

Lab – Securing Network Devices (Instructor Version)

Instructor Note: Red font color or Gray highlights indicate text that appears in the instructor copy only.

Topology



Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway
R1	G0/1	192.168.1.1	255.255.255.0	N/A
S1	VLAN 1	192.168.1.11	255.255.255.0	192.168.1.1
PC-A	NIC	192.168.1.3	255.255.255.0	192.168.1.1

Objectives

Part 1: Configure Basic Device Settings

Part 2: Configure Basic Security Measures on the Router

Part 3: Configure Basic Security Measures on the Switch

Background / Scenario

It is recommended that all network devices be configured with, at least, a minimum set of best practice security commands. This includes end user devices, servers, and network devices, such as routers and switches.

In this lab, you will configure the network devices in the topology to accept SSH sessions for remote management. You will also use the IOS CLI to configure common, basic best practice security measures. You will then test the security measures to verify that they are properly implemented and working correctly.

Note: The routers used with CCNA hands-on labs are Cisco 1941 ISRs with Cisco IOS Release 15.2(4)M3 (universalk9 image). The switches used are Cisco Catalyst 2960s with Cisco IOS Release 15.0(2) (lanbasek9 image). Other routers, switches and Cisco IOS versions can be used. Depending on the model and Cisco IOS version, the commands available and output produced might vary from what is shown in the labs. Refer to the Router Interface Summary table at the end of the lab for the correct interface identifiers.

Note: Make sure that the routers and switches have been erased and have no startup configurations. If you are unsure contact your instructor.

Instructor Note: Refer to the Instructor Lab Manual for the procedures to initialize and reload devices.

Required Resources

- 1 Router (Cisco 1941 with Cisco IOS software, release 15.2(4)M3 universal image or comparable)
- 1 Switch (Cisco 2960 with Cisco IOS Release 15.0(2) lanbasek9 image or comparable)
- 1 PC (Windows 7, Vista, or XP with terminal emulation program, such as Tera Term)
- Console cables to configure the Cisco IOS devices via the console ports

- Ethernet cables as shown in the topology

Part 1: Configure Basic Device Settings

In Part 1, you will set up the network topology and configure basic settings, such as the interface IP addresses, device access, and passwords on the router.

Step 1: Cable the network as shown in the topology.

Attach the devices shown in the topology and cable as necessary.

Step 2: Initialize and reload the router and switch.

Step 3: Configure the router.

Please refer to the previous lab for help with the commands needed for SSH.

- Console into the router and enable privileged EXEC mode.
- Enter configuration mode.
- Assign the name of the router as R1.
- Disable DNS lookup to prevent the router from attempting to translate incorrectly entered commands as though they were hostnames.
- Assign **class** as the privileged EXEC encrypted password.
- Assign **cisco** as the console password and enable login.
- Assign **cisco** as the vty password and enable login.
- Encrypt the clear text passwords.
- Create a banner that warns anyone accessing the device that unauthorized access is prohibited.
- Configure and activate the G0/1 interface on the router using the information contained in the Addressing Table.
- Save the running configuration to the startup configuration file.

Step 4: Configure the switch.

- Console into the switch and enable privileged EXEC mode.
- Enter configuration mode.
- Assign the name of the switch as S1.
- Disable DNS lookup to prevent the router from attempting to translate incorrectly entered commands as though they were hostnames.
- Assign **class** as the privileged EXEC encrypted password.
- Assign **cisco** as the console password and enable login.
- Assign **cisco** as the vty password and enable login.
- Encrypt the clear text passwords.
- Create a banner that warns anyone accessing the device that unauthorized access is prohibited.
- Configure the default SVI with the IP address information contained in the Addressing Table.
- Save the running configuration to the startup configuration file.

Part 2: Configure Basic Security Measures on the Router

Step 1: Strengthen passwords.

An administrator should ensure that passwords meet the standard guidelines for strong passwords. These guidelines could include mixing letters, numbers and special characters in the password and setting a minimum length.

Note: Best practice guidelines require the use of strong passwords, such as those shown here, in a production environment. However, the other labs in this course use the cisco and class passwords for ease in performing the labs.

- a. Change the privilege EXEC encrypted password to meet guidelines.

```
R1(config)# enable secret Enablep@55
```

- b. Require that a minimum of 10 characters be used for all passwords.

```
R1(config)# security passwords min-length 10
```

Step 2: Enable SSH connections.

- a. Assign the domain name as **CCNA-lab.com**.

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

- b. Create a local user database entry to use when connecting to the router via SSH. The password should meet strong password standards, and the user should have administrator-level access.

```
R1(config)# username admin privilege 15 secret Admin15p@55
```

- c. Configure the transport input for the vty lines so that they accept SSH connections, but do not allow Telnet connections.

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

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

- d. The vty lines should use the local user database for authentication.

```
R1(config-line)# login local
```

```
R1(config-line)# exit
```

- e. Generate a RSA crypto key using a modulus of 1024 bits.

```
R1(config)# crypto key generate rsa modulus 1024
```

```
The name for the keys will be: R1.CCNA-lab.com
```

```
% The key modulus size is 1024 bits
```

```
% Generating 1024 bit RSA keys, keys will be non-exportable...
```

```
[OK] (elapsed time was 2 seconds)
```

```
R1(config)#
```

```
*Jan 31 17:54:16.127: %SSH-5-ENABLED: SSH 1.99 has been enabled
```

Step 3: Secure the console and VTY lines.

- a. You can set the router to log out of a connection that has been idle for a specified time. If a network administrator was logged into a networking device and was suddenly called away, this command automatically logs the user out after the specified time. The following commands cause the line to log out after five minutes of inactivity.

```
R1(config)# line console 0
R1(config-line)# exec-timeout 5 0
R1(config-line)# line vty 0 4
R1(config-line)# exec-timeout 5 0
R1(config-line)# exit
R1(config)#
```

- b. The following command impedes brute force login attempts. The router blocks login attempts for 30 seconds if someone fails two attempts within 120 seconds. This timer is set especially low for the purpose of this lab.

```
R1(config)# login block-for 30 attempts 2 within 120
```

What does the **2 within 120** mean in the above command?

If two failed attempts are made within a 2 minute (120 seconds) time span, login access will be blocked.

What does the **block-for 30** mean in the above command?

If login access is blocked, the device will wait 30 seconds before allowing login access again.

Step 4: Verify that all unused ports are disabled.

Router ports are disabled, by default, but it is always prudent to verify that all unused ports are in an administratively down state. This can be quickly checked by issuing the **show ip interface brief** command. Any unused ports that are not in an administratively down state should be disabled using the **shutdown** command in interface configuration mode.

```
R1# show ip interface brief
```

Interface	IP-Address	OK?	Method	Status	Protocol
Embedded-Service-Engine0/0	unassigned	YES	NVRAM	administratively down	down
GigabitEthernet0/0	unassigned	YES	NVRAM	administratively down	down
GigabitEthernet0/1	192.168.1.1	YES	manual	up	up
Serial0/0/0	unassigned	YES	NVRAM	administratively down	down
Serial0/0/1	unassigned	YES	NVRAM	administratively down	down

```
R1#
```

Step 5: Verify that your security measures have been implemented correctly.

- a. Use Tera Term to telnet to R1.

Does R1 accept the Telnet connection? _____ No, the connection is refused.

Why or why not?

Telnet was disabled with the **transport input ssh** command.

- b. Use Tera Term to SSH to R1.

Does R1 accept the SSH connection? _____ Yes

- c. Intentionally mistype the user and password information to see if login access is blocked after two attempts.

What happened after you failed to login the second time?

The connection to R1 was disconnected. If you attempt to reconnect within 30 seconds, the connection will be refused.

- d. From your console session on the router, issue the **show login** command to view the login status. In the example below, the **show login** command was issued within the 30 second login blocking period and shows that the router is in Quiet-Mode. The router will not accept any login attempts for 14 more seconds.

```
R1# show login
```

```
A default login delay of 1 second is applied.  
No Quiet-Mode access list has been configured.
```

```
Router enabled to watch for login Attacks.  
If more than 2 login failures occur in 120 seconds or less,  
logins will be disabled for 30 seconds.
```

```
Router presently in Quiet-Mode.  
Will remain in Quiet-Mode for 14 seconds.  
Denying logins from all sources.
```

```
R1#
```

- e. After the 30 seconds has expired, SSH to R1 again and login using the **admin** username and **Admin15p@55** for the password.

After you successfully logged in, what was displayed? _____ The R1 login banner

- f. Enter privilege Exec mode and use **Enablep@55** for the password.

If you mistype this password, are you disconnected from your SSH session after two failed attempts within 120 seconds? _____ No

Why or why not?

The **login block-for 30 attempts 2 within 120** command only monitors session login attempts.

- g. Issue the **show running-config** command at the privileged EXEC prompt to view the security settings you have applied.

Part 3: Configure Basic Security Measures on the Switch

Step 1: Strengthen Passwords on the switch.

Change the privilege EXEC encrypted password to meet strong password guidelines.

```
S1(config)# enable secret Enablep@55
```

Note: The security **password min-length** command is not available on the 2960 switch.

Step 2: Enable SSH Connections.

- a. Assign the domain-name as **CCNA-lab.com**

```
S1(config)# ip domain-name CCNA-lab.com
```

- b. Create a local user database entry for use when connecting to the router via SSH. The password should meet strong password standards, and the user should have administrative level access.

```
S1(config)# username admin privilege 15 secret Admin15p@55
```

- c. Configure the transport input for the vty lines to allow SSH connections but not allow Telnet connections.

```
S1(config)# line vty 0 15
S1(config-line)# transport input ssh
```

- d. The vty lines should use the local user database for authentication.

```
S1(config-line)# login local
S1(config-line)# exit
```

- e. Generate a RSA crypto key using a modulus of 1024 bits.

```
S1(config)# crypto key generate rsa modulus 1024
```

Step 3: Secure the console and VTY lines.

- a. Have the switch log out a line that has been idle for 10 minutes.

```
S1(config)# line console 0
S1(config-line)# exec-timeout 10 0
S1(config-line)# line vty 0 15
S1(config-line)# exec-timeout 10 0
S1(config-line)# exit
S1(config)#
```

- b. To impede brute force login attempts, configure the switch to block login access for 30 seconds if there are 2 failed attempts within 120 seconds. This timer is set especially low for the purpose of this lab.

```
S1(config)# login block-for 30 attempts 2 within 120
S1(config)# end
```

Step 4: Verify that all unused ports are disabled.

Switch ports are enabled, by default. Shut down all ports that are not in use on the switch.

- a. You can verify the switch port status using the **show ip interface brief** command.

```
S1# show ip interface brief
```

Interface	IP-Address	OK?	Method	Status	Protocol
Vlan1	192.168.1.11	YES	manual	up	up
FastEthernet0/1	unassigned	YES	unset	down	down
FastEthernet0/2	unassigned	YES	unset	down	down
FastEthernet0/3	unassigned	YES	unset	down	down
FastEthernet0/4	unassigned	YES	unset	down	down
FastEthernet0/5	unassigned	YES	unset	up	up
FastEthernet0/6	unassigned	YES	unset	up	up
FastEthernet0/7	unassigned	YES	unset	down	down
FastEthernet0/8	unassigned	YES	unset	down	down
FastEthernet0/9	unassigned	YES	unset	down	down
FastEthernet0/10	unassigned	YES	unset	down	down
FastEthernet0/11	unassigned	YES	unset	down	down
FastEthernet0/12	unassigned	YES	unset	down	down
FastEthernet0/13	unassigned	YES	unset	down	down
FastEthernet0/14	unassigned	YES	unset	down	down
FastEthernet0/15	unassigned	YES	unset	down	down
FastEthernet0/16	unassigned	YES	unset	down	down

```

FastEthernet0/17      unassigned      YES unset    down        down
FastEthernet0/18      unassigned      YES unset    down        down
FastEthernet0/19      unassigned      YES unset    down        down
FastEthernet0/20      unassigned      YES unset    down        down
FastEthernet0/21      unassigned      YES unset    down        down
FastEthernet0/22      unassigned      YES unset    down        down
FastEthernet0/23      unassigned      YES unset    down        down
FastEthernet0/24      unassigned      YES unset    down        down
GigabitEthernet0/1    unassigned      YES unset    down        down
GigabitEthernet0/2    unassigned      YES unset    down        down
S1#

```

- b. Use the **interface range** command to shut down multiple interfaces at a time.

```

S1(config)# interface range f0/1-4 , f0/7-24 , g0/1-2
S1(config-if-range)# shutdown
S1(config-if-range)# end
S1#

```

- c. Verify that all inactive interfaces have been administratively shut down.

```

S1# show ip interface brief

```

Interface	IP-Address	OK?	Method	Status	Protocol
Vlan1	192.168.1.11	YES	manual	up	up
FastEthernet0/1	unassigned	YES	unset	administratively down	down
FastEthernet0/2	unassigned	YES	unset	administratively down	down
FastEthernet0/3	unassigned	YES	unset	administratively down	down
FastEthernet0/4	unassigned	YES	unset	administratively down	down
FastEthernet0/5	unassigned	YES	unset	up	up
FastEthernet0/6	unassigned	YES	unset	up	up
FastEthernet0/7	unassigned	YES	unset	administratively down	down
FastEthernet0/8	unassigned	YES	unset	administratively down	down
FastEthernet0/9	unassigned	YES	unset	administratively down	down
FastEthernet0/10	unassigned	YES	unset	administratively down	down
FastEthernet0/11	unassigned	YES	unset	administratively down	down
FastEthernet0/12	unassigned	YES	unset	administratively down	down
FastEthernet0/13	unassigned	YES	unset	administratively down	down
FastEthernet0/14	unassigned	YES	unset	administratively down	down
FastEthernet0/15	unassigned	YES	unset	administratively down	down
FastEthernet0/16	unassigned	YES	unset	administratively down	down
FastEthernet0/17	unassigned	YES	unset	administratively down	down
FastEthernet0/18	unassigned	YES	unset	administratively down	down
FastEthernet0/19	unassigned	YES	unset	administratively down	down
FastEthernet0/20	unassigned	YES	unset	administratively down	down
FastEthernet0/21	unassigned	YES	unset	administratively down	down
FastEthernet0/22	unassigned	YES	unset	administratively down	down
FastEthernet0/23	unassigned	YES	unset	administratively down	down
FastEthernet0/24	unassigned	YES	unset	administratively down	down
GigabitEthernet0/1	unassigned	YES	unset	administratively down	down
GigabitEthernet0/2	unassigned	YES	unset	administratively down	down

```

S1#

```

Step 5: Verify that your security measures have been implemented correctly.

- a. Verify that Telnet has been disabled on the switch.
- b. SSH to the switch and intentionally mistype the user and password information to see if login access is blocked.
- c. After the 30 seconds has expired, SSH to S1 again and log in using the **admin** username and **Admin15p@55** for the password.
Did the banner appear after you successfully logged in? _____ **Yes**
- d. Enter privilege Exec mode using **Enablep@55** as the password.
- e. Issue the **show running-config** command at the privileged EXEC prompt to view the security settings you have applied.

Reflection

1. The **password cisco** command was entered for the console and vty lines in your basic configuration in Part 1. When is this password used after the best practice security measures have been applied?

This password will not be used any longer. Even though the password command still appears in the line sections of the running-config, this command was disabled as soon as the **login local** command was entered for those lines.

2. Are preconfigured passwords, shorter than 10 characters, affected by the **security passwords min-length 10** command?

No. The security passwords min-length command only affects passwords that are entered after this command is issued. Any pre-existing passwords remain in effect. If they are changed, they will need to be at least 10 characters long.

Router Interface Summary Table

Router Interface Summary				
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2
1800	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
1900	Gigabit Ethernet 0/0 (G0/0)	Gigabit Ethernet 0/1 (G0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2801	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/1/0 (S0/0/0)	Serial 0/1/1 (S0/0/1)
2811	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2900	Gigabit Ethernet 0/0 (G0/0)	Gigabit Ethernet 0/1 (G0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)

Note: To find out how the router is configured, look at the interfaces to identify the type of router and how many interfaces the router has. There is no way to effectively list all the combinations of configurations for each router class. This table includes identifiers for the possible combinations of Ethernet and Serial interfaces in the device. The table does not include any other type of interface, even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in Cisco IOS commands to represent the interface.

Device Configs - Final

Router R1

```

service timestamps debug datetime msec
service timestamps log datetime msec
service password-encryption
!
hostname R1
!
boot-start-marker
boot-end-marker
!
security passwords min-length 10
enable secret 4 jowh6xYPeJucL2dB/ulkSjK2YGee/Usr./fiqFhbxTQ
no aaa new-model
!
no ip domain lookup
ip domain name CCNA-lab.com
ip cef
login block-for 30 attempts 2 within 120
no ipv6 cef
!
username admin privilege 15 secret 4 iAAXTYNDMJ03iHURmpY85S.NR4m72e1HMyRxq9kPN0g
!
interface GigabitEthernet0/0

```

```
no ip address
shutdown
duplex auto
speed auto
!
interface GigabitEthernet0/1
ip address 192.168.1.1 255.255.255.0
duplex auto
speed auto
!
interface Serial0/0/0
no ip address
shutdown
clock rate 2000000
!
interface Serial0/0/1
no ip address
shutdown
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
banner motd ^C

  Unauthorized Access is Prohibited!

^C
!
line con 0
exec-timeout 5 0
password 7 094F471A1A0A57
login
line aux 0
line 2
no activation-character
no exec
transport preferred none
transport input all
transport output pad telnet rlogin lapb-ta mop udptn v120 ssh
stopbits 1
line vty 0 4
exec-timeout 5 0
password 7 104D000A0618
login local
transport input ssh
!
scheduler allocate 20000 1000
```

```
!  
end
```

Switch S1

```
service timestamps debug datetime msec  
service timestamps log datetime msec  
service password-encryption  
!  
hostname S1  
!  
boot-start-marker  
boot-end-marker  
!  
enable secret 4 jowh6xYPeJucL2dB/ulkSjK2YGee/Usr./fiqFhbxTQ  
!  
username admin privilege 15 secret 4 iAAxTYNDMJ03iHURmpY85S.NR4m72e1HMyRxq9kPN0g  
!  
system mtu routing 1500  
!  
no ip domain-lookup  
ip domain-name CCNA-lab.com  
login block-for 30 attempts 2 within 120  
!  
spanning-tree mode pvst  
spanning-tree extend system-id  
!  
vlan internal allocation policy ascending  
!  
interface FastEthernet0/1  
shutdown  
!  
interface FastEthernet0/2  
shutdown  
!  
interface FastEthernet0/3  
shutdown  
!  
interface FastEthernet0/4  
shutdown  
!  
interface FastEthernet0/5  
!  
interface FastEthernet0/6  
!  
interface FastEthernet0/7  
shutdown  
!  
interface FastEthernet0/8  
shutdown
```

```
!  
interface FastEthernet0/9  
shutdown  
!  
interface FastEthernet0/10  
shutdown  
!  
interface FastEthernet0/11  
shutdown  
!  
interface FastEthernet0/12  
shutdown  
!  
interface FastEthernet0/13  
shutdown  
!  
interface FastEthernet0/14  
shutdown  
!  
interface FastEthernet0/15  
shutdown  
!  
interface FastEthernet0/16  
shutdown  
!  
interface FastEthernet0/17  
shutdown  
!  
interface FastEthernet0/18  
shutdown  
!  
interface FastEthernet0/19  
shutdown  
!  
interface FastEthernet0/20  
shutdown  
!  
interface FastEthernet0/21  
shutdown  
!  
interface FastEthernet0/22  
shutdown  
!  
interface FastEthernet0/23  
shutdown  
!  
interface FastEthernet0/24  
shutdown  
!
```

```
interface GigabitEthernet0/1
shutdown
!
interface GigabitEthernet0/2
shutdown
!
interface Vlan1
ip address 192.168.1.11 255.255.255.0
!
ip http server
ip http secure-server
!
banner motd ^C

  Unauthorized Access is Prohibited!

^C
!
line con 0
password 7 110A1016141D
login
line vty 0 4
password 7 110A1016141D
login local
transport input ssh
line vty 5 15
login local
!
end
```