root

Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Which switch is the current root bridge?

Current root is Central

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

Part 2: Protect Against STP Attacks

Secure the STP parameters to prevent STP manipulation attacks.

Step 1: Enable PortFast on all access ports.

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

SW-A(config)# interface range f0/1 - 4

SW-A(config-if-range)# spanning-tree portfast

SW-B(config)# interface range f0/1 - 4

SW-B(config-if-range)# spanning-tree portfast Step 2: Enable BPDU guard on all access ports.

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

SW-A(config)# interface range f0/1 - 4

SW-A(config-if-range)# spanning-tree bpduguard enable

SW-B(config)# interface range f0/1 - 4

SW-B(config-if-range)# spanning-tree bpduguard enable

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

Step 3: Enable root guard.

Root guard can be enabled on all ports on a switch that are not root ports. It is best deployed on ports that connect to other non-root switches. Use the show spanning-tree command to determine the location of the root port on each switch. On SW-1, enable root guard on ports F0/23 and F0/24. On SW-2, enable root guard on ports F0/23 and F0/24.

SW-1(config)# interface range f0/23 - 24

SW-1(config-if-range)# spanning-tree guard root

SW-2(config)# interface range f0/23 - 24

SW-2(config-if-range)# spanning-tree guard root

Part 3: Configure Port Security and Disable Unused Ports

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

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

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

SW-A(config-if-range)# switchport mode access

SW-A(config-if-range)# switchport port-security

SW-A(config-if-range)# switchport port-security maximum 2

SW-A(config-if-range)# switchport port-security violation shutdown SW-

A(config-if-range)# switchport port-security mac-address sticky

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

SW-B(config-if-range)# switchport mode access

SW-B(config-if-range)# switchport port-security

SW-B(config-if-range)# switchport port-security maximum 2

SW-B(config-if-range)# switchport port-security violation shutdown

SW-B(config-if-range)# switchport port-security mac-address 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 network functionality.

Step 2: Verify port security.

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

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

Port Security : Enabled

Port Status : Secure-up

Violation Mode

Aging Time

Aging Type : Shutdown

: 0 mins

: Absolute

SecureStatic Address Aging : Disabled

Maximum MAC Addresses : 2

Total MAC Addresses : 0

Configured MAC Addresses : 0

Sticky MAC Addresses : 0

Last Source Address:Vlan : 0000.0000.0000:0

Security Violation Count : 0

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

Step 3: Disable unused ports.

Disable all ports that are currently unused.

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

SW-A(config-if-range)# shutdown

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

SW-B(config-if-range)# shutdown

Step 4: Check results.

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

!!!Script for Central

conf t spanning-tree vlan 1 root primary end !!!Script for SW-1 conf t 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 root end

!!!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 conf t interface range f0/1 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

Learning Outcomes:

Gained experience in securing STP and configuring port security.

Course Outcome:

Developed skills in preventing network manipulation and ensuring robust Layer 2 security.

Conclusion:

Viva Question:

1-what is the security?

2-what is need of security?

3-Explain layer 2 security?

For Faculty use

	Formative Assessment [ ]	**Timely completion of practical [ ]**	**Attendance Learning Attitude []**

Practical 8

Aim:- Layer 2 VLAN Security

Tools & Technologies used. :- Tools and technologies used include switches, VLAN configuration, private VLANs (PVLANs), 802.1X authentication, and Dynamic ARP Inspection (DAI)

Learning Objectives: The learning objectives involve configuring secure VLANs, implementing port security, and protecting VLAN trunk links. Students will learn how to prevent VLAN hopping, configure private VLANs for network segmentation, and apply security policies to control access to VLANs, ensuring the confidentiality and integrity of data traffic across the network.

Theory :Layer 2 VLAN Security

Objectives

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

Background / Scenario

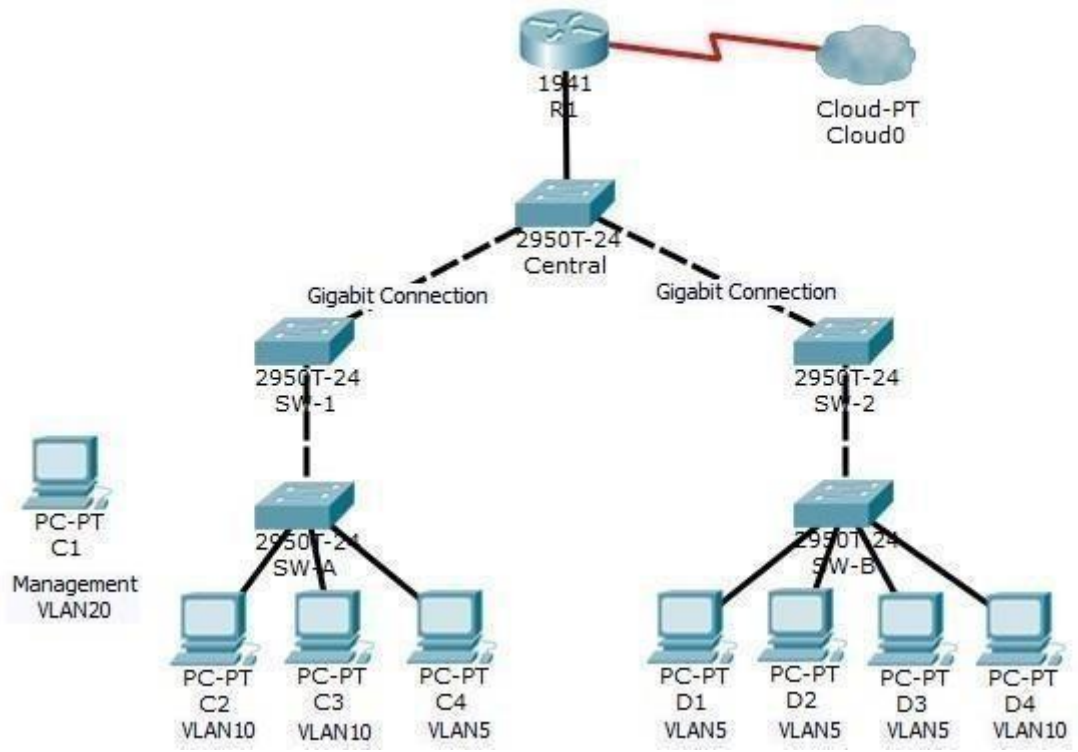
A company's network is currently set up using two separate VLANs: VLAN 5 and VLAN 10. In addition, all trunk ports are configured with native VLAN 15. A network administrator wants to add a redundant link between switch SW-1 and SW-2. The link must have trunking enabled and all security requirements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

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

All devices have been preconfigured with:

- Enable secret password: ciscoenpa55
- Console password: ciscoconpa55
- SSH username and password: SSHadmin / ciscosshpa55

Step



Objectives

- Connect a new redundant link between SW-1 and SW-2.
- Enable trunking and configure security on the new trunk link between SW-1 and SW2.
- Create a new management VLAN (VLAN 20) and attach a management PC to that VLAN
- . • Implement an ACL to prevent outside users from accessing the management VLAN.

Background / Scenario

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

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

All devices have been preconfigured with:

o Enable secret password: ciscoenpa55

o Console password: ciscoconpa55

o SSH username and password: SSHadmin / ciscosshpa55 Part

1: Verify Connectivity

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

Step 2: Verify connectivity between C2 (VLAN 10) and D1 (VLAN 5). Note: If using the simple PDU GUI packet, be sure to ping twice to allow for ARP.

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

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

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

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

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

SW-1(config)# interface f0/23

SW-1(config-if)# switchport mode trunk

SW-1(config-if)# switchport trunk native vlan 15

SW-1(config-if)# switchport nonegotiate

SW-1(config-if)# no shutdown

SW-2(config)# interface f0/23

SW-2(config-if)# switchport mode trunk

SW-2(config-if)# switchport trunk native vlan 15

SW-2(config-if)# switchport nonegotiate

SW-2(config-if)# no shutdown

Part 3: Enable VLAN 20 as a Management VLAN

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

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

a. Enable VLAN 20 on SW-A.

SW-A(config)# vlan 20

SW-A(config-vlan)# exit

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

SW-A(config)# interface vlan 20

SW-A(config-if)# ip address 192.168.20.1 255.255.255.0

Packet Tracer - Layer 2 VLAN Security

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

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

SW-B(config)# vlan 20

SW-B(config-vlan)# exit

SW-1(config)# vlan 20

SW-1(config-vlan)# exit

SW-2(config)# vlan 20

SW-2(config-vlan)# exit

Central(config)# vlan 20

Central(config-vlan)# exit

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

SW-B(config)# interface vlan 20

SW-B(config-if)# ip address 192.168.20.2 255.255.255.0

SW-1(config)# interface vlan 20

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

SW-2(config)# interface vlan 20

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

Central(config)# interface vlan 20

Central(config-if)# ip address 192.168.20.5 255.255.255.0

Step 3: Connect and configure the management PC.

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

Step 4: On SW-A, ensure the management PC is part of VLAN 20. Interface F0/1 must be part of VLAN 20.

SW-A(config)# interface f0/1

SW-A(config-if)# switchport access vlan 20 SW-A(config-if)# no shutdown

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

The management PC should be able to ping SW-A, SW-B, SW-1, SW-2, and Central. Part 4: Enable the Management PC to Access Router R1

Step 1: Enable a new subinterface on router R1.

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

R1(config)# interface g0/0.3

R1(config-subif)# encapsulation dot1q 20

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

R1(config)# interface g0/0.3

R1(config-subif)# ip address 192.168.20.100 255.255.255.0

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

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

Step 3: Enable security.

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

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

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

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

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

Example: (may vary from student configuration)

R1(config)# interface g0/0.1 R1(config-subif)# ip access-group 101 in R1(config-subif)# interface g0/0.2 R1(config-subif)# ip access-group 101 in

R1(config-subif)# line vty 0 4

R1(config-line)# access-class 102 in

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

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

Step 4: Verify security. a. Verify only the Management PC can access the router. Use SSH to access R1 with username SSHadmin and password ciscosshpa55.

PC> ssh -l SSHadmin 192.168.20.100

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

Packet Tracer - Layer 2 VLAN Security

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.

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.

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

Step 5: Check results.

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

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

!!! 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 interface vlan 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 exit

interface 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 conf t interface GigabitEthernet0/0.1 ip access-group 101 in interface GigabitEthernet0/0.2 ip access- group 101 in interface g0/0.3 encapsulation dot1q 20 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 0 4 access-class 102 in

Learning Outcomes:

Gained knowledge in securing VLANs and controlling traffic at Layer 2

Course Outcome:

Developed practical skills in Layer 2 security to safeguard VLANs and enhance overall network integrity.

Conclusion:

Viva Question:

1-what is VLAN?

2-what is use Of security?

3-what is the purpose of security?

For Faculty Use

Correction Parameter	Formative Assessment [ ]	Timely completion of practical [ ]	Attendance Learning Attitude []

Practical 9

Aim:- Configure and Verify a Site-to-Site IPsec VPN Using CLI

Tools & Technologies used:- tools and technologies used include routers, Cisco IOS, and the command-line interface for IPsec configuration.

Learning Objectives: The learning objectives focus on configuring VPN parameters like IP addresses, encryption protocols, and key exchanges (IKEv1 or IKEv2). Students will learn to set up encryption, authentication, and integrity checks, as well as verify VPN connectivity, troubleshoot issues, and ensure data confidentiality and integrity in the tunnel between sites.

Theory :Configure and Verify a Site-to-Site IPsec VPN Using CLI

Objectives

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

Background / Scenario

The network topology shows three routers. Your task is to configure R1 and R3 to support a site-to-site IPsec VPN when traffic flows between their respective LANs.

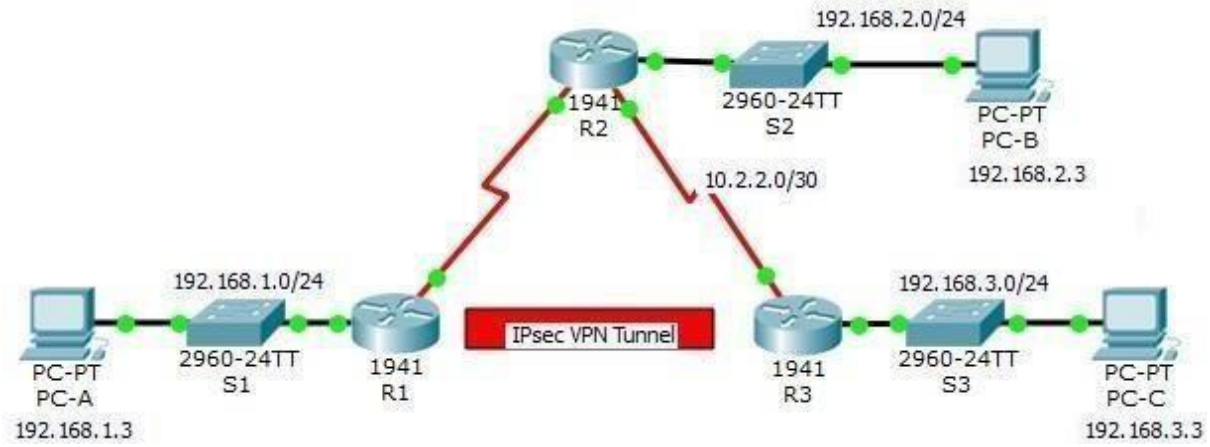
The IPsec VPN tunnel is from R1 to R3 via R2. R2 acts as a pass-through and has no knowledge of the VPN. IPsec provides secure transmission of sensitive information over unprotected networks, such as the Internet.

IPsec operates at the network layer and protects and authenticates IP packets between participating IPsec devices (peers), such as Cisco routers.

\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

Step



Addressing Table

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

Objectives

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

Background / Scenario

The network topology shows three routers. Your task is to configure R1 and R3 to support a site-to-site IPsec VPN when traffic flows between their respective LANs. The IPsec VPN

tunnel is from R1 to R3 via R2. R2 acts as a pass-through and has no knowledge of the VPN. IPsec provides secure transmission of sensitive information over unprotected networks, such as the Internet. IPsec operates at the network layer and protects and authenticates IP packets between participating IPsec devices (peers), such as Cisco routers. ISAKMP Phase 1 Policy Parameters

Configure and Verify a Site-to-Site IPsec VPN Using CLI

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

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 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 3: Identify interesting traffic on R1.

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

R1(config)# access-list 110 permit ip 192.168.1.0 0.0.0.255 192.168.3.00.0.0.255

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

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

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

R1(config)# crypto isakmp policy 10

R1(config-isakmp)# encryption aes 256

R1(config-isakmp)# authentication pre-share

R1(config-isakmp)# group 5

R1(config-isakmp)# exit

R1(config)# crypto isakmp key vpnpa55 address 10.2.2.2

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

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

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

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

R1(config)# crypto map VPN-MAP 10 ipsec-isakmp

R1(config-crypto-map)# description VPN connection to R3

R1(config-crypto-map)# set peer 10.2.2.2

R1(config-crypto-map)# set transform-set VPN-SET

R1(config-crypto-map)# match address 110 R1(config-crypto- map)# exit

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

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

R1(config)# interface s0/0/0

R1(config-if)# crypto map VPN-MAP Part 2: Configure IPsec Parameters on R3

Step 1: Enable the Security Technology package.

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

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 to the LAN on R1 as interesting.

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

Step 3: Configure the IKE Phase 1 ISAKMP properties on R3. Configure the crypto ISAKMP policy 10 properties on R3 along with the shared crypto key vpnpa55.

R3(config)# crypto isakmp policy 10

R3(config-isakmp)# encryption aes 256

R3(config-isakmp)# authentication pre-share R3(config-isakmp)# group 5

R3(config-isakmp)# exit

R3(config)# crypto isakmp key vpnpa55 address 10.1.1.2

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

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

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

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

R3(config)# crypto map VPN-MAP 10 ipsec-isakmp

R3(config-crypto-map)# description VPN connection to R1

R3(config-crypto-map)# set peer 10.1.1.2

R3(config-crypto-map)# set transform-set VPN-SET

R3(config-crypto-map)# match address 110 R3(config-crypto-map)# exit

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

R3(config)# interface s0/0/1

R3(config-if)# crypto map VPN-MAP

Part 3: Verify the IPsec VPN

Step 1: Verify the tunnel prior to interesting traffic. Issue the show crypto ipsec sa command on R1. Notice that the number of packets encapsulated, encrypted, decapsulated, and decrypted are all set to 0.

Step 2: Create interesting traffic.

Ping PC-C from PC-A.

Step 3: Verify the tunnel after interesting traffic.

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

Step 4: Create uninteresting traffic. Ping PC-B from PC-A. Note: Issuing a ping from router R1 to PC-C or R3 to PC-A is not interesting traffic.

Step 5: Verify the tunnel.

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

Step 6: Check results.

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

!!! Script for R1

config t

license boot module c1900 technology-package securityk9

yes end

copy running-config startup-config

reload

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 ipsec transform-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 match address 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 mapVPN-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/

Learning Outcomes:

Gained hands-on experience in configuring and verifying a Site-to-Site IPsec VPN.

Course Outcome:

Developed skills in securing communication between remote sites and ensuring data confidentiality using IPsec VPNs.

Conclusion:

Viva Question:

1-What is the CLI?

2-what is the CLI stand for?

3-what is the uses of CLI ?

For Faculty use

	Formative Assessment [ ]	**Timely completion of practical [ ]**	**Attendance Learning Attitude []**

Practical 10

Aim:- Configure basic ASA settings and interface security levels using CLI , Configure routing, address translation, and inspection policy using CLI , c Configure DHCP, AAA, and SSH , Configure a DMZ, Static NAT, and ACLs

Tools & Technologies used:- Tools and technologies include the ASA device, Cisco ASDM (Adaptive Security Device Manager), and the command-line interface for configuration..

Learning Objectives: The learning objectives focus on configuring basic ASA settings such as interfaces, IP addressing, routing, and access control policies. Students will learn how to set up security levels, define firewall rules, enable NAT (Network Address Translation), and apply access control lists (ACLs) to filter traffic, ensuring secure and efficient network communication.

Theory :Configuring ASA Basic Settings and Firewall Using CLI

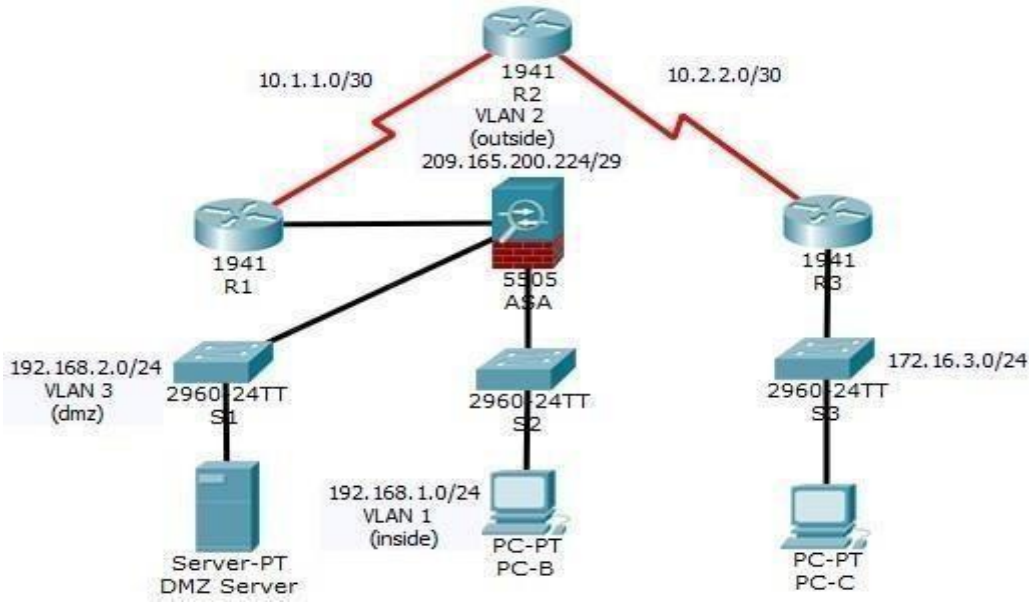
The Cisco Adaptive Security Appliance (ASA) is an advanced network security device that integrates a stateful firewall, VPN, and other capabilities. This lab employs an ASA 5506 to create a firewall and protect an internal corporate network from external intruders while allowing internal hosts access to the Internet.

The ASA creates three security interfaces: Outside, Inside, and DMZ. It provides outside users limited access to the DMZ and no access to inside resources. Inside users can access the DMZ and outside resources. The focus of this lab is the configuration of the ASA as a basic firewall. Other devices will receive minimal configuration to support the ASA portion of this lab. This lab uses the ASA CLI, which is similar to the IOS CLI, to configure basic device and security settings. In Part 1 of this lab, you will configure the topology and non-ASA devices. In Parts 2 through 4 you will configure basic ASA settings and the firewall between the inside and outside networks.

In part 5 you will configure the ASA for additional services, such as DHCP, AAA, and SSH. In Part 6, you will configure a DMZ on the ASA and provide access to a server in the DMZ. Your company has one location connected to an ISP. R1 represents a CPE device managed by the ISP. R2 represents an intermediate Internet router. R3 represents an ISP that connects an administrator from a network management company, who has been hired to remotely manage your network.

The ASA is an edge security device that connects the internal corporate network and DMZ to the ISP while providing NAT and DHCP services to inside hosts. The ASA will be configured for management by an administrator on the internal network and by the remote administrator. Layer 3 interfaces provide access to the three areas created in the lab: Inside, Outside, and DMZ. The ISP has assigned the public IP address space of 209.165.200.224/29, which will be used for address translation

Step



IP Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway
R1	G0/0	209.165.200.225	255.255.255.248	N/A
	S0/0/0 (DCE)	10.1.1.1	255.255.255.252	N/A
R2	S0/0/0	10.1.1.2	255.255.255.252	N/A
	S0/0/1 (DCE)	10.2.2.2	255.255.255.252	N/A
R3	G0/1	172.16.3.1	255.255.255.0	N/A
	S0/0/1	10.2.2.1	255.255.255.252	N/A
ASA	VLAN 1 (E0/1)	192.168.1.1	255.255.255.0	NA
ASA	VLAN 2 (E0/0)	209.165.200.226	255.255.255.248	NA
ASA	VLAN 3 (E0/2)	192.168.2.1	255.255.255.0	NA
DMZ Server	NIC	192.168.2.3	255.255.255.0	192.168.2.1
PC-B	NIC	192.168.1.3	255.255.255.0	192.168.1.1

PC-C	NIC	172.16.3.3	255.255.255.0	172.16.3.1

Objectives

- Verify connectivity and explore the ASA
- Configure basic ASA settings and interface security levels using CLI
- Configure routing, address translation, and inspection policy using CLI
- Configure DHCP, AAA, and SSH
- Configure a DMZ, Static NAT, and ACLs

Scenario

Your company has one location connected to an ISP. R1 represents a CPE device managed by the ISP. R2 represents an intermediate Internet router. R3 represents an ISP that connects an administrator from a network management company, who has been hired to remotely manage your network. The ASA is an edge CPE security device that connects the internal corporate network and DMZ to the ISP while providing NAT and DHCP services to inside hosts. The ASA will be configured for management by an administrator on the internal network and by the remote administrator. Layer 3 VLAN interfaces provide access to the three areas created in the activity: Inside, Outside, and DMZ. The ISP assigned the public IP address space of 209.165.200.224/29, which will be used for address translation on the ASA.

All router and switch devices have been preconfigured with the following:

o Enable password: ciscoenpa55 o Console password: ciscoconpa55

o Admin username and password: admin/adminpa55

Note: This Packet Tracer activity is not a substitute for the ASA labs. This activity provides additional practice and simulates most of the ASA 5505 configurations. When compared to a real ASA 5505, there may be slight differences in command output or commands that are not yet supported in Packet Tracer.

Part 1: Verify Connectivity and Explore the ASA

Note: This Packet Tracer activity starts with 20% of the assessment items marked as complete. This is to ensure that you do not inadvertently change some ASA default values. For example, the default name of the inside interface is “inside” and should not be changed. Click Check Results to see which assessment items are already scored as correct.

Step 1: Verify connectivity.

The ASA is not currently configured. However, all routers, PCs, and the DMZ server are configured. Verify that PC-C can ping any router interface. PC-C is unable to ping the ASA, PC-B, or the DMZ server.

Step 2: Determine the ASA version, interfaces, and license. Use the show version command to determine various aspects of this ASA device.

Step 3: Determine the file system and contents of flash memory.

a. Enter privileged EXEC mode. A password has not been set. Press Enter when prompted for a password.

b. Use the show file system command to display the ASA file system and determine which prefixes are supported.

c Use the show flash: or show disk0: command to display the contents of flash memory.

Part 2: Configure ASA Settings and Interface Security Using the CLI

Tip: Many ASA CLI commands are similar to, if not the same, as those used with the Cisco IOS CLI. In addition, the process of moving between configuration modes and submodes is essentially the same.

Step 1: Configure the hostname and domain name.

a. Configure the ASA hostname as CCNAS-ASA.

b. Configure the domain name as ccnasecurity.com.

Step 2: Configure the enable mode password. Use the enable password command to change the privileged EXEC mode password to ciscoenpa55.

Step 3: Set the date and time. Use the clock set command to manually set the date and time (this step is not scored).

Step 4: Configure the inside and outside interfaces.

You will only configure the VLAN 1 (inside) and VLAN 2 (outside) interfaces at this time. The VLAN 3 (dmz) interface will be configured in Part 5 of the activity.

a. Configure a logical VLAN 1 interface for the inside network (192.168.1.0/24) and set the security level to the highest setting of 100.

CCNAS-ASA(config)# interface vlan 1 CCNAS-ASA(config-if)# nameif inside

CCNAS-ASA(config-if)# ip address 192.168.1.1 255.255.255.0 CCNAS-ASA(config- if)# security-level 100

b. Create a logical VLAN 2 interface for the outside network (209.165.200.224/29), set the security level to the lowest setting of 0, and enable the VLAN 2 interface.

CCNAS-ASA(config-if)# interface vlan 2

CCNAS-ASA(config-if)# nameif outside

CCNAS-ASA(config-if)# ip address 209.165.200.226 255.255.255.248 CCNAS-

ASA(config-if)# security-level 0

c. Use the following verification commands to check your configurations:

1) Use the show interface ip brief command to display the status for all ASA interfaces. Note: This command is different from the IOS command show ip interface brief. If any of the physical or logical interfaces previously configured are not up/up, troubleshoot as necessary before continuing.

Tip: Most ASA show commands, including ping, copy, and others, can be issued from within any configuration mode prompt without the do command.

2) Use the show ip address command to display the information for the Layer 3 VLAN interfaces.

3) Use the show switch vlan command to display the inside and outside VLANs configured on the ASA and to display the assigned ports.

Step 5: Test connectivity to the ASA.

a. You should be able to ping from PC-B to the ASA inside interface address (192.168.1.1). If the pings fail, troubleshoot the configuration as necessary.

b. From PC-B, ping the VLAN 2 (outside) interface at IP address 209.165.200.226. You should not be able to ping this address.

Part 3: Configure Routing, Address Translation, and Inspection Policy Using the CLI

Step 1: Configure a static default route for the ASA.

Configure a default static route on the ASA outside interface to enable the ASA to reach external networks.

a. Create a “quad zero” default route using the route command, associate it with the ASA outside interface, and point to the R1 G0/0 IP address (209.165.200.225) as the gateway of last resort.

CCNAS-ASA(config)# route outside 0.0.0.0 0.0.0.0 209.165.200.225

b. Issue the show route command to verify the static default route is in the ASA routing table.

c. Verify that the ASA can ping the R1 S0/0/0 IP address 10.1.1.1. If the ping is unsuccessful, troubleshoot as necessary.

Step 2: Configure address translation using PAT and network objects.

a. Create network object inside-net and assign attributes to it using the subnet and nat commands.

CCNAS-ASA(config)# object network inside-net

CCNAS-ASA(config-network-object)# subnet 192.168.1.0 255.255.255.0

CCNAS-ASA(config-network-object)# nat (inside,outside) dynamic interface

CCNAS-ASA(config-network-object)# end

b. The ASA splits the configuration into the object portion that defines the network to be translated and the actual nat command parameters. These appear in two different places in the running configuration. Display the NAT object configuration using the show run command.

c. From PC-B attempt to ping the R1 G0/0 interface at IP address 209.165.200.225. The pings should fail.

d. Issue the show nat command on the ASA to see the translated and untranslated hits. Notice that, of the pings from PC-B, four were translated and four were not. The outgoing pings (echos) were translated and sent to the destination. The returning echo replies were blocked by the firewall policy. You will configure the default inspection policy to allow ICMP in Step 3 of this part of the activity.

Step 3: Modify the default MPF application inspection global service policy.

For application layer inspection and other advanced options, the Cisco MPF is available on ASAs.

The Packet Tracer ASA device does not have an MPF policy map in place by default. As a modification, we can create the default policy map that will perform the inspection on inside-to-outside traffic. When configured correctly only traffic initiated from the inside is allowed back in to the outside interface. You will need to add ICMP to the inspection list.

a. Create the class-map, policy-map, and service-policy. Add the inspection of ICMP traffic to the policy map list using the following commands:

CCNAS-ASA(config)# class-map inspection_default

CCNAS-ASA(config-cmap)# match default-inspection-traffic

CCNAS-ASA(config-cmap)# exit

CCNAS-ASA(config)# policy-map global_policy

CCNAS-ASA(config-pmap)# class inspection_default

CCNAS-ASA(config-pmap-c)# inspect icmp

CCNAS-ASA(config-pmap-c)# exit

CCNAS-ASA(config)# service-policy global_policy global

b. From PC-B, attempt to ping the R1 G0/0 interface at IP address 209.165.200.225. The pings should be successful this time because ICMP traffic is now being inspected and legitimate return traffic is being allowed. If the pings fail, troubleshoot your configurations.

Part 4: Configure DHCP, AAA, and SSH

Step 1: Configure the ASA as a DHCP server.

a. Configure a DHCP address pool and enable it on the ASA inside interface.

CCNAS-ASA(config)# dhcpd address 192.168.1.5-192.168.1.36 inside

b. (Optional) Specify the IP address of the DNS server to be given to clients.

CCNAS-ASA(config)# dhcpd dns 209.165.201.2 interface inside

c. Enable the DHCP daemon within the ASA to listen for DHCP client requests on the enabled interface (inside).

CCNAS-ASA(config)# dhcpd enable inside

d. Change PC-B from a static IP address to a DHCP client, and verify that it receives IP addressing information. Troubleshoot, as necessary to resolve any problems.

Step 2: Configure AAA to use the local database for authentication.

a. Define a local user named admin by entering the username command. Specify a password of adminpa55.

CCNAS-ASA(config)# username admin password adminpa55

b. Configure AAA to use the local ASA database for SSH user authentication.

CCNAS-ASA(config)# aaa authentication ssh console LOCAL Step 3: Configure remote access to the ASA.

The ASA can be configured to accept connections from a single host or a range of hosts on the inside or outside network. In this step, hosts from the outside network can only use SSH to communicate with the ASA. SSH sessions can be used to access the ASA from the inside network.

a. Generate an RSA key pair, which is required to support SSH connections. Because the ASA device has RSA keys already in place, enter no when prompted to replace them.

CCNAS-ASA(config)# crypto key generate rsa modulus 1024

WARNING: You have a RSA keypair already defined named <Default-RSA-Key>.

Do you really want to replace them? [yes/no]: no

ERROR: Failed to create new RSA keys named <Default-RSA-Key>

b. Configure the ASA to allow SSH connections from any host on the inside network (192.168.1.0/24) and from the remote management host at the branch office (172.16.3.3) on the outside network. Set the SSH timeout to 10 minutes (the default is 5 minutes).

CCNAS-ASA(config)# ssh 192.168.1.0 255.255.255.0 inside

CCNAS-ASA(config)# ssh 172.16.3.3 255.255.255.255 outside CCNAS-ASA(config)# ssh timeout 10

c. Establish an SSH session from PC-C to the ASA (209.165.200.226). Troubleshoot if it is not successful.

PC> ssh -l admin 209.165.200.226

d. Establish an SSH session from PC-B to the ASA (192.168.1.1). Troubleshoot if it is not successful.

PC> ssh -l admin 192.168.1.1

Part 5: Configure a DMZ, Static NAT, and ACLs

R1 G0/0 and the ASA outside interface already use 209.165.200.225 and .226, respectively. You will use public address 209.165.200.227 and static NAT to provide address translation access to the server.

Step 1: Configure the DMZ interface VLAN 3 on the ASA.

a. Configure DMZ VLAN 3, which is where the public access web server will reside. Assign it IP address 192.168.2.1/24, name it dmz, and assign it a security level of 70. Because the server does not need to initiate communication with the inside users, disable forwarding to interface VLAN 1.

CCNAS-ASA(config)# interface vlan 3 CCNAS-ASA(config-if)# ip address 192.168.2.1 255.255.255.0 CCNAS- ASA(config-if)# no forward interface vlan 1 CCNAS-ASA(config-if)# nameif dmz

INFO: Security level for "dmz" set to 0 by default. CCNAS-

ASA(config-if)# security-level 70

b. Assign ASA physical interface E0/2 to DMZ VLAN 3 and enable the interface.

CCNAS-ASA(config-if)# interface Ethernet0/2

CCNAS-ASA(config-if)# switchport access vlan 3

c. Use the following verification commands to check your configurations:

1) Use the show interface ip brief command to display the status for all ASA interfaces.

2) Use the show ip address command to display the information for the Layer 3 VLANinterfaces.

3) Use the show switch vlan command to display the inside and outside VLANs configured on the ASA and to display the assigned ports.

Step 2: Configure static NAT to the DMZ server using a network object.

Configure a network object named dmz-server and assign it the static IP address of the DMZ server (192.168.2.3). While in object definition mode, use the nat command to specify that this object is used to translate a DMZ address to an outside address using static NAT, and specify a public translated address of 209.165.200.227.

CCNAS-ASA(config)# object network dmz-server

CCNAS-ASA(config-network-object)# host 192.168.2.3

CCNAS-ASA(config-network-object)# nat (dmz,outside) static 209.165.200.227

CCNAS-ASA(config-network-object)# exit

Step 3: Configure an ACL to allow access to the DMZ server from the Internet.

Configure a named access list OUTSIDE-DMZ that permits the TCP protocol on port 80 from any external host to the internal IP address of the DMZ server. Apply the access list to the ASA outside interface in the “IN” direction.

CCNAS-ASA(config)# access-list OUTSIDE-DMZ permit icmp any host 192.168.2.3

CCNAS-ASA(config)# access-list OUTSIDE-DMZ permit tcp any host 192.168.2.3 eq 80 CCNAS-ASA(config)# access-group OUTSIDE-DMZ in interface outside

Note: Unlike IOS ACLs, the ASA ACL permit statement must permit access to the internal private DMZ address. External hosts access the server using its public static NAT address, the ASA translates it to the internal host IP address, and then applies the ACL.

Step 4: Test access to the DMZ server.

At the time this Packet Tracer activity was created, the ability to successfully test outside access to the DMZ web server was not in place; therefore, successful testing is not required.

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. Scripts

ASA enable

!<Enter> for password conf t hostname CCNAS-ASA domain-name ccnasecurity.com enable password ciscoenpa55 clock set 13:52:51 June 10 2015 interface vlan 1 nameif inside

ip address 192.168.1.1 255.255.255.0

security-level 100 interface vlan 2

nameif outside ip address 209.165.200.226 255.255.255.248 security-level 0

route outside 0.0.0.0 0.0.0.0 209.165.200.225

object network inside-net subnet 192.168.1.0 255.255.255.0 nat (inside,outside) dynamic interface class-map inspection_default match default-inspection-traffic exit

policy-map global_policy class inspection_default inspect icmp exit

service-policy global_policy global dhcpd address 192.168.1.5-192.168.1.36 inside dhcpd dns 209.165.201.2 interface inside dhcpd enable inside username admin password adminpa55 aaa authentication ssh console LOCAL crypto key generate rsa modulus 1024 no ssh 192.168.1.0 255.255.255.0 inside

ssh 172.16.3.3 255.255.255.255 outside ssh timeout 10 interface vlan 3

ip address 192.168.2.1 255.255.255.0

no forward interface vlan 1 nameif dmz security-level 70 interface Ethernet0/2 switchport access vlan 3 object network dmz-server host

192.168.2.3 nat (dmz,outside) static 209.165.200.227 access-list OUTSIDE-DMZ permit icmp any host 192.168.2.3 access-list OUTSIDE-DMZ permit tcp any host 192.168.2.3 eq 80 access-group OUTSIDE-DMZ in interface outside PC-B -Change from

Learning Outcomes:

Gained hands-on experience in ASA configuration, including routing, NAT, DHCP, AAA, and SSH.

Course Outcome:

Developed proficiency in configuring security appliances and implementing network policies for effective traffic control and secure network management.

Conclusion:

Viva Question:

1-what is the ASA ?

2-what is the use OF ASA?

3-what is the CLI?

For Faculty use

	Formative Assessment [ ]	**Timely completion of practical [ ]**	**Attendance Learning Attitude []**

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Department of Computer
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Design..Develop..Deploy..Deliver

Prof. name :			Class/SEM : T.Y.BSC.IT / SEM VI (2024-2025)	
Course code : U S I T 6 P 2			Subject name Security in Computing Practical	
Sr. No	**Date**	**Topics**	**Page No**	**Signature**
1 **a)** **b)** **c)** **d)**		Configure Routers OSPF MD5 authentication. NTP. to log messages to the syslog server . to support SSH connections.		
2 **a)** **b)**		Configure AAA Authentication Configure a local user account on Router and configure authenticate on the console and vty lines using local AAA Verify local AAA authentication from the Router console and the PC-A client		
3 **a)**		Configuring Extended ACLs Configure, Apply and Verify an Extended Numbered ACL		
4 **a)** **b)** **c)** **d)**		Configure IP ACLs to Mitigate Attacks and IPV6 ACLs 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 to mitigate attacks. Configuring IPv6 ACLs		
5		**Configuring a Zone-Based Policy Firewall**		

6		Configure IOS Intrusion Prevention System (IPS) Using the CLI a Enable IOS IPS. b Modify an IPS signature.		
7 **a)** **b)** **c)**		Layer 2 Security Assign the Central switch as the root bridge. Secure spanning-tree parameters to prevent STP manipulation attacks. Enable port security to prevent CAM table overflow attacks.		
8		Layer 2 VLAN Security		
9		Configure and Verify a Site-to-Site IPsec VPN Using CLI		
10		Configuring ASA Basic Settings and Firewall Using CLI		

a)		Configure basic ASA settings and interface security levels using CLI		
b)		Configure routing, address translation, and inspection policy using CLI		
c)		Configure DHCP, AAA, and SSH		
d)		Configure a DMZ, Static NAT, and ACLs		

SHRI. G.P.M. DEGREE COLLEGE OF SCIENCE AND COMMERCE

2024 – 2025

Name: _____

Department: _____

Class: _____

Roll No: _____

SHRI G.P.M. DEGREE COLLEGE OF SCIENCE & COMMERCE

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CERTIFICATE

This is to certify that Mr/Ms. _____-_____a student of **T.Y.B.Sc IT** Roll No. _____has completed the required number of practical in the subject of _____ as prescribed by the **UNIVERSITY OF MUMBAI** under my supervision during the academic year 2024-2025.

Signatories:

Subject In-charge (Name & Sign) : _____

Principal Sign (Name & Sign) : _____

External Examiner (Name & Sign) : _____

Date: _____ **College Stamp**