Controlling Switch Access with Passwords and Privilege Levels

Restrictions for Controlling Switch Access with Passwords and Privileges

The following are the restrictions for controlling switch access with passwords and privileges:

- Disabling password recovery will not work if you have set the switch to boot up manually by using the **boot manual** global configuration command. This command produces the boot loader prompt (*switch:*) after the switch is power cycled.

Restrictions and Guidelines for Reversible Password Types

- Password type 0 and type 7 are deprecated. So password type 0 and type 7, used for administrator login to Console, Telnet, SSH, webUI, and NETCONF, must be migrated to password type 8 or type 9.
- No action is required if username and password are type 0 and type 7 for local authentication such as CHAP, EAP and so on for ISG and Dot1x.
- Enable password type 0 and type 7 must be migrated to password type 8 or type 9.
- Type 6 encrypted password is supported for username and password. Auto-conversion of password type 0 and password type 7 to password type 6 is also supported.

Restrictions and Guidelines for Irreversible Password Types

- Password type 5 is deprecated. Password type 5 must be migrated to stronger password type 8 or type 9.
- For username secret password type 5 and for enable secret password type 5, migrate to type 8 or type 9.
- Plain text passwords are converted to non-reversible encrypted password type 9.
- Secret password type 4 is not supported.

Information About Passwords and Privilege Levels

Default Password and Privilege Level Configuration

A simple way of providing terminal access control in your network is to use passwords and assign privilege levels. Password protection restricts access to a network or network device. Privilege levels define what commands users can enter after they have logged into a network device.

This table shows the default password and privilege level configuration.

Table 1: Default Password and Privilege Levels

Feature	Default Setting
Enable password and privilege level	No password is defined. The default is level 15 (privileged EXEC level). The password is not encrypted in the configuration file.
Enable secret password and privilege level	No password is defined. The default is level 15 (privileged EXEC level). The password is encrypted before it is written to the configuration file.
Line password	No password is defined.

Additional Password Security

To provide an additional layer of security, particularly for passwords that cross the network or that are stored on a Trivial File Transfer Protocol (TFTP) server, you can use either the **enable password** or **enable secret** global configuration commands. Both commands accomplish the same thing; that is, you can establish an encrypted password that users must enter to access privileged EXEC mode (the default) or any privilege level you specify.

We recommend that you use the **enable secret** command because it uses an improved encryption algorithm.

If you configure the **enable secret** command, it takes precedence over the **enable password** command; the two commands cannot be in effect simultaneously.

If you enable password encryption, it applies to all passwords including username passwords, authentication key passwords, the privileged command password, and console and virtual terminal line passwords.

Password Recovery

By default, any end user with physical access to the switch can recover from a lost password by interrupting the boot process while the switch is powering on and then by entering a new password.

The password-recovery disable feature protects access to the switch password by disabling part of this functionality. When this feature is enabled, the end user can interrupt the boot process only by agreeing to set the system back to the default configuration. With password recovery disabled, you can still interrupt the boot process and change the password, but the configuration file (config.text) and the VLAN database file (vlan.dat) are deleted.

If you disable password recovery, we recommend that you keep a backup copy of the configuration file on a secure server in case the end user interrupts the boot process and sets the system back to default values. Do not keep a backup copy of the configuration file on the switch. If the switch is operating in VTP transparent mode, we recommend that you also keep a backup copy of the VLAN database file on a secure server. When the switch is returned to the default system configuration, you can download the saved files to the switch by using the Xmodem protocol.

To re-enable password recovery, use the **service password-recovery** global configuration command.

Terminal Line Telnet Configuration

When you power-up your switch for the first time, an automatic setup program runs to assign IP information and to create a default configuration for continued use. The setup program also prompts you to configure your switch for Telnet access through a password. If you did not configure this password during the setup program, you can configure it when you set a Telnet password for a terminal line.

Username and Password Pairs

You can configure username and password pairs, which are locally stored on the switch. These pairs are assigned to lines or ports and authenticate each user before that user can access the switch. If you have defined privilege levels, you can also assign a specific privilege level (with associated rights and privileges) to each username and password pair.

Privilege Levels

Cisco devices use privilege levels to provide password security for different levels of switch operation. By default, the Cisco IOS software operates in two modes (privilege levels) of password security: user EXEC (Level 1) and privileged EXEC (Level 15). You can configure up to 16 hierarchical levels of commands for each mode. By configuring multiple passwords, you can allow different sets of users to have access to specified commands.

Privilege Levels on Lines

Users can override the privilege level you set using the **privilege level** line configuration command by logging in to the line and enabling a different privilege level. They can lower the privilege level by using the **disable** command. If users know the password to a higher privilege level, they can use that password to enable the higher privilege level. You might specify a high level or privilege level for your console line to restrict line usage.

For example, if you want many users to have access to the **clear line** command, you can assign it level 2 security and distribute the level 2 password fairly widely. But if you want more restricted access to the **configure** command, you can assign it level 3 security and distribute that password to a more restricted group of users.

Command Privilege Levels

When you set a command to a privilege level, all commands whose syntax is a subset of that command are also set to that level. For example, if you set the **show ip traffic** command to level 15, the **show** commands and **show ip** commands are automatically set to privilege level 15 unless you set them individually to different levels.

AES Password Encryption and Master Encryption Keys

You can enable strong, reversible 128-bit Advanced Encryption Standard (AES) password encryption, also known as type-6 encryption. To start using type-6 encryption, you must enable the AES password encryption feature and configure a master encryption key, which is used to encrypt and decrypt passwords.

After you enable AES password encryption and configure a master key, all existing and newly created clear-text passwords for supported applications are stored in type-6 encrypted format, unless you disable type-6 password encryption. You can also configure the device to convert all existing weakly encrypted passwords to type-6 encrypted passwords.

Type 0 and type 7 passwords can be autoconverted to type 6 if the AES password encryption feature and master encryption key are configured.

Note Type 6 username and password are backward compatible to Cisco IOS XE Gibraltar 16.10.x. If you downgrade to any release version lower than Cisco IOS XE Gibraltar 16.10.1, type 6 username and password will be rejected. After autoconversion, to avoid an administrator password getting rejected during a downgrade, migrate the passwords used for administrator logins (management access) to irreversible password types manually.

How to Control Switch Access with Passwords and Privilege Levels

Setting or Changing a Static Enable Password

The enable password controls access to the privileged EXEC mode. Follow these steps to set or change a static enable password:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **enable password** *password*
4. **end**
5. **show running-config**

6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**enable password** *password* **Example:** `Device(config)# enable password secret321`	Defines a new password or changes an existing password for access to privileged EXEC mode. By default, no password is defined. For *password*, specify a string from 1 to 25 alphanumeric characters. The string cannot start with a number, is case sensitive, and allows spaces but ignores leading spaces. It can contain the question mark (?) character if you precede the question mark with the key combination Crtl-v when you create the password; for example, to create the password abc?123, do this: **a.** Enter **abc**. **b.** Enter **Crtl-v**. **c.** Enter **?123**. When the system prompts you to enter the enable password, you need not precede the question mark with the Ctrl-v; you can simply enter abc?123 at the password prompt.
Step 4	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.
Step 5	**show running-config** **Example:** `Device# show running-config`	Verifies your entries.

	Command or Action	Purpose
Step 6	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Protecting Enable and Enable Secret Passwords with Encryption

Follow these steps to establish an encrypted password that users must enter to access privileged EXEC mode (the default) or any privilege level you specify:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. Use one of the following:
   - `enable password [level` *level*`]` {*password encryption-type encrypted-password*}
   - `enable secret [level` *level*`]` {*password encryption-type encrypted-password*}
4. **service password-encryption**
5. **end**
6. **show running-config**
7. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	Use one of the following: • `enable password [level` *level*`]` {*password encryption-type encrypted-password*}	• Defines a new password or changes an existing password for access to privileged EXEC mode. • Defines a secret password, which is saved using a nonreversible encryption method.

	Command or Action	Purpose

	• `enable secret [level` *level*] {*password encryption-type encrypted-password*}
	Example:
	`Device(config)# enable password example102`
	or
	`Device(config)# enable secret level 1 password secret123sample`
		• (Optional) For *level*, the range is from 0 to 15. Level 1 is normal user EXEC mode privileges. The default level is 15 (privileged EXEC mode privileges).
		• For *password*, specify a string from 1 to 25 alphanumeric characters. The string cannot start with a number, is case sensitive, and allows spaces but ignores leading spaces. By default, no password is defined.
		• (Optional) For *encryption-type*, the available options for enable password are type 0 and type 7, and type 0, type 5, type 8, and type 9 for enable secret. If you specify an encryption type, you must provide an encrypted password—an encrypted password that you copy from another switch configuration.
		Note If you specify an encryption type and then enter a clear text password, you can not re-enter privileged EXEC mode. You cannot recover a lost encrypted password by any method.

Step 4	**service password-encryption** **Example:** `Device(config)# service password-encryption`	(Optional) Encrypts the password when the password is defined or when the configuration is written. Encryption prevents the password from being readable in the configuration file.
Step 5	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.
Step 6	**show running-config** **Example:** `Device# show running-config`	Verifies your entries.
Step 7	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Disabling Password Recovery

Follow these steps to disable password recovery to protect the security of your switch:

Before you begin

If you disable password recovery, we recommend that you keep a backup copy of the configuration file on a secure server in case the end user interrupts the boot process and sets the system back to default values. Do not keep a backup copy of the configuration file on the switch. If the switch is operating in VTP transparent mode, we recommend that you also keep a backup copy of the VLAN database file on a secure server. When the switch is returned to the default system configuration, you can download the saved files to the switch by using the Xmodem protocol.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **system disable password recovery switch** {*all* | *<1-9>*}
4. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**system disable password recovery switch** {*all* | *<1-9>*} **Example:** `Device(config)# system disable password recovery switch all`	Disables password recovery. • *all* - Sets the configuration on switches in stack. • *<1-9>* - Sets the configuration on the Switch Number selected. This setting is saved in an area of the flash memory that is accessible by the boot loader and the Cisco IOS image, but it is not part of the file system and is not accessible by any user.
Step 4	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.

What to do next

To remove **disable password recovery**, use the **no system disable password recovery switch all** global configuration command.

Setting a Telnet Password for a Terminal Line

Beginning in user EXEC mode, follow these steps to set a Telnet password for the connected terminal line:

Before you begin

- Attach a PC or workstation with emulation software to the switch console port, or attach a PC to the Ethernet management port.
- The default data characteristics of the console port are 9600, 8, 1, no parity. You might need to press the Return key several times to see the command-line prompt.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **line vty 0 15**
4. **password** *password*
5. **end**
6. **show running-config**
7. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	**Note** If a password is required for access to privileged EXEC mode, you will be prompted for it. Enters privileged EXEC mode.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**line vty 0 15** **Example:** `Device(config)# line vty 0 15`	Configures the number of Telnet sessions (lines), and enters line configuration mode. There are 16 possible sessions on a command-capable Device. The 0 and 15 mean that you are configuring all 16 possible Telnet sessions.
Step 4	**password** *password*	Sets a Telnet password for the line or lines.

	Command or Action	Purpose
	Example: `Device(config-line)# password abcxyz543`	For *password*, specify a string from 1 to 25 alphanumeric characters. The string cannot start with a number, is case sensitive, and allows spaces but ignores leading spaces. By default, no password is defined.
Step 5	**end** **Example:** `Device(config-line)# end`	Returns to privileged EXEC mode.
Step 6	**show running-config** **Example:** `Device# show running-config`	Verifies your entries.
Step 7	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring Username and Password Pairs

Follow these steps to configure username and password pairs:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **username** *name* [**privilege** *level*] {**password** *encryption-type password*}
4. Use one of the following:
   - **line console 0**
   - **line vty 0 15**
5. **login local**
6. **end**
7. **show running-config**
8. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:**	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	Purpose
	`Device> enable`	
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

Step 3	**username** *name* [**privilege** *level*] {**password** *encryption-type password*}
	Example:
	`Device(config)# username adamsample privilege 1 password secret456`
	`Device(config)# username 111111111111 mac attribute`
		Sets the username, privilege level, and password for each user.
		• For *name*, specify the user ID as one word or the MAC address. Spaces and quotation marks are not allowed.
		• You can configure a maximum of 12000 clients each, for both username and MAC filter.
		• (Optional) For *level*, specify the privilege level the user has after gaining access. The range is 0 to 15. Level 15 gives privileged EXEC mode access. Level 1 gives user EXEC mode access.
		• For *encryption-type*, enter 0 to specify that an unencrypted password will follow. Enter 7 to specify that a hidden password will follow. Enter 6 to specify an encrypted password will follow.
		• For *password*, specify the password the user must enter to gain access to the device. The password must be from 1 to 25 characters, can contain embedded spaces, and must be the last option specified in the **username** command.

Step 4	Use one of the following:
	• **line console 0**
	• **line vty 0 15**
	Example:
	`Device(config)# line console 0`
	or
	`Device(config)# line vty 15`
		Enters line configuration mode, and configures the console port (line 0) or the VTY lines (line 0 to 15).

Step 5	**login local** **Example:** `Device(config-line)# login local`	Enables local password checking at login time. Authentication is based on the username specified in Step 3.

	Command or Action	Purpose
Step 6	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.
Step 7	**show running-config** **Example:** `Device# show running-config`	Verifies your entries.
Step 8	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Setting the Privilege Level for a Command

Follow these steps to set the privilege level for a command:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **privilege** *mode* **level** *level command*
4. **enable password level** *level password*
5. **end**
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**privilege** *mode* **level** *level command*	Sets the privilege level for a command.

	Command or Action	Purpose
	Example: `Device(config)# privilege exec level 14 configure`	• For *mode*, enter **configure** for global configuration mode, **exec** for EXEC mode, **interface** for interface configuration mode, or **line** for line configuration mode. • For *level*, the range is from 0 to 15. Level 1 is for normal user EXEC mode privileges. Level 15 is the level of access permitted by the **enable** password. • For *command*, specify the command to which you want to restrict access.
Step 4	**enable password level** *level password* **Example:** `Device(config)# enable password level 14 SecretPswd14`	Specifies the password to enable the privilege level. • For *level*, the range is from 0 to 15. Level 1 is for normal user EXEC mode privileges. • For *password*, specify a string from 1 to 25 alphanumeric characters. The string cannot start with a number, is case sensitive, and allows spaces but ignores leading spaces. By default, no password is defined.
Step 5	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.
Step 6	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Changing the Default Privilege Level for Lines

Follow these steps to change the default privilege level for the specified line:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **line vty** *line*
4. **privilege level** *level*
5. **end**
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**line vty** *line* **Example:** `Device(config)# line vty 10`	Selects the virtual terminal line on which to restrict access.
Step 4	**privilege level** *level* **Example:** `Device(config)# privilege level 15`	Changes the default privilege level for the line. For *level*, the range is from 0 to 15. Level 1 is for normal user EXEC mode privileges. Level 15 is the level of access permitted by the **enable** password.
Step 5	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.
Step 6	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

What to do next

Users can override the privilege level you set using the **privilege level** line configuration command by logging in to the line and enabling a different privilege level. They can lower the privilege level by using the **disable** command. If users know the password to a higher privilege level, they can use that password to enable the higher privilege level. You might specify a high level or privilege level for your console line to restrict line usage.

Logging into and Exiting a Privilege Level

Beginning in user EXEC mode, follow these steps to log into a specified privilege level and exit a specified privilege level.

SUMMARY STEPS

1. **enable** *level*
2. **disable** *level*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** *level* **Example:** `Device> enable 15`	Logs in to a specified privilege level. Following the example, Level 15 is privileged EXEC mode. For *level*, the range is 0 to 15.
Step 2	**disable** *level* **Example:** `Device# disable 1`	Exits to a specified privilege level. Following the example, Level 1 is user EXEC mode. For *level*, the range is 0 to 15.

Configuring an Encrypted Preshared Key

To configure an encrypted preshared key, perform the following steps.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **key config-key password-encrypt** [*text*]
4. **password encryption aes**
5. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:**	Enters global configuration mode.

	Command or Action	Purpose
	`Device# configure terminal`	
Step 3	**key config-key password-encrypt** [*text*] **Example:** `Device(config)# key config-key password-encrypt`	Stores a type 6 encryption key in private NVRAM. • If you want to key in interactively (using the enter key) and an encrypted key already exists, you will be prompted for the following: Old key, New key, and Confirm key. • If you want to key in interactively but an encryption key is not present, you will be prompted for the following: New key and Confirm key. • If you want to remove the password that is already encrypted, you will see the following prompt: "WARNING: All type 6 encrypted keys will become unusable. Continue with master key deletion? [yes/no]:".
Step 4	**password encryption aes** **Example:** `Device(config)# password encryption aes`	Enables the encrypted preshared key.
Step 5	**end** **Example:** `Device(config)# end`	Exits global configuration mode and returns to privileged EXEC mode.

Monitoring Switch Access

Table 2: Commands for Displaying DHCP Information

show privilege	Displays the privilege level configuration.

Configuration Examples for Setting Passwords and Privilege Levels

Example: Setting or Changing a Static Enable Password

This example shows how to change the enable password to *l1u2c3k4y5*. The password is not encrypted and provides access to level 15 (traditional privileged EXEC mode access):

```
Device(config)# enable password l1u2c3k4y5
```

Example: Protecting Enable and Enable Secret Passwords with Encryption

This example shows how to configure the encrypted password *1FaD0$Xyti5Rkls3LoyxzS8* for privilege level 2:

```
Device(config)# enable secret level 2 5 $1$FaD0$Xyti5Rkls3LoyxzS8
```

Example: Setting a Telnet Password for a Terminal Line

This example shows how to set the Telnet password to *let45me67in89*:

```
Device(config)# line vty 10
Device(config-line)# password let45me67in89
```

Example: Setting the Privilege Level for a Command

This example shows how to set the **configure** command to privilege level 14 and define *SecretPswd14* as the password users must enter to use level 14 commands:

```
Device(config)# privilege exec level 14 configure
Device(config)# enable password level 14 SecretPswd14
```

Example: Configuring an Encrypted Preshared Key

The following is an example of a configuration for which a type 6 preshared key has been encrypted. It includes the prompts and messages that a user might see.

```
Device> enable
Device# configure terminal
Device(config)# password encryption aes
Device(config)# key config-key password-encrypt
New key:
Confirm key:
Device(config)#
01:46:40: TYPE6_PASS: New Master key configured, encrypting the keys with
the new master key
Device(config)# end
```

Additional References

Error Message Decoder

Description	Link
To help you research and resolve system error messages in this release, use the Error Message Decoder tool.	https://www.cisco.com/cgi-bin/Support/Errordecoder/index.cgi

MIBs

MIB	MIBs Link
	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/support